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THE FORMAL APPROACH TO DEFINITION OF THE REQUIREMENTS FOR THE NEEDS OF COMPUTER APPLICATION SELECTION AND IMPLEMENTATION

Defining the requirements is the fundamental issue for the final user of a computer application. The work suggests a different from UML “Use Case” approach based on a multidimensional computer system view Another complementary method is the extension of the „Use Case” method developed by the author, named as „Comparing method for the Use Case of the subject area and application.”

The problem of defining the requirements is the fundamental issue for the final user of a computer application. Inadequate selection of a ready system results in disastrous consequences relating the implementation of business goals that the system should support.

The methods presented so far are based on UML “Use Case” approach. This method is valid but incomplete because “Use Case” represents only one dimension of the computer system “view” based on its visible functionality for the “end user”.

The principal dimensions essential for the future user of the system are for example as follows: technical, architectural, business functions (supported by the application), knowledge data base. Each of these dimensions has the character of a “properties tree” . The natural method for graphical representation and modeling of such multidimensional model is the “Aris” “*eEpc*” diagram. In the fig. 1 below an example of the formal requirements model for the “work flow” system type is presented.

In this diagram, we can distinguish the above-mentioned dimensions that describe the measured groups of properties of the “Work flow” class system. Some properties presented in this diagram may be decomposed until the level of “elementary property” is achieved. For example the property: “System Administration Service” designated in the diagram by the *ID*: “*WT-02*” may be decomposed as in the fig. 2. From the formal point of view a “properties tree” as presented in the fig 1 is a special case of directed graph, where the properties are nodes, and the connected lines are edges. From that we can come to the conclusion that all the further essential properties of the property tree we can research using the “graph theory”. Thus, fig. 3 presents a general “model of requirements” as certain “directed graph”.

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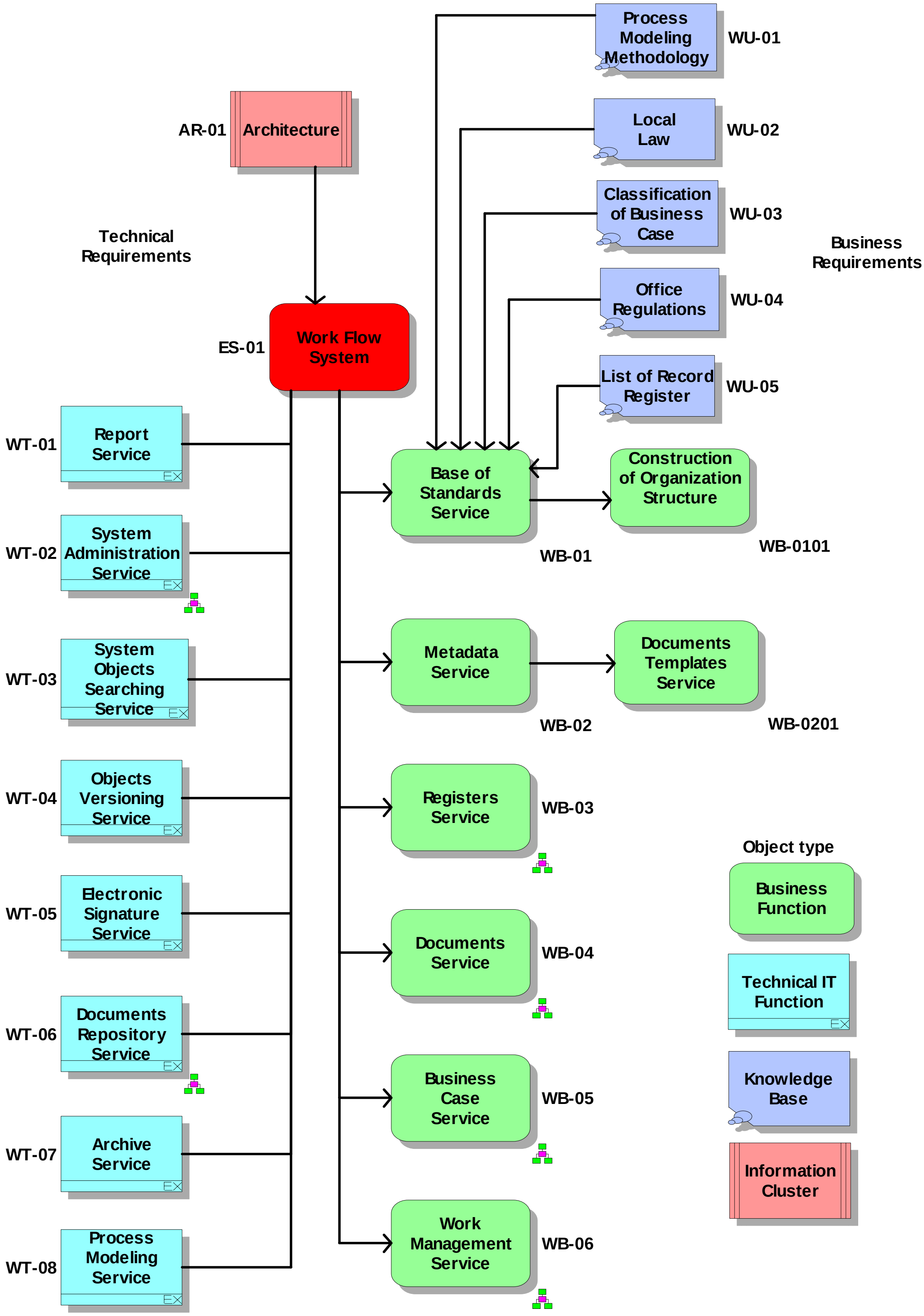

