Processes Visualization Modelling in Distributed Management Systems

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***Abstract*—Modelling of management processes in conditions of cross-sectoral cooperation on the distributed information systems base allows to reduce the means of introduction and exploitation of such complex systems. The proposed method of information models visualization permit to graphically reflects of constituent processes and simplifies the understanding at the stage of analysis and design between the customer and the system developer. The basics of visualization modelling and simplified example of models development of multi-sectoral management system are presented.**

Keywords—visualization modelling, information processes, sectoral cooperation, distributed systems, management

I. INTRODUCTION

Complex system management in terms of cross-sectoral cooperation requires the use of information technology that provides the status displaying and allow managing the system in real time. The presented material in this article is an integrated part of the publication [1], which is a technique for analyzing the management processes, which, in turn, is the basis of the information modelling. Visualization of management processes allows eliminating the psychological barrier and avoiding misunderstandings between the client and the developer of information systems, as well as reducing the cost of development, implementation and maintenance of such complex systems.

The goal of this article is present visual methods for modelling the management processes of complex systems in the context of cross-sectoral cooperation, as well as develop a simplified example of models for the management system of the distribution network.

The novelty of this work consists in development and representation of graphic modelling methods that provide visualization of management processes and simplifying understanding of their course. The practical aspect is the possibility of displaying the structure and course of management processes, avoiding misunderstandings in the tasks formulation and ensuring the customer's requirements, as well as reduces the cost of creation and operation a management system.

Fundamentals of visualization modelling were published in [2]. Let's analyze a simplified example of modelling a management system of the distribution network within the country in order to simplify and facilitate the selection and implementation of a specific order by a potential customer in accordance with his needs at any time. On the basis of process analysis and the performed decomposition of the control system [1], perform information modelling of the control system.

II. MODELLING OF MANAGEMENT PROCESSES

The management system is decomposed into the following organizational and structural units:

M1 - order department;
M2 - delivery department;
M3 - financial department;
M4 - marketing department;
M5 - sales department;
M6 - analytical department;
M7 - customer service (support);
M8 - promotions and discount department.

The decomposition result of the management system processes is the definition of the following system operations [1]:

D1.M1 - Order registration in the system;
D1.M4 - Checking the relevance of the current advertising campaign for the product selected by the customer;
D1.M8 - Checking if the customer has a discount, and, if the result is positive, then automatically give him a discount;
D2.M1 - Receiving feedback;
D3.M3 - Transaction recording;

D3.M5 - Sending the order to the service point from which the customer filed the order;

D3.M6 - Data providing for analysis;

D4.M1 - Receiving information from the service point;

D5.M2 - Sending notification to the customer about the delivery duration;

D6.M4 - Promotion strategy development;

D7.M1 - Entering advertising prices into the system;

D8.M3 - Documentation of the promotion;

D9.M6 - Results collection for analysis during promotion and their evaluation;

D10.M7 - Receiving information from the customer about order violation;

D11.M1 - Complaints placement in the system;

D12.M5 - Informing the service point;

D13.M1 - Feedback from the service point regarding the processing of the complaint;

D14.M7 - Client notification of complaint recognition.

The mentioned system operations are organized and performed in the general management process according to the following graphic models.

A. *Matrix model*

The matrix model of the general system management process includes three subprocesses (fig. 1): order execution, promotion and submission of the complaint by the customer (in case of recognition). This model allows visualizing the execution of individual system operations in the relevant departments on a time scale.

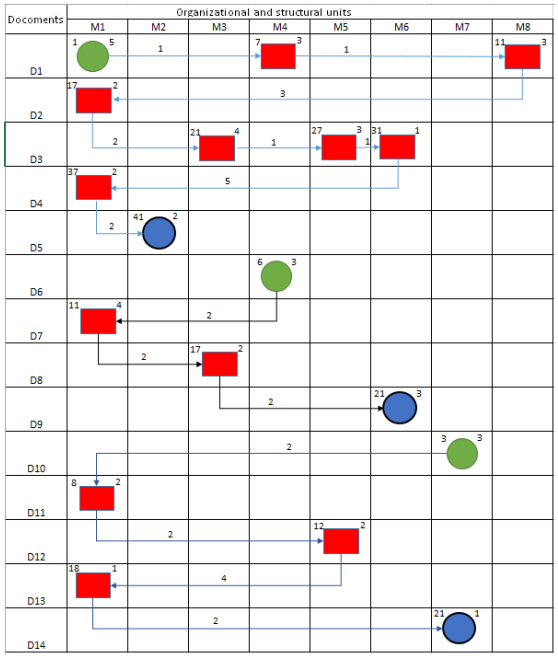

Fig.1. Matrix model of management system.

