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Applications of Process Industrial Engineering in Food Industry.

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Abstract - Industrial engineering is a branch of engineering which deals with the optimization of complex processes, systems, or organizations. Industrial engineers work to eliminate waste of time, money, materials, person-hours, machine time, energy and other resources that do not generate value. Identification of projects- in this phase all the projects and areas of development were identified with proper discussion with owner and all the workers working. Decide proper method for each of the project- then the next step was to decide the proper method of doing the project which was identified. Collection of the required data- in this third phase all the required data for the project was collected like distances, flow of material, number of machines, timing required for each activity , distance travelled by the worker for each activity . Analysis of the collected data- in this phase all the analysis of the collected data is done with the help of industrial engineering tools. Calculate new results –after analysis the new results were obtained and compared the new results with old data. Development of new method- after calculating all the results new methods of doing the work was improved. Suggest new developed method to the industry –we suggested the new developed method to the organization Take corrective actions- after suggesting the new method we took all the corrective actions required for the proper implementation of process. Documentation-after implementation of all the industrial engineering tools we documented all the information and standard operating procedure. Implementation after documenting and identifying the new methods we implemented the new techniques of Industrial Engineering.

Key Words: Industrial Engineering, Process chart, operation research, optimization, data analysis.

1. INTRODUCTION

According to The Institute of Industrial Engineers (IIE), Industrial Engineering is "concerned with the design, improvement, and installation of integrated systems of people, materials, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical and the social science together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such systems."

When we visited the organization we observed few things such as there were no proper systems implemented in the organization such as proper flow of material, proper utilization of man, machine and material. The flow of material was also not proper .thus there was lots of scope for improvement. So in order to increase the productivity we used techniques such as time study, layout analysis, designing of die and 5S to improve the overall productivity of the organization. For time and motion study we have recorded videos and also taken photographs of the workers working in the current environment. After collection of the data we did the analyse of data by breaking down the videos and with the help of time study analysis we calculated the standard time required for the operation. For rearranging the layout we used the relationship chart from which we identified which departments should be close to one another and which should not be close to each other. Then we worked on the die design in which we increased 3 dies in existing die. The designing was done with the help of Solid Works software. For doing this work we fallowed following methodology:

a) Identification of projects- in this phase all the projects and areas of development were identified with proper discussion with owner and all the workers working.

b) Decide proper method for each of the project- then the next step was to decide the proper method of doing the project which were identified.

c) Collection of the required data- in this third phase all the required data for the project was collected like distances , flow of material , number of machines , timing required for each activity , distance travelled by the worker for each activity .

d) Analysis of the collected data- in this phase all the analysis of the of collected data is done with the help of industrial engineering tools.

e) Calculate new results –after analysis the new results were obtained and compared the new results with old data.

f) Development of new method- after calculating all the results new methods of doing the work was improved.

g) Suggest new developed method to the industry –we suggested the new developed method to the organization

h) Take corrective actions- after suggesting the new method we took all the corrective actions required for the proper implementation of process

i) Documentation-after implementation of all the industrial engineering tools we documented all the information and standard operating procedure j)Implementation – after documenting and identifying the new methods we implemented the new techniques of Industrial Engineering

Proper layout results in the best way to reduce the costs remarkably. Producing products or delivering services at high quality, with less cost and in short time using the fewest resources is the objective of properly managing a facility it is important that the facilities must be managed properly in order to attain the objective. After proper implementation of the project we increased about 7.11% overall productivity. 2.1

About Organization –

Name of Organization- Shri Bharat Mata Gruha Udhyog. Address of Organization- Gargoti, Tal- Bhudhargad, Dist. - Kolhapur, and Maharashtra 416209.

Number of workers working – 15

Nature of production – Batch type Production .

Products - Poha Papad, Pudina Papad, Nachani Papad, Udidh Papad, Tak Papad.

Year of establishment – 2002.

Shri Bharat Mata Gruha Udhyog is the organization started under gruh udhyog to empower women‘s in rural areas.

The organization is running in single shift that is from 9am to 6pm.there are 15 workers working during summer and winter season and in rainy season 10 workers are working due to less demand the production is reduced.

2. LITERATURE REVIEW AND PROBLEM STATEMENT

3.1 Literature Review

In the Digitalization era, simulation covers a primary role in every field (finance, management, and manufacturing) and at all levels (strategic, tactical, and operational). In particular, the industrial engineering field, to which manufacturing belongs to, is a very flourished land for simulation development, taking advantage of the recent deployment of Cyber-Physical Systems (CPS) (Negri, Fumagalli and Macchi, 2017).The importance of simulation in industrial engineering was already highlighted by the first pioneers in simulation research studies, since the 80s: it was considered among the first top three methodologies used by industrial engineers, managers and operations researchers (Banks, 1998). Moreover, simulation is ranked as the second most used methodologies for the OM (Operations Management) field of studies (Shafer and Smunt, 2004), only after optimization. This view of simulation as central in company and research is demonstrated by many research papers and empirical studies, whose number has been continuously increased since the first conceptualization of possible uses of simulation in IE, in the mid of 80s. To figure out the amount of works done, some numbers are here provided: from 2002 to 2013, the searching process with the keywords ―simulation‖ plus ―manufacturing‖ finds out about 3000 published papers, whereas the overall research process with other keywords, such as ―industrial engineering‖ or ―operations‖, results in around 12000 published papers in the same periods (Negahban and Smith, 2014). These results are impressive and are confirmed by another survey made in the same year (Mourtzis, Doukas and Bernidaki, 2014), for which the final detailed graph is reported. [6]

Koelling et al. Identify the key activities of industrial engineering as products and processes. Key activities of industrial engineering are productivity improvement of products and processes and integration of esources for productivity improvement. And, in order to do these things industrial engineers must measure. Dean and Susman give an interesting example of the industrial engineers as integrators. Design-manufacturing Integrators work with designers on producibility issues, serving as liaisons to the manufacturing group. Such a role requires individuals who can keep design and manufacturing perspectives in balance with reference to an organization goal. Industrial engineers were employed by an electronics division of a multibillion dollar company for this task. The division has realized substantial payoffs from this arrangement. Savory states that industrial engineers design processes and systems that improve quality and productivity. Industrial engineers integrate combinations of people, information, materials, and equipment that produce innovative and efficient organizations. They make significant contributions to employers by saving money while making the workplace better for fellow workers. What sets industrial engineers apart from other engineering disciplines is the emphasis on both people and technology. It would be more appropriate, if it is said that industrial engineering focuses on three: engineering/technology issues, management issues and people issues to improve productivity of engineering systems. [6]

The second half of the 20th century is characterized by simulation; either in research studies either in industrial fields. The usefulness of this methodology is well-recognized, since it helps in most of the lifecycle phases of product/process/asset, thus providing important support in the decision-making process. Industrial engineers may decide for the selection of a cellular configuration for the production system instead of a transfer line layout, and asset managers could optimize the maintenance policies of a system based on simulated scenarios. However, simulation use has evolved during these last years. The present work is confined to the analysis of ―mega-trends‖ (high-level trends in the evolution of simulation, in the following, called simply ―trend/s‖) in simulation applications in the manufacturing field. To tackle this goal, aiming at not increase variability in definitions and applications, but to use well-established concepts and analysis to create a big picture of simulation in IE, the literature review is performed as follow:

• Databases: Scopus and WoS (Web of Science) (Google Scholar is neglected due to the focus on peer-reviewed literature only, thus avoiding looking for grey literature here extensively present);

• Search by keywords|| approach: Simulation AND (review OR literature review OR survey)

• Limited to English peer-reviewed papers concerning application in manufacturing field (screened through abstract reading).