Fig. 1. An example of multidimensional model.

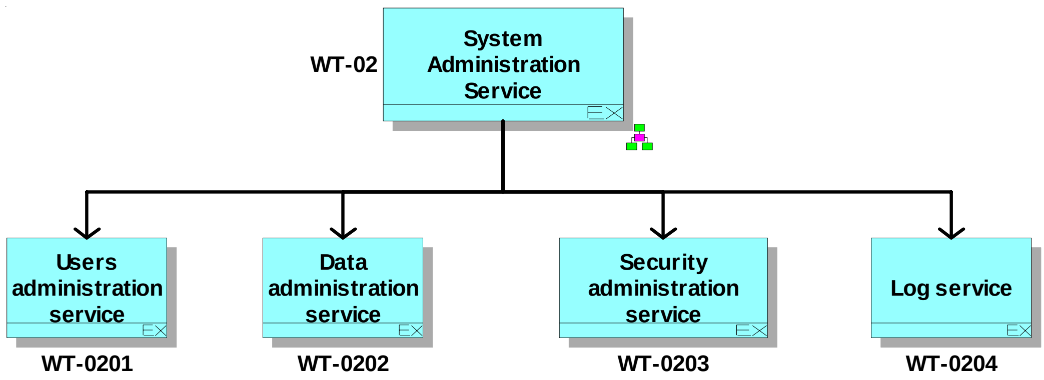

Fig. 2.An example property decomposition to the " elementary properties".

In accordance with the graph theory this graph representing a general model of requirements may be presented as the following adjacent matrix as in formula [1]. The structure of any graph may be remembered in such case of matrix.

