Costs related to quality is an important tool for process optimization and quality of relevant activities. Through these costs the company is able to identify inefficient activities, critical points in the development process. Thus the corrective actions or improvements necessary in a particular sector of the company, can be more robust, ensuring the assessment and tracking the effectiveness of measures taken. On the other hand, knowing the financial impact of failures found in different sectors, they can be more easily analyzed, correlated with the leaders, setting the priority measures to be applied.

An effective quality management based on cost of quality includes:
- Establishing a system for measuring the quality costs;
- Developing long-term trend analysis;
- Establishing annual targets for improving total cost of quality;
- Monitoring the progress of each goal and initiate corrective action when goals are not achieved.

The most common classification of costs related to quality distinguishes the following four categories:
- **Prevention costs** are costs incurred in order to keep costs and assessment failures to a minimum. They are generated by activities taken to prevent or reduce defects.
- **Assessment costs** are costs involved...
in determining compliance with quality requirements. These are generated by activities for assessing product conformity to the requirements established by identifying defects.

- **Internal defects** costs are costs incurred by the organization as a result of defects identified before delivery to the customer. They are costs that disappear if there is any defect in the goods before delivery.

- **External costs** are costs incurred in the organization as a result of defects found after product delivery to the customer. They are costs that would disappear if there was no defect.

### 2. MONITORING RAW MATERIAL COSTS

The costs of quality can occur in all phases of the product life cycle, and in all operational levels of the organization. Any organization takes measures to avoid failures that can occur in products; These measures can be pre- or post-factum.

Ante-factum approaches involve the adoption of measures to prevent the occurrence of defects and their detection in a time efficient manner. The loss decreases for all products and operational phases of the organization. Evidence of the quality and cost analysis involves the use of indicators, tools and specific documents. For example, the balance cost with quality, which presents the summary of these costs by category (cost of prevention, evaluation, these costs of internal and external failures) in absolute terms and as a share of production value.

The presentation below is intended to illustrate some aspects of quality management effects on raw material costs.

Orientation towards these costs are justified given the large share of raw materials in product costs. The case study is conducted on a company that produces and sells milk products in order to apply a model to monitor the consumption of raw materials on technological phases.

Table 1 shows the calculation of cost for the product "Yogurt" in the amount of 375 g, during the year, which shows that the largest share in the costs have costs of raw materials and materials, that is over 60%.

<table>
<thead>
<tr>
<th>Items of expenditure</th>
<th>Unit cost (Lei)</th>
<th>Share of cost (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Raw materials</td>
<td>12 328</td>
<td>60,5</td>
</tr>
<tr>
<td>2. Cost of goods sold</td>
<td>1 223</td>
<td>6</td>
</tr>
<tr>
<td>3. Salaries</td>
<td>1 817</td>
<td>8,9</td>
</tr>
<tr>
<td>4. Taxes</td>
<td>142</td>
<td>0,7</td>
</tr>
<tr>
<td>5. Amortization</td>
<td>896</td>
<td>4,4</td>
</tr>
<tr>
<td>6. Energy and water consumption</td>
<td>810</td>
<td>3,9</td>
</tr>
<tr>
<td>7. Supplies (packing aids)</td>
<td>2 354</td>
<td>11,6</td>
</tr>
<tr>
<td>8. Interest</td>
<td>529</td>
<td>2,6</td>
</tr>
<tr>
<td>9. Other expenses</td>
<td>280</td>
<td>1,4</td>
</tr>
<tr>
<td><strong>TOTAL UNIT COST</strong></td>
<td><strong>20 379</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Fig.1 The cost structure for the product "Yogurt"

Changing raw materials with other materials, cheaper, it is a solution to reduce costs, but it could have serious consequences for the quality of the finished product. Most appropriate would be to find ways to reduce these costs by a greater concern for minimizing losses on the entire flow, from receipt of raw materials to product completion.

The main aspects of monitoring the effects on costs of raw material and materials are:
- Monitoring of the procurement process;
- Inventory control of materials;
- Determination of costs and deviations from norms.
The last aspect will be further developed on an example of loss of material appearing on processing flow.

