

Lean Manufacturing Practices in a Dairy Cooperative

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Abstract

A prominent cooperative dairy in Gujarat – Cow Dairy, India, has successfully implemented lean manufacturing principles to enhance efficiency, reduce waste, and improve product quality. The cooperative, with over 10 lakh farmer members, has adopted strategies such as root cause analysis and process control charts to optimize production processes. The application of these tools has led to significant improvements in quality control, cost reduction, and operational excellence. This case study explores how Cow Dairy addressed key production challenges, including pouch leakage and butter packaging inconsistencies, through systematic problem-solving and data-driven decision-making. The findings underscore the importance of lean manufacturing in the dairy industry, highlighting its role in improving competitiveness, ensuring product consistency, and enhancing customer satisfaction.

Keywords: Dairy cooperative, lean manufacturing, root cause analysis, process control charts, waste reduction, quality improvement, operational excellence, cost efficiency, dairy industry, continuous improvement.

Note: The name 'Cow Dairy' is used hypothetically for the purpose of this case study. Any resemblance to real entities is purely coincidental.

1. About the Dairy Cooperative

A prominent cooperative dairy – Cow Dairy located in Gujarat, India, was established in 1960 with the primary goal of delivering high-quality milk and milk products while ensuring fair returns to its farmer members. The organization has a vast network of over 10 lakh farmer members spanning Gujarat, Rajasthan, Haryana, Madhya Pradesh, and Uttar Pradesh, making it one of the largest cooperative dairies in India.

The cooperative operates eight dairies, two milk chilling facilities, two calf feed factories, a semen collection plant, and a dairy science college. Its product portfolio includes milk in pouches, yogurt, buttermilk, ghee, butter, milk powder, sweetened condensed milk, ice cream, flavored milk, and ultra-high-temperature (UHT) milk, marketed under well-known brands.

From its modest beginnings of collecting 3,300 liters of milk daily from 11 cooperatives, the cooperative has grown significantly under visionary leadership. It now holds ISO 22000:2005 and ISO 9001:2015 certifications for quality and safety, with over 500 village-level societies achieving similar recognition. Beyond milk production, it provides services like cattle feed, veterinary care, breeding programs, cattle insurance, and farmer training.

The cooperative has achieved several milestones, such as manufacturing sweetened condensed milk for defense services, expanding into new markets, and supplying milk powder to the Army. It has received numerous accolades for its technological advancements, food safety practices, and contributions to women's empowerment. Its adoption of lean manufacturing principles has ensured sustained growth and prosperity for both the organization and its members.

2. Lean Manufacturing

Lean manufacturing is a systematic approach to manufacturing that aims to minimize waste and maximize efficiency. It has its roots in the Toyota Production System (TPS), which Toyota created in the 1950s. The TPS is based on the ideas of waste reduction, ongoing improvement, and respect for others.

Lean manufacturing's main goal is to cut back on non-value-added activities in the production process. Overproduction, waiting periods, pointless transportation, superfluous inventory, excessive processing, flaws, and underutilization of employee ingenuity are some of these practices. Manufacturers can cut costs, raise product quality, and increase production by identifying and removing these unproductive practices.

3. Importance of Lean Manufacturing in the Dairy Industry

In the dairy business, where productivity and product quality are crucial to success, lean manufacturing is extremely important. The dairy industry competes fiercely, putting ongoing pressure on producers to reduce costs, improve quality, and keep up with the rising demand for dairy products. The importance of lean manufacturing in the dairy business is highlighted by the following factors in particular:

Cost reduction: Dairy producers can lower costs and increase profitability by reducing waste through lean manufacturing practices. Finding and removing manufacturing process inefficiencies including excess output, excess inventory, and superfluous transportation helps to reduce costs overall.

Improved Quality: By focusing on reducing flaws and non-value-added processes, lean manufacturing can enhance the uniformity and quality of dairy products. Dairy producers may boost customer satisfaction and foster brand loyalty by raising quality.

