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OEE and Countermeasures: A Case Study of a Manufacturing Unit

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Abstract— Overall Equipment Effectiveness is the technique for calculating and identifying the losses of a manufacturing system. Wafer biscuit manufacturing plant is used implement OEE and the countermeasures. Countermeasures such as planned downtime management, root cause analysis, management routines and 5S Workplace Organization are used individually as well collectively for the improvement of three major blocks of OEE which includes availability, performance and quality. OEE of the current process is 48.49%, but implementing countermeasures OEE increases to 50.10% for planned downtime management, 48.49% for root cause analysis, 57.31% for management routines and 59.57% for 5S Workplace Organization.

Index Terms— Countermeasures, Manufacturing system, OEE, Production.

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1 Introduction

OVERALL Equipment Effectiveness (OEE) measures in what way a manufacturing unit executes task relative to its designed capacity, during the periods when it is scheduled for production.

In 1988, Nakajima for the first time identified OEE is a best method to identify the flaws in current manufacturing process and executing the countermeasures for improvements to solve the flaws [1]. OEE considers its three building blocks for calculation which includes availably, performance and quality. It also considers the six losses associated with manufacturing based on the building blocks [2]. Simplest way of calculating OEE is by using (1).

$$OEE = Availability \times Performance \times Quality \qquad (1)$$

Wafer biscuit manufacturing plant is selected for implementing OEE. OEE considers six major losses which must be minimized to achieve improved efficiency of wafer biscuit manufacturing plant.

Availability is the time during which a manufacturing system is actually accessible to keep producing items for the scheduled period. While, performance is a ration of the manufacturing system when it is really productive. The quality of the products is from the total items that could be manufactured subsequently considering availability loss and the performance loss. Quality losses also need to be considered. The six losses of manufacturing system have specific countermeasures could be applied to minimize or eliminate them to enhance the OEE. It can be observed in Table 1 given beneath clarifies the techniques for tackling the losses are categorized and after that tended to utilizing the relevant countermeasures.

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The countermeasures, all the building blocks are presented in Table 1. It is important to note that only a few could be effective for the production of wafer biscuits manufacturing system that is under consideration. Countermeasures discussed for improvement of OEE at selected manufacturing system includes:

1. Planned Downtime Management
2. Root Cause Analysis
3. Management Routines
4. 5S Workplace Organization

Table 1: Reasons of OEE Losses and their Countermeasures

Building Blocks	Six Major Losses	Reasons for Losses	Countermeasures
Availability	Setup/ Planned Downtime	1. Changeover 2. Material Shortages 3. Labor Shortage 4. Planned Maintenance 5. Warm-up Time	1. 5S Workplace Organization 2. Planned Downtime Management 3. ABC Planning
	Breakdowns	1. Equipment Failure 2. Tooling Failure 3. General Breakdowns 4. Unplanned Maintenance	1. Root Cause Analysis 2. Asset Care
Performance	Minor Stops	1. Obstructed Product Flow 2. Components Jam 3. Misfeed 4. Blockages 5. Cleaning and Checking	1. 5S Workplace Organization 2. Management Routines 3. Opportunity Analysis 4. Minor Stop Audits of Line
	Reduce Speed/ Speed Loss	1. Rough Running 2. Below Theoretical Capacity 3. Under Design Capacity 4. Operator Inefficiency 5. Equipment Wear	1. Optimize Line Balancing 2. Management Routines 3. Opportunity Analysis
Quality	Startup Rejection	1. Scrap 2. Rework 3. In Process Expiration 4. In Process Damage 5. Incorrect Assembly	1. 5S Workplace Organization 2. Planned Downtime Management 3. Precisions Settings 4. Standard Operating Procedures
	Production Rejects	1. Scrap 2. Rework 3. In Process Expiration 4. In Process Damage 5. Incorrect Assembly	1. Six Sigma 2. Error Proofing 3. Opportunity Analysis

2 Literature Review

Production system can increase efficiency by considering equipment effectiveness [3]. Performance assessment is key tool to decide world class system [4]. Frost and Sullivan in 2005 anticipated the standards of OEE. Where, world class system based on three factors of OEE that are availability, performance and quality having values of 90%, 95% and 99.9% gives OEE is 85%. OEE of perfect system is 100%, typical system is 60% and 40% is said to be low value [5], [6], [7].

