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APPLICATION OF NEW METHODOLOGY FOR CONTINUOUS IMPROVEMENT IN BREAD MAKING: A CASE STUDY IN ROMANIA

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Abstract: In the recent decades, it was observed that the usage of lean manufacturing (LM) was increasingly used in production systems. This approach focuses on reducing the manufacturer's fear concerning production system by applying optimal, proven and accessible standard methods that are easy to understand and to apply. The current paper focuses on the application of a series of lean manufacturing tools in one Romanian bread making company. The paper presents the main implementation issues, the obtained results after the application of the tools in the production system. The benefits and improvements were analysed and it leads to continuous improvement and increasing production systems efficiency in order to diminish the amount of waste.
Keywords: Kaizen, bread making, safety, optimization, improvement

INTRODUCTION

Innovation is according to Merriam–Webster Dictionary something new or applied to an existing product as a change referring to a product, idea or field. Several authors (*Tohidi, H., Jabbari, M.M., 2016*), mention innovation as a defining success factor for productivity, ensuring a company profit and competitiveness through the market. OECD Glossary of Statistical Terms defines process innovation as the implementation of a new or significantly improved production or delivery method, including significant changes in the manner of techniques and/ or software. (*OECD, 2005*) Process innovation intends to decrease unit costs necessary for production process or delivery, increasing quality and produce or deliver new or significantly improved products. (*OECD, 2005.1*)

The concept of "lean manufacturing" is considered today a practice in production management, which is based on the idea that material resources should be used only where value is created, that effort, space, warehouses should be as little as possible, and losses of any kind must be eliminated. The premise of the emergence of the concept of lean manufacturing organization was the development of total quality management – Total Quality Management (TQM). It involves an approach to improving the quality of products and services by continuously improving all processes related to their manufacture, quality orientation on customer perceptions and needs, production without defects. The focus of production management is a priority on improving processes, reducing attention to employee criticism (criticism at the organizational level) and the decision–making process based on data. Thus, TQM is an integrated management philosophy and a set of practices that focus on continuous improvement, meeting customer requirements, reducing the repetition of processing or work processes, long–term thinking, increased employee involvement and teamwork, redesigning the process, competitive benchmarking, problem solving in the team, constant measurement of results and closer relationships with suppliers.

The philosophy and lean thinking are based on two practices, namely: elimination of losses from the production process (MUDA), which is the most important, and continuous quality inspection (JIDOKA), the latter practice being an operational process designed to ensure a level "0" of losses or within accepted limits (*Gamage, J., et al., 2010; Rao, P.S., Niraj, M., 2016*). As a result, the objective of continuous reduction of losses (waste of any kind, materials, labour, unnecessary operating times, etc.) leads to a decrease in the time between launching the order from the customer and shipping the products to him, production management being permanently concerned with eliminating "Everything that increases time and cost."

Lean manufacturing (LM) has been proved to be an efficient instrument in manner of providing products or services with excellent attributes to clients by reducing waste, improving productivity, training the staff and improving quality. Lean manufacturing tools have been frequently used in companies that export products worldwide, mainly to developed countries. The key element of LM is mass production and it should focus on improving performance of production processes in order to create high quality products. LM is considered an adequate example of process innovation concerning companies, focusing on continuous improvement as a main groundwork. Senior management is implied in ensuring resources for providing high–quality products and outstanding processes by using different methods or instruments such as lean manufacturing (Kaizen, 5's, reducing the seven crucial waste categories, SMED). Nowadays, manufacturing process is perceived by two approaches: sustainable economic growth and the failing of old management styles related to employees without no multi–task training. (*Landers, R.G., et al., 2020*)

According to the lean philosophy, activities that do not generate added value are identified and are either reduced in duration or eliminated, which leads to reduced manufacturing costs, improved productivity, quality and, finally, reduced product delivery time to the client. The lean philosophy was created starting from the idea of eliminating any type of losses that may occur in the production system. The concern for reducing and eliminating losses is closely related to the "supreme" desire of manufacturers to generate added value to the finished product, in accordance with the expressed needs of customers. The seven types of losses defined are: overproduction, waiting, transport, unnecessary processing, unnecessary stocks, movements, defects. Following this point of view, to the seven losses was added an eighth loss supported by Toyota's philosophy: stopping the creativity of employees. Lean production uses half of the human effort, half of the production space, half of the investment to make the means of production (tools, devices, verifiers, etc.), half of the scheduled, standardized hours, so that the development of a new product requires half from the time determined in the classical variant.