Productivity Gains: Lean manufacturing can help dairy producers increase productivity by streamlining their production processes, which leads to shorter cycle times and increased throughput. Shorter lead times as a result of the higher productivity enable producers to quickly respond to the ever-changing market demands.

Enhanced Flexibility: The use of lean manufacturing techniques increases the adaptability and responsiveness of dairy manufacturers to changing market conditions. A Just-in-Time (JIT) inventory system, for example, enables producers to produce precisely the amount needed, reducing excess inventory, and enabling quick reactions to demand variations.

Employee Empowerment: By fostering employee participation and empowerment, lean manufacturing promotes a culture of ongoing innovation and development. This strategy results in better product quality and efficiency, as well as increased staff satisfaction and retention.

In conclusion, lean manufacturing is a useful instrument for dairy producers to raise their level of profitability, improve their competitiveness, and quickly adapt to market changes. Manufacturers can produce high-quality dairy products that satisfy customer expectations while lowering costs and increasing profitability by minimising waste and enhancing efficiency.

4. Implementation of Lean Manufacturing Strategies at Cow Dairy

The excellent application of lean manufacturing techniques, particularly root cause analysis and process control charts, is responsible for Cow Dairy's success in the cutthroat dairy market. By drastically reducing waste and raising product quality, these solutions have increased consumer satisfaction.

The identification and resolution of numerous problems in the production process, such as product contamination and quality flaws, have benefited greatly from root cause analysis. Cow Dairy reduced the likelihood of recurrence by tackling the underlying causes of these issues and implementing durable solutions. Process management over the years has been greatly assisted by process control charts. The dairy could quickly spot process variances and implement remedial measures by visually depicting crucial data, such as equipment performance and product quality metrics. As a result, there was increased uniformity, less waste, and high-quality items were supplied to customers while still being cost-effective.

Cow Dairy has achieved operational excellence, cut costs, and ensured the manufacture of safe and high-quality products through the effective application of root cause analysis and process control charts. This case study shows how Cow Dairy successfully applied the two key root cause analysis and process control charting methodologies of lean manufacturing.

Root Cause Analysis:

Root cause analysis (RCA) is a systematic process of identifying the fundamental reasons behind problems to find appropriate solutions. It emphasizes the importance of addressing underlying issues rather than merely treating surface-level symptoms.

Implementing Lean Manufacturing at Cow Dairy Through Root Cause Analysis:

At Cow Dairy, they used a Fishbone Diagram to carry out root cause analysis in order to introduce lean manufacturing practices. This graphic tool, also known as an Ishikawa or cause-and-effect diagram, aids in locating and classifying potential sources of a problem. The fishbone diagram (Fig. 1) showed a number of potential causes and contributing factors for the pouch leakage at Cow Dairy.

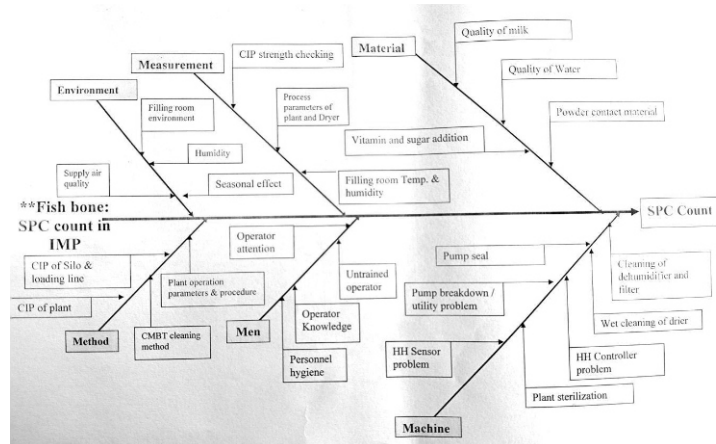


Fig. 1: Fishbone Diagram-Pouch Leakage

Method: Pouch leakage is a common problem that can happen for a number of reasons, such as the manufacturing, sorting, shipping, and storage operations' design, nature, and quality. Production and Operation at Cow Dairy pinpointed several process-related reasons for pouch leakage. Inadequate pouch sorting of good and leaky pouches, inappropriate handling during truck loading, and improper stacking of pouches are only a few examples of faulty pouch storage, handling, and transportation practices.

