

Optimization of Dairy Supply Chain Management

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Abstract—Milk is considered as an essential and complete food. The present study was conducted at Milk Plant Mohali especially in reference to the procurement section where the cash inflow was maximum, with the objective to achieve higher productivity and reduce wastage of milk. In milk plant it was observed that during the month of Jan-2014 to March-2014 the average procurement of milk was Rs. 4, 19, 361 liter per month and cost of procurement of milk is Rs 35/- per liter. The total cost of procurement thereby equal to Rs. 1crore 46 lakh per month, but there was mismatch in procurementproduction of milk, which leads to an average loss of Rs. 12, 94, 405 per month. To solve the procurement-production problem Quality Control Tools like brainstorming, Flow Chart, Cause effect diagram and Pareto analysis are applied wherever applicable. With the successful implementation of Quality Control tools an average saving of Rs. 4, 59, 445 per month is done.

Keywords—Milk, Procurement-demand, quality control tools.

I. INTRODUCTION

THE term quality is concerned with the end use of the product. If the finished product meets with the established specifications then the component is said to be of good quality. Quality plays an important role for enhancing productivity. Quality, productivity and cost of operation proportionately rely on each other. To ensure lower rate of rejection, quality of the products need to become better along with the improved productivity. Improvement in quality leads to grow in productivity, which leads to decrease in costs and magnify the market, which helps the company to remain in business.

A. Seven QC Tools

To upgrade the quality of product seven quality control tools (7QC) plays a significant role. These tools are used to recognize, analyze the problem and control the product standards, these tools give the results to avoid the faults which can occur in future. For the successful use of seven quality control tools statistical literacy is necessary. The procedures uses in these Tools are statistical. Seven quality control tools helps to identify any problem in the process, the data arrange in such a way that is easy to analyze and comprehend.

TABLE I
SEVEN QC TOOLS

Tools	Use
Flow Chart	Identifies faulty situation and their improvement opportunities

Cause and Effect Diagram	Identify, classify and display possible causes of the problem.
Pareto Chart	Separates big complications into smaller pieces, it shows where to pay attention by identifying the most significant factors.
Scatter diagram	Study and Identify the possible relation in two different sets of variables, plots data pairs on diagram.
Check Sheet	Records data helps in taking decisions and actions. Provide historical records.
Histogram	Helps in condensing large data graphically The Graph shows frequency distributions, which collate measurement to specifications.
Control Chart	Graphs used to differentiate between special causes and common cause's variation. It monitors process variation over time

B. Terminology

1. Assessment

Assessment is the ongoing process of collecting, defining, analyzing, designing, and interpreting on evidence to make informed consistent judgment to improve future.

2. Procurement

Procurement is the act of obtaining goods, services or efforts from an outer source. It is favorable that the goods, services or works are suitable and they are procured at the feasible cost to encounter the demand of the purchaser in terms of quality, time, and location.

3. Demand

Demand categorize a customer's need and readiness to pay a cost for a specific good or services, the cost of goods or services grow as its demand grows holding all other factors continual. Demand planning: demand planning is a significant process in the part of supply chain management. Demand planning requires forecasting and other activities.

There are two types of demands; Independent and dependent demand. Independent demand object are normally finished goods while dependent demand objects are mainly components or subassemblies. Independent demand is predicted while dependent demand items demand can be obtained on demand for finished goods.

4. Supply Chain

Supply chain is recognized as a flyover between supply and demand. We can say that it is a matrix of possibilities and supply options that carry out the function of procurement of material; variation of these materials is in between finished products and issuance of these products to customers. It brings the demand to the supply point and brings the supply to the demand point. Supply chain management can be seen as the procedure of managing the procurement, transportation and storage of

materials, components and finished inventory through the organization. It is a marketing method in such a way that present and future profitably are highest through the fulfillment of orders. According to APICS (American production and inventory control society), Supply is recognize as the quantity of goods accessible for use or the actual (or planned) replenishment of a product. The replenishment amounts are generated in answer to a demand for the product or in anticipation of such a demand.