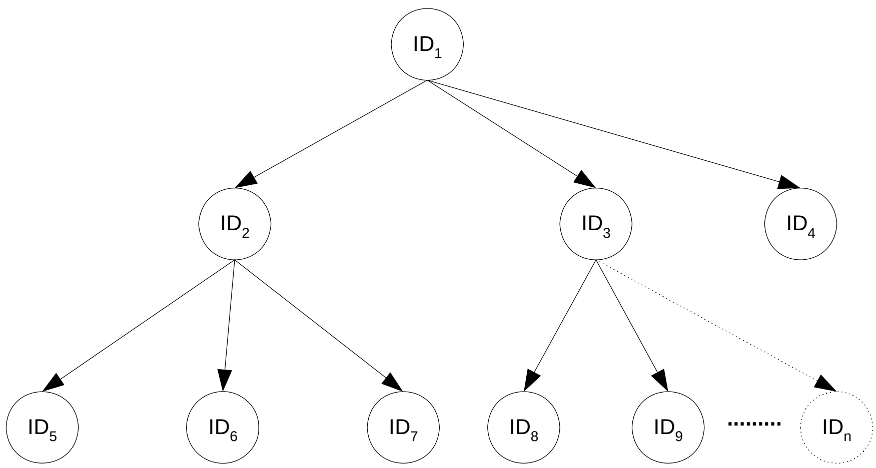

Fig. 3. A general "model of requirements" as a certain "directed graph".

$$[X_{ij}] = \begin{array}{c|cccccccccc|} & ID_1 & ID_2 & ID_3 & ID_4 & ID_5 & ID_6 & ID_7 & ID_8 & ID_9 & ID_n \\ \hline ID_1 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & \ldots\ldots x_{1n} \\ ID_2 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & \ldots\ldots x_{2n} \\ ID_3 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & \ldots\ldots x_{3n} \\ ID_4 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \ldots\ldots x_{4n} \\ ID_5 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \ldots\ldots x_{5n} \\ ID_6 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \ldots\ldots x_{6n} \\ ID_7 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \ldots\ldots x_{7n} \\ ID_8 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & \ldots\ldots x_{8n} \\ ID_9 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & \ldots\ldots x_{9n} \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\ ID_n & x_{n1} & x_{n2} & x_{n3} & x_{n4} & x_{n5} & x_{n6} & x_{n7} & x_{n8} & x_{n9} & \ldots\ldots x_{nn} \end{array} \qquad (1)$$

For a measurement of each of application requirements a number of points representing the value designated by ordering the “end user” should be ascribed to each node of “graph of requirements” fig.4. As a result of this procedure we receive another matrix called “Value matrix” for the requirement model as in the formula (2) below.

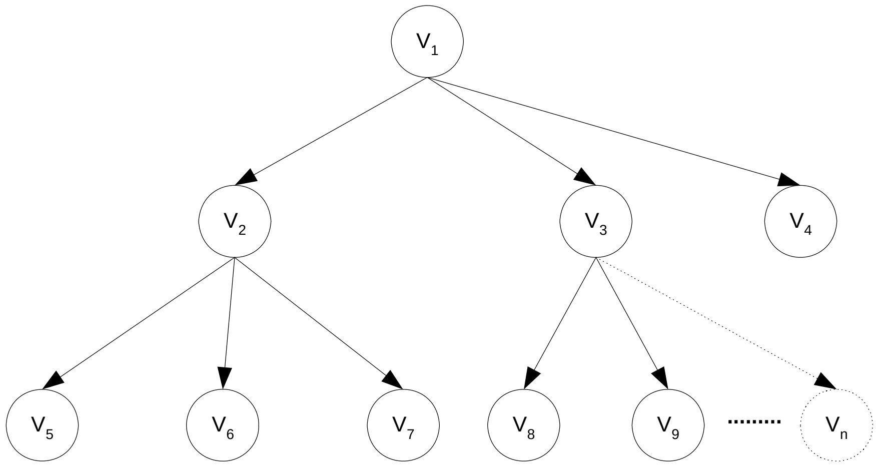

Fig.4. A general “model of requirements” as a certain “directed graph” with point values in each of the node.

