

IMPLEMENTING A VALUE STREAM MAPPING TO IMPROVE THE PRODUCTION PROCESS IN AL- CREAM FACTORY, APPLIED STUDY IN THE GENERAL COMPANY FOR FOOD PRODUCTS FACTORIES DAIRY ABI GHRAIB

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ABSTRACT

Purpose –The scientific significance of the study is reflected in explaining the impact and importance of spreading the culture of graceful production using the value flow map as an important way to achieve this in the production company, and the resulting result in eliminating waste and loss, identifying methods for improvement, spreading a culture of interest in the work environment and achieving sustainability.

Design/methodology/approach - The proposed methodology that was implemented in the Karim Factory of the General Company for Food Products first, it analyzed the researcher and with the help of the production manager and the areas of waste and loss using the value flow map. Then they improved the specific problems.

Originality/value – The proposed solutions greatly contributed to saving time and effort

Carrying out the various production operations in Al-Qeshta Factory. The company agreed to implement the proposed solutions, which indicates that these proposed solutions are feasible and practical.

Findings -The result was It showed savings in terms of effort, time and improvement of the production process.

Paper type- Applied study

Keywords, lean, Continuous improvement, 5S, Waste, Value stream mapping.

1-1: The concept of a lean production system

The lean production system is the production philosophy emerging from Toyota Motor Corporation of Japan's automaker and its production system, called the Toyota Production System

Where the term "lean " was coined to describe the Toyota business program by a research team headed by Jim Womack PhD at MIT, and he first mentioned in James Womack's book "1990 The Machine That Changed the World" that graceful production is a theory that helps simplify and organize an environment Acting so that losses are identified and minimized (Pandey, 2015: 1)

The word “lean” means thin or slender. The basic idea is to reduce the process from all unnecessary factors (Järvenpää, & Lanz, 2019: 2). (Waste) can be defined as any measure that does not add value to the product or service (Mrugalska & Wyrwicka, 2017: 466). The concept of lean production works well where demand is relatively stable and therefore predictable and where diversity is low and volume is high(Ravet, 2011: 4)

The prevalence of the lean Production System (LPS) concept throughout the world and industries is caused by severe challenges, such as unstable demand and growing customer expectations and competition in globalized markets, so the lean Production System has contributed to making a clear impact in both academic and industrial societies, where organizations depend

Table 1. The definitions of Lean production

researcher	Definition	focus
(Hofer&Hofer,2012:442)	A strategy or philosophy that promotes the use of practices such as Kanban ,Total Quality Management (TQM)To reduce waste and enhance the performance of the organization.	Use of practices
(Belekoukiasetal,2014:5346)	It is an industrial management approach that seeks to make organizations more competitive in the marketBy increasing efficiency and reducing costs by removing steps that do not add value and are inefficient in the production process.	Increased efficiency
(McGovern, 2018:1)	It is an organizational management system characterized by a collaborative performance approach between employees and managersor stakeholders to identify activities that do not produce value for customers and then reduce or remove them from the	Participate

Around the world the lean production system to eliminate waste, increase its productivity and due to the existence of this approach there is a clear impact on the restructuring of the global industry, 2019: 939) Chan et al.

On the other hand, the technological development and competitiveness of organizations, provided opportunities for customers to choose customized products, with the smallest details to suit the required specifications, and that the most successful way to achieve an increase in production flexibility is through the production of batches of smaller sizes (Sousa etal, 2018: 612).

In addition, leanproduction plays a major role in developing new products, through its ability to improve existing products, including idea creation, prototyping, rapid assembly and testing, product portfolio management, market and competitor analysis, risk management, and forecasting.

Sales, establishment of KPIs, value analysis and cost reduction of existing products

(Gobinath, etal, 2015: 44)

1-2: Definition of lean production

There are many definitions of lean production Each one depicts the researcher's idea the direction of this type of production and table (1)It highlights the definitions that explain the precise meaning of lean production.

	production process.	
(Chan et al.,2019:940)	It is a disciplined, process-oriented system focused on improving limited material and human resources by identifying the main sources of waste.	Improving material and human resources
(KHAN et al.,2020:181)	A systematic approach used to improve overall process systems on the basis of complex practices and interlinked with social and technical methods.	Integration with the social and technical side

As shown by this presentation of definitions, giving a unified definition of Lean production is not an easy or simple matter. Because its implementation is linked to the specific circumstances and factors of each industrial or service organization.

But it can be said that most researchers focused on the term waste or elimination of waste, as it is the main reason for the high costs. Others focused on agile production, as it considered best practices to achieve customer satisfaction and consider time and quality as the primary value of the customer.