Availability has diverse meanings based on its applications [8]. Unplanned downtime events are the main factors that influence OEE adversely. Downtime is one of the greatest culprits for cutting down the OEE of plant in light of the fact that it can require a gigantic lump of investment out of planned production time [6]. The time in which any anticipated repairs, overhauls are performed for preventive or predictive maintenance activities [9]. The maintenance role of diminishing downtime sways not very perceived [10].

Quality change tools is applied for failure mode and effect analysis (FMEA) main driver of any OEE apportion can be found [11]. The 5-Why strategy for root cause analysis obliges to question how the sequential reasons for a failure emerged and distinguish the cause-impact path of failure. "Why" is requested that locate each first trigger until we as far as anyone knows touch base at the root cause of the occurrence [12].

It critical to measure performance of production system [13]. The measurement of performance of the system has been under study [14], [15], [16], [17]. Performance optimization for OEE important and is achieved by data collection [18]. Manufacturing firms are all the more concentrating on enhancing production [19].

Analysis is done on issues that occur almost every day and preventive measures are taken to facilitate reinforce the performance [20]. Industrial sector, it is progressively common to utilize strategies and devices for performance measurement. There has been a consistent increment in the reception of the methods that are considered the fundamentals to measure the accomplishment of the organizations [21]. Efficiency is vital production management as numerous techniques have been created by keeping in mind the end goal to enhance performance of industry [22]. Management routine in any organization that must be supervised on predictable schedule are administration obligation, organization, employee's contribution and worker responsibility [23].

A spot for everything where it is placed is the mantra of the 5S technique. Capacity and workspace frameworks permit enhanced association and greatest utilization of cubic space for the most elevated stockpiling. The outcome is an enhanced manufacturing process and the most minimal general expense for products created [24]. If an efficient plant layout is introduced to achieve benefits [25]. The visual systems with effective implementation has dramatic improvements as 15% increase in throughput, 70% cut in materials handling, 60% decrease in floor space, 80% decrease in distance flow 68%, reduction in rack stockpiling, 45% decrease in number of forklifts, 12% decrease in engineering cycle time, 50% decrease in annual physical inventory time and 96% decrease in defects [26].

3 Methodology

3.1 OEE Calculation

Calculation of OEE are based on the manufacturing losses for selected manufacturing system that are calculated are shown in Table 2.

Once table of OEE losses is generated. It becomes an easy task to generate table in which OEE is calculated based as shown in Table 4 which is based on (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14) and (15) which provides all the necessary details needed for calculating OEE.

$$Schedule\ time = Total\ available\ time - Lunch\ break - Asar\ prayer \quad (2)$$

$$Actual\ production\ time = Schedule\ time - Availability\ loss \quad (3)$$

$$Availability(\%) = \frac{Actual\ production\ time}{Schedule\ time} \times 100\% \quad (4)$$

$$Theoretical\ output = Actual\ production\ time \quad (5)$$

$$Actual\ output = Theoretical\ output - Performance\ loss \quad (6)$$

$$Performance(\%) = \frac{Actual\ output}{Theoretical\ output} \times 100\% \quad (7)$$

$$Maximum\ number\ of\ boxes = \frac{Actual\ output}{Time\ for\ box\ packing} \quad (8)$$

$$predicted\ boxes = Maximum\ number\ of\ boxes \quad (9)$$

$$Total\ weight\ processed\ per\ day = predicted\ boxes \times Weight\ of\ one\ box \quad (10)$$

