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The Accounting and Management Procedure Model for Material and Energy Flows in the Enterprises of Building Materials Production

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***Abstract*—The paper notes the importance of classifying material flows in relation to the logistic system itself and its elements, nomenclature and assortment. On the example of a chemical company, a simulation of the process of accounting for material costs in the processing of raw materials, where material flows are required, is considered. Using the Cobit methodology, we have established target benefits for the business, its adequacy of the business strategy: optimization of the cost of material resources, regularity and availability of material resources, ensuring the stability of the quality of raw materials. The quantitative and qualitative indicators of material flows in the processing of raw materials are analyzed. System models of business processes were developed as some dynamic and structural program models. A mathematical model has been developed to assess the efficiency of the distribution of material resources. To assess the importance of the components, an adaptive control algorithm is applied by the magnitude of the error in the feedback section. The objective function is to minimize the standard deviations of the actual values from the given values. The structure of the database will allow to inform about the results of production in different time periods and for different blocks. The goals of stock minimization, quality control and production are implemented programmatically. Software support added.**

Keywords—modeling, business processes, material flows, Cobit, account policy, optimization of expenses, ER diagram.

I. Introduction

Material flows is the logistics category which is irreplaceable to account various material operations with raw materials at all production phases. Its are classified in relation to the most logistics system and it elements, nomenclature and assortment. Such extensive division of material flows into types allows to cover a wide range of logistic processes at the enterprises practicing activity in the various areas: from the food market to the chemical plants. This article will concern the chemical company, engaged in raw materials processing. Let's consider the accounting process modeling for material costs during the raw materials processing where the material flows is required.

The main objectives were formulated during the development and putting into operation of system of material flows balances optimization in a chemical company allowing to strengthen control of material and power flows and those quality.

To trace different statuses (various states) of a multiple parameter object, before measurements it is necessary to put in the processing center database the information about the allowed values interval boundary for each parameter of the production object and a rule set determining the status parameters assessment and data forming about the found values adequacy or inadequacy with the norms also it is set how the results of dynamic system complex monitoring will be generated and displayed. The measurements analysis referring to the norms adequacy allows to build a graphical display of a system status in a polar coordinate system, along with text data output [1,4].

The methodology Cobit (Control Objectives for Information and Related Technology) Allowed to set the target benefits for business, its adequacy with the business strategy: optimization of material resources costs, regularity and availability of material resources, ensuring stability of raw materials quality [5,6,7].

The purposes of process of power flows movements were defined and specified on categories:

1) The direct purposes mean to maintain the material flow at the minimum safe level as a reserve [8].

$$Q_g \geq \sum Q_{ip} + \sigma\xi \text{ ,}$$

where – Q_g - the total material flow;

Q_{ip} – the material flow on i-products;

σ – root mean square deviation of a material flow on productions;

ξ – reserve norm.

Minimization of a material flow on a production unit:

$$F(Q_g / \sum Q_{ip}) \to min \text{ .}$$

The quality control of raw materials composition on compliance with the functional standards is calculated as follows [2,3]:

- saturation coefficient:

$$KH = \frac{\%CaO - \left(1{,}65\%Al_2O_3 + 0{,}35\%Fe_2O_3\right)}{2{,}8\%SiO_2};$$

- silica modulus:

$$n = \frac{\%SiO_2}{\left(\%Al_2O_3 + \%Fe_2O_3\right)};$$

- alumina modulus:

$$p = \frac{\%Al_2O_3}{\%Fe_2O_3}.$$

Production is calculated as follows:

$$CM = \frac{P_{LC} \cdot (100 - K_{LMC})}{100} + \frac{P_{CC} \cdot (100 - K_{CMC})}{100} + \frac{P_{CIC} \cdot (100 - K_{CIMC})}{100},$$

where P_{LC} – lime consumption; K_{LMC} – lime moisture coefficient; P_{CC} – cinder consumption; K_{CMC} – cinder moisture coefficient; P_{CIC} – clay consumption; K_{CIMC} – clay moisture coefficient.