On the fig. 1: - Information source;
- data processing;
- obtaining information.

B. *Time tables*

Time tables contain the times of operations of beginning, formation, processing and documentation, as well as information exchange between system operations. They determine the ordering in the time scale of individual system operations of the management process.

Table I defines the times of beginning, creation, processing and documenting of system operations, table II defines the times of information exchange during performing the system operations.

TABLE I. TIMES OF EXECUTION OF SYSTEM OPERATIONS

Documents	Times			
	beginning	creation	processing	documenting
D1.M1	1	5		
D6.M4	6	3		
D10.M7	3	3		
D1.M4	7		3	
D1.M8	11		3	
D2.M1	17		2	
D3.M3	21		4	
D3.M5	27		3	
D3.M6	31		1	
D4.M1	37		2	
D7.M1	11		4	
D8.M3	17		2	
D11.M1	8		2	
D12.M5	12		2	
D13.M1	18		1	
D5.M2	41			2
D9.M6	21			3
D14.M6	21			1

TABLE II. TIMES OF DOCUMENTS TRANSFERRING DURING SYSTEM OPERATIONS PERFORMING

Documents	Transfer time
D1.M1-D1.M4	1
D1.M4- D1.M8	1
D1.M8 - D2.M1	3
D2.M1 - D3.M3	2
D3.M3 - D3.M5	1
D3.M5 - D3.M6	1
D3.M6 - D4.M1	5
D4.M1 - D5.M2	2
D6.M4 - D7.M1	2
D7.M1 - D8.M3	2
D8.M3 - D9.M6	2
D10.M7 - D11.M1	2
D11.M1 - D12.M5	2
D12.M5 - D13.M1	4
D13.M1 - D14.M7	2

C. *"Network graph" model*

This is the basic model (Fig. 2) that allow to switch to UML-modelling and represents such basic system parameters as the start and the end times of system operations, as well as the way of system and communication channels.

D. *Combined time model*

To assess the total computational load of the control information system, a combined timeline model is applied (Fig. 3). However, this graph does not display the units in which separated system operations are performed.

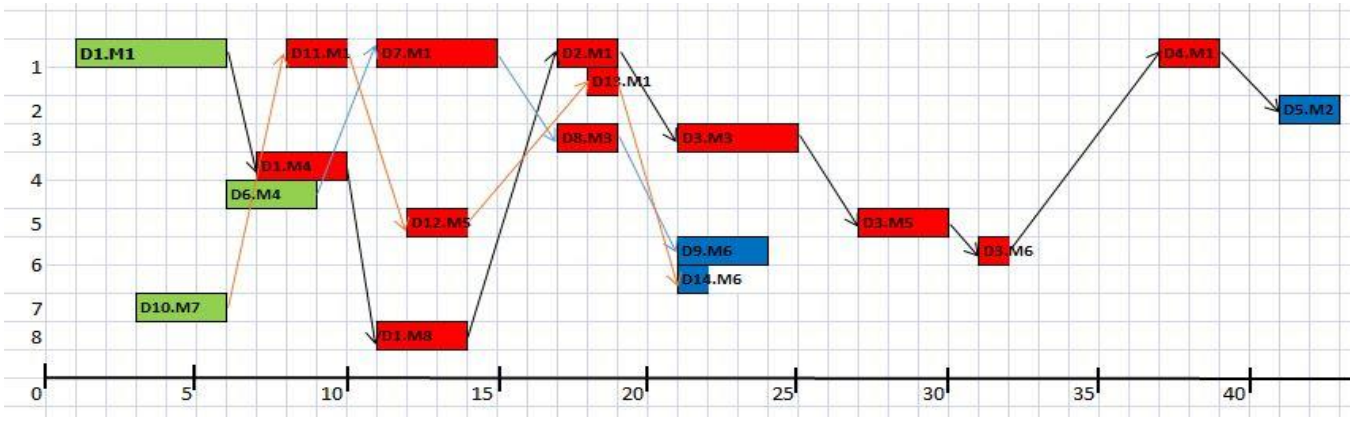

Fig. 2. "Network graph" model (Gantt type).