Therefore, the analysis of the literature has led to the individuation of two main trends in the use of simulation in IE. The first trend is determined by the shift from the view of manufacturing design simulation only to a wider perspective of simulation as useful during the lifecycle, for the operations management (Smith, 2003); the second trend is the increase in the number of application fields of simulation in IE (Negahban and Smith, 2014).In the next, these two trends are analyses in the details, highlighting for each the most significant research studies. [2]

There is a pressure on manufacturing companies to optimize their production related to

lowering costs and increasing productivity The way material is monitored and managed impacts the costs an inappropriate way increases costs and as well as decreases productivity The facility layout impacts the manufacturing costs and a company‘s productivity where a mismatch between facility layout and the way materials are moved and handled can be devastating .The flow of material in manufacturing processes is of Great importance in order to meet customer demand on time and maintain customer Satisfaction remaining competitive and increasing the productivity of the company the aim of material flow is that it should be continuous and synchronous. Continuous entails that the flow should have no interruptions and no unnecessary inventories. Synchronous means running smooth at the same pace Therefore, an efficient material handling system is crucial, which results in increased productivity [2]

3.2 Problem Statement

As per the manufacturers catalogue the capacity of the machine is 150kg/day but at present they are achieving 50kg/day .

1. The flow of material is not uni-directional which increases the lead time.
2. Improper flow of material also increases distance travelled by material.
3. There was no standard set for packing of Papads.

3. METHODOLOGY

PHASE 1: Identification of area of developments

PHASE 2: Decide proper method for each of the area.

PHASE 3: Collection of the required data for defined area.

PHASE 4: Analysis of the collected data.

PHASE 5: Creation of new results.

PHASE 6: Selection of new method.

PHASE 7: Suggest new method to the industry.

PHASE 8: Approval of new methods from organization

PHASE 9: Documentation.

PHASE 10: Implementation and result analysis.

4. DATA COLLECTION AND ANALYSIS

4.1 Layout Study

The way in which machinery, equipment and material are arranged in a working area determines the layout in that area. Layout is often determined at the outset of operations, i.e. when a plant or even an office starts operating. Even if the initial layout was well thought out, a re-examination of the utilization of space is often called for because of various factors, among them the following:

1. New products are added or product design changes introduced. Both types of action may necessitate a different sequence of operations.
2. New equipment or machinery or a different shape and size of materials are: introduced.
3. Materials-handling equipment that has different space requirements from the original equipment is acquired.
4. Modifications are made to the building to increase space.
5. Temporary arrangements may have been made to cope with an upsurge of demand for a certain product, but these then remain semi-permanent.
6. Mixes am made by management towards advanced technologies such as the use of robotics, automation, computer networking or flexible manufacturing systems.

When situations like these arise, it is said that the plant or a working area has outgrown its present layout. Operations become cumbersome with either congestion or lengthy and unnecessary movements of products-in-progress or operators often with criss-crossing lines of production resulting in loss of time and energy.

To rethink a layout one has to start by distinguishing among four basic tapes; (1) layout by fixed position; (2) layout by process or function; (3) 1ayaut by product or line layout; and (4) group layout. In practice a combination of two types or more of layout may exist in a working area.

(1) Layout by fixed position. This arrangement is used when the material to be processed does not travel around the plant but stays in one place: all the necessary equipment and machinery are brought to it instead. This is the case when the product is bulky and heavy and when only a few units are made at a time. Typical examples are shipbuilding or aircraft construction, and the manufacture of diesel engines or large motors.

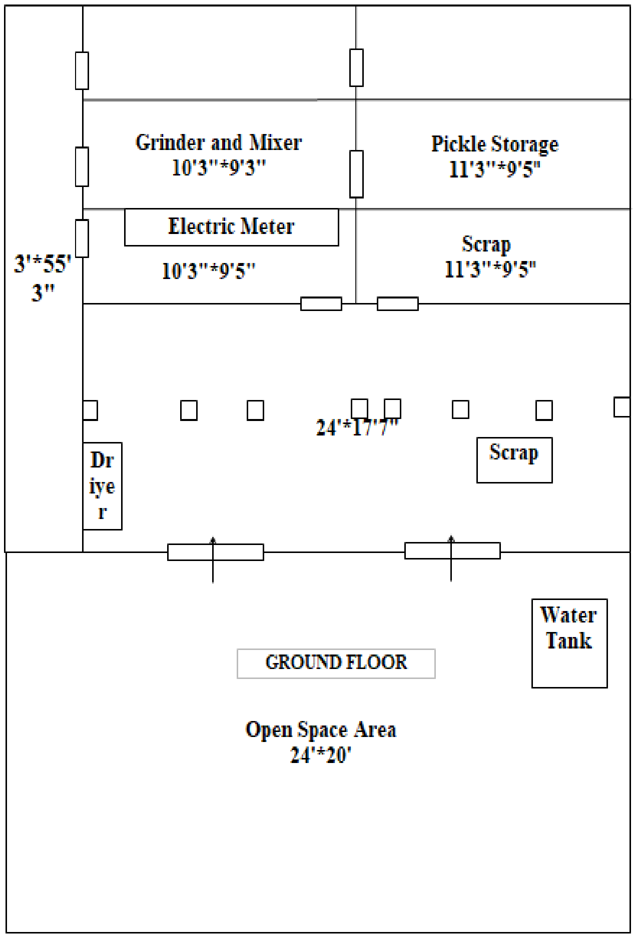
(2) Layout by process or function. Here all operations of the same nature are grouped together; for example, in the garment industry all the cutting of material is carried out in one area, all the sewing or stitching in another, all the finishing in a third, and so on. This layout is usually chosen where a great many products which share the same machinery are being made and where any one product has only a relatively low volume of output. Other examples are textile spinning and weaving, and maintenance workshops.

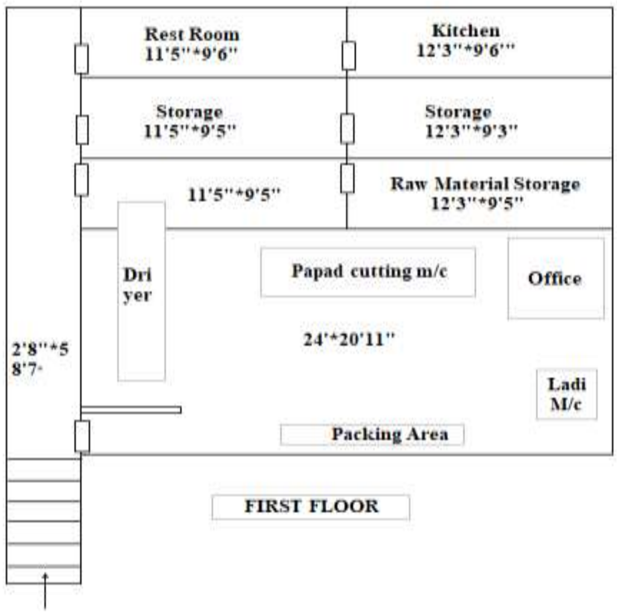
(3) Layout by products or line layout, sometimes popularly referred to as "mass production". In this layout all the necessary machinery and equipment needed to make a given product are set out in the same area and in the sequence of the manufacturing process. This layout is used mainly where there is a high demand for one or several products that are more or less standardized. Typical examples are soft drinks bottling, car assembly and some canning operations.

(4) Layout making possible group production methods, or group layout Recently, in an effort to increase job satisfaction, several enterprises have arranged their operations in a new way, with a group of workers working together on a given product or on a part of a product and having at hand all the machinery and equipment needed to complete their work. In such cases the workers distribute the work among themselves and usually interchange jobs. Further details of this method of production are given in Chapter 29.

With these various kinds of layout in mind, we may now analyse the flow of materials in a working area. In some situations, rapid changes in output may be realized by switching from one type of layout to another. This is particularly true when a shift is made from a layout by function to a line layout for one or more products whose output has been increased significantly.