The application of the control adaptive algorithm on value od error in a feedback section allows to obtain quickly the change of components moisture [9].

The production object is to minimize the root mean square deviations function of the actual values from the preset ones:

$$\sigma = \sqrt{\sum (CM_A - CM_P)^2} \rightarrow min.$$

The deviations norm index is introduced:

$$N_{DEV} = \frac{\sigma}{CM_P} \le N_P.$$

2) The contextual (indirect) purposes. To simplify the accounting procedure and the documents circulation.

3) Purposes of access and safety. The settings of security policies to access to primary information and reporting.

II. Realization

To describe the administrative accounting profile for data collection, a functional workflow model in IDEF0 notations was developed.

To describe the information structure of an accounting process model for material flows the ER model in a notation of IDEF1X (fig. 1) was developed. All the production string is divided into separate blocks upon which accounting of material flows is made. The income and the outcome of material resources for each of the blocks are taken as the separate entities. The central entities are Smena and SmenaDay which include daily indicators of the material flows movement, equipment operation modes and the working personal information.

The created database structure allows to obtain the results of production in the different temporary periods and for different blocks or personal.

The stated above purposes of minimization of stocks, quality control and production are realized by a program way. At the week or month deviations from the production norms, the system stats are fixed and input in the knowledge base for postprocessing.

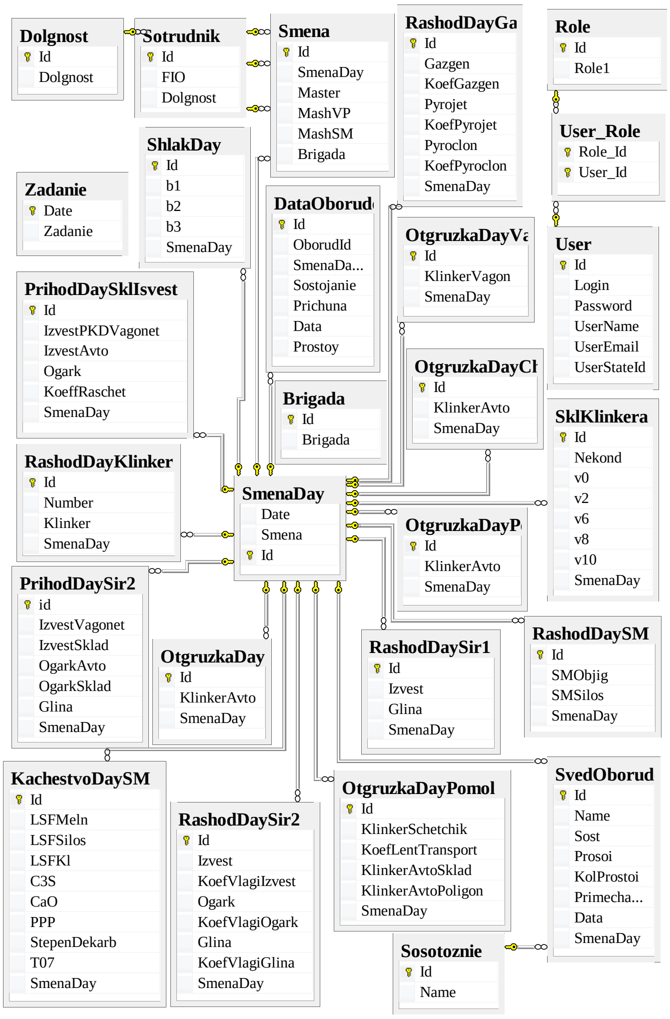

Fig. 1. Information model of a material flow

The fig. 2 shows a diagram of use variation helping to determine the general functionality boundary of the future system based on selected data domain, to itemize the requirements to the functional system behavior and to develop on its basis a initial conceptual model. The diagram shows the main actions at the quality data input:

- input of indexes in a mill, a silo and clinker index;
- input of clinker index.

