EVALUATION OF STRUCTURAL PROPERTIES FOR BUSINESS PROCESSES

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Abstract: This paper describes the issue of the evaluation of processes designed on the principles of reengineering. Especially business process structures on high-level modelling are subjected that substantially support the company's successful running. Presented analysis and assessment put emphasis on the structural properties of business processes. For evaluation such tools as comparing of quantitative indicators of business processes are used.

1 INTRODUCTION

One of the important roles of BPR is building of unified logistic concept of organisation, which should involve co-ordination and management of all material and information flows. This concept is based on mapping and classification of processes that representing the core of Business Process Reengineering (BPR). In present BPR activities converge on modelling and processes analysis and as a result the principal activities are aimed at the processes, strategy, managerial information systems and changes in control [Earl, 1993]. In the following, the contribution outlines the procedure applied to modelling of business processes, on the basis of that deals with the set of quantitative indicators used for analysing and redesigning structural properties of business processes.

2 PROCESS CLASSIFICATION IN TERMS OF BUSINESS PROCESS REDESIGN

From the methodical point of view the process redesign requires in the first place revision of existing processes in terms of their effectiveness, and verifying of their mutual connections. Further stage involves a draft a new arrangement of processes, which should be carried out either on the basis of empiricism, or on a certain systematic basis. The business process redesign requires also explicit classification basis by which processes can be represented by classes.
The classification that will be analyzed further had come out from these following basic reengineering principles:

P1: In the overall arrangement of processes it is suitable to combine elements of decentralization with elements of centralization;
P2: Specification of the substance of the process at a certain level has to be as precise as possible;
P3: In the arrangement of processes the minimizing of the number of hierarchical levels is needed take into account.

On the basis of the above, the classification framework for systematic rebuilding of processes can be built from three hierarchical levels, which are (from down to top):
- Elementary process (EP) that is represented by a set of complex tasks, consisting from smallest elements-activities;
- Integrated process (IP), which represents a set of two or more elementary processes with the purpose to create the autonomic organizational unit of on second hierarchical level;
- Unified enterprise process (UEP), which consists of one or several integrated processes at the extent that is conditioned by its capability to flexibly and effectively secure customers' requirements

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As it is evident processes and their elements by these classification are clustered in hierarchical manner into classes and subclasses. Naturally, process models have to be understood by different levels of management. Managers of higher level may not need to know each detail about the process, but they may want to get an overview about the overall process landscape [G&W, 1999]. Process landscaping avoids these problems by identifying core processes and by describing how process models are related. These aspects are outlined in the next section.

3 BUSINESS PROCESS REDESIGN

When specifying the process as an object of modelling, we also start from the requirement of monitoring its value-adding function. Then as parts of commodity flows there are also information flows. They are realized in the control of processes, but they are essential for a pricing the commodities and costs in financial units. Since, by gathering information, a large number of sizable files are created, it is not necessary in this stage to reflect them explicitly into models of the processes in the conceptual stage. In the proposed procedures, they can be therefore given the role of a 'shadow', which is unveiled when making a concept of data models. Tools for their modelling are, for example, data flow diagrams (built bottom-up), which in the stage of drafting an information system, they should copy the hierarchical and content structure of commodity flow diagrams and extract their information flows and procedures from them. The application of classification approach in the modelling of organisational context of business processes is further shown on the procedure, which has been inspired from more methods [C&Y, 1990], [SVD, 1993].

From the carried out analysis of methodologies of designing information systems, Structured System Analysis and Design Method (SSADM) [A&G, 1990] and the Object Modelling Technique (OMT) [RBP, 1991] were most compatible with the proposed procedure based on the Structured Process Decomposition (SPD). In contrast with a structured analysis, in which the cardinal modelling tools are data flow diagrams and other additional diagrams, the procedure of SPD consists of a set of tools, which are:

- **system diagram,**
- **context diagram,**
- **commodity flow diagrams,**
- **state transition diagrams.**

The sequence of the first three diagrams with the links between individual modeling levels is shown in figure 1.

