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Presentation and Interaction Analysis of Business Processes Within the Quality Management System Based on Graphs

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Abstract: The model of presentation and efficiency analysis of the organization business processes is studied. This model is based on the system presentation as a directed graph. In order to develop the model to create the algorithm of an automated information system on its basis for the economic data analysis of the organization the study is focused on the graph representation as a set of matrices. The features of matrix transformation concerning the studied subject field are discussed.

Key words: Quality Management System (QMS), business process oriented graph, matrix, efficiency, organization

INTRODUCTION

The creation and improvement of modern quality systems in organization is possible only if the implementation of information tools takes place. These are the tools providing an efficient operation of a QMS. The relevance of this problem is mentioned by a number of publication researchers (Hill *et al*., 2004). The general opinion may be expressed by the words of the article title "Information systems is the key for an effective QMS development".

Currently, the means that use different process models to solve the informational support problems of an organization process management may be divided into three classes: the software packages for a complex enterprise management system, the software for electronic document processing organization and the special tools for the information support of an organization QMS. The latter are represented at the Russian market by several companies. Let's describe some of them: Microsoft (USA), Peter-Soft (Russia), System-Plus (Ukraine).

The solution of Microsoft company called "The process manufacturing in Microsoft Dynamics AX" is aimed at large companies, according to information from Microsoft official website. These are the companies the staff of which makes no <10,000 men. Often, the introduction of such a product is related to the cost of consulting firm services and the acquisition of additional hardware.

The solution of "Peter-Soft" is also aimed at the problems solution of a quality management system but contains the elements that hinder its implementation. In particular, it hinders the integration of this solution with an accounting system. It is assumed that the solution for QMS and accounting system should have the same platform-1C: Enterprise 8.0. This solution may make the task an unfeasible one because of the fact that the enterprises using other platforms will be limited concerning a QMS program functionality.

"ISOratnik" solution from the Ukrainian company "System-Plus" has a lot of customers. One of its main advantages is that it is possible to work in the system within a LAN, intranet and internet but its main purpose is a workflow automation in a QMS and the process approach is not implemented completely.

Also, the discussed developments are not fully adapted to the modern requirements in the field of quality management that makes the development and the implementation of new algorithms concerning the representation and analysis of processes in a company QMS.

It is essential that in accordance with the regulatory requirements in the field of quality management the detailed analysis in the first place is necessary for a set of processes acting in a company and making its basis. This is due to the definition of the process approach defined in (MS ISO 9001, 2008). "The use of a process system in a company, along with their identification and interaction as well as the process management aimed at obtaining of a desired result may be defined as a process approach".

MATERIALS AND METHODS

The presentation of interrelated processes within the discussed information systems is implemented by using different models as by graphical flowcharts and also by the CASE-tools of BPwin, supporting IDEF0 functional models and its modifications (Maklakov and Erwin, 2001)

as well as ERP, the business process management technique. According to Kostyakov, the selection and development of the model is the first and crucial task for the subsequent implementation of an information system.

The study of properties and characteristics for existing information systems shows that the technique of organization process modeling is a promising one for the development of QMS IT support by directed (oriented) graph (Vernikov, 2004).

Main part: Let's imagine that the processes participating in the organization system are the graph peaks and the channels through which the information flows, documentation, components, materials, products, etc. circulate from one process to to another one (we use for a given set of the generalized concept which is the resource flow) with the edges connecting the inputs and outputs of theprocesses. Such a graph will represent a system of interrelated processes, implementing the process approach requirement. Let's associate each peak with a set of features:

- The names of outgoing resources
- The planned values of outgoing resource volumes
- The actual value of outgoing resources volume
- The names of incoming resources
- The planned volume values of incoming resources
- The actual values of incoming resources

Considering the various methods of a model formalized representation, one may note that the graphical view is the most visible form of the graph representation. However, it may not be used for the structural analysis problems of resource use efficiency in the processes of the organization. In this regard, let's choose a different form which is most suitable for the task of process analysis within which the graph is defined by a set of matrices.

The graph theory determines a peak adjacency matrix, an incidence matrix, an edge adjacency matrix. Let's consider the transformed matrix view matrix concerning the problem under study.

The adjacency matrix for n graph peaks which are the process of a company QMS is shown in Table 1. The names of lines and columns in this case are the names of processes. In transformation takes into account that each process in the quality system of an enterprise acts as a receiver and a source of resources at the same time (for customers and suppliers, according to ISO 9000 terms),

Table 1: Process adjacency matrix for a company QMS

Process supplier/ consumer	Processes					
	1	2	0	i	0	n
1	0	2	-	-	1	-
2	-	0	1	-	-	1
0	-	-	0	-	-	-
i	-.	-	3	0	-	
0	-	-	-	-	0	-
n	-	-	-	-	1	0

Table 2: The incidence matrix of processes and resources in company QMS

	Resources					
Processes	1	2	0	j	0	m
1	-	-1	-	-	-	-
2	-	-	1	-	-	1
0	-	-	-	-	-	-
i	-	-	1	-	0	-
0	-	-	-	-	-	-
n	-	-	-	-	-1	-

i.e. has the inputs and outputs for the obtaining and dispatching of resource flows. According to the transformed peak adjacency matrix the processes are considered as consumers by lines and the names of columns represent the same processes as suppliers.