To solve the process-related problems shown in the figure (Fig. 1), Cow Dairy used a variety of solutions. They started by putting quality control processes in place to monitor every step of the packaging process, including handling, storage, and transportation. This guaranteed accurate pouch sorting, a clean, dry storage environment, and cautious stacking to avoid any damages. In order to improve handling methods and decrease errors, the corporation also trained its employees.

In addition, Cow Dairy established a tracking system to keep an eye on pouches as they are being transported. This made it possible to identify problems early and take quick corrective action. To verify compliance with necessary protocols and best practises, regular audits of transportation partners were also carried out. The dairy was able to successfully address process-related issues and raise the general effectiveness and standard of its operations by implementing these methods.

The amount of pouch leakages was significantly reduced at Cow Dairy as a result of the implementation of these process-related remedies. Training and the implementation of quality control measures enhanced the handling and delivery of pouches. The tracking system and regular audits also made it possible to quickly identify and address any problems. Together, these steps made sure that the goods constantly met the necessary quality requirements, which raised client satisfaction.

Materials: The type or quality of the materials used to manufacture the pouches can significantly impact the likelihood of leakage. The Production and Operation department at Cow Dairy has pinpointed certain root causes for this issue. The presence of printing matter in the seal area, poor winding or rewinding positions, the use of packing materials with incorrect micron standards, and pinholes in the film are a few examples. To address these material-related issues, Cow Dairy implemented the following solutions:

Improved supplier selection and quality control: Improvements were achieved by Cow Dairy in supplier selection and quality assurance. To make sure the materials fit the necessary requirements, they developed close working relationships with the suppliers of packaging materials. A strict quality control process was also implemented by the business to ensure the quality of the materials received.

Regular testing of the materials: To check for pinholes and other flaws in the film, Cow Dairy established a testing technique. To make sure the film wasn't harmed during the process, they also looked at the winding and rewinding locations.

Proper storage of materials: To avoid the supplies being contaminated or damaged before usage, the company put in place adequate storage measures.

Equipment maintenance: To make sure the packaging equipment was working well and wasn't causing problems with the materials; it was periodically maintained at Cow Dairy.

These remedies assisted in raising the calibre of the packaging supplies and lowering the possibility of pouch leaks as a result of material-related problems.

Machine: Pouches at Cow Dairy were leaking frequently, and this is mostly due to machine-related issues. Inadequate preventative maintenance, the use of outdated equipment, voltage fluctuations, the state of the backup rubber strip, frequent power outages, inadequate cooling of the sealing jaws, and any protrusions in the milk flow, tube, or tray are some of these problems. To address these causes, Cow Dairy implemented several solutions.

Investment in cutting-edge machinery: To lessen the occurrence of pouch leakages, Cow Dairy invested in cutting-edge machinery with superior sealing technology and automatic inspection systems.

Usage of voltage stabilizer: Voltage stabilisers are used to make sure that the machinery runs at a constant voltage, lowering the possibility of pouch leaks.

Regular preventive maintenance of machinery: Maintaining equipment regularly and proactively helped find and stop problems that could lead to pouch leaks. This entails routine inspections of the cooling systems, sealing jaws, and other crucial parts. In order to lessen pouch leaks, worn-out backup rubber strips were replaced in step four.

Installing uninterrupted power supply systems: It assisted in addressing the problem of frequent power outages, which disrupted the packing process and led to machinery failure and pouch leaks. Last but not least, routinely checking the milk flow, tube, or tray allowed for the detection of any protrusions or obstructions that can result in pouch leaks.