$$Actual\ productive\ weight = Total\ weight\ processed\ per\ day - Quality\ loss \quad (11)$$

$$Actual\ boxes\ produced = \frac{Actual\ productive\ weight}{Weight\ of\ one\ box} \quad (12)$$

$$Boxes\ loss = predicted\ boxes - Actual\ boxes\ produced \quad (13)$$

$$Quality(\%) = \frac{Actual\ boxes\ produced}{predicted\ boxes} \times 100\% \quad (14)$$

$$OEE(\%) = Availabili\ ty \times Performance \times Quality \times 100\% \quad (15)$$

In the initial stage for ideal case it is identified while considering that losses during production are not occurring. The system is able to produce 245 boxes every day. While, in Table 4 calculations of based on losses of Table 2 are shown.

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Table 2: OEE Losses Calculation

Minor Categories of OEE Losses	Six Major OEE Losses	OEE Losses
Changeover = 10.625 min Material Shortages = 0 min Labor Shortage = 0 min Planned Maintenance = 5 min Warm-up Time = 35.08333 min	Setup = 10.625+0+0+5+35.08 =50.708 min	Availability Loss = 50.708+48.12 = 98.828 min
Equipment Failure = 6.141667 min Tooling Failure = 28.575 min General Breakdowns = 7.9375 min Unplanned Maintenance = 5.4667 min	Breakdowns = 6.141667+28.575+7.93 75+5.466667 =48.12 min	
Obstructed Product Flow = 0 min Components Jam = 49.975 min Miss feed = 11.27708 min Blockages = 0 min Cleaning and Checking = 26.8375 min	Minor Stops = 0+49.975+11.27708+0 +26.8375 =88.0895 min	Performance Loss = 88.089+20.987 = 109.077 min
Rough Running = 7.458333 min Below Theoretical Capacity = 0 min Under Design Capacity = 0 min Operator Inefficiency = 0 min Equipment Wear = 13.52917 min	Reduce Speed = 7.458333+0+0+0+13.5 2917 =20.987 min	
Scrap = 2.558333 kg Rework = 0 kg In Process Expiration = 0 kg In Process Damage = 1.464583 kg Incorrect Assembly = 0 kg	Startup Rejection = 2.558333+0+0+1.4645 83+0 =4.022 kg	Quality Loss = 55.7996+ 4.022 = 59.822 kg
Scrap = 20.75833 kg Rework = 0 kg In Process Expiration = 0 kg In Process Damage = 35.04167 kg Incorrect Assembly = 0 kg	Production Rejects = 20.75833+0+0+35.041 67+0 =55.7996 kg	

3.2 Planned Downtime Management

The time amid which a system or machine is not working appropriately for different reasons. Schedule downtime is arranged ahead of time for reasons including planned maintenance, redesigning and updating a system.

Planned downtime is a timeframe in which operations are confined with a specific end goal to execute upgrades, repairs and different changes. Dissimilar to disastrous sorts of downtime, planned downtime happens when the organizers have put aside a specific time to close down or confine operations. Planned downtime is regularly stood out from unplanned downtime, where technical issues of machines shut down or limit operations. The capacity to planned downtime is profitable, since clients can be educated previously and can arrange exercises around a blackout, instead of be gotten amidst an adjustment in operations.

3.2.1 Planned Downtime Management Minimization Technique

There are five ways to minimize manufacturing downtime are:

1. Establish goals
2. Updating machinery
3. Explain downtime for workers
4. Regular system evaluations
5. Monitor efficiency of manufacturing processes

3.2.2 Steps for Zero Downtime

Three steps necessary to achieve zero downtime includes:

1. Prevent downtime of the machine
2. Maximize availability
3. Minimize human mistakes

3.2.3 Improvement by Planned Downtime Management

Planned downtime is a technique used to minimize or eliminate setup/ planned downtime/ external unplanned events and adjustments. Planned maintenance is not considered as it is necessary for plants to run smoothly and on a weekly basis the problems are solved and machine is faltering in such manner that it must run all the week without any interruption. Warm up time is another loss which can't be disposed of on the grounds that it incorporates baking of wafer sheet which is unrealistic to be eliminated nor it could be minimized. The loss which would be under consideration includes only changeover time.

