Automated Strategic Management Batch Accounting in a Processing Industry

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Abstract **– This paper examines managerial, technological, and organizational development aspects of strategic management accounting and analysis in a processing enterprise. The purpose of this research is to perform comprehensive methodological integration of strategic management accounting in a milk processing enterprise in order to increase its efficiency and competitiveness. This can be accomplished by using analytical information sources, and by developing a single list of options for operations in management accounting. The author has developed and implemented the concept of an automated management reporting system, and revealed that planning and achieving financial results within a branch structure implies a plan-factual analysis of both the branch itself and the entire company.**

Keywords **– Automated management accounting, Production automation, Enterprise digitization, Analytical information database.**

1. Introduction

During the recent years there was a steady decrease in the number of dairy producing enterprises and their competitiveness. The issues regarding support for such enterprises by means of digitization, include automation and the use of specialized databases. Such issues have become highly relevant in the conditions of intense competition for the markets of processed products [1] in North America, Europe, Australia, and New Zealand.

The methods of strategic management accounting and analysis, developed for various industries, have confirmed their practical importance in solving problems of strategy optimization, as the main factor in increasing the competitiveness of an enterprise.

Firstly, monetary measurement and life cycle costing (LCC) depend heavily on strategic management accounting for modern projects and project-oriented enterprises [2]. Kaplan and Norton [3] characterize management accounting as a combination of subjective and objective measures, as a system for obtaining information to make management decisions, including a set of accounting and analytical procedures and a certain part of the accounting information base, methods for its rearrangement, synthesis and processing, built on the principle of maximum adaptability to the specifics of an enterprise.

Secondly, in the current "unstable and complex, and consequently unpredictable" environment [4, p. 96], it is necessary to develop a system for transforming the flow of information space in order to prepare a high-quality database for making strategic management decisions. While most of the studies are concentrated on five "keystones" regarding strategic costing; strategic planning, control and performance management; strategic decision making; competitor accounting; and customer accounting [5].

At the stage of business planning, management is responsible for the results of enterprise activities. Therefore, management accounting should provide more detailed information on the activities within economic entity.

Methodological aspects of strategic management accounting and analysis of the external environment of economic entities engaged in milk processing require further analysis and clarification as a set of factors determining the competitiveness of an organization.Moreover, further analysis are required along with methods of strategic management reporting on the external environment of such enterprises, and digitization under advances of IT,

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implemented mostly in chemical production [6] and aircraft [7] or geospatial control [8], [9] companies' data management.

The issues of methodological support for automation of processing enterprises in terms of strategic management analysis have practical importance, and serve as a key to improving the efficiency of agricultural production. However, few researches had developed and modeled robotized automated meat processing [10], milking, feeding systems, and dairy control and management systems [11] as well. Compared to well-developed operations management including data, production and inventory management, only a small part of research implemented automation of a whole process, beginning from the provision and assessment of raw materials through the production and quality assessment stages and ending with packaging and labeling before sending to dealers for sale. Being new to the Russian management in the field of dairy production, a similar system has already been tested in Canada and the United States in 2017 in terms of reducing the costs of milk production as raw material, raising calves, increasing livestock by changing the feeding system [12]. This study addresses the topic even further – by assessing the automation of cheese production from the produced milk on the example of a Russian enterprise and anticipates modernization of the management system in the next stage, the supply chain management.

Thus, the most promising areas regarding development are automation and the use of databases in the areas of strategic management accounting and management analysis. For example, in the field of storage the fresh products in a cross-dock center [13] above mentioned issues are of great importance. Therefore, experts suggest a possible division of management accounting into two interrelated elements:

- Strategic management accounting for the top management, which includes an enterprise automation project;
- Operational management accounting for internal management, which operates mainly within the framework of the established automation system and introduces only a few innovations in the original model.

The proposed development satisfies both criteria.

The purpose of this study was to draw up a plan and an automation concept based on the sales plan, cheese residues at the finished goods warehouse (hereinafter referred to as the FG) and maturity terms, in order to produce finished products (considering the minimum production batches, the calculation of raw materials, the actual separation of costs on a daily basis), and maintain stable cheese residues in the assortment.

2. Methods

The methods of strategic management accounting and analysis, as well asthe concept of sustainable product development in a competitive environment served as the theoretical basis for the study. Since there is no single right management decision, each model is a compromise, which affects the interests of one segment, and at the same time influences others. In particular, it was necessary to consider that cheese, as the raw materials for its production, is a time-critical product, along with the previously revealed peculiarities [14].