In most cases, however, a careful] analysis of the flow is called for before any decision is taken to change a given layout, since this is usually a costly process, and management has to be convinced that real savings will result before authorizing the change.





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4.1.1 Dimensions of Machines and Room

Table 1: Machine dimensions

Machines	Dimensions(Length*Width* Height) in ft.
Papad Cutting Machine	9'*1'11? * 3'10"
Ladi Machine	3'4?*1'3?*3'6?
Dryer 1	24'*2'*3'
Dryer 2	4'3?*2'2"*3'10?
Grinder	3'9?*1'5?*4'5?
Mixer 1	2'11?*1? 10? *3'4?
Mixer 2	2'4?*1'8? *3'

Table 2: Machine dimensions

Department	Dimensions (in ft.)
Raw Material Storage	12'3‖*9'5‖
Grinder And Mixer	10'3‖*9'3‖
Production Area	24'*20'11‖
Pickle Storage	11'3‖*9'5‖
Finished Goods Storage	I.12'3‖*9'3‖ II. 11 '5‖*9'5‖
Electric Meter	10'3‖*9'5‖
Rest Room	11'5‖*9'6‖
Kitchen	12'3‖*9'6‖
Scrap Area	24'*17'7‖
Open Space Area	24'*20"

4.1.2 Flow Process Chart

The next step in the basic procedure, after selecting the work to be studied, is to record all the facts relating to the existing method. The success of the whole procedure depends on the accuracy with which the facts are recorded, because they will provide the basis of both the critical examination and the development of the improved method. It is therefore essential that the record be clear and concise.

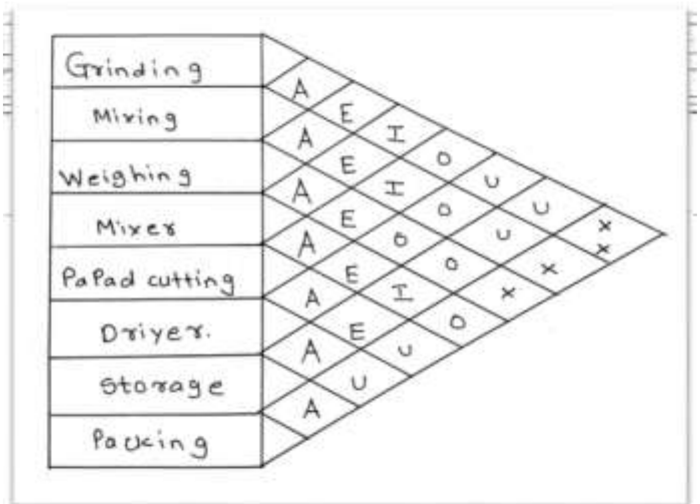
Recording serves essentially as a basis for subsequent analysis and examination. It is not an end in itself. Recording may be carried out in two phases: first, a rough sketch or charting of the job being studied to establish whether the recorded information is of use: and, second, a more formal and accurate chart or diagram to include in a report or presentation.

The usual way of recording facts is to write them down. Unfortunately, this method is not suited to recording the complicated processes which are so common in modem industry. This is particularly so when an exact record is required of every minute detail of a process or operation. To describe exactly everything that is done in even a very simple job which takes perhaps only a few minutes to perform u-Quid probably result in several pages of closely written script, which would require careful study before anyone reading it could be quite sure that he or she had grasped all the detail. [2]

To overcome this difficulty other techniques or "tools" of recording have been developed, so that detailed information may be recorded precisely and at the same time in standard form, in order that it may be readily understood by all method study persons, in whatever factory or country they may be working. The most commonly used of these recording techniques are charts and diagrams. There are several types of standard chart available, each with its own special purposes. They will be described in turn later in this chapter and in subsequent chapters. For the present it will be sufficient to note that the charts available fall into two groups:

those which are used to record a process sequence, i.e. a series of events or happenings in the order in which they occur, but which do not depict the events to scale: and Those which record events, also in sequence, but on a time scale, so that the interaction of related events may be more easily studied.

4.1.3 Layout Analysis (Relationship Chart):-



A- Absolutely necessary

O- Ordinary Closeness,

E- Especially,

U- Unnecessary, I- Important,

X- Avoid Closeness.

4.1.4 Distance Mapping Between Processe

Distance from	Distance (ft.)	Distance to
Raw material storage	108‘8‖	Grinding machine
Grinding machine	83‘	Mixing area
Mixing area	83‘	Mixer
Mixer	95‘	Papad machine
Papad machine	5‘/52‘	Dryer
Dryer	8‘/66‘	Finished goods Storage
Dryer	28‘/49‘	Packing
Finished goods Storage	38‘	Packing
Packing	8‘	Stock
Total Distance Travelled	582’8”	

4.1.5 Material Flow Mapping

Material flow analysis (MFA) also referred to as substance flow analysis (SFA), is an analytical method to quantify flows and stocks of materials or substances in a well-defined system. MFA is an important tool to study the bio-physical aspects of human activity on different spatial and temporal scales. It is considered a core method of industrial ecology or anthropogenic, urban, social and industrial metabolism. MFA is used to study material, substance, or product flows across different industrial sectors or within ecosystems. MFA can also be applied to a single industrial installation, for example, for tracking nutrient flows through a waste water treatment plant. When combined with an assessment of the costs associated with material flows this business-oriented application of MFA is called material flow cost accounting. MFA is an important tool to study the circular economy and to devise material flow management.

4.2 Application 5’S

5‘S is an approach to organize, order, clean, standardize and continuously improve a work area. 5S is not just about housekeeping, it is one of the efficiently working tools of Lean Manufacturing. The program gets its name from five activities beginning with the letter S, which were derived from five Japanese words. The words are Seiri, Seiton, Seiso, Seiketsu and Shitsuke, which when translated mean Sort, Set in Order, Shining, Standardize and Sustain, respectively. Sort helps to remove all unneeded items: only what is needed stays. Set establishes locations and quantities needed for efficient operation. Shine represent cleaning through inspection. Standardize implements visual displays and controls. Sustain helps to keep the organization effort in place through training and total employee involvement.

Figure 4: The Schematic Diagram of 5S principles

4.2.1 Sort (Seiri)

Sorting is the first step-removing all surplus items from the work center which are not needed for the immediate continual operations at this stage it is decided what is really needed and what is not. Any item or tool that is unaccounted out of place or unnecessary needs to be clearly documented. A red tag is a document made on red colored paper that is attached to potential junk items in a workplace. The items are stored temporarily until assignable action can be undertaken; it is usually the starting point of a 5S exercise. Items are red tagged with the best description of use or placement recorded on it. All red tagged articles are moved to a temporary holding area, and that area clearly is identified as the red tag or Seiri area. Equipment or anything else that is not of use, should be discarded as refuse to be thrown out To implement the first step of 5S, a production team needs to know what material is used when the material in storage are to used where the required materials are, and what the users requirement are). This is an opportunity for every team to re-evaluate the tools at their disposal and make sure that they are using the best available tools for the process.

In this small scale food industry this type of technical terms were never applied , thus when we were implementing 5S we listed out all the material and components which are there in this small scale industry . After listing all the material in the industry we gave them the category no as

1. Needed and in good condition
2. Needed but need to repair
3. Needed but not now
4. Needed but not available
5. Not needed

For giving the category number we discussed use and applications of all the material with the workers as well as the owner and then we gave the category number to all the components that we listed out. That is nothing but actual sorting of the component.