Food industry is one of the most complex and unique industries comparing to other industries and the application of lean manufacturing was often perceived as an advantage due to a series of advantages such as: extra output, lower costs, better yields, improved systems, better working environment, keeping in contact with consumer needs, eliminating contamination.

LM was perceived as rather difficult to apply in food processing industry. Several authors (*Dora, M.K., 2014*) identified a sequence of factors that are considered important when deciding to apply LM principles: the high perishability of products, complex process flow, diversity of raw and auxiliary materials, oscillating demand.

Bread making, as a branch of food industry with significant importance in the national economy of states is one of the most challenging industry considering the continuous change of raw and auxiliary materials used and applied technologies. The bread making market needs to find a way to overcome the challenge of the economic crises and operational cost increase – raw components, energy and other resources. (*La Sala, P., 2017*) As a consequence, the main questions of the current study are: Can Lean Manufacturing improve the quality of the final products? In what extent the efficiency of the process will be higher? The competitiveness of the business can be enhanced?

MATERIALS AND METHODS

— 5S Methodology

The methodology represents a systematic form of management that involves the usage of multiple instruments from several areas, such as floor type, workplace cleanliness, ergonomics and work area organization. The 5S methodology leads on five pillars, named after Japanese stages: Seiri, Seiton, Seiso, Seiketsu, Shitsuke. The stages are represented and explained in Figure 1.

The steps describe the stages of visual management, each term starting with S and having a corresponding definition in English as related in Figure 1. 5S is an indispensable ingredient of the management of the workplace, of a good administration of the processes and the activities related to it.

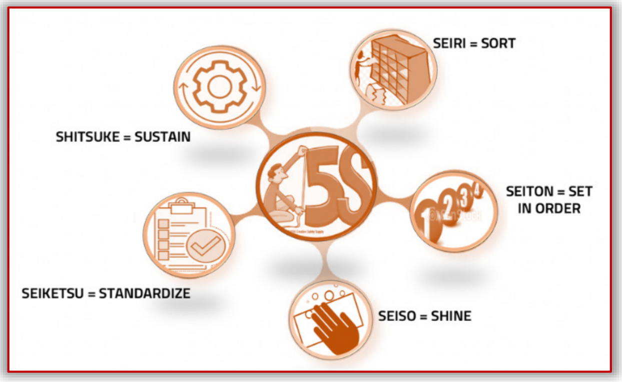

Figure 1 – The 5S Concept

Through a good management of the inventory, the materials related to their activity, the employees acquire and practice self–discipline. 5S activities include:

≡ *seiri – sort*: the right arrangement. It involves sorting unnecessary objects from work. For example, machines, tools, devices, unused defective products, etc. should be removed from work;
≡ *seiton – set in order*: sort the remaining objects. Each rack or pallet of tools must have a well–defined place so that its location can be easily identified for use;
≡ *seiso – shine*: cleans, cleans everything that remains. Clean and paint to give you a pleasant appearance;
≡ *seiketsu – standardize*: personal cleaning. Keep the workplace clean of dirt, dust and oil to provide a pleasant working environment;
≡ *shitsuke – sustain*: discipline. It means work instructions, safety measures, better discipline and a work culture.

