Management accounting information system for block parquet manufacturing

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Abstract. The article deals with a management accounting information system (MAIS) for block parquet manufacturing. The presented solution ensures the implementation of the accounting policies adopted at a particular enterprise for raw material (round timber), work-in-process (parquet friezes) and finished products (block parquet) within a single MAIS on the basis of a logistic approach. Applying design patterns and modular architecture of the MAIS simplifies the process of its adaptation and configuring. Utilizing the proposed MAIS at a block parquet manufacturing enterprise allowed introducing effective measures to reduce industrial wastes and improve the quality of the finished product.

1. Introduction

Enterprises producing block parquet belong to the woodworking industry and are characterized by the use of hardwood timber (oak, ash, walnut, etc.) as a raw material, which leads to a high cost of the finished product [1]. Other main features of parquet manufacturing include its organization on the basis of a multi-stage model of the technological process.

To carry out an objective cost assessment for the processing of an expensive raw material in any part of the technological chain and to purposefully reduce the expenditure rates for the block parquet manufacturing, we need to have reliable information about all the components that make up the material flow balance including wastes and production losses.

To solve this problem, it is required to implement a management accounting information system (MAIS) at a block parquet manufacturing enterprise [2, 3].

It should be noted that the methodological basis for building effective production management systems is a logistic approach. It defines a system of principles, methods and means and provides control of the material flow and the information flow accompanying it subject to the specifics of a particular multi-stage manufacturing system [4, 5].

Thus, one of the necessary conditions ensuring the efficiency of modern block parquet manufacturing is to utilize a MAIS developed on the basis of the logistic approach to controlling the material flow of the wood flooring enterprise.

2. Problem formulation

The broad production cycle of the block parquet manufacturing consists of the following separate production processes [6]:

- producing friezes (semi-finished product) from round timber;

- producing block parquet (finished product) from the friezes.

At the same time, both processes can be deployed at geographically dispersed manufacturing sites of the enterprise.

Figure 1 and Table 1 present a model of material balance of the block parquet manufacturing process and its technological map, respectively.

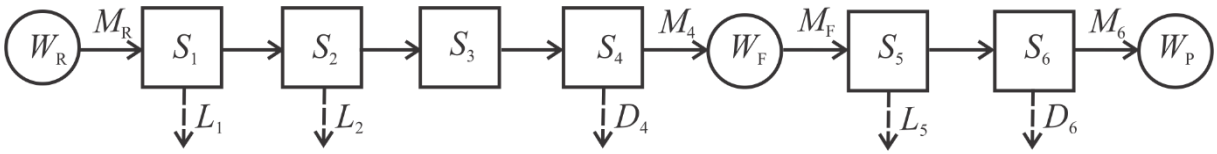


Figure 1. A model of material balance of the block parquet manufacturing process.

Table 1. A technological map of the block parquet manufacturing process.

Warehouse/Stage	Operation	Unit
	Friezes production process	
W_R	Raw material (round timber)	m^3 (cubic meter)
S_1	Round timber sawing	m^3
S_2	Friezes producing	pc (piece)
S_3	Friezes drying	pc
S_4	Friezes sorting	pc
W_F	Friezes storage	pc
	Block parquet production	
S_5	Parquet producing	pc
S_6	Parquet sorting and packing	m^2 (square meter)
W_P	Finished product (block parquet) storage	m^2

Accordingly, the balance of the material flow in the parquet manufacturing is described using the following system of equations:

$$\begin{cases} M_R = M_4 + L_1 + L_2 + D_4 \\ M_F = M_6 + L_5 + D_6, \end{cases} \quad (1),$$

where:

- M_R – expenses of round timber;
- L_1 – sawn losses of round timber;
- L_2 – lumber losses;
- D_4 – wastes of the friezes;
- M_4 – receipts of the friezes;
- M_F – expenses of the friezes;
- L_5 – losses of the friezes;
- D_6 – wastes of parquet;
- M_6– receipts of parquet.