By implementing these solutions, Cow Dairy was able to reduce the occurrence of pouch leakages caused by machine-related factors and improve the quality of their products.

Man: Pouch leakages had been a problem for Cow Dairy, which was mostly ascribed to human mistake. The failure to capture and analyze leakage data, the insufficient training of operators for the Drop Test, and ignorance of machine operations were some of the root reasons of this issue. To address the issue, Cow Dairy implemented the following solutions:

Better process monitoring: Effective quality control methods were put in place by Cow Dairy to closely monitor the process and identify problems early, allowing for fast corrective steps. These measures included visual inspection and routine testing of packaging equipment.

Record and analyze leakage data: The dairy also used a data-driven strategy by gathering and examining information on pouch leakage. By doing so, they were able to spot patterns and trends and address certain issues with the packaging process or equipment before they became more serious.

Adequate training for operators: Operators underwent thorough training on handling equipment and executing the Drop Test in order to maintain smooth operations. This gave them the ability to spot and fix any possible problems as they arose.

Increased understanding of machine operations: To improve operators' comprehension of the procedure and equip them to spot potential problems, Cow Dairy regularly held training sessions and workshops on machinery operation.

Cow Dairy saw a noticeable improvement in pouch leakages as a result, guaranteeing that their products consistently fulfilled the necessary quality standards.

Process Control Charts

Process control charts are a powerful graphical tool for monitoring and managing a process over time. They display critical data, such as product quality measurements, process cycle times, or equipment performance, enabling the identification of process variations and facilitating corrective actions to ensure consistency and reduce waste. These charts play a crucial role in ensuring that products meet customer requirements and are produced in a cost-effective and timely manner.

Implementing Lean Manufacturing at Cow Dairy through Process Control Charts:

Process control charts are essential for monitoring and managing operations at Cow Dairy in order to

maintain product consistency, satisfy customer needs, and guarantee excellent quality. Here are some ways in which process control charts are vital for Cow Dairy:

Quality assurance: Dairy products must be handled and processed with extreme caution because they are perishable goods. Cow Dairy can keep track of crucial variables like temperature, weight, pH, and microbial counts thanks to process control charts. With the use of this information, the dairy is better equipped to quickly address problems and preserve the quality and safety of its products.

Product consistency: Customers anticipate a consistent taste and weight in every purchase of dairy goods. Cow Dairy uses process control charts to make sure that the procedures it employs to create its goods are reliable and consistent, resulting in goods that regularly satisfy consumer expectations.

Waste reduction: Cow Dairy generates a considerable amount of waste during production. Process control charts make it easier to spot process variances that increase waste and to take the necessary corrective action to reduce it. With this strategy, production costs are reduced, and the process is more environmentally friendly.

Compliance: Cow Dairy is a food producer and is subject to stringent laws governing the safety and quality of its products. Process control charts serve as a record of the manufacturing procedure and the measures taken to guarantee product quality and safety, proving compliance.

In summary, process control charts are a valuable tool for optimizing production processes, reducing waste, maintaining product quality and safety, and complying with regulatory requirements in Cow Dairy.

Implementation of X-Bar Chart for Consistent Butter Packaging at Cow Dairy:

X-Bar Chart has been successfully adopted by Cow Dairy to guarantee the uniform packaging of 20-gram butter that satisfies customer specifications. The dairy keeps an eye on crucial quality indicators such package weight, dimensions, and seal integrity using the process control chart.