The number at the intersection of row i and column j, determines the number of resource flows, directed from the process j to the process i. In visual compact form, the transformed matrix defines all the relationship of processes.

The incidence matrix will be the following Table 2. In order to systematize the relationships of resources and processes in a QMS, according to the line names of this matrix let's postpone the naming of processes according to the resource names of the columns.

Since, the resource flows have a direction, the possible values in the cells at the intersection of a matrix row and a matrix column may be -1 if the resource is supplied by the process; 0 if the resource is not associated with this process (the edge is not incident to the peak); 1 if the resource is accepted by process. For example, the value of -1 at the intersection of process 1 line and resource 2 column means that the process 1 is the resource 2 provider for one or more processes. In order to analyze the effectiveness and efficiency of processes, the initial incidence matrix of processes and resources is convenient to divide into two ones: the incidence matrix of supply and resource provision processes and the incidence matrix of consumer processes and consumed resources. Besides the matrices may be divided into the planned and actual ones on the basis of values brought in the resource matrix.

The third kind of matrix representation for a directed graph of a company business process interaction is a transformed matrix of the edge adjacency. Since, the

Table 3: Transformed matrix of resource interaction

Outgoing resources	Incoming resources					
	1	2	0	j	0	m
1	0	-	1	-	1	-
2	-	0	1	-	1	1
0	-	-	-	-	-	-
i	-	-	-	1	-	-
0	-	-	-	-	-	-
m	-	-	-	1	-	-

Table 4: Resource conversion efficiency matrix

Outgoing resources	Incoming resources					
	1	2	0	j	0	m
1	-	-	0.81	-	1.20	-
2	-	-	1	-	1	1.33
0	-	-	-	-	-	-
i	-	-	-	1	-	-
0	-	-	-	-	-	-
m	-	-	-	0.72	-	-

edges of the original graph are the resource flows, this matrix will have the appearance shown in Table 3. In this matrix, the value 1 in the cell at the intersection of the line and the column means that the resources are associated with a common process and the corresponding input resource is transformed into an output one. The blank intersection or 0 means the absence of connection.

A considerable interest for the further analysis in the information system is presented by the use of resource adjacency matrix. This matrix allows to assess the nature of the resource transformations in QMS processes. For this purpose, the values in the cells at the intersection of lines and columns of a matrix may be represented as the resource transformation efficiency indicators into the productive activity of a corresponding process. Let's define the initial characteristic as the resource conversion function. You may calculate the planned and actual resource conversion function. The planned (nominal) conversion function is defined as the quotient of the planned value division of an outgoing resource process by the planned value of an incoming resource. The actual conversion function is defined similarly on the basis of the accounting data for the last time interval. The value of function is determined by the dimension ratio involved in the transformation of values. As we mentioned already, the results of calculations may be represented as the original matrices of transformation process planned and actual functions if the source data are available. However, let's create a transformed matrix (Table 4) for the visual analysis of the process operation in the appropriate cells of which we will put in the ratio of an actual and planned conversion function from an original matrix. We shall call the result calculation efficiency ratio of resource conversion $K_{эфф}$ in a QMS process, $K_{эфф} = f_{факт}/f_{план}$. $K_{эфф}$ ratio value = 1 specifies the planned nature of changes in the process, the value $K_{эфф}<1$ and defines the incoming resource overrun and therefore, calls for immediate corrective actions. $K_{эфф}>1$ and is a positive fact and after the verification of compliance with the production technology one should be spread the rational use of resource experience throughout an organization in the process. One should take into account that the obtaining of a certain output resource not always includes all the incoming resources of a process and hence, some of the efficiency coefficients in the matrix will be excess ones, however, they do not distort the actual structure of changes in the process and do not prevent a meaningful analysis of resource use efficiency within a company.

The analysis of resource supply failure causes for performance values <1 creates an informative basis for taking corrective actions in order to improve the resource use efficiency.

RESULTS AND DISCUSSION

Thus, the study developed the model of the interacting company business processes as of a directed graph represented as the transformed matrices: the "producer-consumer" process adjacency matrices, the incidence matrix of consuming processes and used resources, the incidence matrix of supply processes and supplied resources, the adjacency matrices of used and supplied resources. The model may serve as the basis of a new automated information support system for the process management in a company QMS.

CONCLUSION

The proposed matrix model allows to describe the interaction processes for any organization as well as the supply and conversion of resource flows used in production.

The ratio of planned and actual resource values in QMS processes, based on the model makes it possible to obtain the numerical values of the resource conversion efficiency coefficients. The analysis of the coefficient effectiveness values allow to identify the critical points in the process operation. These critical points are the processes the operation of which is characterized by the coefficient values ≤1. They need prompt corrective actions to eliminate the discrepancies. The periodic comparative analysis of the matrix content allows to

evaluate the efficiency of resource conversion change within the business processes of a company in the course of time.

REFERENCES

Hill, N., B. Selph and G. Roche, 2004. Customer Satisfaction Measurement for ISO 9000. The Publishing House Tehnologii, Moscow, Pages: 192.

MS ISO 9001, 2008. Quality management systems-requirements. International Organization for Standardization, Geneva, pp: 30.

Maklakov, S.V. and Erwin, 2001. CASE-Tools for Information System Development. Dialog-MIFI Publisher, Russia, Pages: 304.

Vernikov, B.M., 2004. Elements of Graph Theory. The Publishing House of the Ural University, Yekaterinburg, Russia, Pages: 160.