Here, the researcher defines graceful production as an integrated work methodology that focuses on identifying waste of all kinds during the production process, analyzing its causes and working to remove it or reduce it through innovating renewable methods and methods.

1-3: Goals and benefits of lean production

Most researchers agree that the application of the lean production system enables organizations of all kinds to achieve a number of goals, namely:

1. Improve customer service (Reid&Sanders, 2013:20)
- 2.Improve competitiveness(Costa, & Filho,2016:1)
- 3.Slim production increases profitability(Wu et al., 2015 :3841)
- 4.Reduced waiting time(Udokporo et al.,2020:7)
- 5.Reduce costs(Udokporo et al.,2020:9)

1-4: The basic principles of lean production

1. Determining the value from the customer’s point of view: The first principle in lean thinking is to determine exactly what value the product or service provides, from the customer’s perspective, The value is defined by the customer and presented in the product or service that the customer needs in the right place, time and price, to be willing to pay and the figure (1) shows the determination of the value to the customer, by raising the level of quality and services and reducing response and delivery time, and the value is characterized in its nature by dynamic and changing Over time as customer preferences change (Kelly, 2019: 17).



Figure 1. determining the value of the customer

Source: Kelly, R. (2019). The Myths and Truths of Lean Transformations: How to Successfully Make the Transition from Theory to Effective Deployment. Productivity Press.p:2

2. Determination of the value stream: The second principle in lean thinking is to define, study and improve the process of value flow for each product or service. Value-flow planning requires direct observation of work and work-flow within the process so that opportunities for improvement can be identified (Rungtusanatham et al., 2018: 139)

3. Value flow through the value stream: To achieve success in managing the value flow, the following steps must be followed (Keyte & Locher, 2015: 2)

- Align the organization's strategic direction to perform the value stream within the organization.

- Understand and support the need to improve and manage value flows, by engaging those responsible for job redesign and performance improvement.

- Align new operations management to support new business processes.

- Creating lean measures that support agile production behavior in creating value, eliminating loss and monitoring financial and operational matters to reach strategic success.

- Implementing future map flow designs with a focus on scientific experiments.

- Demonstrate leadership in senior management in focusing on the organization's pursuit of more effective business methods for operations throughout the organization.

4. Attracting the customer to withdraw the value: It is making the customer request the product, and this principle relies on the withdrawal system (PULL SYSTEM) that the organization adopts in marketing the product, unlike the payment system (PUSH SYSTEM). The idea of agile production is to reach zero inventory by applying lean production systems.

5. The pursuit of perfection: lean production requires the pursuit of perfection by eliminating waste in the production process continuously. It relies on key practices such as product design, operations, equipment, human resource practices and concurrent engineering. Planning, production control and

relationship of suppliers and customers to improve production process (353: Kafuku, 2019).

6. Continue to improve: lean production is a coherent manufacturing system in its attempt to reduce waste, as it may require workers to take on responsibilities that exceed what are usually required in a mass production environment. As this situation requires skilled workers and they have a high level of commitment, they are ready to solve problems and take action to solve problems

(Lim, 2020: 430).

Some researchers have defined the principles of lean production on two levels:

(Leyer et al., 2020: 2)

- The level of implementation: where this level aims to reduce the process time and costs, to simplify operations and enhance workflow. And achieving high quality products that depend on the needs of customers, and this is achieved through the following:

- a. Understanding customer needs: Employees know and understand their customers' preferences and how willing they are to spend money for a product or service. Provided by the organization are among the principles necessary for lean production.

- b. Establishing value flows: workers know how the value stream runs through the production stage to create or manufacture a product or service and are aware of the specific needs of customers.

- c. Create flows within value flows: Reducing the availability of the required information may lead to demand delays at all stages within the value stream.

- d. Implementing a withdrawal system: this means the organization begins to act only in response to customer demand or when stock levels reach a minimum.

- e. Seek to find the perfect value: All activities are designed to eliminate waste and maximize the use of resources at each production stage, to increase value creation constantly.

-The level of self-awareness: the philosophy of lean production encourages workers to strive for perfection and as a result can.

Developing their personal skills through the following: (Leyer&Moormann, 2014: 1370)

a. Leadership style: The extent to which leaders' direct workers toward strategic organization goals and targets.

b. Individual responsibility: The degree to which employees assume personal responsibility for their activities, either independently or collectively within the team.

c. Culture of continuous improvement: By strengthening nature, the organization strives constantly for long-term improvement of the entire value stream.