II. LITERATURE REVIEW

Patel et al. conducted study at MIRANDA TOOLS, GIDC Gujarat; the focus of the study was to develop the quality level by obtaining out the root causes with the support of quality control tools. The tools used in the study were Cause-and-effect diagram, Pareto Diagram, Check Sheet, Histogram, Run-Chart, Control Chart, and Scatter-Diagram. Quality control tools are important tools used extensively at manufacturing field to observe the uninterrupted process development and overall operation. The Quality Control tools were used to discover the root Causes and remove them. The study described the function of seven Quality tools in Taper Shank drill Industry. These basic tools were apply on Company data, examined this data, and discover the Rootcauses. Based on root causes the action plan for further development has made [1]. Awaj et al. conducted study in production processing line to decrease the faults by classifying where the maximum waste takes place. The Statistical Process Control (SPC) tool was used. The approach used in this study was direct observation, brainstorming session, fishbone diagram, and details has been composed from customers and workers all the way through questionnaire and interviews. Pareto chart and control chart (p-chart) was create. It was originate in the company there was high refusals and misuse in the production line. The vital few problems were identified, with the Pareto analysis. It was found that the double seam, blisters, stone, overweight, pressure failure were the imperative few problems. The aim of the study was use of SPC tools in the problem analysis. Particularly to train the quality team about how to hold a successful brainstorming session and utilization of these data in cause-and-effect figure construction, control chart and Pareto analysis construction. Within short period, the company has many limitations to implement all suggestion for development; the company accepted that in the long the suggestion will present significant productivity development [2]. Pal conducted study in an automobile company using quality control tools. Pareto chart, fishbone diagram and flow diagram have been used in the study. It has been found that the defects of casting components have 9.79% per month, which has been finally reduced to 8.52% per month by using quality control tools [3]. Behman et al. conducted study in tire retarding company in Middle East. The data was collected throughout all year of 2009 from quality and production accounts. The quality control tools were used to categorize, classify and evaluate the major troubles according to their priority; the tools used were Fishbone diagram, Pareto chart, Brainstorming, and Matrix diagram. The quality tools used to the company data allowed creating a record of possible causes for the happening of the tread separation defects caused through the renovating step [4]. Boniface et al. discusses the agribusiness

supplier's relationship management literature both empirically and theoretically presents consequences from a study of 133 diary producers in Malaysia. They classified how Malaysian milk buyers can make loyal customer support with their suppliers as a mean to secure continuous milk supplies [5]. Qureshi et al. studied about the total quality management included management approach, which aimed constantly develop the performance of products and process. This objective was accomplished by selecting some key features that contribute to the achievement of TQM. The study identified and purposed record of fundamental few TQM CSFs for the assistance of researchers and service industry practitioners. Pareto analysis was used to arrange the CSFs according to the order of critically. The result of this study help in successful implementation of TQM program in organization and leads to continue improvement in productivity [6]. Pavletic et al. conducted study about quality tools in actual practice; the study aimed to show realistic examples that there was real prospect of application of 7QC. Although the seven-quality tools cause and effect diagram, flow chart, Pareto diagram, check sheet, histogram, control charts and scatter plot were used. The study was aimed to illustrate to what areas were opted tools in actual use and what was the reasons of dropping applications. It was shown that quality tools hold vital place in data collection, analyzing, visualizing and for decision-making [7]. Paliska performed research in different regions like power plant, government, process industry, health and tourism. In the research systematic approach was, clarify on the example of preferred company in process industry, which was ISO 9000:2000 certified. The 7QC tools had been verified and its validity in the structure of preferred business has been shown. Research has revealed that there was opportunity of systematic application of all of the 7QC tools in the structure of companies throughout quality management system [8].

III. METHODOLOGY OF THE RESEARCH

To carry out the research work the following methodology were used.

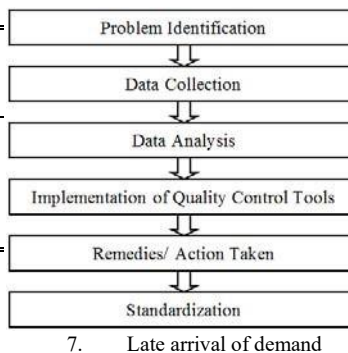
- Problem Identification: In Verka milk plant it was observed that in procurement section there was mismatch in procurement of milk and demand of the milk and milk products
- Data Collection: The data was collected during the month January 2014 to March 2014; the data reveled from procurement section that Average 36983 liters (8.8%) milk wasted in per month.
- Data Analysis: By using brainstorming with the members of top-level to low-level management. The possible causes listed that was responsible for wastage of milk. Through observations, it was noted that these causes were valid or not.
- Implementation of Quality Control Tools: The tools used were cause and effect diagram, flow diagram and Pareto analysis. With the help of these tools the main causes came out which were highly responsible for wastage of milk.
- Remedies / Action Taken: the modified and corrective action has been taken during the month April 2014 to June 2014 against the possible causes.

