

Application of Lean Concepts in Process Industry



T. Niruban Projoth, R. Rohith Renish, K. Arun Kumar, P. Jeyaraman

Abstract: In any process industry, there will be a chance to increase the efficiency of the process. There is a less possibility of achieving complete efficiency in any system but there are certain concepts to make it possible. One such concept is lean manufacturing. In this paper, bakery is taken as the industry and its process is studied. It has been analyzed that there are certain possibilities to make the process efficient. For that, the concept 5s, a Japanese concept is been implemented in the bakery and the efficiency of the process is increased. Also, process flow chart and Two handed process chart is has been worked out for the system and thus the productivity of the bakery is increased by eliminating the wastes.

Index Terms: Lean, six sigma, 5s, process chart, two handed process chart, process industry, bakery, efficiency, productivity

I. INTRODUCTION

Lean manufacturing or the word "lean", clearly specifies the minimization of waste with a systematic method within a manufacturing system by increasing or not disturbing the productivity. [2] Wastes created because of the overburden and unevenness in the workloads are taken into account in Lean. Any customer would be willing to pay for the value in a process when it is taken from the client's perspective. The non-value added activity that is decided to be the waste in many industrial processes comprise more than 90% of a factory's total activity. [1] Many Manufacturing and service industries mainly trying to implement such lean practices and the adoption of lean is getting accelerated. The Process chart shows the operating and static position in relation to each other when the process is simultaneous. For repetitive operations, the two-handed process chart is generally used, and when a complete cycle of work is been recorded. [7] What may be shown as a single operation on a flow process chart is considered to be broken into many number of elements to take up the operation. A process Industry (bakery) has been taken for implementing the Lean concept and productivity has been achieved.

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II. PROCESS OF BAKERY

A Process industry like bakery which involves the production and selling process of flour based baked food items that consists of pies, cakes and breads. Bakeries can provide a wide range of deliverables that is related to the baking industry. Some bakeries will be specialized in handmade or traditional types of bread with local milled flour, or flour treatment agents.

III. TYPES OF WASTE

Muda, Mura and Muri are the three types of waste that was given by Toyota. [6] And other wastes that includes in any process are

- Delay, that deals with the time variation from the actual scheduled time.
- Over processing, that deals with the extra processing state that need not add any value to the process.
- Over production, that denotes the extra production of goods than the demand.
- Waiting, that denotes the actual readiness of the process but it should wait for the previous other processes to get completed.
- Motion, that denotes the movement of the worker for completing a task.
- Inventory, that actually describes the warehouse of a manufacturing unit that stores the extra produced goods.
- Transportation denotes the movement of the materials or the products involved in the process.

IV. THE APPLICABILITY OF LEAN SIX SIGMA IN THE FOOD INDUSTRY

Lean Six Sigma have its great successful implementation and results in a common industry, but it is unfortunate that it is still very limited in the expansion of Lean in food industry as per the reviews[3]. But the case studies have proven that the possibilities of expanding the area of quality improvement in the industry that deals with food. [4]. And the main challenges faced during the implementation of Lean in such food process industry completely varies from the common industry in order to evaluate the high variable changing nature in the constraints that includes the fierce competition, the product quality, varying material costs and the requirements that are regulated [5].

V. S TABLE

In order to keep the working environment in a sequential and clear order to maintain the same quality and timing of progress at each steps, 5s which is a lean practice used to evaluate the things and implement the lean conceptual reorder the sequence. Refer table 1. [8]



VI. CONTROL POINTS IN BAKERY

1. Weighing on ingredients

Storage of the bakery raw materials has its own disadvantages which needs special attention. Weighing of

the goods leads to confusions because of the lack of standard weights.

5S (Japanese)	Definition
Seiri	Separate the tools and other needed items from the items that are termed to be unnecessary for the process.
Seiton	Set in order in such a way that it should not cross the optimality and the working area
Seiso	Shine in order to clean the working environment to maintain the same each day.
Seiketsu	Standardizing the corrections made earlier to maintain the work place by following it.
Shitsuke	Sustaining the same practice in the organization to maintain the discipline of sorting and organizing.

2. Mixing

The ingredients are getting mixed in order to form a dough. There are two kind of mixers, rotator mixer and spiral mixer. It is to be noted that the maintenance of the mixer is essential to avoid corrosion. It is better to always have a semi automated sytem for mixing.

3. Kneading

The process of fermentation takes place in with the initial stage of making a paste of dough with water which facilitate the final result.