The changeover time is associated with the creaming pot. This pot is cleaned during changeover for manufacturing wafer biscuits with different flavors. Removable pot is installed that can be evacuated whenever the flavor is changed. The roller should be cleaned rather than pot. The changeover time is brought down to 2.5 minutes. It can be found in Table 3 that changeover time is decreased.

Planned down time increases OEE from 48.49 % to 50.10% and the production of boxes is increased from 118 to 122 on a daily basis as shown in Table 4. It can be observed in Table 3 and Table 4 that the effect is not up to expectation rather findings exhibited here will be utilized as a part of alternate countermeasures displayed later. It must be remembered that little improvements can create incredible benefits. This countermeasure will be used when all the techniques will be applied collectively.

3.3 Root Cause Analysis

Root cause analysis is the procedure for finding and eliminating the cause that would keep the issue from reoccurring. When the root cause is recognized and eliminated the productivity losses. A strategy for determining nonconformance that is followed back from the inability at the end to its unique source. The fundamental apparatus for comprehension and taking out productivity losses.

3.3.1 Steps for Implementing Root Cause Analysis

The Root Cause Analysis is a six step continuous process involving the following:

1. Identify the problem
2. Define the problem
3. Understand
4. Identify the root cause
5. Corrective action
6. Monitor the system

The technique used Root Cause Analysis is shown in Fig. 1. It is a continuous improvement process.

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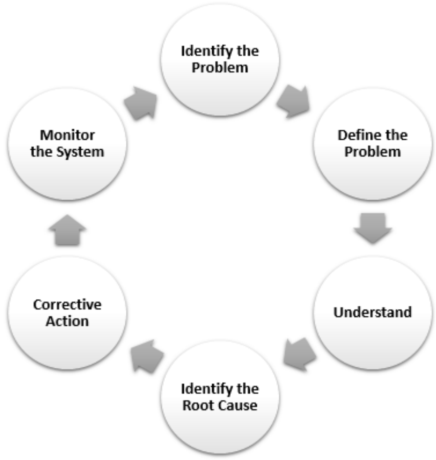

Fig. 1: Steps for Root Cause Analysis

Brainstorming is vital to make a fish bone diagram if necessary to take actions. The brainstorming is based on steps in Fig. 1 to identify event and actions that must be accordingly.

3.3.2 Improvement by Root Cause Analysis

Root Cause Analysis is a countermeasure concerned with availability. If we are more precise it considers breakdown losses. Cause mapping is used to identify the issues as appeared in Fig. 2 which incorporates three steps. Root cause analysis is used to prevent the breakdown, but it doesn't guarantee that the breakdown won't happen.

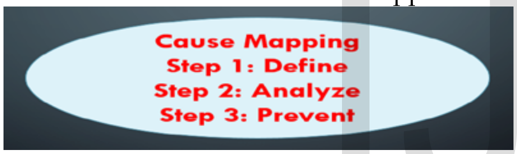

Fig. 2: Cause Mapping

It can be seen in Fig. 3 the losses and the causes associated with them. It must be kept in mind that OEE can increase, which recommends that the boxes produced on a daily basis will be increased if these losses are managed properly.