Fig. 1 Methodology of Research Work

IV. PRESENT WORK

TABLE II
PROCUREMENT–DEMAND MISMATCH

Month	Procurement Milk (liter)	Demand of Milk + Products (liter)	Excess (+)/ Shortage (-) (liter)
January 2014	389606	361260 + 52594 = 413854	-24248
February 2014	426779	365776 + 27681 = 393457	+33322
March 2014	441700	351840 + 36479 = 388319	+53381
Average	419361		-36983



The Procurement – Demand Mismatch was tabulated in Table II. Average Procurement = 419361 liter, Average Loss = 36983 liter, Percentage Loss = $(36983/419361) \times 100 = 8.8 \%$, Cost of milk per liter = Rs. 35, Total Loss per month = $36983 \times 35 = \text{Rs. } 12,94,405$.

A. Brainstorming

The brainstorming for procurement–demand mismatch was

- Standardization: After implementation of quality control tools and action taken the problem has been reduced and full proofing of the work.

done in two sessions i.e. Session 1, Session 2 with top level, lower level management. Session 1: With 12 persons, include section heads from top level. Session 2: With 13 persons, lower level management and operators. Following brainstorming points were comes out which were tabulated in Table III.

Table III shows the causes, which were given by top-level management and low-level management and workers. By toplevel management the main cause were improper production planning, old plant and machinery, handling losses in plant, unskilled labour, improper maintenance and pilferage. The causes given by low-level management were leakage in pipelines, losses during unloading, supply demand not clear, Losses during packaging of milk due to temperature difference in Form Fill Seal (FFS) machine and supply demand not clear.

TABLE III

BRAINSTORMING POINTS FOR PROCUREMENT – DEMAND MISMATCH

S. No.	Brainstorming Points By Top Level Management	Brainstorming Points By Low Level Management/Operators
1.	Improper Production Planning	Leakage in pipelines
2.	Handling Loss	Losses during unloading
3.	Unskilled Labour	Valve leakage in plant
4.	Old Plant and Machinery	No backup available for frequent breakdown of power
5.	Improper maintenance	Supply demand not clear
6.	Pilferage	Losses during packaging of milk due to temperature difference in Form Fill Seal (FFS) machine

7. Late arrival of demand -

B. Flow Chart

The milk producers and dairy farmers from different areas deposit their milk in milk societies, the procurement department procures milk and send it into four milk chilling centers namely Morianda, Nurpurbedi, Jhingri and Mohali having total chilling capacity of approx. 4, 00, 000 liters per day. The total milk received per day was send to Verka Milk Plant through milk tankers. The temperature of the milk records which must be below than 7 degree Celsius. The milk is thoroughly stirred by plunger and smell is taken, small amount of milk is tasted and sample of milk is tested for fat and acidity. If result is satisfactory then milk is pumped to dump tank from which milk is pumped to storage tanks through the plate chiller and this raw milk is stored in raw milk storage tank. Stored milk is pumped to pasteurizer and then passed to filtrations followed by heating in between the temperature 75-80 degree Celsius. Chilled water is added in the hot milk and then sent to Form Fill Seal (FFS) Machine. The milk’s packets are stored in cold storages and then supplied to market for sell.

C. Cause and Effect Diagram

The cause and effect diagram constructed through the brainstorming technique in which causes were identified organized according to problem. The causes were divided according to Man, Machine, Method and Measurement, which help to find out the root causes. Handling Loss, Unskilled labour were the causes due to man, old machines, breakdown etc. were the causes due to machine, improper maintenance, unloading etc. were the cause’s due to method, late arrival of demand etc. was the causes due to measurement. The detail causes for man, machine, method and measurement are shown in Fig. 3.