Visual Management is promoted in the workplace so that all employees understand correctly, transparently and can manage their own activity in a safe, clean and organized environment, which accelerates communication and continuous improvement. It facilitates the dissemination of information on the current, actual situation of the production flow (for example, information on the safety of the working environment, operations, stored quantities, quality level and condition of the equipment, etc.), production, thus providing motivation and feeling of pride to continue the activity at maximum intensity (*Steenkamp, L.P., et al., 2017*)

In recent years there has been a revival of visual management in the management of production and operations, as the concept has evolved and its techniques have diversified. Researchers study the implementation of visual management independently of other lean practices (*Bateman, N., et al., 2016*), especially in the context of continuous improvement efforts. Therefore, modern visual management goes beyond the provision of information on the evolution of key processes or performance indicators (KPIs) and also includes strategic information and the visualization of continuous improvement progress. (*Bateman, N., et al., 2016*)

Recent empirical studies suggest that visual management facilitates the sharing of strategic information between departments within a company and involves the involvement of teams in continuous improvement (*Bateman, N., et al., 2016*), both of which are key factors for the success of initiatives in this field. Overall, the importance of visual management has increased, as it is used more as a control and guidance tool to support continuous improvement initiatives, than as a principle for job design. Given the extended role of visual management in today's production environment, more research is needed on this topic to facilitate its application in the practice of different organizations. (*Tezel, A., et al., 2016*)

— Single Minute Exchange or Die (SMED) Methodology

Changing tools "in one minute" (Single Minute Exchange of Die, SMED) is a fast and efficient method of converting a manufacturing process related to making one product to another (next). In the case of lean manufacturing, the goal of reducing time loss has led to the creation of orderly tool storage devices, which allow their extremely rapid change in order to reconfigure the machines for a new operation related to the technological flow of making another product. The concept states that all steps, the maneuvers to be performed can take less than 10 minutes. Also, the rapid change of tools helps to reduce costs due to time savings, as well as an increase in the flexibility of the production system. (*Godina, R., et al., 2018*)

This method aims to increase the flexibility of manufacturing by reducing the time required to change the manufacturing series, changes that have a long duration, have a complex character and are performed by highly qualified workers.

The analyses performed highlight the fact that the size of a manufacturing series is proportional to the cost of launching into manufacturing, which, in turn, is proportional to the time of changing the equipment for adjustments. To reduce by 50% the time of changing the series, the size of the manufacturing batch must be reduced to 70% compared to the initial economic quantity of the batch, and for a 75% reduction of the change times, the batch to be launched in manufacturing must represent 50% of the optimal batch size.

It follows that in order to reduce the change times of the manufacturing series, the size of the manufacturing batches must be reduced, which at the same time responds to the requirements of increasing the production flexibility.

Following the reduction of the change times of the manufacturing series at the MAZDA Japanese plant, the SMED method was designed and applied.

Following the process of changing the manufacturing series, according to the method, internal operations were identified, which require a stop of the machine, so a stop of production and external operations that can be performed when the machine is in operation and does not require stops. (*Ulutas, B., 2011*)

The application of the SMED method has as starting point the analysis of the existing situation, with the question – "What?", following the choice of the sector that requires the most urgent improvement and to apply the reduction methodology to answer the question – "How?", going through the following steps:

- *Stage 0*: Observing each operation in order to determine as accurately as possible the time required to perform each operation;
- *Stage I*: Separation of internal operations from the external ones;
- *Stage II*: Transforming as much as possible the internal operations into external operations;
- *Stage III*: Rationalization of the settings for the transition to the new manufacturing series.

By applying the method, the aim is to reduce the internal operations to the minimum necessary and to reduce the stopping times by passing some internal operations in external operations that can be performed without the need to stop the production process. (*Costa, E., et al., 2013*)

RESEARCH METHODOLOGY

The research was carried out in a bread making organization located in Romania and trading on the Romanian market. The name of the company is not going to be published for data protection reasons. The data collected from the company was analysed in order to complete the qualitative research of the current study. The company was aimed to diminish the number of nonconformities and increase working satisfaction towards the employees, reaching to the need for continuous improvement.