1-5: lean production system and improving the production process

Manufacturing excellence can be achieved through balanced efforts to improve product quality, reduce holidays and inventory, and meet delivery deadlines, and reduce system costs by removing activities and expenses that do not add value to the product. Managers and decision makers in industrial organizations try to do this by collecting information on key factors affecting productivity, reliability, and cycle times in production systems (Tayyab, et al., 2019: 8).

Product design or development involves many processes that must be resolved, which include the following: (Filip, 2018: 584)

a. Product design

b. Analysis of the organization's ability to manufacture new products.

c. - Determine the suppliers of raw materials and machines.

d. Choose all the machines needed to build the technological path to the product manufacturing process.

e. Setting time standards in operating the new product.

f. Planning processes for product manufacturing in the workplace, defining methods for tracking and controlling the product in the manufacturing process.

The process of improvement represents a dynamic ability that can be defined as learning and the stable pattern of group activity through which the organization systematically identifies additional focused and sustainable improvements and adjusts its routine procedures in an effort to improve effectiveness (Eaidgah, et al., 2016: 5)

Success may not be in adopting methods and systems, but rather by the organization. Then assessing the parts that can be adopted or modified according to current conditions, and most importantly, what can be improved (18: Schmidt, & Schmidt, 2019)

The process of improvement means the need for organizations to search for ways to make things better and more continuously. Not only is it responding to persistent problems and crises, but rather constantly striving to improve business practices. By setting an agenda to improve basic operations, this approach is criticized for the failure of some organizations to trace the root cause of the problem which leads to failure to treat it.

2: GENERAL ENTRANCE TO LEAN PRODUCTION TOOLS

2-1: Value stream mapping (VSM): Value stream mapping (VSM) is a special type of streamlined planning tool with value for developing Lean production practices (Jacobset al., 2018: 355).

It is a way to identify loss sources and reduce production costs and to achieve the fastest response to customers with the highest quality, its importance lies in being a source for basic information about production processes (Lacerda et al, 2016 : 1710)

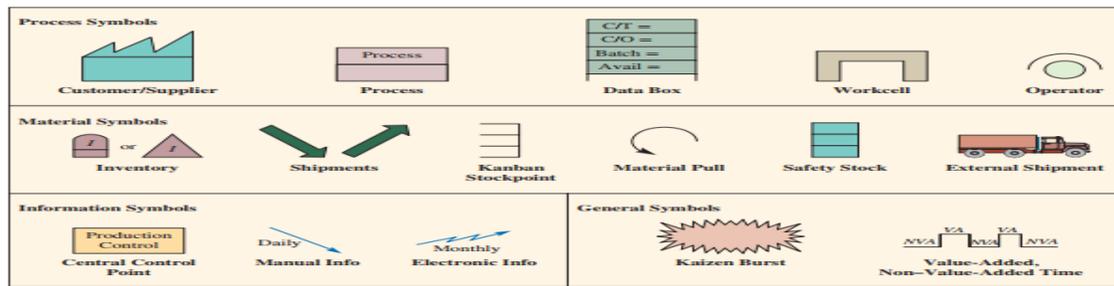


Figure 2. some value flowchart symbols

Sources: Jacobs, Robert F., Chase, Richard B., and Lummus, Rhonda R., 2018, Operations and Supply Chain Management, 15th ed., McGraw-Hill / Irwin, China. P: 356

2-2:Continuous improvement program: Managers need to understand that process standardization is one of the safest ways to improve productivity and competitiveness internationally. It is one of the foundations of modern management. Organizational improvement is achieved through system consolidation. By increasing technical capabilities, knowledge, profits and customer satisfaction (Espíndola, et.al, 2019: 708)

Therefore, most production organizations need small gradual changes in production processes or in practice. That allows some performance indicators to be improved (Ghicajanu, 2019: 503).

Table 2. shows Lean production tools

2-3:Lean internal layout:lean planning is a concept closely related to the concept of cellular manufacturing. A cell is a mixture of workers, machines, and workstations. Which are arranged according to the flow

process, Manufacturing the entire production unit or part thereof. It helps reduce work in process stocks by setting up a balanced material flow. From one machine to another and improving communication between workers. Better scheduling and material flow and better use of machines. Reduces problems with reduced work in the design process. Reduces productivity time, helps develop workers' abilities, with multiple skills (Ratnayake&Dinosh, 2018: 18). Table 2 shows the types of lean production tools

2-13 5S: Lean production is a set of tools and practices, which when implemented properly and fully, helps improve system performance. The 5S tool is one of these practices and it is short for sorting, arranging, fluorescence, uniformity and preservation. It helps reduce time that does not add value to the product, increase productivity and improve quality by integrating it with other agile production tools to reduce change time (Omogbai, &Salonitis, 2017: 380).