The indicators L_1, L_2 and L_5 are the irretrievable technological losses of raw materials (sawdust, woodchips, etc.) to be calculated based on the normative coefficients adopted at the enterprise for each type of timber.

The wastes D_4 and D_6 are the products that do not correspond to the utilized at the enterprise classification of block parquet according to types of sawing or grades of timber [7].

All values in the expression (1) must be assigned to the same reporting period and converted to a common unit of measurement.

Production accounting is maintained subject to the results of physical inventory at W_R, W_F and W_P warehouses.

This reduces the efficiency of production management, because real work-in-process (WIP) balances are not recorded at all cost centers of a multi-stage technological process, which does not allow one to get an objective cost assessment of the finished product [8].

Based on the above, let us formulate the requirements for the functionality of the MAIS for block parquet manufacturing:

- providing support for all types of management accounting using a single information system;
- reflecting the specifics of block parquet production accounting at a particular enterprise;
- providing WIP accounting throughout the block parquet manufacturing process.

To ensure the required functionality, it is necessary to utilize the MAIS that has mechanisms for adaptation to changing process parameters and to the specifics of the cost accounting organization at a particular parquet manufacture.

3. Solution approach

In [9], an approach to configuring of the MAIS for multi-stage manufacturing is presented.

According to this approach, a MAIS for block parquet manufacturing can be described using an object-structured model, the elements of which are described as follows:

$$S_i = < A_i (C_i, K_i), W_i >, \text{ where:}$$

- A_i – an object of the virtual class “Aggregate”;
- C_i – a normative output coefficient (for stages S_1, S_2 and S_5 the value of this coefficient is less than 1 and it is equal to 1 for the remaining stages);
- K_i – a conversion factor to a common unit of measurement for the item quantity;
- W_i – an object of the virtual class “Warehouse” loaded with item balance.

Since the concept of management accounting for block parquet manufacturing is based on the principles of inventory accounting, a virtual warehouse as the basic element of the object-structured model is used.

To simplify the building of the MAIS software architecture on the basis of the described model, a design pattern of the virtual class “Warehouse” in UML (Figure 2) was developed [10].

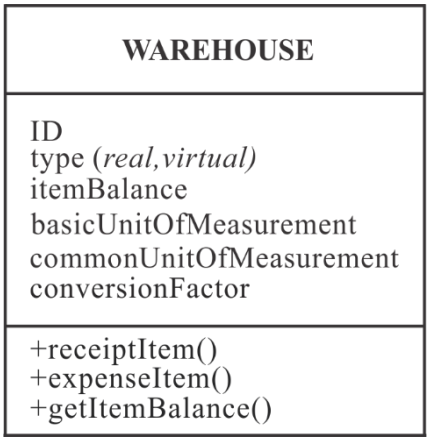
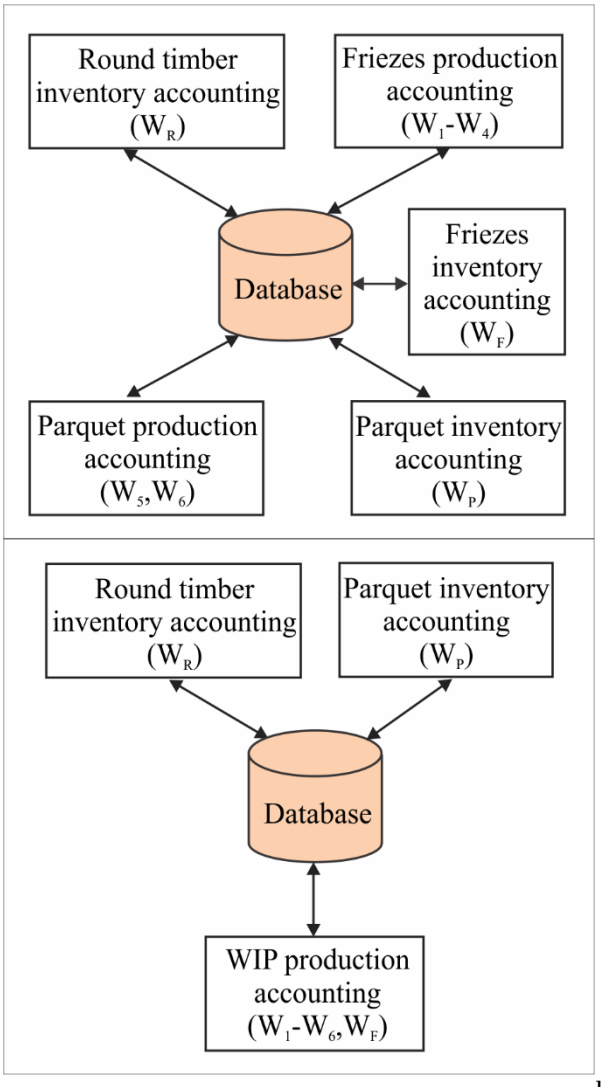