2.1. Determination of raw materials consumption

To determine the consumption of raw materials and losses, we will use each technology stage of processing the product yogurt with a fat content of 2.8%, highlighting some of the management costs of the company.

Thus, before normalization, calculating the amount of milk for manufacturing stages, knowing the amount of whole milk as 4500 kg (corresponding production of a day) and losses in these steps:

- Reception, filtering, cooling, storage: \( p = 0.05\% \);
- Normalization: \( p = 0.20\% \);
- Pasteurisation: \( p = 1\% \);
- Sowing, thermostating: \( p = 0.1\% \);
- Mixing: \( p = 0.5\% \);
- Packing: \( p = 0.3\% \)

\[ L_i = \text{amount of milk before reception} \]
\[ L_r = \text{amount of milk after reception} \]
\[ P_r = \text{losses at reception} \]
\[ L_r = L_i - P_r = 4500 - 2.25 = 4497.75 \text{ kg} \quad (1) \]
\[ P_r = 0.05 \% \times L_i = 0.05 \% \times 4500 = 2.25 \text{ kg} \quad (2) \]

\[ L_f = \text{amount of filtered milk} \]
\[ \text{L}_r = \text{the amount of milk received} \]
\[ P_f = \text{losses at filtering process} \]
\[ L_f = L_r - P_f \quad (3) \]
\[ L_f = L_r \times (1- \frac{P_f}{100}) = 4497.75 \times (1- \frac{0.05}{100}) = 40495.5 \text{ kg/day} \quad (4) \]

\[ L_c = \text{the quantity of filtered milk} \]
\[ L_r = \text{the amount of cold milk} \]
\[ P_r = \text{losses found in milk cooling} \]
\[ L_r = L_f - P_r \quad (5) \]
\[ L_r = L_f \times (1- \frac{P_r}{100}) = 4495.5 \times (1- \frac{0.05}{100}) = 4493.25 \text{ kg/day} \quad (6) \]

\[ L_s = \text{the amount of skimmed milk} \]
\[ P_n = \text{losses of normalization step} \]
\[ L_n = L_r + L_s - P_n \quad (7) \]
\[ C_n = \text{quantity of milk normalized} \]
\[ G_i = \text{fat content of the normalized milk} \]
\[ G_{in} = \text{the fat content of the standardized milk} \]
\[ L_s = \frac{C_n \times (G_i - G_{in})}{G_{in}} = \frac{4493.25 \times (3.5 - 2.8)}{2.8} = 1123.3 \text{ kg/day} \quad (8) \]
\[ L_n = 4493.25 + 1123.3 - P_n \quad (9) \]
\[ P_n = 0.20 \% \times (L_f + L_s) = 0.20 \% \times (4493.25 + 1123.3) = 11.23 \text{ kg/day} \quad (10) \]
\[ L_n = 4493.25 + 1123.3 - 11.23 = 5605.32 \text{ kg/day} \quad (11) \]
Improving Industrial Systems Performance by Monitoring Quality Costs

\[ L_i = L_r + CB - P_i \]  \hspace{1cm} (21)

\[ CB = 1.5 \% \times L_i = 1.5 \% \times 5543.73 = 83.15 \text{ kg/day} \]  \hspace{1cm} (22)

\[ P_i = 0.1 \% \times (L_i + CB) = 0.1 \% \times (5543.73 + 83.15) = 5.62 \text{ kg/day} \]  \hspace{1cm} (23)

\[ L_i = 5543.73 + 83.15 - 5.62 = 5620.5 \text{ kg/day} \]  \hspace{1cm} (24)

\[ L_i = L_r + CB - P_i \]  \hspace{1cm} (21)

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\[ L_i = 5543.73 + 83.15 - 5.62 = 5620.5 \text{ kg/day} \]  \hspace{1cm} (24)

\[ L_i = L_r + CB - P_i \]  \hspace{1cm} (21)

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\[ L_i = L_r + CB - P_i \]  \hspace{1cm} (21)

\[ CB = 1.5 \% \times L_i = 1.5 \% \times 5543.73 = 83.15 \text{ kg/day} \]  \hspace{1cm} (22)

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\[ L_i = 5543.73 + 83.15 - 5.62 = 5620.5 \text{ kg/day} \]  \hspace{1cm} (24)
The overall losses rises to 113 kg per day, which is about 1,98% of the input. Valuable daily losses are about 244 lei, and the annual output is over 70 000 lei.