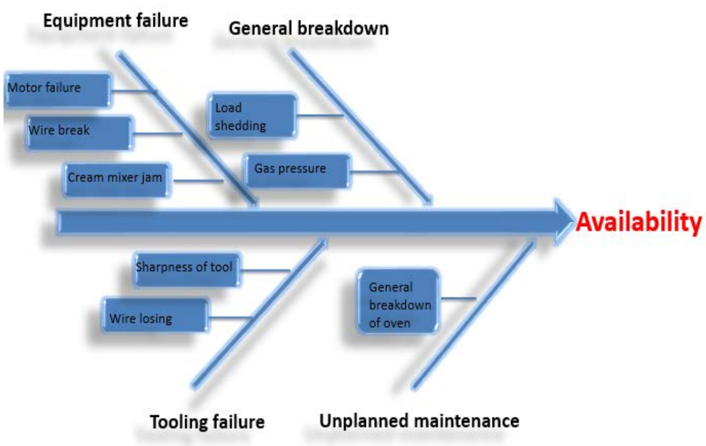

Fig. 3: Root Causes of Availability Loss

3.4 Management Routines

Management routines are the activities performed regularly. The activities are performed at settled or consistent intervals. Management routines are unvarying redundancy of a methodology. As per set up a methodology that is kept in a decent day by day routine in order to have organization running easily, proficiently and dependably be large and in charge.

3.4.1 Implementing Management Routines

Management must take actions on the problems identified to tackle the losses of performance for improving OEE. The daily activities of management are explained with the solution that must be implemented.

3.4.2 Improvement by Management Routines

Management routines are performance related administrative countermeasure in which management takes the decisions on the basis of observations. It was observed that imperfections related to mechanism can be minimized on the basis of international standard with the assistance of research papers and manufacturing plants across the globe. The losses considered for management routines are shown in Table 3.

Losses affecting performance are minor stops and reduce speed. Losses connected with minor stops that are occurring in selected wafer biscuit manufacturing system are components jams, misfeed and cleaning/checking. Components jams are due to the improper blending of sugar, improper sugar from the supplier and hardening of cream due in open environment due to time. This loss can be minimized or removed due to appropriate checking. This loss can be solved by the management. It had not been diminished due to the fact that the material is being acquired from suppliers that provide the raw material on less cost. This loss can be solved if the industry becomes stable and production in the initial phase is increased.

Second loss considered in minor stop is misfeed that occur when cream is not legitimately embedded into the cream pot and falls on the outer edges of the pot or at the conveyor belt while third loss occurring under minor stop is cleaning/ checking that is due to breakages of the wafer biscuit sheet. The cream that falls on the conveyor belt must be cleaned for smooth running of the process. It can be observed in Fig. 4 that the conveyor belt that uses tires and ropes can be used to wipe out the misfeed as the cream will fall directly down and will be cleaned without affecting the production. This conveyor belt will eliminate the time for cleaning of conveyor belt.

The second category has reduced speed that is improper handling of equipment. Rough running occurs when the workers need to finish the assignment in a rush because the breaks are approaching. This is the mind set and difficult to wipe out as most of the workers are on contract and legitimate training process can't be introduced. Equipment wear incorporates roughing of cutting tool that is used for cutting the flakes of wafer sheet. These tools are in the closet or at the time needed to be shaped which consumes time. If tools are near to the workers that will reduce time and the cutter must be in extensive numbers on premise to be used in case of failure. It is possible to save this time and conveyed down to 0.2 minutes by considering the same losses.

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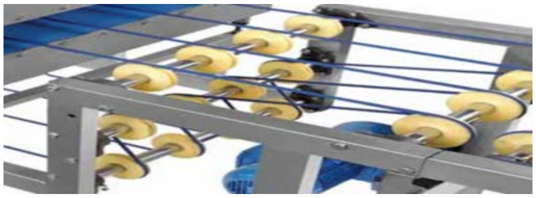

Fig. 4: Standard Conveyor Belt

The new time for performance loss during production is based on the values of Table 3. It can be seen in Table 4 that OEE is increased from 48.49% to 57.31%. The increase is quite significant, but this could have been more if the other recommendation is implemented, but that must be forced subsequent to executing the essential enhancements before moving to the optional ones. With increasing OEE the boxes are likewise increased from 118 to 139 as shown in Table 4.