Table 2. Lean production tools

Standardized Work	ContinuousImprovement	diagrammingSpaghetti
Pull System	PDCA	Risk assessment
Level Production	5 Whys	IPO diagramming
Visual Control	Supplier integration and partnership	Safety improvement programs
Pre-Production Planning (3P)	Cellular manufacturing	Pre-Production Planning
Quick Changeovers	Work site organization5S	Reduced setup time

Employee involvement	Quality at the Source	Value stream mapping
Kanban	Focused Factory	SMART Goals
Lean internal layout	bottleneck management	Troubleshooting Team
5w2h	Takt time	Overall Equipment Effectiveness
Force field diagrams	Six Big Losses	Poka-Yoke
Hoshin Kanr	Gemba	Single Minute Exchange of Die (SMED)

3. AN ANALYTICAL DESCRIPTION OF THE REALITY OF THE WORK OF THE STATE COMPANY FOR FOOD PRODUCTS (AL-CREAM FACTORY)

3-1: A brief introduction to the State Company for Food Products / Dairy Factories Abi Gharib

The dairy industry is one of the most important food industries in Iraq. It works to improve the health status by containing the essential benefits for the human body. The State Company for Food Products / Abi Gharib Dairy Factories (Currently) A leading role in the production of dairy products of all kinds. Since the beginning of 1958 During King Faisal II's assumption of the presidency of Iraq, with the assistance of UNICEF Was established and operated, To produce sterile bottled milk. Then, production lines were purchased to produce pasteurized cream, Cooked cheese and ripened cheese. All products are subject to dairy factories To various laboratory tests to ensure their conformity with the Iraqi standard technical specifications. The products are free from preservatives that have a negative impact on the customer's health. In 2016, it was merged into four companies under one name General company for food products. Dairy factories include the following:

1. Abi Gharib Dairy Factories
2. Baby milk factory
3. Mosul plant
4. Al-Diwaniya Factory
5. Raw milk collection and cooling centers

In order to develop the dairy industry according to modern production and packaging methods. Through the management of production lines and machines located in the factory. With the latest technology and transfer of global experiences. It was agreed with the Turkish company (Al-Makkah Konami Company) Specialized in the dairy industry under contract number 1/2019 dated 29/1/2019 with a joint contract. According to the provisions of Article (15) in the General Companies Law No. 22 of 1997 for a period of (15) years. Realizing the company's vision to revive the dairy industry again in Iraq. Thus supporting food security. And encourage the growth of non-oil sectors. Meeting the growing demand for food and improving its distribution standards. And meet the needs of the Iraqi market.

3-2: Reasons for choosing cream factories:

1. Provide data and information on the cream plant needed for the study.
2. Constant demand for cream products
3. This work helps shift attitudes towards more ethical and sustainable diets

3-3: General description of Al-cream Factory

The dairy industry is distinguished by its diversity of products. Consequently, with multiple product lines, they may include devices and machines of various functions. From storage tanks, pumps, heat exchangers and separators. And metal tubes to connect devices together. As well as service units that provide and supply water and energy. Laboratories, maintenance, storage and quality requirements. Since the raw materials are subject to microbial contamination, the design of machines, devices and tanks in Al-cream

Factory Allows easy cleaning and sterilization, It fulfills the health conditions during operation, It may require cleaning and sterilization twice a day at the beginning and end of the shift The production process path is clear

and defined Calculated times according to certain specifications. Figure 3. shows the production process path for the cream product.