Figure 2. UML design pattern of the virtual class "Warehouse".

As shown in Figure 3, the MAIS architecture has a modular structure and consists of subsystems that ensure the implementation of the accounting policies of the enterprise producing block parquet [11].



a b

Figure 3. A structurial scheme of the MAIS for block parquet manufacturing: a – for separate management accounting of friezes and block parquet; b – for management accounting of friezes and block parquet whithin a single manufacturing process.

To organize the maintenance of all types of management accounting within a single production process, it was proposed to assign friezes to the category of WIP [12]. In this case, W_F is considered as an intermediate warehouse of the block parquet manufacturing.

The presented solution of a MAIS ensures the implementation of the production accounting policies adopted at the enterprise, the formation of item numbers for each accounting group and the maintenance of relevant transaction logs in a single database.

For each real and virtual warehouse, the standard material balance equation is true:

$$B_t^{(n)} = K(B_{t-1}^{(n)} + R_t^{(n)} - E_t^{(n)}) \quad t = \overline{1,T}, \text{ where:}$$

- n – item number;
- $B_t^{(n)}$ – item balance at the end of the reporting period t;
- $B_{t-1}^{(n)}$ – item balance at the beginning of the reporting period t;
- $R_t^{(n)}$ – item receipts during the reporting period t;
- $E_t^{(n)}$ – item expenses during the reporting period t.

As a rule, the conversion factor K is defined subject to the geometric characteristics of a parquet strip, for instance, area and volume. Thus, for parquet strips of standard sizes 350x70x15 (mm), the conversion factors are 0.0245 m^2/pc and 0.0003675 m^3/pc, respectively.

The validation of output data of the MAIS is carried out by comparing them with actual data obtained on the basis of physical inventory results in real (W_R, W_F, W_P) and virtual warehouses (W_1-W_6) of the manufacturing process at the end of the working day [13, 14].

If the discrepancy between these indicators exceeds the allowable value, a reconfiguring procedure for the parameters of the corresponding subsystem in the MAIS is performed.

The proposed MAIS has been implemented on the 1C: Enterprise 8.x platform [15].

The system contains tools for creating operational reports and charts (Figure 4) to support decision-making for the block parquet production management.