The R&D project bases on the concept of development and application of information systems and databases design in enterprises. Furthermore, the indirect distribution of costs hides the real results of the business segments. In this regard, overhead costs should not be distributed, but covered by the total marginal income received by the segments [4].

The second problem is the choice of methods for assessing the performance of segments located in the beginning or in the middle of the technological cycle.

The automated system, databases, and documentation of LLC Azbuka syra served as research materials for this study. LLC Azbuka syra is the largest producer of hard, semi-hard and grilled cheese, as well as butter and dry whey in Russia, which was founded in 1974.

In accordance with the purpose of this R&D, the author developed a project, which includes the following stages:

(1) Studying the theoretical and methodological foundations and directions of strategic management accounting and analysis;
(2) Developing the methodology of batch regulation;
(3) Automation of batch regulation using the 1C system at all stages.

3. Results: The automation of workplaces and the movement of raw materials and finished products

At the first stage of this study, the author defined the following input data:

- there is a 1C accounting system with two control points: input of raw materials and shipment of FG (digitized);
- the accounting month is closed with the separation of costs by the "boiler" method (not by address);

- there is no working production order planning system;
- the loss standards and production recipes are not relevant; there is no step-by-step production control;
- there are no current residues in the FG warehouse (the result is a violation of the FIFO principle (the first one went in, the first one came out), the warehouse balances are written off due to expiration, there is no accounting for returns of FG);
- there is no management accounting and reporting;
- the area of responsibility of the process participants is not provided, and there are no documented procedures, no regulation of the interaction between the services;
- there is no batch traceability by the product nomenclature.

The second stage of this study revealed that the implementation of this project implies:

(1) Diagnostics of the current business process, description of all stages of the production process, documentation of the control procedures with a list of existing reporting documents;

(2) Development and description of a target business process for batch accounting, including key control points;

(3) Development of the batch accounting methodology (regulation);

(4) Implementation of batch accounting (third stage) using the 1C system at all levels:

a) planning and actual execution of orders,
b) monitoring compliance with production technology,
c) daily write-off of costs,
d) accounting of losses of raw materials, supplies, and FG,
e) monitoring and updating stock balance,
f) monitoring of customers' orders;

(5) Ensuring traceability by HACCP (Hazard Analysis and Critical Control Points) from raw materials to the customer;

(6) Ensuring compliance with the requirements for the issuance of electronic veterinary certificates through the "Mercury" system and customer requirements.

The project implementation is illustrated in Figure 1.

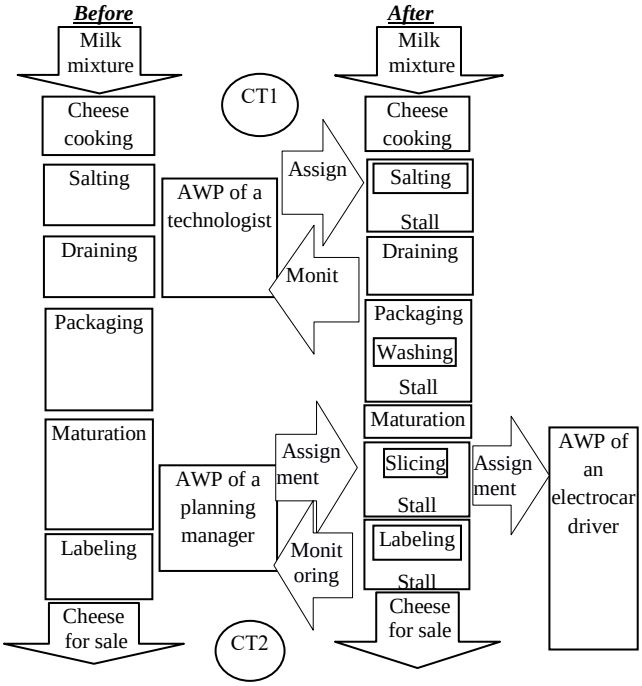

Figure 1. Stages of activity and automated workplaces (AWP) in the processing system (by the example of dairy production). Compiled by the author

Detailed description of the system is shown below.

Raw milk is accepted as follows. First, the laboratory technician enters information concerning the quality indicators of milk, creating batches in the system. Once the milk is downloaded to the tank, the inspector enters the information about the quantity received for each batch into the system. The accepted weight is calculated and based on capacity indicated by the receiver, and density is indicated by the laboratory technician or specified manually if the milk is accepted by weight.

