

Standard Operation Process Applied on Lebanese Dairy SMEs

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Abstract

Lean manufacturing is a production practice and a way of thinking. Its aim is to eliminate any non-value added work in a system. Its implementation in “Small Medium Enterprises” (SMEs) has to be altered and twisted in a different manner since one of the problems that SMEs encounter is the lack of formal procedure and regulation. In this paper we are trying to formulate a standardized work operation for the production of white cheeses in the Lebanese Dairy SME community. No Standard Operation Process was documented in order to be distributed to the different dairy owners by the Lebanese Ministry of Industry. Moreover when addressing dairy processing and more specifically cheese making, using traditional recipes, we observe a sequence of integrated and dependant factors that lead to the final quality result of the cheese produced. These factors include the milk’s state, delicacy of the pasteurization stage, and the cheese maker’s consistency in the different steps of the cheese recipe. We will be targeting the cheese makers’ detailed progressive steps. In order to achieve the best Standard Operating Process (SOP), we will benefit from the applications of lean in food industries and incorporating it with its implementation in SMEs. This will be done in compliance to the regulations of dairy processing and with high standards of health and cleanness. This will lead in reduction in the time, effort, and money of the dairy companies that can use these SOP in order to improve their work and manage it in a more efficient way.

Keywords

Lean Manufacturing, SME, Dairy Companies, SOP.

1. Introduction

It is a well-known fact that Lebanon is in need of an industrial revolution. What better way to start other than in the production field. The new trend, for solutions, in this stage, would be Lean manufacturing; this is because it finds for any possible problem a respective solution. Even though its’ main core problem solving strategies lie in automotive industry, it can be tweaked in order to accommodate the different type of industries. For example Dairy companies, SMEs, in Lebanon suffer from being unorganized and costly when it comes to cheese production. The solution to this problem resides in combining Lean manufacturing aspects with cheese making standards. The outcome of this combination would be an SOP for cheese making. The next step would be directly applying this derived SOP and observing the results. In order for all Dairy SMEs to gain from this finding, Lean manufacturing should be well introduced to them. Then after actually realizing the SOPs’ impact and importance, experts in the field should in turn formulate new ones to accommodate all cheese recipes. Later a general lean objective would be used in the industry as a whole.

2. State of the Art

Antelo et al. (2007) stated that the Lean Production model has been successfully implemented in a big number of automotive industries. Its methodologies have shown their potential in the manufacturing and service sectors. Now Lean is being applied to large food industries, but little reviews are found in the scientific literature. However, it is still not clear if these methodologies can be valid using the same approach on SMEs. The advantage of Lean manufacturing in being flexible to the different systems makes it a powerful tool to be used by SMEs. The main problem resides in the ability of an SME to engage in Lean when it comes to funding and to management

commitment. Dennis et al. (2010) thought that in order to reach a successful implementation, the discipline that the upper management imposes on the employees. In turn these employees should realize the importance of the Lean tools. Specifically when addressing Dairy SMEs for example, we are pointing out on traditional cheese processing factories. In this type of factories we face a problem where the cheese flavors will differ due to different factors. One of these factors is the processing conditions that the cheese is faced with. Moreover the different natural additives should be monitored in a timely manner in order to reach a standard end product. The cheese maker in turn should know the different results that reside from all the steps that are applied on the cheese making process. These include the various steps that the milk will pass by in order to become a cheese and all the natural additives that lead to the cheese. These steps can be tweaked and altered in a way to accommodate to the various and specific cheeses (Fellows,2008). One of the main tools in implementing lean in industries, whether large or small is SOP. By definition a Standard Operating Procedure is a document which described the operations that should be regularly done. The main goal of an SOP is to have these operations done correctly and in the same way when repeated. A SOP should be present where the work is done. The deviation from any instructions is permitted on the condition that permission is made by the management. Also this change in SOP should be stated in a new form. Several categories and types of SOPs can be distinguished. Also worksheets belonging to an analytical procedure have to be standardized (Natural Resources Management and Environmental Department, 1998). Moreover the definition of a successful dairy company lies in its workers and through consistently and accurately completing their work. Dairy companies can use SOP in order to combine the efforts of the multiple working divisions and drive the company towards outstanding performance and success. It is the managers' job to recognize that most people naturally want to do a good job. This will lead to the channeling their efforts in a way that will benefit the business. Well-written standard operating procedures (SOPs) provide direction, improve communication, reduce training time, and improve work consistency. Standard operating procedures used in combination with planned training and regular performance feedback lead to an effective and motivated workforce. In this way workers also benefit from increased confidence and a clear sense of achievement (Stup, 2001). It is a requirement that every organization should have a system in order to select the processes that need to be documented. In order to generate an SOP for a specific procedure, a specialist in the field should be the one performing the different steps involved in attaining it. This is carried out while keeping in mind that the person faced with this SOP is with limited experience. Checklists are also useful in assuring that the proper job is carried out. A general form that can be used to generate any SOP is found in (U.S Environmental Protection Agency, 2007). It presents a detailed guide of all the different aspects of SOPs and the importance of each one of them. Moreover, the multiple advantages of having an SOP are: eliminating or reducing of worker errors, training new employees, leading to continuous improvement, solving production problems, and in proving the presence of quality standards (Moore, 2008).