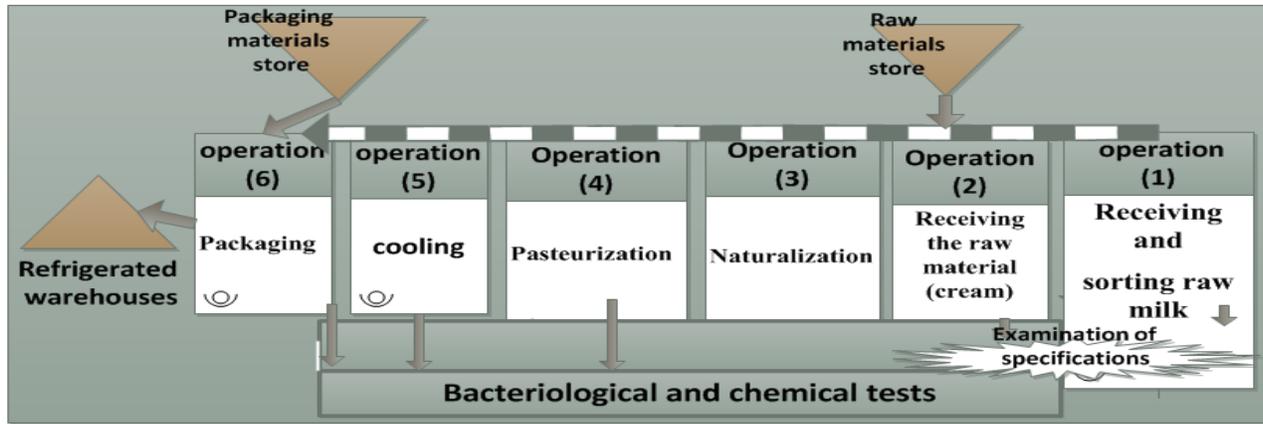


Figure 3. The production process path in the cream Factory

From Figure 2. the clarity of the continuous flow process of the cream product can be seen It is an integrated and continuous process, governed by quality control processes Through laboratory tests for each process, there is no storage in operation during the production process.

3-3: Implementation

3-3-1 Daily customer requirements:

Daily requirements for customers can be determined through the monthly plan Which determined the daily production amount (1000) kilograms and the size of (100) grams per carton, with a limitation of (26) working days per month as a result, there is an amount of (26,000) kilograms per month.

3-3-2 Information on each production stage in the value stream:

- a. **Cycle time:** The amount of time to accomplish the standard work sequence for one product, excluding waiting.
- b. **Changeover Time:** It is the time that elapses between the completion of one production run and the beginning of another production run.

Table 2. Uptime for each production stage

c. **Available production time:** refers to the setting and configuration time, which is the time required to change from setting one device to another It can be found by applying the following equation:

$$\text{Available time} = \text{Total production time} - \text{Planned down time} \text{ (Vinodh, et al., 2010:892)}$$

To extract the results, the available production time for each meal was determined by fixing the total production time for each meal and equal (9) hours An hour equivalent to (540) minutes and subtracted planned stop times (60) minutes (Clean and sterilize the production halls at the beginning of the work, (30) minutes of maintenance, 30-minute break) So I can apply the formula for my agencies:

$$\text{Available production time} = 540 - (60 + 30 + 30) = 420 \text{ minutes}$$

d. **Uptime:** It represents the percentage of work time that a particular machine or work spends working time from the total available time. The results can be extracted by applying the following equation: Table 2. shows Uptime for each production stage

$$\text{Uptime} = \frac{\text{Available time} - \text{Changeover time}}{\text{Available time}} * 100\% \text{ (Vinodh, et al., 2010:892)}$$

The production process	C\T(min)	(C\O) min)	Uptime
Preparation	99	0	100%
Naturalization	25	0	100%
Pasteurization	32	0	100%
Cooling	139	0	100%
Packaging	199	0	100%

e. **Available production time for each production stage:** The formula can be applied and the results extracted as follows:

Available production time for each production stage=

Available production time for each Shift * Shift number*Number of Workers

Table 3. Available production time, number of Shift and employees, and available production time daily, weekly, and monthly for each stage

The production process	Available production time (min)	Shift number	Number of Workers	Available production time for each production stage	Available production time per week (Min / 6 days)	Available production time per month (min / 26 days)
Preparation	420	1	3	1260	7560	32760
Naturalization	420	1	2	840	5040	21840
Pasteurization	420	1	2	840	5040	21840
Cooling	420	1	2	840	5040	21840
Packaging	420	1	6	2520	15120	65520
Total			15	6300	37800	163800

f. **Lead time** = Value added time + Non-value-added time (Swarna & Mia, 2018:223)
 Lead time = (494 + 1495) = 1989 min

g. **Takt Time:** It is called the time of frequency and represents the rate at which the cell must be produced Modules in order to meet the demand. The results can be extracted according to the following formula:

Takt time = Available work time/ Customer's demand (Swarna & Mia, 2018:223)

The relative time was determined by dividing the available production time (420) minutes per day by the required quantity (1000) kilograms

Takt time = $420/1000 = 0.42$ minutes = 25 seconds

Factory power = $6300 * 60 * 0.8 / 25 = 12096$ (sec)

= $12096/60 = 201.6$ (minutes) = 3.30 (hours)

H.Number of employees required.: It can be extracted according to the following formula:

Table 4. shows number of workers required for each production stage

Number of employees required

= The actual number of employees*available time*80% / Total operation time

Table 4. number of workers required for each production stage

The production process	The actual number of employees	available time/ min	Total operation time/ min	Number of employees required
Preparation	3	420	494	2
Naturalization	2	420	494	1
Pasteurization	2	420	494	1
Cooling	2	420	494	1
Packaging	6	420	494	4
Total	15			9

I. Noise level: Noise is measured in decibels, which is the unit for measuring the intensity of sound (db.)Where the field of hearing the human ear reaches 130 decibels, and the field of the high level of sound that reaches 130 decibels generates a painful feeling in the human being.