Item Name	Purpose	Category no
Certificate 2	show	5
Rough Book	not in use	5
Plastic sheet (tub)	not in use	5
Part of dryer	not in use	5
Calendar	not in use	5
Paly wood	not in use	5
Wallpapers	not in use	5
Validity certificate	not in use	5
Plywood (fan)	not in use	5
5lts can	not in use	5
Box 2 (empty)	not in use	5
Box 1 (rough books)	not in use	5
Sheet	not in use	5
Raw material storage cupboard	not in use	5
5lts can (cupboard back)	not in use	5
Boxed (cupboard top)	not in use	5
Plastic container 2	not in use	5
Electric Switch (big)	not in use	5
Stand for Induction	holding	5
Motor	-	5
Calendar	not in use	5
Box 6	not in use	5
Plastic bag 10	not in use	5
Switches 3	not in use	5
Cupboard (wall)	not in use	5
Box 3	not in use	5
Wooden Table	not in use	5
Tiles	not in use	5
Big stapula (ulatna)	not in use	5
Swing (zopala)	not in use	5
Box 2 (empty)	not in use	5
Garlic Machine and Tiles	not in use	5
Light Fittings Pipes	not in use	5
Papad Drier Stand	not in use	5
Rubber Belt	not in use	5
Plastic Sack	not in use	5

4.2.2 Set in Order (Seiton)

The second step in a 5S launch is taking the stored items and putting them where they best support the function they provide. Workers should be motivated to place items at their point of use and improve the workplace_s visual management. Before and after photos should be taken to document progress and explain activity benefits are of key importance at this stage. One important advantage of Set in order is that everything needed for the job is clearly visible. Another objective of this step is to arrange the work in such a manner that missteps can be easily identified and corrected which is one of the main reasons why the implementation of visual controls is encouraged during this step. Associates may apply these philosophies by referring to checklists, designing tool boards, parts container and improving workplace design. The practice of shadow boarding can be quickly identified when a piece of equipment is missing from a work station. The main advantage of tool —shadowing|| is that people instantly know which tool is missing and where it stored. Furthermore if one is missing it's easy to guess what shop users are looking for and where it belongs.

4.2.3 Shine (Seiso)

Once the unneeded is thrown away and sorting and set in order has taken place, it is now time for the sanitize phase A cross functional team should agree on what the cleaning standards need to be This is sometimes referred to as shine or sweep stage where teams thoroughly remove clutter and fix equipment or building components The objective of this phase is to identify and eliminate the root cause of waste, dirt and damage as well as clean up the work station 5S projects that are almost entirely focused on cleaning and painting, prevent recording the valuable information that can be gained from assessing it This step needs to have the full involvement of employees to gather the data of what they feel needs to be cleaned and how often it should be cleaned Although it is imperative to create a cleaning schedule along with appointed duties for all personal working in designated areas, some employees may mistakenly believe that they are not being paid to clean. In that situation, make the suggestion to list all applicable responsibilities in detail including all areas to be cleaned and desired expectations where they are assigned. Another issue worth considering is that an unclean area is more susceptible to safety hazards that could potentially cause worker injury of such importance that also recommend this particular event be followed as a daily regimen

7: Before Implementation of Set in Order

4.3 Die Designing

Food Grade Stainless Steel 316

Grade 316 stainless is an austenitic stainless steel alloy with a high chromium and nickel content. Like many steel alloys, it has a continuous use temperature several times higher than most food making processes will ever require (more than 800°C, or 1472°F).

What makes the grade 316 alloy an ideal food grade steel sheet material is the fact that it has a high resistance to acids, alkalis, and chlorides (such as salt). Other austenitic stainless steels, such as grade 304 SS, can experience severe pitting corrosion when exposed to salt, which is often present in food products. Grade 430 Stainless Steel and Food

As an alloy, stainless steel 430 food grade metal is very similar to grade 316 stainless. It has the same chromium content as 316, but only a fraction of the nickel content, which makes it a more affordable alternative for some food makers.

Another major difference between 430 and 316 stainless steel is that grade 430 SS is a ferritin alloy, meaning that it's magnetic by default. Ferritin alloys like 430 SS also have extraordinary resistance to stress corrosion cracking (the growth of crack formations that can cause sudden failure in corrosive environments).

Which is best for Food-Safe Applications?

Overall, grade 316 is usually the better choice when making food-grade stainless steel containers. 316 SS is more chemically-resistant in a variety of applications, and especially when dealing with salt and stronger acidic compounds such as lemon or tomato juice.

However, 430 is a good, lower-cost alternative for food makers that need a moderately resistant, food grade steel sheet for their manufacturing process.

It's important to note that the resistance properties of both alloys can be enhanced via electro polishing. This process not only improves the oxide layer that protects the steel, it removes microscopic peaks and valleys on the alloy's surface, making it harder for food to stick to the steel and easier to clean.

However, it's also important to note that maintenance of a custom stainless steel tray or basket plays a huge role in prolonging its useful life. For example, stainless steel sheet metal should never be scrubbed using a plain steel or iron brush, as this may transfer iron particles onto the surface of the stainless and compromise its protective oxide layer.

With the right stainless steel alloy, you'll have a metal tray or basket that will boost your productivity for years to come. Need a custom metal form for your food production process? Contact Marlin Steel for a food grade metal tray or basket quote today.

Figure 9: Solid works drawing of actual die

5.4 Total productive Maintenance (T.P.M.)

The food and beverage industry is a sector that is particularly sensitive to any lapses during the production process. As the products coming from the food manufacturing plant are set for consumption, they must be produced under very strict conditions that are closely monitored by multiple public authorities.

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In addition, most of the equipment being used on the plant floor is complex and every machine that comes in direct contact with the food, either during the production or packaging, must work efficiently and safely. There is several proactive maintenance strategies that a plant might want to adopt to ensure product quality, one of these being total productive maintenance (TPM).

TPM is not just a maintenance tool, it is a lean manufacturing philosophy centered on achieving near-perfect production through no breakdowns, no small stops or slow running, no defects, and no accidents. It demands proactive maintenance to extend the lifespan and reliability of equipment and it does this by empowering all employees to take responsibility for the equipment they operate.

In industry, total productive maintenance (TPM) is a system of maintaining and improving the integrity of production and quality systems through the machines, equipment, processes, and employees that add business value to an organization. TPM focuses on keeping all equipment in top working condition to avoid breakdowns and delays in manufacturing processes. [6] 5.4.1 C.L.I.T Activity

Clean - Cleaning with meaning, making it easy for cleaning are the key drivers in this phase. If we make it easy to clean, we will can clean very frequently and in the process of cleaning, we can see many abnormalities. Thus, it increases the opportunity for correction.

Lubricate - A well-oiled machine is likely to have less wear and tear. Hence, there is a need to ensure proper lubrication for the machine / equipment. Key is to make lubrication points visible and accessible.

Inspect - Periodical inspection will lead to discovering abnormalities and leads to correction at early stage. Here, it is customary to use our sensory organs for diagnosis. Touch (for heat and vibration), See (for leakage, wear-out, missing part, loosening), Hear (noise of machine) and Smell (for any burning smell of cables, deterioration of coolant, etc.) are the tools used and are recorded in TPM chart.

Tighten – Once we see that any of the fasteners are loose, we need to tighten them to original tightness and put a mark on them so that we can easily identify if they become loose. About 50% of the breakdowns (mechanical / electrical) are caused by looseness and the measure of tightening enables us to reduce the breakdowns drastically, initially.

After the discussion with the manager and all the workers we found that there is not proper record of machine breakdown and its maintenance done. Then we asked them to keep the record of the machines breakdown and its maintenance done.

Maintenance Observation			
Machine Name	Date of Breakdown	Component Name	Reason of Breakdown
Mixer A	08-02-2018	Blade	Over loading
Sealing Machine	28-04-2018	Heating coil	Absence of reaostat
Mixer B	16-07-2018	Belt	Improper maintenance

Table 6: Observation table before implementation of T.P.M

After observing and discussing maintenance done by the workers we came to know that there is lack of maintenance, and the only time they do repair work or maintenance is when the machine totally stops functioning.