3.5 5S Workplace Organization

5S is a sensible procedure which is effortlessly justifiable and appropriate. 5S methodology is utilized frequently across the world as a part of the huge organization for the change in their production and lean manufacturing.

5S is fundamentally determined from the Japanese language that are deciphered into the English language. The procedure is connected with standardized cleaning. Nevertheless, it is more than just cleaning. 5S is the strategy to oversee, compose the workspace and smooth the work flow with to achieve proficiency by taking out and minimizing the waste, enhancing the waste and diminish the procedure that causes inefficiency of the manufacturing unit. Implementation of 5S is usually preferred while implementing OEE as it considers all the pillars of OEE. The major objective behind implementing 5S is due to systematic demonstration to reduce the waste.

5S is a continuous improvement cycle as appeared in Fig. 5. Problem identification is important in any environment for presenting the solutions to solve the issues. Implementation of 5S in any organization is essential due to the fact that it considers all the building blocks of OEE.

Single closet contains every item in it either cleaning equipment or flavors. Closet also contains small items that could be stored in it. Each item needs to be allocated a predefined place. It must be kept closer to the workplace as it will be easy for worker to access it.

3.5.1 5S Implementation Cycle and Improvement

It can be observed in Fig. 5 the process for implementing 5S in an organization. It is a continuous improvement cycle.

As it can be observed in Fig. 5 that for implementing 5S following steps are followed systematically.

1. Sort
2. Set in Order or Straighten
3. Shine or Sweep
4. Standardize
5. Sustain

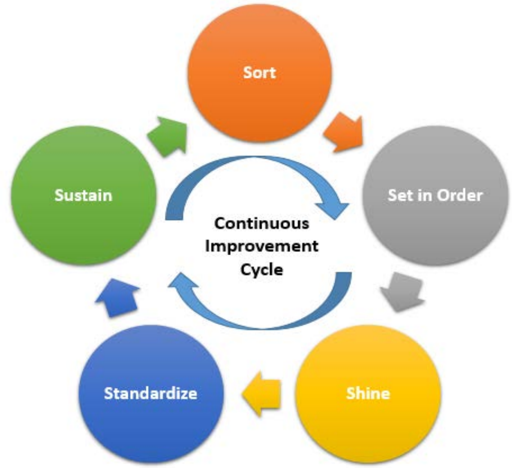

Fig. 5: 5S Implementation Cycle

3.5.1.1 Sort

Sort implies setting off to the work region and ensuring that the crucial things are available. It includes eliminating apparatus, materials, installations or whatever other things not utilized as a part of the procedure. Everything else is either put in store or most likely disposed of.

1. Sort cream ingredients according to schedule of production. These are separated from the others for the respective planning.
2. Sort of new removable cream pots are near to the conveyor belt in reach of the worker by assigning ergonomic location.
3. Location of batter mixer as shown must be changed to bring it much closer to the oven as much as possible. This strategy will remove the distance and traveling time for shifting batter from the batter mixer while pouring into the tub of oven for moving into the baking plates. It will keep the shop floor clean.
4. The worker had to move and fetch the cutter for removing flakes of the wafer sheets from the closet. Similarly, sharpening tool for cutter also placed inside the closet. These needed to be sorted out to give workers a friendly work environment.
5. Cutting machine need repair when the wire breaks. As new removable frames are introduced, they must be repaired. These problems are needed to be sorted out by proper maintenance plan.
6. Sort cleaning equipment near to the conveyor belt, cutting flakes and assembly table.