The level of the effect of noise on workers can be found according to the following formula:

According to the previous data, a flowchart of the current value of the cream product can be drawn. Figure (4) shows a flowchart of the current value of the cream product.

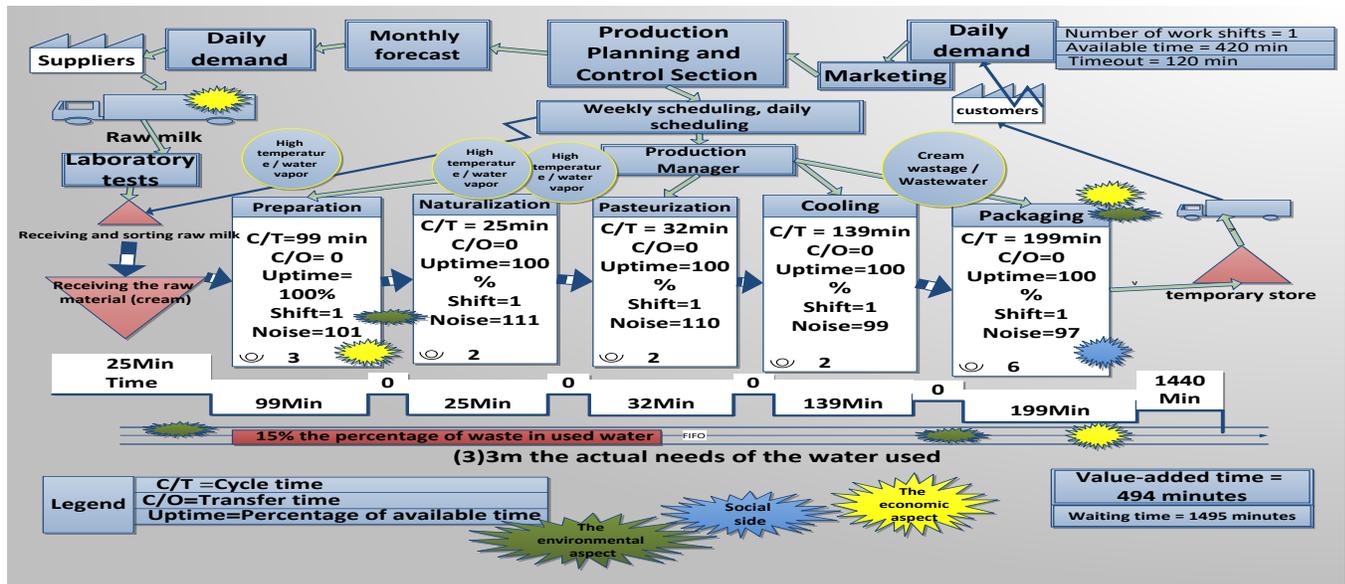


Figure 4. Map the current value of the cream product

With reference to the current value flow chart and through the help of the production manager, the interviews were conducted with the team. Problems and pollution sources can be identified of the cream factory, which is set on the map. Three sides of the economy (yellow) and social (blue) and environmental (green) which include the following:

- a. Failure of suppliers to meet delivery times for raw milk increases overall time and Power outages, especially during the pasteurization stage, the reason for the decrease in temperature and thus the poor treatment of the product.
- b. Stops and holidays during the production process, the mechanic interfered to perform maintenance on the machine may be one of the causes of product pollution.
- c. The use of open machines in the process of filling/Packaging may expose the product to contamination.
- d. Interference between the production process and laboratory tests. One of the reasons for the increase in

time. Moreover, after the laboratory site, Cream production results in increased delay or wait. Until laboratory results appear, and move to the next process in the production line.

- e. Noise arising from the operation of machines and devices.
- f. The water used to wash the factory floor, which is contaminated with the remains of production by 15% waste, as well as there is no key to open and close (faucet).
- g. Thermal emissions from pasteurization and naturalization devices.
- h. Gas emissions (organic matter) in the work environment.
- i. The presence of a steam leak, which affects the temperature and humidity of the working environment.
- k. Unhealthy climate, such as low level of lighting and ventilation.