Thus we gave them the C.L.I.T activity for proper maintenance of the machines. After introducing the C.L.I.T activity to all the workers we took training of all the workers regarding the maintenance activity in which we focused on autonomous maintenance and gave the responsibility of machines to workers for daily cleaning and doing proper maintaining the machine.

Fig. 10 Ladi Machine

Figure 11: No lubrication done for gears

4.5 Time Study

Work measurement techniques find the time required to do a job by a qualified operator working at a standard pace and using the standard method. The time in minutes or hours calculated is known as standard time. The commonly employed work measurement techniques are:

- Stop Watch Procedure of Time Study
- Predetermined Motion Time Systems
- Synthesis-Synthesized Time Standards
- Analytical Estimating
- Work sampling

Importance and Uses of Time Study:

Generally this technique is used, to determine the time required by a qualified and well trained person working at a normal pace to do a specified task. The result of time study is the time that a person suited to the job and fully trained in the specific method. The job needs to be performed if he or she works at a normal or standard tempo. This time is called the standard time for operation. This means the principle objectives of stop .watch time study are to increase productivity and product reliability and lower unit cost, thus allowing more quality goods or services to be produced for more people. The importance and uses of stop watch time study can be stated as under: [4]

1. Determining schedules and planning work

2. Determining standard costs and as an aid in preparing budgets

3. Estimating the costs of a product before manufacturing it. Such information of value in preparing bids and determining selling price.

4. Determining machine effectiveness, the number of machines which one person can operate, and as an aid in balancing assembly lines and work done on a conveyor.

5. Determining time standards to be used as a basis for labor cost control.

6. Helps to know the Labour productivity, Labour efficiency, Labour Performance and overall time required to perform the task.

7. Helps to improve the process of operation.

4.5.1 Problem Identification

According to pilot study two problems were found. First was to established tile production norms title scientific base and other was to remove the wastages MUDAS to improve production by eliminating them. There was need to this project as there were many predefined norms which need revision. This might be due to change in the infrastructure like new machines, better 5 S, etc.

4.5.2 Data Collection

It is a Work Measurement technique for recording the time for performing specific job or its element carried out under specific condition and for analyzing data so as to obtain time necessary to an operator to carry out at defined rate of performance.

The stop watch is electronica data capture device provides necessary accuracy for all general purpose work. For highly repetitive cycle: very short cycle work, then some other measurement techniques is more appropriate than time study.

Time study can be extended into such areas using film or video 6f work. With video recording, number of frames can be counted for very short sequence of work to give an accurate time deviation. Time can be read of this timing device when the film or video is replayed at slower speed.

Advantages of Film or Video over direct observation are:

1. Permit greater detailing than eye observation

2. Provide greater accuracy than pencil, paper, and watch technique3. More convenient

4. Provide a positive record and proof

5. Help in development of work study person

Steps in making Time Study

1. Obtaining and recording all the information available about the job, the operative and surrounding conditions, which is likely to affect the carrying out of the work.

2. Recording a complete description of the method, breaking down the operations into element.

3. Examining the detailed breakdown to ensure that the most effective method and the motions are being used, and determining the sample size.

4. Measuring with the timing device and recording the time taken by the operative to perform each element of the operation.

5. At the same time, assessing the effective speed of working of the operative relative to the observer's concept of the rate corresponding to standard rating.

6. Extending the observe time to ''basic time".

7. Determining the allowances to be made over and above the basic time for the operation.

8. Determining the "standard time" for the operation.

All the recorded data collected and analyze for that use the simple excel sheet in which all the activities and breakdown element are included Form the table: in which start time and end time can be included From the: start and end time calculate the Elapsed time and it converts into minutes. The time form higher side eliminated for each of the activity and calculated the average timing for each activity accordingly. Final sheet prepared by using data analysis sheet. All the activities and their respective Observed Time entered in that sheet. For the operator according to their speed of working rating is given. By including rating and the observe time calculate the Basic Time for each of the activities. From that basic time: add allowances according to their working posture, working environment/ conditions, their basic needs.

Rating:

It is assessment of the workers rate of working relative to observer's concept of the rate corresponds to standard pace. The standard level is average rate at which worker will naturally work at a job, using correct method and when motivated to apply themselves to their work.

The standard pace is maintainers by the worker and appropriate relaxation is taken, the worker will achieve standard performance over the working of day or shift.

Allowances:

As per the guidelines from the ILO (International Labor Organization), it is the base for any, allowances that depends upon the factors Plated to individual, nature of the work and related to environment. The factor related to individual that variations in the fatigue experienced by the worker, particularly when engaged on the heavy manual work. Factor related to nature of the work is that the worker is performing the Work by standing or sitting down posture during working.

- Formula to calculate Basic Time:

  Basic Time = observed time * (rating / standard rating)

- Formula to calculate Standard Time:

  Standard Time = (BASIC Time + Allowances)

5.5.3 Breaking down of Activity:

Analysis to determine the time study.

	Activity - Filling Bag				
Cycle	Start Time	End Time	Elapse Time	Basic time (min)	Qty
1	00:00:00	00:00:12	00:00:12	0.200	100gm
2	00:00:13	00:00:35	00:00:22	0.367	100gm
3	00:00:36	00:00:48	00:00:12	0.200	100gm
4	00:00:50	00:01:03	00:00:13	0.217	100gm
5	00:01:04	00:01:19	00:00:15	0.250	100gm
6	00:01:20	00:01:41	00:00:21	0.350	100gm
7	00:01:43	00:02:06	00:00:23	0.383	100gm
8	00:02:07	00:02:27	00:00:20	0.333	100gm
9	00:02:28	00:02:44	00:00:16	0.267	100gm
10	00:02:45	00:03:04	00:00:19	0.317	100gm
11	00:03:05	00:03:22	00:00:17	0.283	100gm
			00:00:00	0.000	100gm
			Sum:	3.167	0
			Avg(min)	0.288	
			Avg (sec)	17.273	

Table 8: Analysis of Filling Bag

The analysis done for Filling Bag operation. The activities separated and their actual time collected from video recording. The non-value added activities were separated from value added activities. The standard time was calculated for operation by eliminating non value added activity.

In this operation wait for oil tin found non value added activity. The activity was eliminated and calculated the standard time for particular operation.

Analysis to determine the time study

Activity – Weight				
Start Time	End Time	Elapse Time	Basic time (min)	Qty
00:00:00	00:00:05	00:00:05	0.083	100gm
00:00:21	00:00:34	00:00:13	0.217	100gm
00:00:45	00:01:13	00:00:28	0.467	100gm
00:01:23	00:01:27	00:00:04	0.067	100gm
00:01:50	00:02:18	00:00:28	0.467	100gm
00:02:31	00:02:40	00:00:09	0.150	100gm
00:02:54	00:03:03	00:00:09	0.150	100gm
00:03:20	00:03:23	00:00:03	0.050	100gm
00:03:33	00:03:40	00:00:07	0.117	100gm
00:03:51	00:04:05	00:00:14	0.233	100gm
00:04:14	00:04:26	00:00:12	0.200	100gm
		00:00:00	0.000	100gm
		Sum:	2.200	0.000
		Avg(min)	0.200	
		Avg (sec)	12.000	

Table 9: Analysis of Weight

The analysis done for Weight operation. The activities separated and their actual time collected from video recording. The non-value added activities were separated from value added activities. The standard time was calculated for operation by eliminating non value added activity.

In this operation wait for oil tin found non value added activity. The activity was eliminated and calculated the standard time for particular operation.

Analyse to determine time study.