Thus, before the start of the manufacturing process shall establish rules on the types of expenses, such as time consumption of materials for the product to be manufactured. Actual cost is determined by adding the losses during the manufacturing process and to modify the rules.

To reduce waste and in the same time the quality costs, investments must be made in the modernization of techniques and technologies that will lead to the reduction of nonconformities, respectively a rigorous control during the manufacturing process. There will be create new categories of costs, depending on the effort that the firm makes investment and add existing ones.

Regarding the cost of raw materials it is necessary to follow all the movements of consumption and quantity of materials involved in the production.

By comparing the data taken from the deposit materials, that can be entered in a form of consumption, with the situation of production achieved, it aims to frame the material consumption within the limits of the standardized consumption, in order to identify the loss or non-conformities, while being able to take the best decisions in this regard.

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**Fig.2 The record of losses in each of the phases of the manufacturing process**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Entries (kg / day)</th>
<th>Losses (%)</th>
<th>Output (kg / day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception</td>
<td>4 500</td>
<td>0,05</td>
<td>4497,7</td>
</tr>
<tr>
<td>Filtering</td>
<td>4497,8</td>
<td>0,05</td>
<td>4495,5</td>
</tr>
<tr>
<td>Cooling and storage</td>
<td>4495,5</td>
<td>0,05</td>
<td>4493,2</td>
</tr>
<tr>
<td>Normalization</td>
<td>4493,2</td>
<td>0,20</td>
<td>5605,3</td>
</tr>
<tr>
<td>Homogenization</td>
<td>5605,3</td>
<td>0,05</td>
<td>5602,5</td>
</tr>
<tr>
<td>Pasteurization</td>
<td>5602,5</td>
<td>1</td>
<td>5546,5</td>
</tr>
<tr>
<td>Cooling</td>
<td>5546,5</td>
<td>0,05</td>
<td>5543,7</td>
</tr>
<tr>
<td>Sowing</td>
<td>5543,7</td>
<td>0,1</td>
<td>5620,5</td>
</tr>
<tr>
<td>Automatic Packaging</td>
<td>5620,5</td>
<td>0,3</td>
<td>5604,4</td>
</tr>
<tr>
<td>Thermostating</td>
<td>5604,4</td>
<td>0,1</td>
<td>5598,8</td>
</tr>
<tr>
<td>Cooling</td>
<td>5598,8</td>
<td>0,05</td>
<td>5596</td>
</tr>
<tr>
<td>Storage</td>
<td>5596</td>
<td>0,05</td>
<td>5593</td>
</tr>
</tbody>
</table>
CONCLUSION

Industrial systems performance is focused on the performance of technological processes and also through the quality of raw materials and of the obtained products. Quality of raw materials is critical in any manufacturing activity. Also, due to extremely high share of costs of raw materials in each production activity, it is imperative to implement a system by which to monitor and analyze constantly the consumption of raw materials for production [7].

Thus, this paper has aimed to highlight the importance of creating and implementing a monitoring system for the raw materials consumption. In this sense, in the first part of the work we performed a theoretical exposure in terms of definition and classification of quality costs, as in the second part of the work to achieve an applicative exposure, a study case concerning the determination of the consumption of raw materials and losses related to each stage of the technological process of manufacturing of yogurt.

Because there are no records in the company on the cost of quality, we presented some aspects about the costs of raw materials, revealing the methodology of calculation of raw materials consumption and technological losses coefficients.

Using the mass balance we determined the consumption of raw materials and the losses that were recorded in every stage of the manufacturing process, their reduction can be achieved through a stricter control, as the improvement of the manufacturing technology. It was found that most of the losses occurred during pasteurization stage. In the end of the paper we also presented some improvements measures that may be applied in order to improve industrial system performance.

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BIBLIOGRAPHY