The bread making company focusing on the current study is one of the major companies in the field from the Romanian industry with 12 factories and over 150 stores. The organization includes milling units, production units and selling units, counting about 6000 employees in 2019. The company produces fresh bread and bread products, frozen products and milling products – flour, bran, and hominy. In the last years, the company managed to trade the products across the border reaching to different countries. The study was focused on fresh bread production, the working shift being divided in three shifts and three technological flows – white whole–wheat bread, intermediate bread, and whole wheat bread. The case study was developed on the main technological flow – white whole–wheat bread production applying 5S and SMED methodology. Considering the fact that the internationalization of the company has become more intense, it was considered convenient to apply lean manufacturing principles in order to improve process efficiency.

RESULTS

— Application of 5S and SMED method on the process

The study was focused on one of the technological flows – white wheat bread production. The technological flow produces white wheat bread – 300g, 500g and 1000g and white wheat buns – 50g.

In order to apply lean management instruments, the staff was taught on the principles and regulations that were going to be applied, lean management instruments were explained and the aim of the applied methods. Both applied methods were explained and motivated, so the staff could better understand and assume the working procedures in order to achieve better results and ensure the success.

— 5S methodology

The methodology was supposed to be applied on a series of working areas in the factory – raw and auxiliary materials reception, raw and auxiliary materials dosing, raw and auxiliary materials preparation, dough dividing, baking and cooling. Firstly, all the steps were analysed concerning the organization of work, equipment, staff distribution, staff movement and materials flow.

The main matters identified were: disorganized equipment, storage of the raw and auxiliary materials, distance between storage and equipment, excessive quantity of raw materials existing in the technological flow area (flour bags deposited on the floor near the equipment). The existence of these matters was affecting productivity and work efficiency. In some cases, the matters could affect workers safety and health: the presence of raw and auxiliary materials on the floor caused a slippery surface and endangered the safety of workers, the flour bags disturbed workers movement. Also, the cleanliness of the surfaces encouraged the development of several microorganisms – mould and bacteria.

The analysis of the current status of the production was performed according to the issues required by the 5S methodology and was adjusted on each work area.

Table 1. 5S check list applied

Category	Check item	Evaluation Criteria
1S: Sort "Eliminate the items that are not useful from the production area"	Materials	Excessive raw material bags, empty bags, containers resulted from the emptying of raw and auxiliary materials?
	Equipment	Equipment that is not used in the area, defective equipment present?
	Tools	Unnecessary tables, bowls, knives, scissors, tools?
	Supplies	Excess cap, gloves stored in the area?
	Documents	Procedures, regulations, organizing instructions stored on the workstations?
2S: Set in order "Reorganizing the items required for production so as to be easy to access and to use"	Jars	Raw and auxiliary materials jars are accessible and labelled? Jars are filled at the beginning of the production flow?
	Placement	Jars are easy to use? Containers are easy to identify? Containers are located near the equipment? Supplies are accessible to workers? Disinfecting areas are situated near the production entries?
	Floors	Marked and properly cleaned?
	Tools	Easy located and accessible? Cleaned and set in order?
	Instructions, regulations, standards	Accessible for workers? Easy to read and observe? Easy to manipulate?
3S: Shine "Cleaning the production areas and implying the workers in the cleaning process of the working area"	Equipment	Clean and located correspondingly? Cleaning schedule is performed regularly? Cleaning agents are used properly?
	Supplies	Supplies are kept in separate areas? Supplies are kept in disinfected containers? Supplies are stored in separate areas?
	Tools	Tools are cleaned regularly? Tools are cleaned on a regular basis or schedule? Cleaning register is kept?
	Work areas	Floors are cleaned regularly? Disinfectant bottles are filled regularly? Cleaning is performed on a regular basis?
4S: Standardize "The workers develop activity in the same way and according to the same regulations"	Tools	Tools are suitable according to the regulations? The material of the tools is standardized?
	Materials	Raw and auxiliary materials are stored according to the standard regulations? The handling of raw and auxiliary materials is standardized?
	Equipment	Equipment is maintained and operated corresponding to the standard regulations? Equipment is configured according to the standard procedures?
	Standards	Visibility of the standard procedures is ensured? Standards are continuously updated according to the period? Workers are trained according to the standard procedures?
5S: Sustain "The workers take control of all the actions that happen in the organization"	Work area	Disinfected, clean, organized and tidy? The procedures suppose organization of the workplace? All the tools and equipment are on the right place?
	Documents, procedures	Are procedures updated and revised regularly? Documents and procedures are current? Check the application of procedures?
	Workers	All the workers are 5S trained? New workers are 5S trained?
	Equipment	Equipment is periodically technically checked? Equipment is set on the right place?