Activity - Tag Seal				
Start Time	End Time	Elapse Time	Basic time (min)	Qty
00:00:05	00:00:19	00:00:14	0.233	100gm
00:00:34	00:00:44	00:00:10	0.167	100gm
00:01:13	00:01:22	00:00:09	0.150	100gm
00:01:27	00:01:43	00:00:16	0.267	100gm
00:02:18	00:02:30	00:00:12	0.200	100gm
00:02:40	00:02:51	00:00:11	0.183	100gm
00:03:03	00:03:18	00:00:15	0.250	100gm
00:03:23	00:03:32	00:00:09	0.150	100gm
00:03:40	00:03:49	00:00:09	0.150	100gm
00:04:05	00:04:12	00:00:07	0.117	100gm
00:04:26	00:04:33	00:00:07	0.117	100gm
		00:00:00	0.000	100gm
		Sum:	1.983	0.000
		Avg(min)	0.180	
		Avg (sec)	10.818	

Analysis of Tag Seal

The analysis done for tag seal operation. The activities separated and their actual time collected from video recording. The non-value added activities were separated from value added activities. The standard time was calculated for operation by eliminating non value added activity.

In this operation wait for oil tin found non value added activity. The activity was eliminated and calculated the standard time for particular operation.

5.0: IMPLEMENTATION OF PROPOSED WORK

5.1 Layout Study

We collected all the data from existing layout which was required for doing the analysis and for producing the new layout. Thus we discussed about the existing layout with all the workers along with the owner, and after that as per the requirement of the owner and we plotted the new layout. But our aim was to reduce the total travelling distance of the workers and eventually which would directly reduce the time required for performing the task.

As our aim was to reduce the total distance travelled by the material and workers we used the Industrial Engineering techniques such as distance mapping, process flow chart, time required for travel from one work station to another work station and at the last relationship chart which have us the closeness of one department with the other department and then we draw the new layout after discussing that with owner and workers.

An activity relationship chart (ARC) is a tabular means of displaying the closeness rating among all pairs of activities or departments. In an ARC there are six closeness ratings which may be assigned to each pair of departments, as well as nine reasons for those ratings (each is assigned by a reason code).

A: Absolutely necessary

E: Especially important

I: Important and core

O: Ordinary

U: Unimportant

X: Prohibited or Undesirable

A rule of thumb is used to restrict the choice of rating letters:

- Very few A and X relationships (no more than five percent) should be assigned
- No more than 10 percent should be E
- No more than 15 percent should be I
- No more than 20 percent should be O
- About 50 percent of the relationships should be U

While developing a relationship chart

- List all the departments within the facility, and draw a rectangle around each one.
- Draw a rhombus between each department, until you fully construct the rhombus as a tree. Divide each rhombus into two halves; the upper half will contain the rating letter, while the lower half will contain the rating-reason code.

5.2 5 'S'

Implementation of 1 ‗S' (sort) –

The first S focuses on eliminating unnecessary items in the workplace. It is the series of steps which keep only

- What is needed
- The amount needed and
- When it is needed

To implement the first S the Red-Tag process is commonly employed. The Red-Tag strategy helps to identify unwanted items and determine their usefulness. There are six steps involved in creating a successful Red-Tagging process.

Step 1: Launch the Red-Tag Project This is usually done by the Steering Committee by creating holding areas and planning for the disposal of unwanted items using the Red-Tag form.

Step 2: Identify the Red-Tag Targets Specify the type of items and the physical work areas to be evaluated.

Step 3: Set Red-Tag Criteria Three questions need to be asked to determine if an item is necessary.

- Is it useful ?
- How often is it needed ?
- How much is needed ?

Step 4: Attach the Tag. The Red-Tagging event must be quick and decisive. The target scope must be completed before the Lunch.

Step 5: Evaluate Red-Tagged Items. Decide what to throw and the actions required.

Step 6: Document the Results of Red-Tagging. Results must be logged for accounting purposes so that the organization can measure the improvements and savings realized through the process.

UNNECESSARY ITEMS

- Throw away immediately
- Items having no value and easy to dispose
- Divide each rhombus into two halves; the upper half will contain the rating letter, while the lower half will contain the rating-reason code.

5.2 5 'S'

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The process shown in Figure 4, eliminates waste in production or in clerical activities and ensures all materials, tools and equipment have designated locations which are easy to find. The second S includes activities such as:

1. Mark reference materials with an oblique line to detect disorder from a distance.

2. Put names and numbers on all jigs and tools.

3. Store tools beside the machine with which they will be used according to sequence of work operations.

4. Organize files and store using color code to make it easy to identify materials at a glance.

5. Store similar items together.
6. Store different items in separate rows.
7. Do not stack items together, use rack or shelf.
8. Use smalls bins to organize small items
9. Use color for quick identification of items.
10. Label clearly each item and its storage area (Visual Control)
11. Use see-through cover for better visibility.
12. Use specially designed carts to organize tools, jigs and measuring devices that are needed for each particular machine.

Create tool boards.

The key word in this description is anyone. Labeling is specifically for other people who need what is in area, when the area owner is away. The benefit is searching time reduced. When orderliness is established, there is no human energy waste or excess inventory.

Potential Impacts:

- Items easily returned to its designated location after use.
- Required items easily located, stored and retrieved.
- First-In First-Out (FIFO) is practiced.
- Retrieval time is reduced.

Right Item, Right Place, Right Quantity and Right Method (4R) are in place.

3 ‗S‘ (shine) –

The third S stresses on cleanliness because it ensures a more comfortable and safer workplace, as well as better visibility, which reduces retrieval time and ensures higher quality work, product or service. The third S is to thoroughly clean the workarea. Daily follow-up cleaning is absolutely necessary to maintain a clutter-free workplace and a desirable environment. SHINE speaks for itself. Everyone enjoys working in a cleanenvironment which raises morale and increases productivity. To successfully implement the third S as a daily value-adding activity, the following steps must be practiced.

Step 1: Delegate Cleaning Assignments. Cleanliness is the responsibility of EVERY employee and the workplace must be divided into distinct cleanliness areas, which can be based on:

• 5S Zones:

Show all the cleanliness areas and the names of the people responsible for them.

• 5S Schedules:

Show in greater detail the different areas and the names of those responsible for them, including daily rosters.

Step 2: Determine What is to be Cleaned. Develop targets and categories them for ease of use.

Step 3: Determine the Methods to be Used. Decide on the tools and materials required and what is to be cleaned in each area. Cleanliness must be practiced daily and must take only a short time to execute. Standards must be adopted to ensure people do the cleaning efficiently.

Step 4: Prepare the Cleaning Tools and Materials. Set up cleaning tools and the required materials in such a manner so that they are easily retrieved for use.

Step 5: Implement Cleanliness All equipment malfunction or defects must be fixed or reconditioned. The key word in this practice is keeping the workplace and everything in it clean and in good functional condition. This is achieved through the combination of the cleaning function and defect detection.

Potential Impacts:

- Higher quality work and products.
- More comfortable and safer work environment
- Greater visibility and reduced retrieval time
- Lower maintenance cost
- Creates positives impression on visitors and during customer inspections6.3 Total Productive Maintenance

The idea here is that all TPM participants should continuously be restoring equipment back to its basic condition using the activities outlined in the 5S foundation. Once this has been established as the status quo, operators and maintenance staff should begin their autonomous maintenance program, which involves cleaning equipment

Total Productive Maintenance (T.P.M)-

Steeps involved in implementation of TPM are;

Step one: Identify a pilot area

While you may be tempted to introduce TPM activities across an entire facility at once, getting started with one pilot area, or even one machine, will allow you to pay close attention to what works, what doesn‘t, and what may need to be adjusted for the future. It also allows early adopters of the program to become champions who will help support the rollout of the program later on.

When selecting pilot equipment, you may choose to start with a simple machine that is not critical to production, or conversely, with machinery that causes a bottleneck or is highly critical. There are costs and benefits to each approach. Starting with a simple machine is low-risk, but makes it harder to measure the effectiveness of the improvements made. Choosing a highly critical piece of equipment can have a big effect, but can be risky if the TPM process is not carried out correctly. You‘ll know which approach is best for your team.