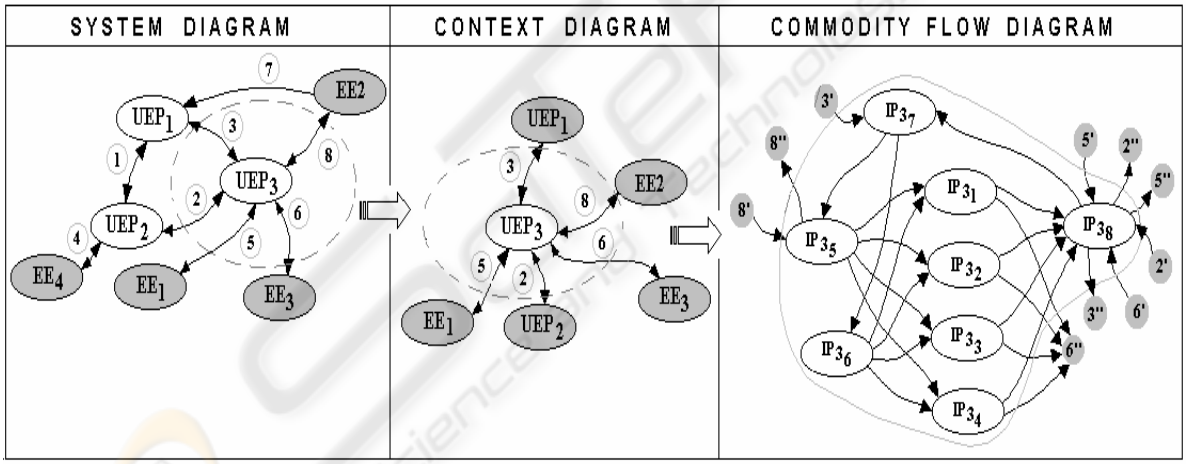

Figure 1: The example of the sequence of diagrams

4 STRUCTURAL PROPERTIES ANALYSIS ON THE HORIZONTAL LEVEL

Within the outlined models of the business processes by the help of the SPD method, individual diagrams were designed based on the principles of the graphs theory. In order to design such models, a complete amount of information about the reality that is being modelled is not required. However, considering reengineering, we have to take into consideration the structural properties of the process. They should be

investigated by means of a topological structure analysis in terms of which the basic elements of the process structure – nodes and links are the subject of investigation. As a rule, the starting point of this analysis is the linkage matrix of a graph expressed by notation V = $\| v_{ij} \|$. According to this matrix, each node "k" (k = 1, 2,…,n), where "n" is the number of nodes in the graph, corresponds to a vector v(k) = (v_k, v^k) with following components :

$$v_k = \sum_{j=1}^{n} v_{kj} \qquad v^k = \sum_{i=1}^{n} v_{ik}$$

In accordance with the previous relations, symbol "v_k" represents the number of the matrix elements of the k-th line and "v^k" is the number of elements of the k-th column of the linkage matrix. Then, for the isolated node, it is valid this precondition: $v_k = v^k = 0$.

4.1 Structure binding

Of several possible indicators of the complexity of the business processes structure, the 'redundancy" degree of the structure linkage can also be considered useful. This is based on the concept of *the graph binding,* which means the least possible number of the linkage graph, the reduction of which would lead to the graph unbinding which contains isolated nodes. When the graph consists of "n" links, then graph binding is possible if

$$L_{min} = n - 1 \qquad (1)$$

which is valid for both oriented and non-oriented graphs.

In order to determine the degree of binding structure "B", the following indicator expressing a relative measure of the size of the number of the "L" links that occur within a given structure can be applied:

$$B = \frac{L - L_{min}}{L_{min}} \qquad (2)$$

With the oriented graphs, each link (i,j) has one element in the linkage matrix $v_{ij} = 1$. Within the non-oriented graph, each link has two elements, where it is valid $v_{ij} = v_{ji}$. With the minimum number of links, the value of this relation equals zero.