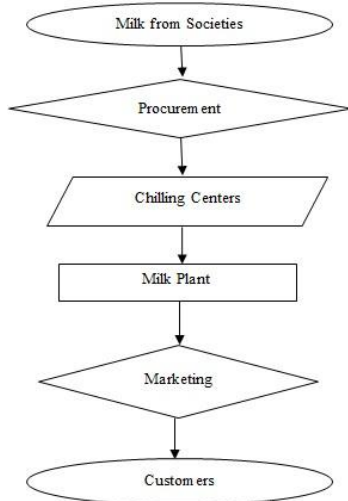


Fig. 2 Flow through observations.

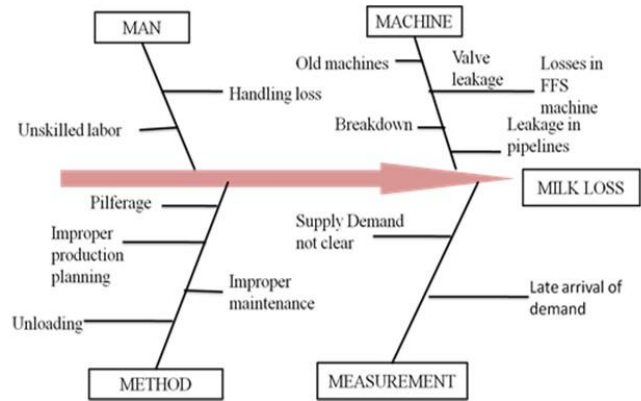


Fig. 3 Cause and Effect Diagram for Procurement–Demand Mismatch

D. Data Collection and Validation

Chart for Procurement – Demand Mismatch The data collected and validated

TABLE IV
DATA COLLECTION AND VALIDATION OF CAUSES

S. No.	Causes	Average wastage of milk	Valid/ Invalid	Observations
1.	Improper Production Planning	6290 liter (1.50%)	Valid	No optimization procedure is adopted while doing production planning.
2.	Handling Losses	4822 liter (1.15%)	Valid	Lots of milk loss during handling.
3.	Unskilled labor	2096 liter (0.50%)	Valid	Workers are working under contract level, which is frequently changeable.
4.	No backup available for frequent breakdown of power	0 liter	Invalid	Back-up available in plant.
5.	Leakage in pipelines	3983 liter (0.95%)	Valid	Gasket leakage
6.	Pilferage	4822 liter (1.15%)	Valid	Leakage due to improper stacking of trays in cold storage
7.	Late arrival of demand	1677 liter (0.40%)	Valid	Demand received at late hours against the standard hour.
8.	Losses during unloading	0 liter	Invalid	Validated through actual observations
9.	Losses during packaging of milk due to temperature difference in FFS machine	1887 liter (0.45%)	Valid	Improper internal system
10.	Supply demand not clear.	0 liter	Invalid	Not Valid, as in actual observation
11.	Old plant and machinery	9225 liter (2.2%)	Valid	It was observed that plant and its machinery is too old, the market demand is increasing day by day.
12.	Improper maintenance	2096 liter (0.50%)	Valid	Plant needs maintenance time to time.

E. Pareto Chart

Pareto chart was created by plotting the cumulative frequency of the relative frequency of the causes in descending order, after that the most essential factors for the analysis are graphically apparent and orderly format. For all nine contributing causes 80:20 rule was applied, 80% of the causes were considered and found that old plant and machinery, improper production planning and handling losses were vital.

According to Pareto chart analysis three major causes i.e. old plant and machinery, improper production planning and handling losses on which various action has been taken which is tabulated in Tables V-VII respectively along with results.