In terms of whom to include in your pilot TPM efforts, it‘s best to involve as many employees as possible. This will help to build momentum, and, as the benefits of a TPM program are realized, ensure that efforts do not fall by the wayside.

Step two: Return equipment to its basic condition

Once your pilot area has been defined, it‘s time to get moving on your TPM efforts with a combination of 5S and autonomous while inspecting it for deterioration or abnormalities, identifying and eliminating factors that contribute to deterioration, and establishing standards to clean, inspect, and lubricate an asset properly.

Step three: Measure OEE

OEE, or overall equipment effectiveness, measures how available your equipment is, how it performs, and what kind of quality it produces. Measuring this regularly will give you a great indicator of whether or not your TPM program is performing as planned. This will provide you with data-backed confirmation on whether your efforts to eliminate downtime are working, and then track the effectiveness of your efforts over time. Step four: Reduce major losses

This step is carried out using the ―focused improvement‖ pillar of TPM. Once OEE has been established, it‘s important to assemble a cross-functional team that can look at the OEE data that has been produced and identify main reasons for losses that have occurred. After a root cause analysis has been conducted, measures can be taken to eliminate these losses where possible. Continued use of OEE measurement will verify whether the focused improvement efforts are working as planned.

Step five: Implement planned maintenance

The final stage of implementing a TPM program is planning and scheduling maintenance activities. Since the goal of total productive maintenance is to eventually eliminate unplanned breakdowns, planned maintenance with a CMMS solution should entail the preventive maintenance that will allow your machinery to run as planned after all TPM activities have been carried out successfully.

Of course, there are other pillars to a successful TPM program, such as training and education and new equipment management. These pillars should be continually carried out as you gather learning's from your implementation efforts. You can read more about each of the pillars of TPM here.

Advantages of implementing total productive maintenance are

the major advantage of TPM is that it takes some pressure off the maintenance team and allows them time to concentrate on more complicated (and more important) maintenance tasks. Eventually, this shift in the workflow improves overall productivity and performance of a food and beverage plant.

TPM is a systems-wide approach: From top to bottom, from boardroom to plant floor—everyone is involved. It encourages learning and improvement across an entire plant's value chain. The quality management and focused improvement pillars help identify and quickly eliminate non-conformances in a methodical and structured manner.

By implementing TPM, companies will reduce safety risks and eliminate some common symptoms of disorderliness such as dirty or messy workstations, missing or wrongly placed tools that can constitute a trip hazard, and so on.

On top of that, since major food manufacturers must adhere to several FDA regulations such as current Good Manufacturing Practices that regulate equipment, methods, facilities, processes, and controls, TPM also helps staff detect and address issues proactively and make a facility better prepared for any regulatory audits. Training given to workers – Total productive maintenance is such a activity that it cannot be implemented without giving training to the workers so in order to tell all the workers about the TPM we took two training sessions in which we conducted the C.L.I.T activity in this C.L.I.T activity an autonomous maintenance of machines is done so that the breakdown percentage can be reduced.

Our aim was to reduce the breakdown percentage of machines so we created a chart which was containing the C.L.I.T activity and all the information of doing the maintenance such as what to clean where to clean what type equipment's should be used for cleaning and most importantly lubrication. Frequency of doing the lubrication and what type of lubricant should be used was all included in that chart thus during the training we told all the information about the machines and where the maintenance should be done. The training was given to all the 12 workers presently working in the organization and we distributed all the machines to workers for performing the daily maintenance activity, and we also gave them the check sheet so that they can keep the daily record of maintenance done.

5.4 Die Design

While collecting the data required for die design we found that there was blank area present on the roller of the die which could be reduced by including that blank area in side of die.

Thus our aim was to reduce the blank area over the die by redesigning the die. For redesigning the die we collected all the dimensions of the die. Thus while designing the die our main aim was to increase the number of dies. As the existing die was having 15 numbers of dies on its roller we tried to increase that number without changing any of the dimensions.

We also visited one of the die manufacturers in Ichalkarangi for manufacturing the new die and the approximate cost of the die which we got from them was 13000/- Rs. Along with the dies we also studied on the material of the roller which was stainless steel (SS) which is mostly used where manufacturing of food products is done. We also found an alternative material which can be used that was food graded steel.

5.5 Time Study

Use of time study

It is useful in determining the standard time for various operations, which helps in fixing wages and incentives. It is useful to estimate the cost of a product accurately. It helps in production control. It helps in predicting accurately as to when the work will be completed and hence customers can be promised to take delivery on a fixed date. Using the time study techniques, it can be found that how much machines an operator can run.

Procedure for Time Study

(a) Analysis of Work - The complete job and its operations are split up into various elements. These elements are finalized after conducting motion study. In the end, time required for the job preparation, cleaning of machine and oiling etc. should be included. Thus time study includes all the tasks performed by the worker and not only the effective work.

(b) Standardization of Methods:- Before conducting time-study, all the constituents of the job such as materials, equipment, tools, working conditions and methods are standardized. The method should be easy, safe and quickest in the given conditions, so that it can be accepted by workers.

(c) Making Time Study:-The study is done on a printed time study record sheet as shown below which is fixed on a board known as Time Study Board. On one corner generally right hand top corner a stop watch is placed. This stop watch should have a decimal scale dial so that it can read up to 0.001 minute.

Different time readings of one element are recorded in the corresponding column of the record sheet. Several sets of readings are taken to arrive at an accurate result. After noting all these readings, average time is calculated, neglecting abnormal values, if any.

This average time is multiplied by a leveling factor also called ‗Rating Factor', which is generally assumed as 90-120% to get the time required by a normal worker. The multiple of average time and rating factor is known as ―Normal Time‖ Some allowances such as personal allowance (20%), fatigue allowance (5%), preparation allowance (5%) are added in normal time to obtain the standard time. The standard time is the basis for the calculation of wages and incentives.

Thus, Standard time = Average Time × Rating factor + other allowances.

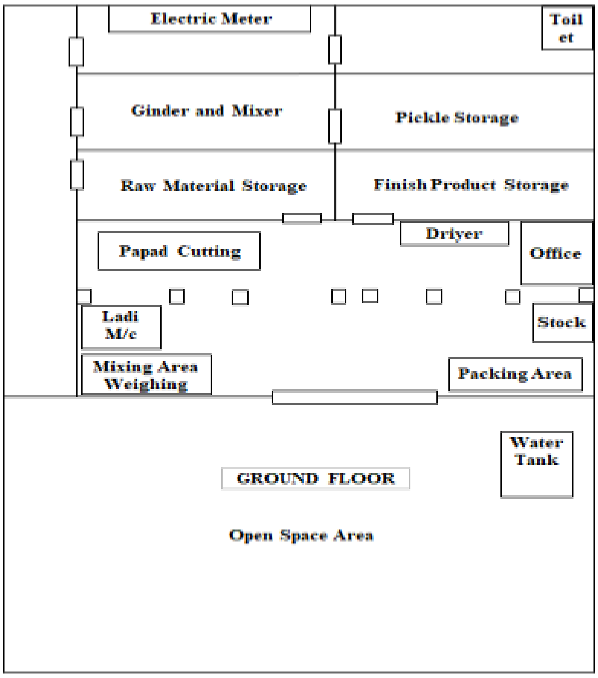
6.0: RESULTS AND DISCUSSION

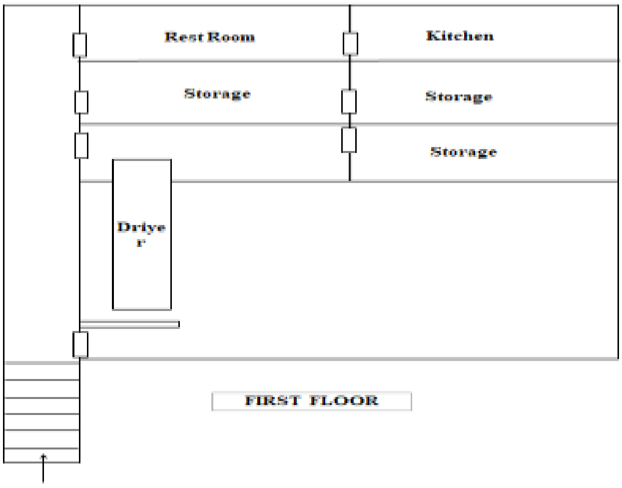
6.1 Results of layout study

The building occupied 2470 sq. ft. of area at the ground floor and the on the first floor. The machines were distributed on both ground and first floor. As discussed and also mentioned in problem statement the layout was not properly arranged. Which resulted in zigzag flow of the material from ground floor to the first floor.