In connection to the described processes modelling techniques, the indicator of the structure binding can be used with the analysis of the processes structure of the UEP type that are represented by means of Commodity flow diagrams of the first degree. For the purpose of analysis, only internal structure of the investigated process is relevant, where the relations of the process to its immediate environment are not taken into consideration. In order to apply the given indicator, the process structure UEP_3 will be taken into account. The structure, which was obtained based on the diagram in Figure 1, is shown in Figure 2 a The index value of the structure binding "B" of the given process, when L = 13 and L_{min} = 7 by formula (2) equals 1,14. The reduction of the structure linkage can be obtained by the purposeful integration of the matter in hand joinable processes either sequentially or parallel arranged. This integration is in conformity with the principles of reengineering, according to for instance [H&C, 1993; R&U, 1996]. In this case, the integration of the processes $IP3_1$ all the way to IP 3_4 will be applied to the process IP $3_{1\text{-}4}$ and similarly
IP 3_7 and IP 3_8 will be applied to the process IP $3_{7\text{-}8}$ based on which the new process structure seen in Figure 2b will be obtained. The index value obtained by this transformation will be reduced to B= 0,66.

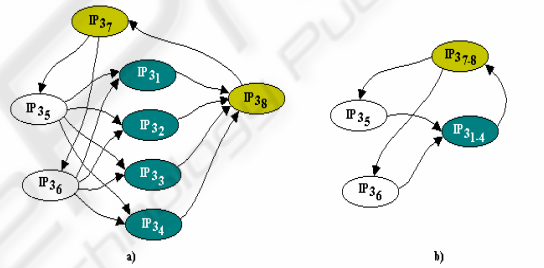

Figure 2: The example of internal process structure linkage reduction

4.2 Structure diameter

The *Structure diameter* is another indicator used to compare the structural characteristics of the process. This indicator can be formally expressed under the following suppositions:

C1: Let "dij" be the length of the minimum path between the node "i" (from which the linkage was initiated) and the node "j" (in which the performance of the network graph finishes) expressed by the number of links which the path consists of.

C2: Let "I" and "J" represent the number of input and output nodes.

Then the structure diameter can be expressed by the relation:

$$D = \max d_{ij}, i \in I, j \in J, \qquad (3)$$

which characterizes the maximum number of linkage separating the initial and target structure elements.

When applying this indicator to the same process as with the previous case, it is necessary to consider the structure of the given process that includes the elements of the environment, which are in a direct interaction with the elements of the internal structure of the process.
With the process analysis, using this indicator we will consider the initial state the original structure of the UEP_3 process that is shown in Figure 2a that contains also the elements with which the given process is in interaction. The structure defined in such a way can be seen in Figure 3 (left-hand).

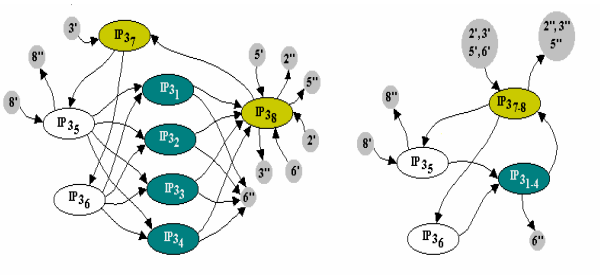

Figure 3: The example of internal and external process structure linkage integration

Then for I={2', 3', 5', 6', 8'} and J={2'', 3'', 5'', 6'', 8''} we obtain: max $d_{ij} = d_{2',6''} = d_{3',2''} = d_{3',3''} = d_{3',5''} = d_{5',6''} =$. $D_{6',6''} = 5$, thus D = 5.
A lower value of this indicator for the given process can be obtained again by the purposeful integration, which is represented by the joining of sequentially arranged processes IP 3_7 and IP 3_8 to the process IP $3_{7\text{-}8}$ and the joining of the processes $IP3_1$ all the way to IP 3_4 to the process IP $3_{1\text{-}4}$. Through such a modification of the process structure, the process model presented in Figure 3 (right-hand) can be obtained. The *Diameter of the structure* for the structure of the same process modified by the integration and extended by the elements with which the given process is in an interaction (Figure 3b) can be calculated in the same way. The number of the graph nodes "I" and "J" does not change.
Based on this, it is obvious that the new value D = 4. It affirms obtaining the process simplification from the viewpoint of the number of the one after another links controlled autonomously.

5 CONCLUSION

Structural business process metrics seems to be also very helpful especially in choosing a meaningful target for process improvement during the reengineering activities. The position of this kind of metrics is looking for its stable place in the practical steps of BPR, because the analysis and assessment of business process structures are critical in achieving enhanced effectiveness of business processes.

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