3.5.1.2 Straighten or Set in Order

Straighten principle center is in the workplace and it simply concentrates on the effectiveness. It is more than masterminding the instruments and equipment when they can be later utilized. It is way clearer to work for materials, instruments and work process. Out of all the strides this is the one which creates the best cost diminishes. Straightening the work procedure can incorporate changing in the dies or tooling that decreases completing work. For example, it might incorporate direct communication with the clients to execute changes in the design that may bring a reduction in quality change. It is likewise the progression that bears the most rehash visits to actualize persistent change.

Ingredients for cream mixing must be placed in order before starting the production. The ordering of ingredients is set according to planned production of the flavors. This is done during warm up in oven as workers were free at that time. Management needs to inform workers about wafer biscuits of respective flavor a day before or in the morning.

3.5.1.3 Sweep or Shine

Shine implies have perfectly clean and flawless work place. Amid the work procedure or toward the end of the shift clean the work place and reestablish everything back to its legitimate spot. In straighten, it plainly demonstrates where the things are to be put or from where the things ought to be gathered when required. The main fact is that, cleaning is a constant part of the day by day work. It is not just when the workplace gets excessively untidy however it ought to be always kept clean.

Clean shop floor, cream pot and conveyor belt on regular occasions. Cleaning item must be placed close to the individual work cell. The raw material must be properly placed on respective locations. These must be tags on the raw material as well as the finished good to be sort out.

3.5.1.4 Standardize

Standardizing work practices implies working in institutions and appropriate fashion. Everybody comprehends the job assigned to them and process followed to execute with that obligation. Actions are always taking the same right way every time.

Standardize the process according to international standards to eliminate production wastes that are observed during wafer biscuit manufacturing.

3.5.1.5 Sustain

Sustain implies more than simply keeping up what has been set up. 5S turns into a lifestyle and better approach to work. It implies the administration does not permit workers to work with the old strategies for working. Likewise, sustain implies that whenever another issue emerges a recommended change in the form of another instrument accessibility or another yield prerequisite for the procedure is looked into for the change.

Maintaining new implementations and the same process it repeated to achieve long lasting effects. Production losses considered in the implementation of 5S are shown in Table 3. Implementing 5S increased OEE from 48.49% to 59.57% and the boxes from 118 to 145 as shown in Table 4. OEE is almost 60%, which is observed in typical industries across the world.

4 Results and Conclusion

The calculated OEE, availability, performance and quality of wafer biscuit manufacturing system in contrast with the world class system shown in Fig. 6. The comparison of results demonstrates that current OEE must be enhanced by large numbers to accomplish that greatness for widely known world class systems.

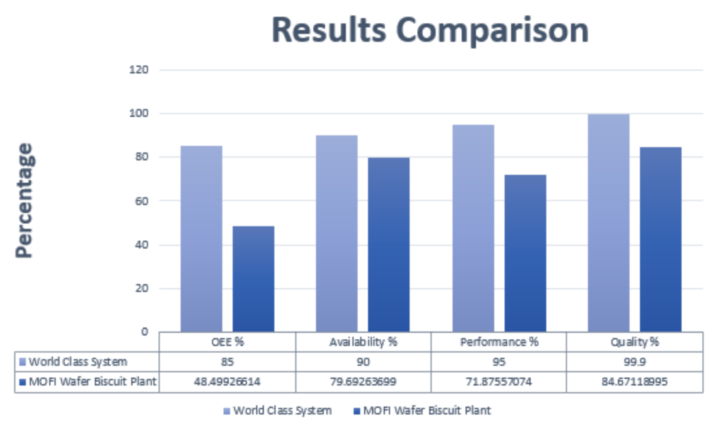

Figure 6: OEE Comparison

Losses that are considered in every classification to be illuminated with the help of countermeasures are presented in Table 3. The values of losses are highlighted with red shading for countermeasures that are either eliminated or reduced to be distinguished from those that are not possible to be reduced at this stage. Table 3 shows the losses that were occurring in manufacturing unit.