3. General Methodology

We will be focusing on the Cheese making area. Multiple steps and stations are found in it. The different steps that the cheese making process encounters in this area are the following:

1. Transformation Step: Raw Milk is transformed into cheese curds.
2. Separation and Pressing Step: Separation between whey and cheese curds followed by the pressing operation.
3. Finishing Step: Final transformation of the cheese into the Halloum Cheese through boiling.

In parallel to these steps the cheese production is affected by multiple factors as clean and synchronous work. This work in turn is affected by the "Storage Station". This station or area deals with occupying the different tools that lead to the previous stated factors. Therefore in this station no cheese making steps are found, instead layout and station divisions are dealt with.

Figure 1: Steps in Cheese Making Section

3.1 Transformation Step

3.1.1 Procedure

The transformation step comes directly after dividing the milk initially in the factory and sending it to the double jacket vat. The boiler in this case is the placement where all the sub steps will take place. In order to achieve the transformation of raw milk into cheese curds, certain critical actions should be done in this stage:

1. A temperature control and stability at 37°C inside the boiler.
2. The addition of Rennet and culture to the milk: This step requires minor calculations regarding the amount added to the milk.
3. The milk stirring: time is an important factor in this step.
4. The waiting time until the coagulation of the milk take place.
5. Cutting of the milk into cheese curds of specific dimensions: After checking that the correct coagulation has taken place, the cutting of the cheese takes place. In this step the coagulated milk must be cut into curds. In this cutting process the size of the curd differs depending on the type of cheese being processed. The cutting process will take 3 minutes and on a specified cutting speed. It is very important for the cheese maker to stay observing the cutting process since this step is a pure human observation result. Stop the cutting process when the required curd size is observed. After 2 minutes the whey starts to separate from the cheese. This is when the curd is sent to the Vat.

3.1.2 Observation

While observing the initial step some remarks were made and are listed as follows:

1. No correct documentation concerning the milk that was sent to the boiler was handed over to the cheese maker. The following information is transferred orally to the cheese maker:
 1. The Number of the boiler that the specific type of desired cheese is transferred to.
 2. The Quantity of Milk transferred.
 3. The physical state of the milk: Full Cream, Light, Fat Free.
1. No checklist is found on the boiler in order for the cheese maker to go through the different crucial factors influencing the end state of the cheese. The cheese maker instead relies on memory. These factors include:
 1. Temperature control where the stability in the boiler's temperature at 37°C is very important,
 2. Amount of Rennet and culture needed to be added based on the end cheese required. Each cheese has a different demand regarding these natural additives
 3. Waiting time for coagulation that should be timed using a timer.

4. Size of the cheese curds that result from the cutting of the coagulated milk.
5. No decide list is found in case the cheese maker encounters problems during the process.
6. No written documentation is found in order to be kept in the factory's database concerning the cheese produced daily.