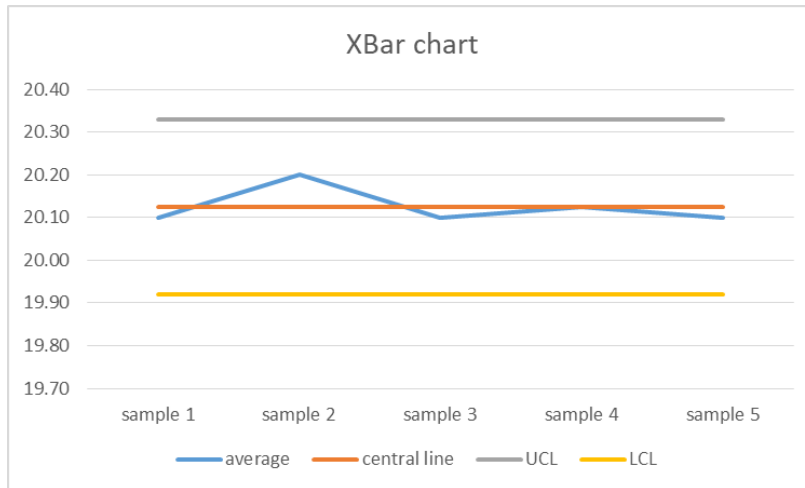
Cow Dairy frequently samples the 20-gram butter packaging procedure at different time intervals in order to achieve this (Table 1), and the company then plots the results on a process control chart (Fig. 2). The dairy can identify process variances and swiftly implement corrective steps by analysing the chart in order to assure uniformity and prevent waste. For instance, if the weight of the packaged butter deviates from the desired weight limits, the management can identify the root cause of the problem and put remedial measures in place.

The use of process control charts is essential to maintaining the consistency, effectiveness, and production of high-quality goods that satisfy customer expectations during the 20-gram butter packaging process. Cow Dairy minimises the possibility of consumer complaints, lowers waste, and improves manufacturing procedures by using this strategy.

Table 1: Observation for X bar Chart

Sample No.	Observation 1	Observation 2	Observation 3	Observation 4
Sample 1	20.00	20.10	20.30	20.00
Sample 2	20.10	20.30	20.10	20.30
Sample 3	20.00	20.10	20.30	20.00
Sample 4	20.10	20.30	20.00	20.10
Sample 5	20.30	20.10	20.00	20.00

Fig. 2: X bar Chart



Cow Dairy's success in the dairy industry can be attributed to the implementation of lean manufacturing strategies, like root cause analysis and process control charts. These methods have produced better product quality, lower costs, and operational excellence. Cow Dairy has improved its competitiveness and customer focus while offering low prices by identifying and reducing inefficiencies. Root cause analysis and process control charts have been used to focus on product quality, resulting in consistently high-quality products and increased consumer loyalty. The business is more competitive thanks to its flexibility in responding to market needs and employee empowerment. Cow Dairy has earned consumer trust by achieving sustainable growth and regulatory compliance through a data-driven strategy. Adopting lean concepts has helped the business gain market leadership and pave the way for future success.

5. Teaching Notes:

Introduction:

The case study centers around Cow Dairy, a prominent dairy cooperative society located in Gujarat, India. The cooperative's main goal is to improve the socioeconomic standing of local milk farmers. Cow Dairy has become a prominent player in the Indian dairy business with a sizable membership base and a sizable daily milk collection. Numerous recognitions and honours have been bestowed upon the dairy as a result of its commitment to quality, customer satisfaction, and ongoing progress. Root cause analysis and process control charts are two crucial lean manufacturing practices that the dairy has employed as part of its dedication to continuous improvement. The teaching notes are intended to help professors talk with students about the case while cultivating a knowledge of lean manufacturing concepts, their importance to the dairy industry, and Cow Dairy's effective use of them.

Key Learning Objectives:

1. Understand the idea and tenets of lean manufacturing.
2. Know the value of lean manufacturing in the dairy sector.
3. Examine how root cause analysis is used to find and fix problems in the manufacturing process.

4. Describe how process control charts help monitor and improve product quality and process effectiveness.
5. Analyse the effects of lean manufacturing practises on the accomplishments and performance of Cow Dairy.