Percentages of milk fat and protein are indicators affecting the calculation of test weight. The values of fat, protein, and other quality indicators are recorded in the context of batches of accepted milk. The type of milk, which determines the price, is determined by the registered indicators. Milk is taken into account according to the values of fat, protein, and density is indicated by the laboratory assistant.

Batches are formed in the context of the receipt days.

All written off batches of raw milk are distributed to all batches of produced milk and batches of residues. The batch of milk residues from the previous day is distributed to everything except residual batches of the current day.

Process stages are reflected in the system daily. One report is generated for each corpus per day. The table of incoming raw materials is filled automatically, and based on the data of balances. Then the batches of milk residue, and skim milk of the day before yesterday is entered in a table. The output table is filled automatically based on the data from the completed reports of the "Cooking" stage. Batches of cream and leftovers are added manually. When writing off, batches of residues of the previous day are distributed to the release of the mixture and cream, but not distributed to the batch of residues of the current day.

One batch is formed for the residue of thermalized milk per day. One batch is formed for the residue of skim milk per day.

All written off batches of raw materials are distributed to all batches of manufactured products and residues. Vegetable fat is distributed only to those types of a normalized mixture, where it is specified in the recipe (mixture for cheese product). Batches of milk and skimmed milk residues of the previous day are distributed to everything except batches of residues of the current day.

Accounting for produced cheese.

Accounting is conducted in kilograms (kg) and pieces (pcs). The fat serum is accounted in kg and solid content.

Production in the processing stages is reflected in the system daily. One report is generated for each cooking stage. After dialing the cheese mixture, a document is formed, and it indicates the cheese name, cooking room, the amount and the date of mixture production. After the release of cheese under the press, the document is filled with the amount of production received (pcs and kg), and auxiliary materials are used (yeasts and dyes). In the first building, this information is entered on a computer, in the second – on a stall located near the belt scales. At the same time, the system records the time for indicating the quantity of output, and considers this time as a batch input time into the pool.

The whey is distributed between documents at the end of the day. In a special window, the foreman indicates the total amount of oily whey that has passed during the shift. The system automatically distributes the whey between the documents.

One batch is formed per one cheese cooking. If different cheese is made in different boilers, cooking will correspond to the boiler; respectively, the batch of the mixture will correspond to the boiler. One batch is formed per produced fat whey per shift. Each mixture batch is distributed to the appropriate cheese cooking. All the mixture batches used in the cooking of the current day are distributed to the whey batch.

Supply materials (ferment, dyes) are entered into the report for each cooking manually, with an indication of the actual amount, and distributed to the mixture and cheese.

Shop managers form an assignment for drivers of electric cars to place packaged cheese. The assignment is formed and based on the information regarding the cooking of cheese in the pool, and the time of their stay in the pool. The foreman indicates cells for the cooking stages to be taken during the day, in which they should be placed. Meanwhile, the system shows the reference load for cells as a percentage of the standard (the maximum capacity in cells).

The specified cell will be automatically displayed in an automated workplace (AWP) packaging, while thecar drier chooses the cheese and cooking it after weighting.

Processing stages are reflected in the system in real time – as the cheese is withdrawn from the pool and packaged. To account the output, the author suggests using a sensor stall and a special form (AWP). An employee at the packaging area, or a car driver fills in the weight of an empty frame with shelves in the system, and then, after finishing packaging (cheese on the container), they fill in the weight of the under-frame with cheese in the system. The system automatically calculates the net weight. In this case, the employee indicates the type of cheese and cooking.

Each container is assigned a unique number within the year. The release document is generated automatically. One release document is formed per one shift. Packages are deducted automatically, 1 pc for each cheese head. Defective packages are written off with a separate document.

The system also forms a document for the cheese transfer, from the salting pool to the ripening cell. By default, after selecting the type of cheese and cooking, the system substitutes the camera indicated by the head of the raw food department for this cooking when planning the packaging task. The car driver can manually choose another camera.

The system saves a cooking batch for the produced cheese. The batch of finished cheese must have the same name as the batch of cheese during cooking. Each cheese cooking is saved at this stage, i.e. the batch that has left the press goes into the batch that appeared after packaging.

Packages that are specified in the product specifications in an amount equal to the number of pieces of packaged cheese are automatically entered into the table of processed raw materials. Torn packages are written off with a separate document at the end of the day.

Processing stages are reflected in the system after the laboratory technician tests the matured cheese

and indicates in the system that this cheese can be considered mature.