3.1.3 Enhanced Step

In order to enhance the different problems and mistakes that occur in a regular basis the following solutions are introduced: A clear checklist should be found on each Double Jacket Vat (DJV) in order to reduce the natural human error that the cheese maker could encounter when preparing the cheese. The checklist is just a clear representation of how the cheese maker should think and note while transforming the raw milk into cheese curds. The checklist should include the following:

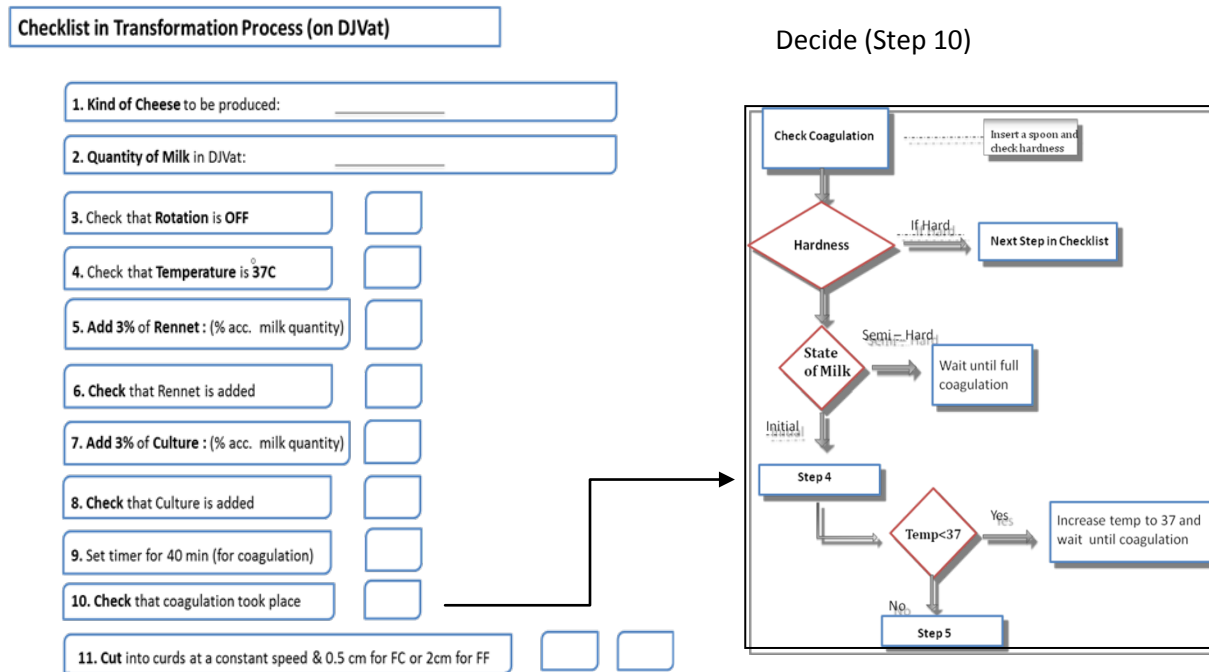


Figure 2: Check List

In parallel to this checklist there should be a small graduated flask in order for the cheese maker to put the required Rennet and Culture. This is to further check that these 2 have been actually inserted in the Milk. Next to this checklist, a DECIDE paper should also be provided. This is for the coagulation step that alters the whole recipe. This is present since in case the step 10 in the checklist is stating that the coagulation is not complete, what are the actions that should be taken.

3.2 Separation and Pressing Step

3.2.1 Procedure

The cheese curds and whey are now found inside a Vat and this step needs a synchronous way of work. First the cheese should be taken out of the whey and inserted in cloths. Then the curds should be manually split and recollected together in order for the cheese to become homogeneous inside the cloth. Then the cloths are made in a square shape and placed under the pressing machine. This pressing machine should have coordinates on the quantity of pressure and time needed for the halloum cheese. After this step the cheese is now taken to the finishing stage. Also the temperature and cleanness are 2 aspects that should be taken in priority while working throughout this step. The synchronous work is a result of the need to quickly finish the cheese while maintaining a steady temperature. Also now the cheese is considered eatable. This means that the clean environment is essential and the contamination

of the cheese is very easy considering that if the cheese touches raw unpasteurized milk and non UV water it will lead to contaminated cheese. Moreover the cheese makers should be wearing gloves, masks, and coats at all times.

3.2.2 Observation

This step is being done by 6 employees: One takes the curd out of the vat and places it in the cloth. One prepares the cloth in the corresponding square billet. Two take the cloth that is filled with the cheese curds and start to smooth the curd and flatten the lump. This is in order for the curd to become more homogeneous. After the homogeneity is attained they place the cloth on the pressing machine plate. This plate is currently placed on the table since there exists a distance between the working table and the pressing machine. Two take the trays that are topped with the final cheese filled cloth and place them in the pressing machine. The last two of them are spending most of the time waiting. These 2 have only the job of carrying multiple square cloths and placing them under the pressing machine. In addition, none of the employees was doing a specific job in a desired manner all over the cycle. This means that they were changing positions and working specifications randomly. Also the pressing machine has no function manual that states the correct pressure and time relative to the quantity and type of cheese produced.

