Assessment of Procurement-Demand of Milk Plant
Using Quality Control Tools: A Case Study
Jagdeep Singh, Prem Singh

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. 1 crore 46 lakh per month, but there was mismatch in procurement-production 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.

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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

<table>
<thead>
<tr>
<th>Tools</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Chart</td>
<td>Identifies faulty situation and their improvement opportunities</td>
</tr>
<tr>
<td>Cause and Effect Diagram</td>
<td>Identify, classify and display possible causes of the</td>
</tr>
<tr>
<td>Pareto Chart</td>
<td>Separates big complications into smaller pieces, it</td>
</tr>
<tr>
<td>Scatter diagram</td>
<td>Study and Identify the possible relation in two different</td>
</tr>
<tr>
<td>Check Sheet</td>
<td>Records data helps in taking decisions and actions.</td>
</tr>
<tr>
<td>Histogram</td>
<td>Helps in condensing large data graphically The Graph</td>
</tr>
<tr>
<td>Control Chart</td>
<td>Graphs used to differentiate between special causes and</td>
</tr>
</tbody>
</table>

TABLE I

SEVEN QC TOOLS

Over time

International Scholarly and Scientific Research & Innovation 9(10) 2015 3350
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
to 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
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 Root-
causes. 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 dairy
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.
- Standardization: After implementation of quality control tools and action taken the problem has been reduced and full proofing of the work.

### Table II

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

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

### 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.


**D. Data Collection and Validation**

The data collected and validated through observations.

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

**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.
TABLE V
ACTIONS TAKEN AND RESULTS FOR OLD PLANT AND MACHINERY

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

TABLE VI
ACTIONS TAKEN AND RESULTS FOR IMPROPER PRODUCTION PLANNING

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

TABLE VII
ACTIONS TAKEN AND RESULTS FOR HANDLING LOSSES

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

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.

VI. CONCLUSION

1. 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%.

REFERENCES