Fig. 3. Combined time model for system operations performing.

E. *Flowchart diagram for system operations performing*

Based on the diagram of the combined time model, a flowchart diagram of the system operations implementation algorithm (Fig. 4) is built, which is based on the object-oriented programming and enables the fast implementation and deploying the application software for the control system.

III. PROCESSES SIMULATION OF THE MODELLED SYSTEM

The Process is simulated using the online application BPSimulator, Located at http://www.bpsimulator.com [2]. Below is a model used for simulation (fig. 5), and the rapport that was generated by simulator (fig. 6). Simulation allowed assessing the system's costs and determining the average time of the process.

IV. CONCLUSIONS

Based on the developed visualization methods of the course of processes in operation of complex management systems in conditions of cross-sectoral cooperation the bases and methods of modelling are defined, which allowed to reflect process progress and to make the information system management in real time. Visualization of management processes has allowed removing the psychological barrier and avoiding mutual misunderstanding between clients and developers of information systems, as well as reducing the costs of development, implementation and maintenance of nutrients control systems.

The goal of the project has been achieved – to perform a modelling of the service system for the distribution portal and investigate the load on the system. System modelling is performed based on real management systems. The system implementation allowed optimizing costs, improving the quality of services and automating product delivery processes, as well as improving the information exchange between individual departments and move to an electronic management system. The application of changes in the system has led to increased competitiveness of the company, and system functionality was adapted to market standards.