4. Fermentation

Bread products are some examples for baked items that needs the process of fermentation. Formation of gas takes place which in turn makes the dough rise where the yeast breaks out the carbohydrates that can be considered as a leavening process. A good quality of yeast should leave the bread that should not be contaminated as strains with microbes which would effect in undesirable form. There should be a time bound to avoid such situation.

5. Panning/ Molding

This step consists of addition of dough into moulds or pans for further baking step. These should be preferably made with stainless steel of food grade material and use of plastic should be avoided. Usage of pans and moulds to make the dough to get its shape is the next step in the baking process. Preferable it should be a stainless steel and which should be a food grade material. Use of plastic can be avoided in the process.

6. Slicing / Cutting

The baked bread product is supposed to be sliced before it is getting packed. A constant level of cutting that can be both manual or automated is followed by them. Using a stainless steel sharp blades / knives without corrosion is to be considered during the process.

7. Packaging/ Wrapping -

In order to safeguard the food products from the external environment which may damage the product and also to

provide the information about the product to the consumer. Manual Packaging is mostly preferred in smaller bakery units rather than automated packaging units to reduce cost.

I. LAYOUT MODIFICATION BY IMPLEMENTING 5S

Existing Layout Of Bakery:

The different elements involved in the process is listed according to the layout and position of the process occurred(figure1).

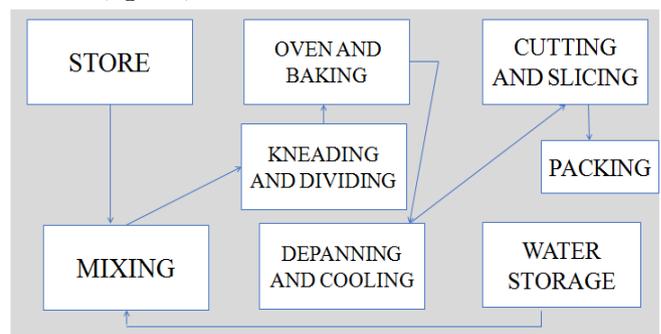


Figure 1.Existing layout of the bakery

Proposed Layout Of Bakery

After the implementation of 5s, the things were segregated accordingly and a deep analysis on positioning the process has been made and a layout has been proposed figure 2.

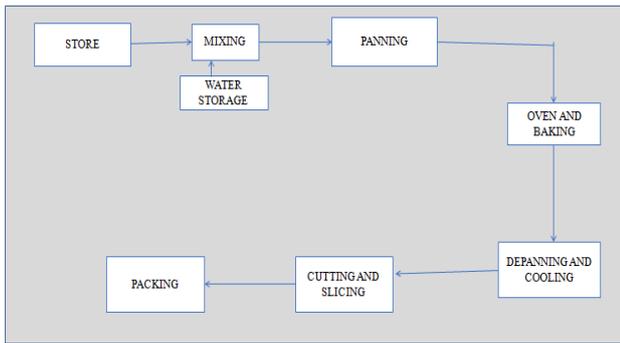


Figure 2. Proposed Layout Of Bakery

VIII. PROCESS FLOW CHART

Activity	Symbol	Summary
Operation	○	Whenever hand grasps, releases or assemble materials.
Transport	⇒	Whenever hand moves from one point to other
Delay	◐	Whenever the hand is idle or it is not performing any activity
Hold	▽	Whenever hand holds an object in order to perform an operation on object by other hand

The Process Flow Chart Of The Existing System :

The process is recorded in the bakery by analysing the elements involved in the process [11] .

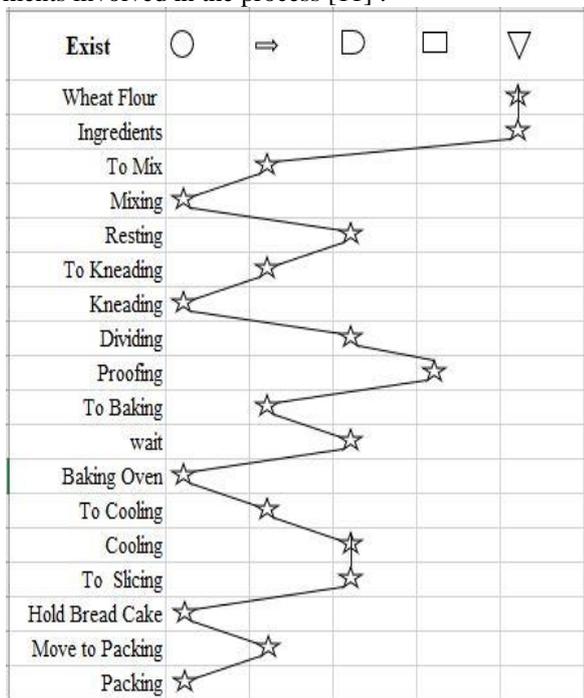


Figure 3.Process Flow Chart (Existing)