Table 3: Summary of Losses with Countermeasures

Reason of Loss	Observed	Planned Downtime	Root Cause Analysis	Management Routines	5S
Changeover	**10.625**	**2.8125**	10.625	10.625	10.625
Planned Maintenance	5	5	5	5	5
Warm-up Time	35.08333	35.08333	35.08333	35.08333	35.08333
Equipment Failure	**6.141667**	6.141667	6.141667	6.141667	**2**
Tooling Failure	**28.575**	28.575	28.575	28.575	**16.41667**
General Breakdowns	7.9375	7.9375	7.9375	7.9375	7.9375
Unplanned Maintenance	5.466667	5.466667	5.466667	5.466667	5.466667
Components Jam	49.975	49.975	49.975	49.975	49.975
Misfeed	**11.27708**	11.27708	11.27708	**0**	11.27708
Cleaning and Checking	**26.8375**	26.8375	26.8375	**7.5**	**7.5**
Rough Running	7.458333	7.458333	7.458333	7.458333	7.458333
Equipment Wear	**13.52917**	13.52917	13.52917	**1.25**	**1.25**
In Process Damage	1.464583	1.464583	1.464583	1.464583	1.464583
Scrap	2.558333	2.558333	2.558333	2.558333	2.558333
In Process Damage	**35.04167**	35.04167	35.04167	35.04167	26.67167
Scrap	**20.75833**	20.75833	20.75833	20.75833	20.75833

The summary of countermeasures is presented in Table 4 gives every last insight about the computation of OEE and the results of countermeasures. There are qualities highlighted in red shading because of their significance.

Table 4: Summary of Improvement with Countermeasures

	Current	Planned Downtime	Root Cause Analysis	Management Routines	5S Workplace
OEE %	48.4993	50.1046	48.4993	57.313	59.574
Total Available Time (min)	540	540	540	540	540
Lunch (min)	43.3333	43.3333	43.3333	43.333	43.333
Asar Prayer (min)	10	10	10	10	10
Schedule Time (min)	486.667	486.667	486.667	486.67	486.67
Availability Loss (min)	98.8292	91.0167	98.8292	98.829	82.529
Actual Production Time (min)	387.838	395.65	387.838	387.84	404.14
Availability %	79.6926	81.2979	79.6926	79.693	83.042
Theoretical Output	387.838	395.65	387.838	387.84	404.14
Performance Loss (min)	109.077	109.077	109.077	66.183	77.46
Actual Output (min)	278.76	286.573	278.76	321.65	326.68
Packing (min)	2	2	2	2	2
Performance %	71.8756	72.4309	71.8756	82.935	80.833
Weight per Cotton (kg)	2.8	2.8	2.8	2.8	2.8
Predicted Boxes	139.38	143.286	139.38	160.83	163.34
Weight Per Day (kg)	390.265	401.202	390.265	450.32	457.35
Wastage (kg)	59.8229	59.8229	59.8229	59.823	51.453
Productive Weight (kg)	330.442	341.379	330.442	390.49	405.9
Actual Boxes	118.015	121.921	118.015	139.46	144.96
Boxes Loss (Quality)	21.3653	21.3653	21.3653	21.365	18.376
Quality %	84.6712	85.0891	84.6712	86.715	88.75

5 Future Recommendation

1. Numerous countermeasure shown in Table 1 can be applied be applied for improvement which were not under consideration for this anticipation.
2. Schedule of production can be performed to analyze the effect on OEE. This will be research based venture to assign activities and time to perform them by the worker.
3. Simulation can be performed for analysis and for improvement of the process.
4. Market analysis for can be performed for purchasing raw materials from a supplier with best quality and cheap rates as compared to others. Utilization of OEE for conveying cost based examination in which loss of effectiveness is critical. The financial aspects have gained greater appreciation if reduced from the manufacturer and supplier.
5. OEE methodologies can be useful in assisting inventions. This can be performed and illustrated with the examples.
6. Maintenance strategies can be introduced to discover their impact on OEE.

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