Value matrix represents complete information about the graph “model of requirements” and may be considered instead of this model. It is very useful in fast computer calculations designated for the comparison of many different “models of a requirements”.

$$
[V_{ij}] = \begin{array}{c} \\ ID_1 \\ ID_2 \\ ID_3 \\ ID_4 \\ ID_5 \\ ID_6 \\ ID_7 \\ ID_8 \\ ID_9 \\ \cdots \\ ID_n \end{array}
\begin{array}{cccccccccc} ID_1 & ID_2 & ID_3 & ID_4 & ID_5 & ID_6 & ID_7 & ID_8 & ID_9 & ID_n \\
v_1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \ldots\ldots & v_{1n} \\
1 & v_2 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \ldots\ldots & v_{2n} \\
1 & 0 & v_3 & 0 & 0 & 0 & 0 & 1 & 1 \ldots\ldots & v_{3n} \\
1 & 0 & 0 & v_4 & 0 & 0 & 0 & 0 & 0 \ldots\ldots & v_{4n} \\
0 & 1 & 0 & 0 & v_5 & 0 & 0 & 0 & 0 \ldots\ldots & v_{5n} \\
0 & 1 & 0 & 0 & 0 & v_6 & 0 & 0 & 0 \ldots\ldots & v_{6n} \\
0 & 1 & 0 & 0 & 0 & 0 & v_7 & 0 & 0 \ldots\ldots & v_{7n} \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & v_8 & 0 \ldots\ldots & v_{8n} \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & v_9 \ldots\ldots & v_{9n} \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
v_{n1} & v_{n2} & v_{n3} & v_{n4} & v_{n5} & v_{n6} & v_{n7} & v_{n8} & v_{n9} \ldots\ldots & v_{nn}
\end{array} \qquad (2)
$$

For the each of a “ready made” application that should to meet the requirements, the sum of the points estimated for each property should be calculated. We should find the value of the above expression for each application A_z from the collection under consideration, and then choose the one that has the maximum value.

$$
\underset{z \in Z; A_z}{Max \ \forall} \ \sum_{\forall \, i=j} V_{ij} \qquad (3)
$$

Another complementary method is the extension of the „Use Case" method developed by the author, named as „Comparing method for the Use Case of the subject area and application

The essence of this method is the final decision on the selection of an application. The criterion for the choice is the correspondence between the Use Cases of an existing information system and the ready-made Use Cases of a future computer system. If we assume that:

Pai is the symbol of the Use Case *i* for the selected application *a*, where $i = 1, ..., k$; $a = 1, ..., m$;

and *Oai* is the symbol of a description of this Use Case;

and *Pst* is the symbol of the Use Case *t* for the selected system model *s* for a relevant subject area *s*, for which the model is constructed: $s = 1, ..., n; t = 1, ..., w$;

and *Ost* is the description of the Use Case, then the following formal statement may be constructed:

$$Max \{\sum \mu[(Pai, Oai),(Pst,Ost)] * Wst \}$$

$$a = 1, ..., m \qquad i = 1, .., k \qquad t = 1, ..., w \qquad (4)$$

where:

μ is the measure of the adequacy (correspondence) for the selected Use Cases ***P**ai* application and the modeled information system ***P**st* and $0 \leq \mu \leq 1$.

We should find the maximum value of the above expression for each of the subject areas. This expression defines the degree of correspondence of the Use Cases for the application and the information system

Wst is the statistical weight of the objective Use Case, where $0 \leq Wst \leq 1$. For simplification this measure can be determined as:

$$\mu[(Pai, Oai),(Pst,Ost)] := \mu^{ai}_{st} \qquad (5)$$

Table 1 .

Name and weight of Use Ccase for the System '*s*'		Name of the Use Case of the application '*a*'		
Name	Weight	Name 1	....	Name *k*
Name 1	Weight 1			
....	.... ***W**st*		$\mu^{ai}_{st} * Wst$	
....	....			
	....			
Name *w*	***W**sw*			

The application that will be selected must have the following maximum value for the expression presented below.

$$\text{Max}\ \{\Sigma\mu^{ai}_{st}\ * Wst\} \qquad (6)$$

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