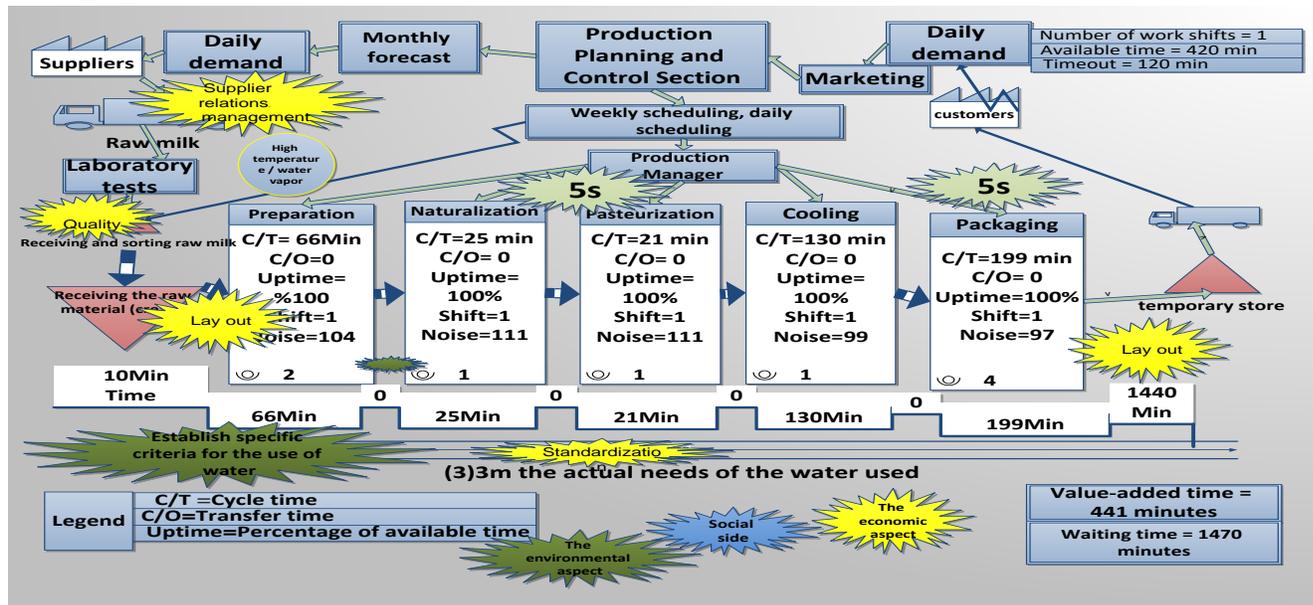


Figure 5A map of sustainable future value flows

Through the sustainable future value value mapping, the following proposals for improvement in the production environment can be observed:

- a. The necessity of partnership and developing the relationship with suppliers
- b. The location of the laboratory near the laboratory can reduce the time to complete the examination
- c. The long distance between the location of the cold store from the filling machines leads to an increase in time and effort when transporting the product. Overvoltage can be eliminated and time reduced by using the warehouse nearest to the filling machines

Table 5. Compare the meager scales in the current state map and the sustainable future state map

Process	Current state of map			map of sustainable future value flows		
	C/T (min)	No. Operator	Noise	C/T (min)	No. Operator	Noise
Preparation	99	3	101	66	2	104
Naturalization	25	2	111	25	1	111
Pasteurization	32	2	110	21	1	111
Cooling	139	2	99	130	1	99

Packaging	199	6	97	199	4	97
Total		15			9	

CONCLUDING

This paper presented some suggested solutions based on principles and tools To improve the production process . Where the value flow map contributed to the clear identification of waste and lost areas during the production process and analysis of the work environment