— SMED methodology

Analysing the sequentially of the tools in the manufacturing process, one of the tools was identified as important for innovation – baking area. It was observed that the area had, during a month, about 30 changeovers, the times between changes being estimated at about 15–20 minutes. This aspect was noticed for improving efficiency and productivity. Among all the equipment, one was identified as significant: tunnel oven. SMED methodology was implemented in order to reorganise the changeover process between charges.

The first step to implement SMED was a critical analysis of the actual conditions and manufacturing system. The importance of this study was relevant due to the fact that a better understood of the switchover actions and potential disfunctionalities can help to improve the process. The research was conducted by continuous monitoring, communication with the staff involved in the process and finding out process details. The data were collected from head manager and process engineer and concluded the following aspects: the period to develop actions was too long, the time to charge and discharge the trays with the products was prolonged, the staff had to change the equipment and gloves after each stage and the position of the trays was not adequate – too far from the oven.

The main issue observed was that the workers had different working procedures for the same operation – fact that implied long times for processing and transition. Among the 15 workers in this area, 7 had their own strategies for developing the same task. It was also observed that the staff proceeded to introducing the trays with the products in the oven just few minutes after the oven was ready. Several disfunctionalities identified in this area were the following:

≡ lack of staff training;
≡ lack of procedures;
≡ the indicators for placing the trays and other instruments were missing;
≡ absence of standards and documents that regulate the working directions;
≡ lack of training in equipment functioning.

Table 2. Number of assignments and duration of each action before applying SMED methodology

Actions	Baking	
	Duty	Duration
Shutdown	5	00:15:22
Configuration	24	01:10:14
Startup	7	00:32:14
Total	36	01:57:50

The duties were classified as internal or external and organized according to the SMED methodology regulations. The convert stage focused on converting the configuration stage into external (introducing water into the container for steaming system, adjusting conveyor belt speed, setting baking temperature). Performing tasks before the first charge and filling the container while adjusting conveyor belt speed and adjusting temperature in the same time by three operators, not just by one single person were a series of modifications applied. In table 3, can be observed how the number of assignments and duration of each action was diminished.

Table 3. Number of assignments and duration of each action after applying SMED methodology

Actions	Baking	
	Duty	Duration
External	5	00:10:34
Shutdown	0	00:00:00
Configuration	23	01:00:04
Startup	5	00:20:14
Total	28	01:20:18

Diminishing the configuration times and charge and discharge periods, provided several increases in profit with minimum financial investment. In addition, it was established a series of facts that were really encouraging: regulation of several procedures, work area organization, visual management concepts application, organization of storage and working areas and improvement of the manufacturing system.

Considering the reminded and analysed aspects, the lean manufacturing concepts were really effective for improvement and can be considered as a first step in the continuous improvement process.

CONCLUSIONS

This paper presented an application of lean manufacturing procedures in a breadmaking factory. The implementation was considered effective, leading to several gains concerning the organisational procedures and financial gain. This procedure can be applied in order to improve production flexibility and continuous improvement methodologies. Considering this aspects, lean manufacturing concept can be successfully applied in several other areas, bringing benefits for both manufacturers and involved staff.

Lean methodology, which has evolved over time from a set of principles of organizing production processes to a true organizational culture, and which aims to create value for the customer, while reducing costs, shortening process cycles and improving quality can be considered a reference for manufacturing companies involved in production.

Furthermore, the paper highlights that the workers involvement in the production represents the definitive aspect for successfully implement lean manufacturing methodology in a large category of areas.

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