Teaching Approach:

To guide the discussion, instructors can adopt the following approach:

Introduction of Lean Manufacturing: Introduce the topic by outlining the core idea of lean manufacturing. Stress the need to reduce waste and increase manufacturing processes' efficiency. Briefly describe the Toyota Production System (TPS), which serves as the foundation for lean principles.

Lean Manufacturing's Importance for the Dairy Sector: Examine the dairy industry's competitiveness and the value of effectiveness and quality. Learn more about how lean manufacturing helps the dairy industry overcome issues including cost control, quality improvement, and flexibility.

Overview of Cow Dairy: Briefly describe the history of Cow Dairy, highlighting its cooperative structure and crucial position in the Indian dairy industry. Emphasise the dairy's dedication to excellence and client happiness.

Applications Root Cause Analysis at Cow Dairy: Explain the idea of root cause analysis and how it helps to determine the underlying causes of problems with production processes at Cow Dairy. Use the case study's fishbone graphic as an example to show how Cow Dairy used this approach to address pouch leakage issues.

Applications of Process Control Charts at Cow Dairy: Describe how process control charts can be used to monitor and manage industrial processes and their advantages. Show how Cow Dairy used this technology to manage product quality by using the X-Bar Chart for consistent butter packaging as an example.

Impact of Lean Manufacturing Strategies: Describe the results of applying process control charts and root cause analysis at Cow Dairy. Encourage students to consider how these tactics helped reduce waste, enhance product quality, and boost operational effectiveness.

Student Group Discussion: Divide the class into groups, then give each group a specific topic to investigate deeper. For instance, one group can research how lean manufacturing has affected Cow Dairy's ability to cut costs, while another might talk about how the quality of the company's products has improved. The groups should then present their findings to the class.

Real-world Application: Encourage your students to think of additional areas within the dairy industry or other industries where lean manufacturing principles could be used to improve operations and results.

Conclusion: Summarise the case study's main lessons learned and stress the importance of applying lean manufacturing techniques to other sectors as well as the dairy industry.

Assessment and Evaluation:

1. Instructors can use written assignments, group presentations, and class participation to gauge students' comprehension of the case study. Assess students' abilities in relation to:
2. Describe the idea and tenets of lean manufacturing.
3. Know the value of lean manufacturing in the dairy sector.
4. Examine the impact root cause analysis has had on process improvement at Cow Dairy.
5. Analyse Cow Dairy's usage of process control charts and how it contributes to product quality maintenance.

6. Analyse the total effect of lean manufacturing practices on the performance and success of Cow Dairy.

6. Conclusion

The Cow Dairy case study offers insightful information about how a dairy cooperative successfully applied lean manufacturing techniques to increase productivity, decrease waste, and improve product quality. Students can learn about the real-world implementations of lean manufacturing principles in a competitive industry by using the case study as an illustration. It emphasises the value of continuous improvement and the application of instruments like process control diagrams and root cause analysis to achieve operational excellence. This case study offers students insightful lessons that they may use in a variety of manufacturing and service-oriented sectors.

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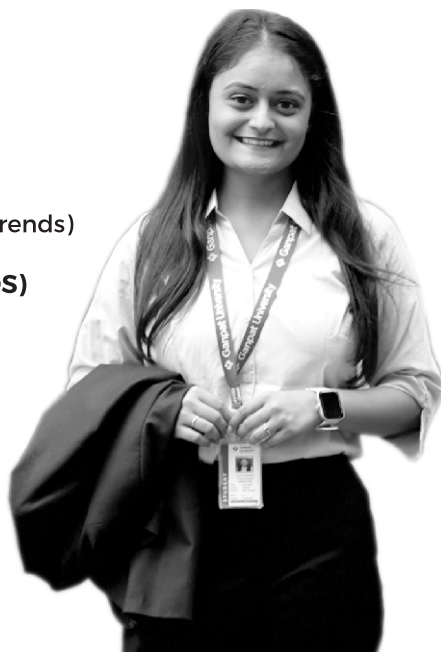
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