Process Flow Chart (Proposed)

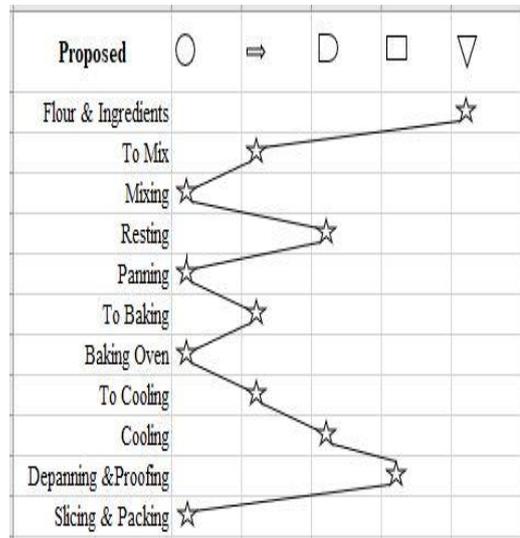


Figure 4. Process Flow Chart (Proposed)

TWO HAND PROCESS CHART (Before 5S)

Left Hand	○ ⇒ ◐ □ ▽	Time in Sec	○ ⇒ ◐ □ ▽	Right Hand
Wait	☆	100	☆	Wheat Flour
Wait	☆	200	☆	Other Ingredients
To Mix	☆	50	☆	To Mix
Mixing	☆	1200	☆	Mixing
Resting	☆	1800	☆	Resting
To Kneading	☆	150	☆	To Kneading
Kneading	☆	900	☆	Kneading
Dividing	☆	600	☆	Dividing
Proofing	☆	1500	☆	Proofing
To Baking	☆	50	☆	To Baking
wait	☆	20	☆	Baking Oven Open
Baking Oven	☆	1200	☆	Baking Oven
To Cooling	☆	60	☆	To Cooling
Cooling	☆	1800	☆	Cooling
To Slicing	☆	90	☆	To Slicing
Hold Bread Cake	☆	2500	☆	Slicing
Move to Packing	☆	50	☆	Move to Packing
Packing	☆	1000	☆	Packing

Figure 5. Two Hand Process Chart [Before 5s]

Left Hand	○ ⇒ ◐ □ ▽	Time in Sec	○ ⇒ ◐ □ ▽	Right Hand
Ingredients	☆	100	☆	Wheat Flour
To Mix	☆	50	☆	To Mix
Mixing	☆	1200	☆	Mixing
Resting	☆	1800	☆	Resting
Panning	☆	1500	☆	Panning
To Baking	☆	50	☆	To Baking
wait	☆	20	☆	Baking Oven Open
Baking Oven	☆	1200	☆	Baking Oven
To Cooling	☆	60	☆	To Cooling
Cooling	☆	1800	☆	Cooling
panning & Proofing	☆	1500	☆	Depanning & Proofing
Slicing & Packing	☆	2500	☆	Slicing & Packing

Figure 6. Two Hand Process Chart [After 5s]

IX. MATHEMATICAL FORMULA FOR CALCULATING NUMBER OF BREAD

Productivity & Efficiency (Before 5s)

Efficiency = (Standard Time for N items/Actual time for N items)*100

$$=(10800/13270)*100$$

$$=81.38\%$$

Productivity (P) = (Total No. of Items * Standard time to produce one item) / Total time to produce N items

$$=(50*216)/13270$$

$$=0.81$$

Productivity & Efficiency (After 5s)

Efficiency = (Standard Time for N items/Actual time for N items)*100

$$=(10800/11760)*100$$

$$=92\%$$

Productivity (P) = (Total No. of Items * Standard time to produce one item) / Total time to produce N items

$$=(50*216)/11760$$

$$=0.92$$

Hence, **13270 (before 5s) - 11760 (after 5s) = 1510 sec**

1510/216 = (App) 7 bread cakes

Thus the implementation[12] of the 5s gives an increase in the productivity of the bakery with 7 bread cakes.

CONCLUSION

It is suggested to the process industry that 5s implementation will increase the efficiency and the layout has been changed accordingly. [10] Also it have been worked out with the help of two handed process chart and process flow chart, in which certain modifications can be done to increase the productivity

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