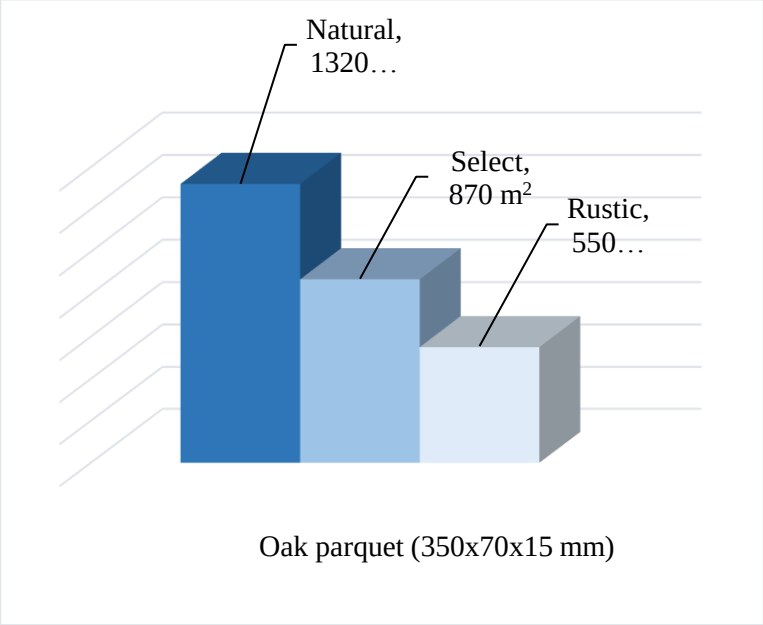


Figure 4. An example of a chart showing the total values of block parquet outputs by grades of timber.

4. Conclusion

The article presents a MAIS solution for block parquet manufacturing based on a logistic approach.

Applying design patterns and modular architecture simplifies the process of adaptation and configuring the MAIS, and also ensures high efficiency in the implementation of the accounting policies of a particular enterprise.

Utilizing the proposed MAIS at an enterprise for block parquet manufacturing allowed developing effective measures to reduce production wastes and to improve the quality of the finished product at a relatively low cost of the MAIS implementation and maintenance.

References

[1] Schmithüsen F, Kaiser B, Schmidhauser A, Mellinghoff S, Perchthaler K and Kammerhofer A W 2014 *Entrepreneurship and Management in Forestry and Wood Processing: Principles of Business Economics and Management Processes* (Oxon: Routledge) p 496
[2] Chen P-C, Liu K-H, Reu R,Yang B-C, Cheng K-L,Wu S-C, Lee Y-H, Ho C-L, Houng H J and Ma H-W 2017 An information system for sustainable materials management with material flow accountingand waste input–output analysis *Sustain. Environ. Research* **27(3)** 135-145
[3] Grladinović T, Oblak L and Hitka M 2007 Production management information system in wood processing and furniture manufacture *Drvna Indusrtija* **58(3)** 141-146
[4] Hitomi K 1996 *Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics* (Bristol: Taylor & Francis) 2nd ed p 508
[5] Mkrtychev S V 2004 Visual automated system model for goods accounting in technological processes *Avtomatizatsiya I Sovremennye Tekhnologii* **2** 9-12
[6] Fonti P and Giudici F 2002 Production of parquet flooring using chestnut timber from coppices in southern Switzerland *Schweiz. Z. Forstwes.* **153(1)** 10-16
[7] Xu L and Li T Y 2013 Material properties test of wooden architecture and its mechanical properties *Advanced Materials Research* **788** 651-655
[8] Andersch A, Buehlmann U, Palmer J, Wiedenbeck J K and Lawser S 2013 Product Costing Program for Wood Component Manufacturers *Forest Prod. J.* **63(7/8)** 247-256
[9] Mkrtychev S V, Ochepovsky A V and Enik O A 2018 Configuration of management accounting information system for multi-stage manufacturing *J. Phys.: Conf. Ser.* **1015** 042039
[10] Larman C 2004 *Applying UML and patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development* (New Jersey: Prentice Hall) p 736
[11] Evsutin O O, Meshcheryakov R V, Kozlova A S and Solovyev T V 2017 The architecture of the management system of complex steganographic information *J. Phys.: Conf. Ser.* **803** 12038
[12] Bivin D 1999 A model of the production lag and work-in-process inventories *J. of Macroeconomics* **21(3)** 509-536
[13] Low A M and Kelton W D 2000 *Simulation Modelling and Analysis* 3rd ed (New York: McGraw-Hill)
[14] Bragg S M 2015 *Accounting for Inventory* 2nd ed (Centennial: AccountingTools)
[15] 1C: Developer Network https://1c-dn.com, last accessed 2018/11/12