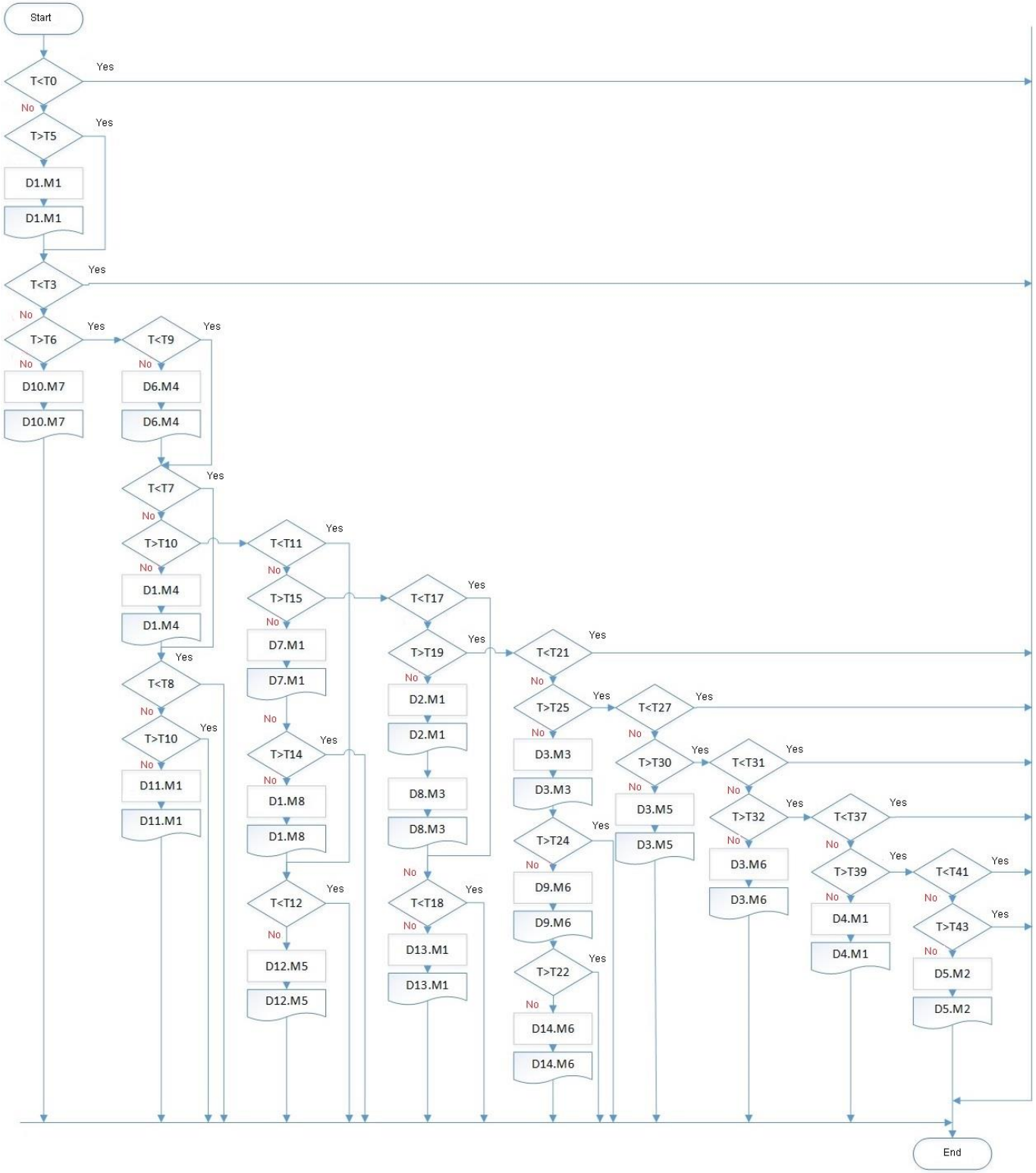

Fig. 4. Flowchart diagram of system operations execution.

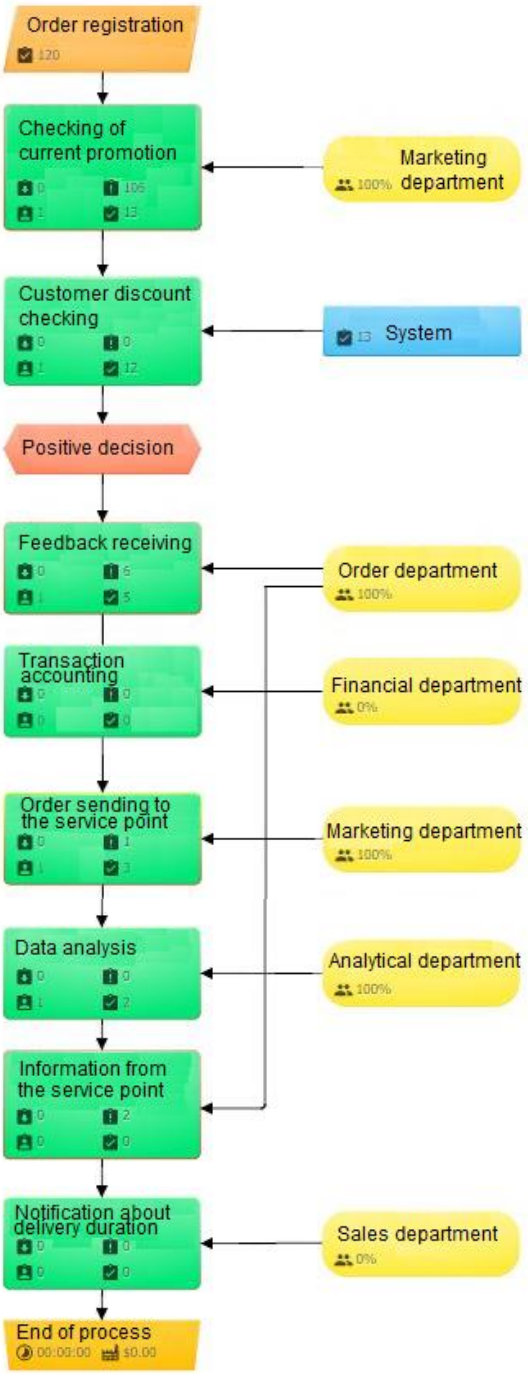

Fig. 5. Simulation model of control system operation.

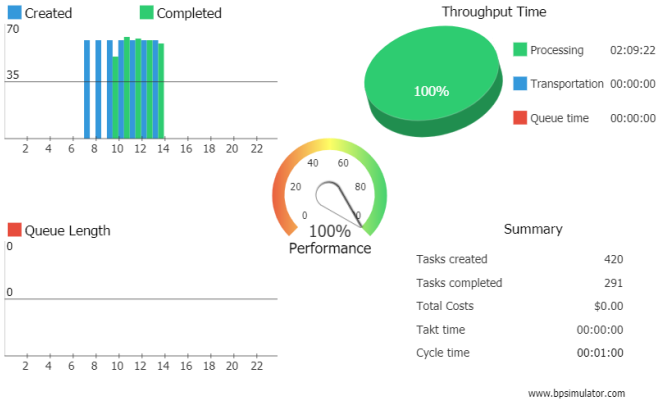

Fig. 6. The simulation rapport of loading on the information management system.

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