Thus we decide to change the layout, and we used relationship chart for the formation of the ***new layout.***

From the above Chart we came to know about the department and there closeness that is which department should be close to one another and which department should not be close to one another. The department which were required to be close to each other were given category number as A which was ―Absolutely necessary ― and department which didn't had any kind of connections were given the category number as X which indicate as ―Avoid





7.1.1 Distance Mapping Between Processes

Sr.no	Distance from	Distance in (ft.)	Distance to
1	Raw material storage	8'	Grinding machine
2	Grinding machine	36'10"	Mixing area
3	Mixing area	36'10"	Mixer
4	Mixer	48'5"	Papad machine
5	Papad machine	58'/7'	Dryer
6	Dryer	71'/8'	Storage
7	Dryer	68'/8'	Packing
8	Finished goods Storage	15'10"	Packing
9	Packing	4'	stock
	Total distance travelled	345'8"	

Table 11: Distance Travelled by New layout

Sr. No.	Distance from	Existing Distance in (ft.)	New Distance in (ft.)	Distance to
1	Raw material Storage	108'8"	8'	Grinding Machine
2	Grinding Machine	83'	36'10"	Mixing Area
3	Mixing Area	83'	36'10"	Mixer
4	Mixer	95'	48'5"	Papad Machine
5	Papad Machine	5'/52'	58'7'	Dryer
6	Dryer	8'/66'	71'8'	Storage
7	Dryer	28'/49'	68'8'	Packing
8	Finished goods Storage	38'	15'10"	Packing
9	Packing	8'	4'	Stock
	Total Distance Travelled	582'8"	345'8"	

Comparison of distance Travelled as per old and new layout

Thus the total distance travelled by the workers was reduced by 237 ft.

By studding the layout we developed the relationship chart through which we increased the working area by 36% which is about 424.8 sq. ft.

Timing Saved by New layout:

Sr. No.	Time Required (min)	Time Required (min)
1	2	0.33
2	4	4
3	0.9	0.5
4	2	2
5	10	10
6	2	2
7	0.9	0.41
8	0.25	0.25
9	1	0.35
10	45	45
11	0.9	0.33
12	30	30
13	0.5	0.5
14	5	5
15	2	0.5
16	0.21	0.21
17	0.17	0.16
18	0.2	0.2
19	0.52	0.25
Total	107.55	102.15

Table 14: Timing Saved by New layout

- Total cycle /day = 14
- Current daily production = 52 kg
- Proposed daily production = 55.7kg
- Current cycle time = 107min 55 sec
- Saved daily time = 7.5*14=105min
- Total time saved =7.5÷107.55*100 = 7%
- Production output increased by 7.11%

6.2 Results of implementation of 5'S'

- 1 s Removed all the unwanted material
- 2 s Kept only required material working area
- 3 s Implemented C.L.I.T activity for cleaning

- Before Implementation of 5 'S'

- After Implementation of 5 'S'

- Before Implementation of 5 'S'

- After Implementation of 5 'S'

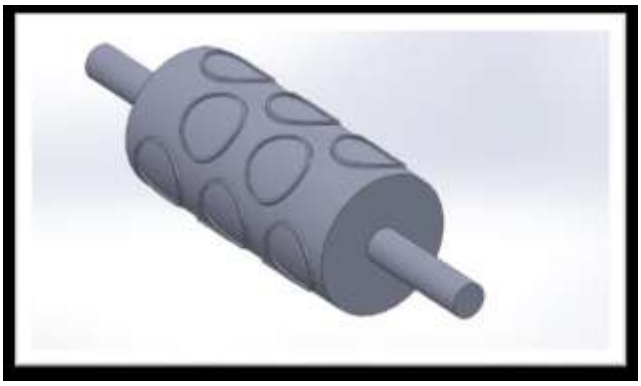
With the implementation of 5s we removed the waste scrap which was about 11,500 Rs.

7.3 Results of die design

7.3.1 New Die Calculation

- Number of impressions on a cylinder = 18
- Length of cylinder = 340mm
- Diameter of cylinder = 160mm
- Area of cylinder = π *D*L i.e. π * 160*340 = 170903mm^2
- Diameter of impression = 80mm
- Area of die = π/4 *D^2 i.e. π/4 * 80^2 = 5027mm^2
- Total area of dies = 5027*18= 90486mm^2

- Blank area on cylinder = 170903 – 90486 = 80471mm^2



- Old die design

- Redesigned die

7.3.2 Improvement in Die

Sr. No	Parameters	Old Die	New Die	Improvement
1.	Number of dies on a impressions	15	18	3
2.	Length of cylinder	340 mm	340 mm	-
3.	Diameter of cylinder	160 mm	160 mm	-
4.	Area of cylinder	170903 mm^2	170903 mm^2	-
5.	Total area of impressions	75405 mm^2	90486 mm^2	15081 mm^2 Increased
6.	Blank area on cylinder	95498 mm^2	80471 mm^2	15027mm^2 Reduced

Table 16: Comparison of die

6.4 Results of Total Preventive Maintenance (T.P.M.)

CLIT Activity

Tagging

Total productive maintenance (T.P.M) was implemented on 18/12/2018 after implementation we gave them training on how to do the maintenance and what should be the schedule for doing proper maintenance.

Machine name	Date of maintenance	Component name
Mixer A	26/12/2018	Blades
Papad machine	23/03/2019	Belt of machine

Table 17: Preventive Maintenance done

7.6 Results

Sr no.	Project	Existing	New	Improvement
1.	Die design	No of Dies 15	No of Dies 18	20% Increased
2.	Distance Mapping	582'8"	345'8"	40.66% Reduction
3.	Layout	1154.1 sq. ft.	1578.9 sq. ft.	36.80% Increased
4.	5'S'	-	Scrap 700-800 kg	11000-12000/- Profit
5.	Flow Process Mapping	107.55 min	102.15 min	3.25% Reduced
6.	Time Study	-	Setting the standard	-
7.	T.P.M.	-	Setting the standard	-

Table 19: Final results of I.E tools after Implementation

After successful implementation of project the total productivity increased by 7.11%. This increase in productivity is nothing but increased one cycle per day, so with this basic changes Papad making machine which is of 150kg/day capacity which was priory utilized about 34% of total capacity which was 50kg/day, is now utilized 36.5%.

7.0: CONCLUSIONS

The following achievements in productivity improvements can be noticed as follows:

By studding the layout we developed the relationship chart through which we increased the working area by 36% which is about 424.8 sq. ft.around3.5% of timing was reduced per cycle with the help of flow process mapping. Along with flow process mapping we calculated the distance mapping and reduced the overall distance travelled by workers which is 40.66% reduction. With the implementation of 5s we removed the waste scrap which was about 11,000-12000/- Rs. And kept only the required material near the machines .With the help of time study we obtained per hour packing rate for 100gms of Papad which was 900 bags/hr. By re designing the die we increased the number of dies on roller by 20% which is the number of die was increased from 15 to 18 die. Total productivity improvement per day is 7.11%

8.0: REFERENCES

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