REFERENCES

- Lim, E. C. (2020). Lean Production and Job Satisfaction: Perception of Workers in Plastics Manufacturing. *Review of Integrative Business and Economics Research*, 9, 429-437.
- Chan, S. W., Ismail, F., Ahmad, M. F., Zaman, I., & Lim, H. Q. (2019). Factors and Barriers Influencing Lean Production System Adoption in Manufacturing Industries. *Int. J Sup. Chain. Mgt Vol*, 8(2), 939
- Costa, L. B. M., & GodinhoFilho, M. (2016). Lean healthcare: review, classification and analysis of literature. *Production Planning & Control*, 27(10), 823-836.
- Filip, D. (2018). Modern methods and tools to improve the production processes from small series and unique production. *ACTA TECHNICA NAPOCENSIS-Series: APPLIED MATHEMATICS, MECHANICS, and ENGINEERING*, 61(4).
- Gobinath, S., Elangovan, D., & Dharmalingam, S. (2015). Lean Manufacturing Issues and Challenges in Manufacturing Process–A
- Hofer, C., Eroglu, C., & Hofer, A. R. (2012). The effect of lean production on financial performance: The mediating role of inventory leanness. *International Journal of Production Economics*, 138(2), 242-253.
- Jacobs, Robert F., Chase, Richard B., and Lummus, Rhonda R., 2018, *Operations and Supply Chain Management*, 15th ed., McGraw-Hill / Irwin, China.
- Järvenpää, E., & Lanz, M. (2019). Lean Manufacturing and Sustainable Development.
- Kafuku, John Mbogo. (2019): "Factors for effective implementation of lean manufacturing practice in selected industries in Tanzania." *Procedia Manufacturing* ,33, 351-358
- Kelly, R. (2018). *The Myths and Truths of Lean Transformations: How to Successfully Make the Transition from Theory to Effective Deployment*. Productivity Press.
- Keyte, B., & Locher, D. A. (2015). *The complete lean enterprise: Value Stream mapping for office and services*. CRC Press
- KHAN, H. M., ASIM, D. M., & MANZOOR, S. (2020). THE IMPACT ON LEAN PRACTICES BY OPERATIONAL FACTORS: EVIDENCE FROM THE MANUFACTURING FIRMS OF PAKISTAN. *CenRaPS Journal of Social Sciences*, 2(1), 178-196.

- Lacerda, A. P., Xambre, A. R., & Alvelos, H. M. (2016). Applying Value Stream Mapping to eliminate waste: a case study of an original equipment manufacturer for the automotive industry. *International Journal of Production Research*, 54(6), 1708-1720.
- Leyer, M., & Moormann, J. (2014). How lean are financial service companies really? Empirical evidence from a large scale study in Germany. *International Journal of Operations & Production Management*.
- McGovern, K. (2018). *A Public-Sector Journey to Lean: Fighting Muda in Times of Muri*. CRC Press
- Mrugalska, B., & Wyrwicka, M. K. (2017). Towards lean production in industry 4.0. *Procedia Engineering*, 182, 466-473
- Pandey, S. (2015). *Awareness of lean in the Indian garment manufacturing industry*, NIFT
Publisher: CRC Press, Year: 2018
- Ravet, Denise. (2011). "Lean production and agile organization: the link between supply chain and sustainable development."
- Schmidt, S., & Schmidt, B. S. (2019). REVIEW OF 35 YEARS OF LEAN PRODUCTION—OUTLOOK DEVELOPMENT TO LEAN, AGILE, AND IOT. *Annals of the Faculty of Engineering Hunedoara-International Journal of Engineering*, 17(1).
- Sousa, E., Silva, F. J. G., Ferreira, L. P., Pereira, M. T., Gouveia, R., & Silva, R. P. (2018). Applying SMED methodology in cork stoppers production. *Procedia Manufacturing*, 17, 611-622
- Swarna, N. A., & Mia, M. A. S. (2018). Productivity improvement of leather products industry in Bangladesh using lean tools: a case study. *Revista de Pielarie Incaltaminte*, 18(3), 219
- Tayyab, M., Jemai, J., Lim, H., & Sarkar, B. (2019). A sustainable development framework for a cleaner multi-item multi-stage textile production system with a process improvement initiative. *Journal of Cleaner Production*, 246, 119055.
- Udokporo, C. K., Anosike, A., Lim, M., Nadeem, S. P., Garza-Reyes, J. A., & Ogbuka, C. P. (2020). Impact of Lean, Agile and Green (LAG) on business competitiveness: An empirical study of fast moving consumer goods businesses. *Resources, Conservation and Recycling*, 156, 104714.
- Wu, L., Subramanian, N., Abdulrahman, M. D., Liu, C., Lai, K. H., & Pawar, K. S. (2015). The impact of integrated practices of lean, green, and social management systems on firm sustainability performance—evidence from Chinese fashion auto-parts suppliers. *Sustainability*, 7(4), 3838-3858.
- Leyer, M., Reus, M., & Moormann, J. (2020). How satisfied are employees with lean environments?. *Production Planning & Control*, 1-11.
- Vinodh, S., Arvind, K. R., & Somanaathan, M. (2010). Application of value stream mapping in an Indian camshaft manufacturing organisation. *Journal of Manufacturing Technology Management*, 21(7), 888-900.
- Ratnayake, R. M. D. K., & Dinoshya, V. (2018). Effectiveness of lean manufacturing layout of a firm within the apparel industry of srilanka: a case study.