3.2.3 Enhanced Step

A line should be formed with specific instructions for each employee. This way will lead to less time in dividing the jobs between employees during the procedure. Also this will lead to the use of fewer personnel in the stated step. A rotation procedure between days should take place according to lean principles. A standard way of removing the curd from the vat should be taught to the employees. More importantly a standard way to homogenize the curd should be applied and taught previously by the experienced cheese maker to the new ones. In the pressing machine a checklist should be found containing the following:

Table 1: Pressing Machine Checklist

| 1 | 2 | 3 | 5 | 4 | 6 |
|----------------|------------------------------|--------------------|-----------|---------------|-------------|
| Kind of Cheese | Pressure Required | Quantity of Cloths | Timer set | Time of start | Time of end |
| Halloum FC | 250 <input type="checkbox"/> | --- | | | |
| Halloum FF | | --- | | | |

In this way, the cheese makers would decrease their fatigue in the halloum making process and focus on other cheese making processes. The employees would eventually produce more quantities and types of cheese while decreasing their unnecessary fatigue. Eventually the introduction of new cheese types in the factory will maintain the same number of employees.

3.3 Finishing Step

3.3.1 Procedure

This station represents the last state of the cheese before being refrigerated. This is a crucial step in the Halloum cheese making. The cheese maker here takes the cheese squares one by one and cuts them into small cheese pieces. This cutting is done using a knife and we find multiple shape errors in the final pieces. This is due to the cheese makers' delicacy in cutting the cheese. At the same time the whey is being prepared in a container where its temperature should be 85°C. The cheese is now inserted into the whey and when it starts to float remove it and start fitting the cheese in the rectangular cheese molds. Put the cheeses on the back side and constantly spray them with cold water (UV). Then flip them back to the other side and after spraying them with cold water remove the cheeses and put them in icy salty water: 2-5 °C and 5°Baumer. Set the timer to 1.5 hrs in the refrigerator. Then the cheeses can be filled in vacuum bags in the packaging department.

3.3.2 Observation

The cutting of the cheese into small ones is being done by the cheese maker using a regular knife. This leads to multiple errors concerning the shape of the cheese sent to the consumer. No measure of the icy salty water was taken place before the insertion of the cheese. No writing on the cheese filled container was done in order to specify the date and type of cheese produced.

3.3.3 Enhanced Step

The cutting process should be done using a cutting tool that has the same size as the square mold that is used for the production in order to be consistent in the final products shape. Also the measurement of the water should be noted on the container just before the insertion of the cheese occurs. Moreover the writing of the type and quantity of cheese found inside the container should be stated along with the date of production.

3.4 Storage Station

3.4.1 Requirements

In this station, all the material used for the actual production resides. These include: Vats, Spoons, Spatulas, Water hose, cheese molds, work tables, whey containers, knives, gloves, mouth pads and hats. The number of each material should be relative to the production volume that will be produced. Also this station is normally open to the previous ones. This is due to the constant need of material in order to perform the cheese making process.

3.4.2 Observation

During the actual manufacturing, the cheese maker was searching several times for the same material since no specific place was found for it. Also the Vats and working tables were placed in the end of the station which lead that the cheese maker had to walk and set up the station without any standard way of doing it. The material placed in the station is not checked whether it is clean or it has not yet been cleaned after a previous use.

3.4.3 Enhanced Workstation

Every material should be placed in a specific place and several visual aid tools should be used in this station. This means that every material should have a marked space with a name tag identifying what is the object that should be present in each space. This visual aid tool will lead to quicker placement of the needed work stations. The need for any material will no longer form a problem. Another main point in this enhancement would be that less contamination of necessary material during the cheese making process will be detected.

4. Outcome assessment Criteria

4.1 Life of Cheese

One way of checking whether the cheese has been correctly produced under the required standards is by monitoring its' expiry date and condition throughout that period. The better quality of cheese resides in the long duration of cheese. Regarding the "Halloum Cheese" specifically, "Libnor" has already stated that the expiry date is of 40 days. Never the less, this stated date may never be attained with the same physical properties of the cheese. The most important factor leading to a better (quality: expiry date) ratio is the degree of contamination while producing the cheese. This is after making sure that the correct recipe was performed. Moreover any change in the required temperature might lead to the change in the final products' quality and life span.