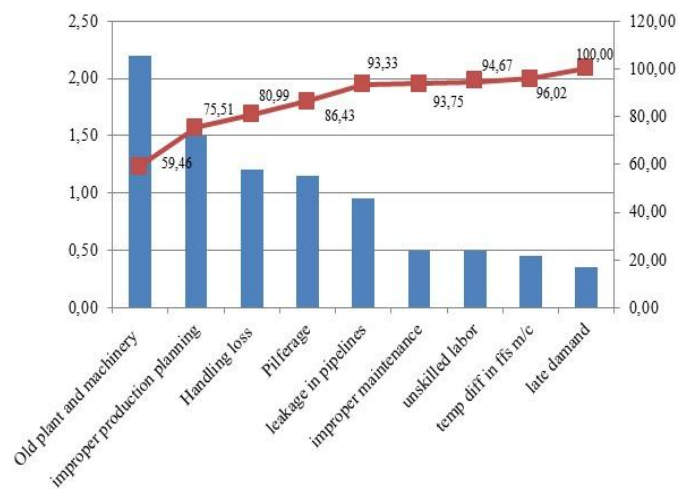


Fig. 4 Pareto Chart Analysis for Causes

TABLE V
ACTIONS TAKEN AND RESULTS FOR OLD PLANT AND MACHINERY

S. No.	Before Action Taken	Average Milk Wasted per day	After Action Taken	Average Milk Wasted per day
1.	Only breakdown maintenance schedule followed. Old preventive maintenance schedule never followed	Intangible	Preventive maintenance schedule prepared and revised	Intangible
2.	Irregularity in attending breakdown	5000 liter	Documentation work started	3000 liter
3.	Optimum utilization of plant and machinery was not there	4225 liter	Rational distribution of processing work distributed optimally among all plant and machines	2032 liter
	Total	9225 liter		5032 liter

TABLE VI
ACTIONS TAKEN AND RESULTS FOR IMPROPER PRODUCTION PLANNING

S. No.	Before Action Taken	Average Milk Wasted per day	After Action Taken	Average Milk Wasted per day
1.	The processing time from Jan 2014 to march 2014 was 22 hour.	4920 liter	Processing activity like manufacturing of Curd, Kheer, Cheese and Lassi clubbed together there by reducing processing time by 20 hr on average since April 2104 to June 2014	1596 liter
2.	There was no implementation of time utilization schedule.	Intangible	It was implemented thereby saving of milk processing time and handling wastage of raw milk.	Intangible
3.	In spite of having enough storage facility it was not utilized properly.	2000 liter	During April 2014 to June 2014 unutilized tank started using cause saving production time and handling loss.	500 liter
	Total	6920 liter		2096 liter

TABLE VII
ACTION TAKEN AND RESULTS FOR HANDLING LOSSES

S. No.	Before Action Taken	Average Milk Wasted per day	After Action Taken	Average Milk Wasted per day
1.	Old and torn gasket	1000 liter	Old and torn gasket in pipelines changed in time.	0 liter
2.	Workers were unaware of value of milk.	of Intangible milk.	Workers educated regarding scarcity and value	Intangible
3.	No floats in balanced tanks	all 1532 liter balanced tanks.	Float control mechanism incorporated in	322 liter
4.	Milk wasted in storage tanks	tanks 2500 liter for further use.	The flushed milk started collecting in storage	600 liter
	Total	5032 liter		922 liter

V. RESULTS AND DISCUSSIONS

Fig. 5 shows the comparison of procurement – demand mismatch; it shows the comparison of three vital causes, which were old plant and machinery, improper production planning and handling losses due to which the loss of milk occurred before and after implementation of the tools. After taking modified action against three vital causes in Procurement – Demand mismatch percentage losses reduced by 42%, 48% and 41% for old plant and machinery, improper production planning and handling losses respectively.

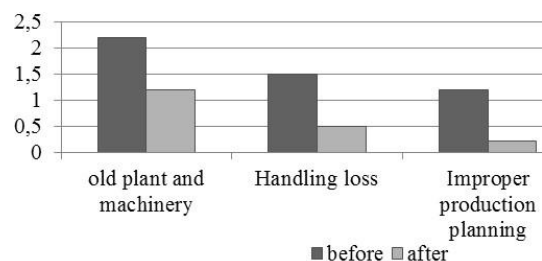


Fig. 5 Comparison of the Results for Procurement – Demand Mismatch

VI. CONCLUSION

- At the milk plant, Mohali the average milk loss from January 2014 to March 2014 was 42679 liter per month after implementation of quality control tools from month April

2014 to June 2014 the average loss was 29220 liter. The average saving is 13459 liter per month. Hence productivity increased by 31%.

2. The average saving in procurement – demand mismatch is Rs 4, 59, 445.

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