As the module to work with information in the database Entity Framework was selected [10]. It allows to reduce the quantity of the code lines to write the access logic for a database, working with relational data through objects [11]. The architecture of EF includes the model describing the relation of the client's objects to the database tables (Entity Data Model), and the different layers which are responsible for the requests from the front end and its execution in the database. To access to the relational DBMS the data provider of ADO.NET is used [10,12,13,14].

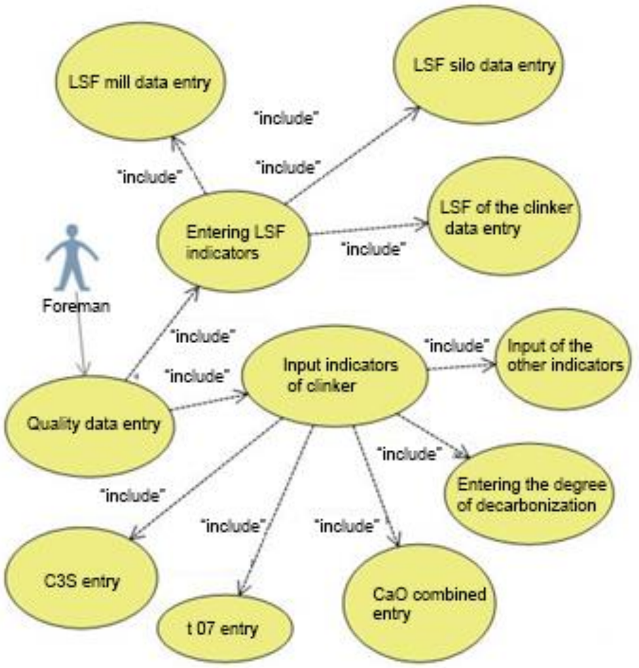

Fig. 2. Chart of variants of "Quality data input"

The fig. 3 shows the reporting form for the selected time frame on the set production blocks.

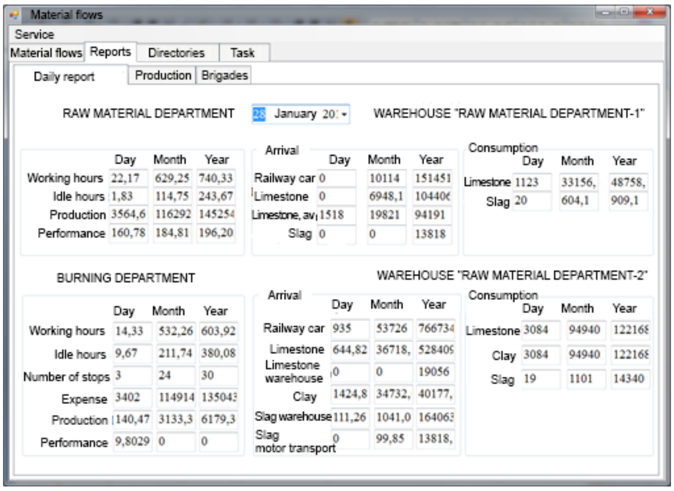

Fig. 3. The daily report form

As a result the users have a possibility to:

- input an operating data on the material flows in the enterprise;
- obtain an operating statement on material resources income and outcome, equipment operating time and on quality in selected time frame;
- control the materials quality;
- determine the deviation norm and the system status when exceeding norm;
- obtain the calculation results for a minimal needed quantity of material resources;
- obtain the productivity values on personnel and equipment.

III. Conclusion (Summary)

This article referring to the performance of modern technologies determines the architecture of an intellectual system. The recommendations about the selection of diagnostics criteria for status and identification of adaptive balance model parameters and adjustment of results of the IC flows parameters measurement are made;

The problem of generation and displaying of real-time data analyzers in the program complex database for a chemical enterprise is solved;

A method of material flows balance analysis on the basis of balance models as a part of the integrated information system is developed.

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