4.2 Bacteriological Test

A more scientific process would be through bacteriological testing of the cheese. In this way the cheese specimen results are compared to the standards. These tests and the required norm values according to "Libnor" include the following:

Table 2: Bacteriological Norm Values

| <i>Type</i> | <i>Norm</i> |
|-----------------------|----------------------------|
| Staphilococcus Aureus | $10^2 - 10^3/g$ |
| Escherichia Coli | $10^2 - 10^3/g$ |
| Total Coliform | $10^4 - 10^5/g$ at 30°C |
| Salmonella | 0/25g |

5. Application in the Halloum Station

5.1 Change the station to the new layout

The new layout for the stations is found in the picture below. The layout represents the three steps that are previously discussed. After the thorough observations and after requesting the appropriate improvements that can be implemented, the new layout will hold the requirements that are needed in order to achieve the main goal. First for the transformation station the checklists should be placed on the control board as well as with the instructions of the Double Jacket Vat and the graduated flasks for the Rennet and Coagulation Additive. As for the separation step, the Vat and the tables should be placed as seen in the figures below. This is in order to ensure the timely and clean steps that are held in the separation step. The tables are found between the vat and the pressing machine. This is in order to reduce the number of employees from 6 to 4 during the actual production. Finally for the finishing step, the cutting of the cheese after being removed from the pressing machine should be done on a table placed between the pressing machine and the Vat containing the whey. Also on the other side of the vat, there should be a table having the correct molds for the Halloum cheese in order to properly obtain the cheese shape.



Figure 3: New Layout



Figure 4: Transformation



Figure 5: Separation Step



Figure 6: Finishing Step

5.2 Train Employees

When implementing lean manufacturing in a company, one must think that the efforts that will be put are from the employees' side in changing and adapting. This is because when we are trying to implement lean, we are affecting their job requirements and most importantly their job performance. When explaining this new concept to the employees, one must be very clear in deliberating the following strategies:

5.2.1 Stimulate employees for alteration

The employees should take interest in how they form one part of a cycle that will lead eventually to an improvement in the company. By showing the cheese makers that their new efforts will not go in vain, these efforts will lead to an overall increase in work efficiency and eventually to an improvement for them and for the company.

5.2.2 Support Lean strategies

This is done when each employee understands the definition of Lean since they most probably never have heard of it. Lean implementations can be supported by: persistence, improvement goals, and discipline. When the cheese

maker will specifically feel in need to enhance his work in order for the company and himself to be more efficient, then we will be heading towards the right direction.

5.2.3 Assure Job Security

All the employees should know that their place in the factory is safe when they are performing their jobs as required. This is because employees tend to believe that since the work is becoming more organized and efficient, they will be let go from their jobs. This is why in this step, it is very important to emphasize that the introduction of this procedure is purely within the benefits of the workers and the factory at the same time. This plan will lead to the introduction of new products in the company and therefore more work for the employees. This is done while keeping the employee fatigue level within norms. These products would be produced with the best final product outcome as a goal. This in turn will lead to the increase in the employee participation in the new management plan.

6. Outcome

The different improvements in this workstation during a whole week are as follows. The number of mistakes that were done in the transformation step is reduced from 6 to 2. The time needed to actually produce the cheese from step 1 to 3 is reduced by 15 min. This is due to the organization of material in the storage area, the checklists found, and the new predefined layout. The bacteriological tests were always on the higher margin of the norms before the application. After one week of work the tests were already on the lower boundary of the norms. Also when it comes to the number of employees, no complaints were stated regarding the fewer people working on the workstations.

7. Conclusion

Lean manufacturing is a continuous loop of improvements. No company can reach a point and say that it is lean and stops working on improving its production. Even with the previously stated improvements, dairy companies should take each corner in their facility and turn it upside down while acquiring lean principles. In this paper we focused the most on the cheese making station and more precisely on the consistency of the work being done. Starting from the transformation step and reaching the storage area, we were able to catch multiple problems that were solved through simple ways. The most important thing is to always facilitate the situation in hand. SOP is a start to a long journey of alterations in any company. Also an important note is that the company should always keep in mind that constant improvement in all departments is the solution. In the end, the study should continue to be implemented in the departments that follow. This is a start of a long road in applying lean principles in the Lebanese dairy SME industry.

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