The shop managers form the assignment, which is based on the information on ripening batches confirmed by laboratory assistants. The assignment is formed, and based on the information about cooking batches in the pool. The foreman indicates cells for the cooking batches, which are planned to be removed from maturation during the day (in which they should be placed after). Meanwhile, the system shows the reference load for cells as a percentage of the standard (the maximum capacity in cells).

All containers specified by the cooking foreman are transported to the expedition's warehouse and outweighed. The system automatically generates a release document. One document is formed for each cheese container. The system also generates a document for the transfer of cheese from the ripening cell to the storage chamber.

The system saves a cooking batch for the produced cheese. The batch of produced cheese must have the same name as the batch of cheese during cooking. The labeling assignment is formed, and it is based on customer orders by the head of the expedition warehouse. In accordance with each order, one assignment is formed for one site (labeling, smoking or packaging).

When forming an assignment, the manager reserves a batch of products suitable for the customer in a warehouse. The batch is selected according to the following criteria:

- percentage of remaining shelf life;
- cheese score;
- "after washing" sign;
- theremaining batches are sorted in accordance with the FIFO principle.

To monitor the assignment, the author suggests using a sensor stall with a special form and several table scales. The foreman selects the assignment, scans the container label to indicate which cheese and which cooking is being labeled, and starts weighing the cheese individually. The result of each weighing is fixed in the system. An individual label is printed for each piece and each box. When switching to a new container, the employee scans the label of the new container.

The system automatically generates a release document with the release of a new cheese batch and information about the cooking used. For each site, one release document is formed per shift. The system also generates a document for the transfer of cheese from the storage chamber to the finished products warehouse. The system assigns a new batch to the produced cheese, with information on the order. One batch is formed for rejected cheese per day.

For each released batch, the system maintains a one-to-one correspondence with its cooking stages. In particular, the system stores information on the number of pieces from each cooking in a batch together with their weight.

Auxiliary materials (corrugated box, scotch tape) are written off automatically according to the standard and distributed to each batch of labeled cheese. If mold is detected, the cheese is sent to the sink. After washing, the following options for accounting are available:

- the cheese is recognized as defective and transferred to the defective nomenclature for further sale as such.
- the cheese is returned to the storage warehouse and placed in the free balance, similar to regular cheese. At the same time, the "Non-standard" feature is removed from the batch, so that the cheese can be used for shipment to the customer.

Customer orders are initially entered or loaded from third-party systems into the accounting system. On confirmation, the orders are automatically uploaded to the operational accounting system, and they are used for processing assignments.

4. Discussion

Summarizing the results, the HACCP management standards were implemented in the production, along with strict control of input raw materials, appropriate quality policies (product declarations) and supplier audits. Cheese production is carried out on automated lines, with the minimal use of manual labor. All the process operations are performed strictly in cycles, while people control the completion of these cycles.

The introduction of the batch accounting system became relevant upon the analysis of daily reports on the sale of finished products, cash flow, and information on production activities. Initially, the developer found inconsistency in the production of cheese, the residues of mature cheese and the schedule of shipments. Deviations were found in several positions: the residues of cheese were in the volume of two-month sales, the storage of best-selling cheese, on the contrary, was in a volume less than 50% of monthly demand. The production program was formed without considering the ripening period and the residues in the assortment. It was not possible to form a cash flow forecast based on the shipment regarding the finished products. Another reason for launching the project was to ensure that the requirements for issuing electronic veterinary certificates through the "Mercury" system were met, and that the labeling requirements for

finished products were consistent with requirements of federal networks.

Research limitations: although the suggested automated system has solved all the production management tasks, the production cycle under consideration does not entirely capture all spectrums of pertinent configurations. As for implications, the relationship between developed choices and management accounting system design cannot be one-sided or universal. If prior case studies proposed fragmented and unidirectional management accounting methods, the current research concerns how key phases and tasks should follow and act within a whole automated system for raising organization's effectiveness, including creating an interface for data management and archival. The scientific value consists of the demonstration in conjuction with a way to design multiple systems of strategy and strategic management accounting, which are effective in the production.

5. Conclusion

The study confirmed the expected effects from the introduction comprising automated management system in an enterprise. That includes transparency of inventory control in production, improved product quality by monitoring deviations from production technology, collection of information for changes (an increase of reliability) in the production cost calculation. Further research will doubtlessly provide more detailed and reliable information for the practical implementation of the attained developments.

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