Collaborative Systems Orthogonality

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Abstract. *This paper describe the concepts of collaborative systems. It is presented the concept of orthogonality applied to collaborative systems. There are presented the criteria used to classify the collaborative systems.*

Keywords. *collaborative systems, orthogonality*

1. Collaborative systems

A collaborative system is one where multiple users or agents are engaged in a shared activity, usually from remote locations. In the large family of distributed applications, collaborative systems are distinguished by the fact that the agents from the system are working together towards a common goal and have a critical need to interact closely with each other [1].

Collaborative systems represent a new interdisciplinary domain at the intersection of economics, computer science, management, sociology, etc. Using IT technologies new collaboration opportunities were developed on the electronic products and services market. Collaboration involves organizations with same goals that are uniting in order to form a new structure. A collaboration example it is a strategic alliance [2]. Implementing a collaborative system is accomplished using software instruments that allow the development of distributed software applications.

Science has great impact on the development of different types of collaborative systems from various activity fields. The medical field in which modern communication technologies allow doctors from around the world to work on the same patient gives one important domain that was one of the first fields presenting great interest in implementing complex collaborative systems. In a chirurgical operation each person from the group of doctors has distinct roles. In [3] it is analyzed a collaborative system model representing a training on different chirurgical activities that is done in a virtual medium. The training is based on the scenario in which the instructor and the trainee are on different locations. The instructor and the trainee share a common virtual space that contains various three-dimensional anatomical models. Each person interacts with the other one through the virtual space and a medical simulation engine describes the physical and logical behavior of objects present on the virtual scene. The interaction is maintained by a multi-modal interface that uses visual 2D and 3D data, voices and audio simulation. Each person is in front of a working table that has a monitor and stereo active pair of glasses. All of these generate a three-dimensional desktop. For collaborative use, it has been implemented a mini broadband system that allows creating a videoconference between persons. The interaction between the instructor and the trainee is based on voice, gestures, chirurgical demonstrative actions, step by step tutorial and simultaneous actions.

People working collaboratively must establish and maintain awareness of one another's intentions, actions and results [4].

2. Classification of collaborative systems

Collaborative systems are classified according to the following criteria:

a) *level of complexity*, and by this criterion are identified:

- *collaborative systems with low complexity level*, have few components and the number of relationships is limited;
- *collaborative systems with medium complexity level*, have small number of components, but do not have large number of streams or *systems with large number of flows* and which have large number of components;
- *collaborative systems with large or highly complexity level*;
- *collaborative systems extremely complex*, have many components and many streams: banks, police, internal chain of hotels, airline transport; the banking system is among collaborative systems with very high level of complexity, because it consists of many components and is characterized by a large variety of links between them.

b) *type of application*, criterion which groups systems in:

- *collaborative systems in education*;
- *collaborative systems of defense*;
- *productive collaborative systems*.

c) *method of organization*, criterion which divide systems into:

- *linear systems*, in which subsystems interact with each other in both directions;
- *tree systems*, organized by levels.

In a tree system, messages are moving between activities in a hierarchical manner, a message from the second level will reach the level zero only if he move and at level one, and a message of basic activity, represented by the tree root, will be propagated only to activities on the immediately below level. From this level, the message will be forwarded to the activities represented by child nodes of the nodes from level one;

Considering the collaborative system as a tree structure, there are taking into consideration:

- the degree of vertical collaboration as the number of links between components from level k to the ones on level $k+1$;

- the degree of horizontal collaboration as the number of links between components on same level.

Systems of this kind meet in organizational management and public administration.

- *network systems*, the components communicate with each other regardless of the level that is;

In the case of a collaborative system, network type, subsystems are all interconnected, that all transfers are interrelated. In such a system, messages circulate between all components without any restriction. Network type collaborative systems meet in the field of production and banking.

The business collaborative system works under the black box principle set out by Zadeh, the entries being given by raw materials and information and the outputs being materialized in finished products, services and other information which turns into costs for

that business.

Dynamics of collaborative systems concern changes regarding the quality, structure, functions, size, their procedures and standards. Dynamics of collaborative systems are studied using mathematical analysis, providing long-term behavior of each major systems, winning a look inside the system design: which parameters determine the group behavior and how the system characteristics are affected. Is developed a class of mathematical models which describe the collective dynamics of the collaborative system and which illustrates the approach by applying to several case studies, including both software agents and robots. For each system, is transformed a set of equations that describe how the system is changing in time and analyze their solutions. Finally, is shown what say these solutions about the collaborative system behavior.

3. The orthogonality

The orthogonality studies the semblance degree between two or more entities. Through this quality characteristic is determined the measure in which the entities are different one from another.

The orthogonality is being studied on the basis of the orthogonality criteria. With the help of these criteria are highlighted the characteristics that have the same value for the studied entities and are being determined the semblance levels.

The comparison of two entities is reduced to relating one entity to the other entity, respectively to identifying the common parts and the parts that are different. In this way are compared the correspondent characteristics of the two entities. For the text entities, the frequency of the words' appearance as part of the entities has an important roll. Through frequency is being determined the importance of the words as part of the entities and is being determined the degree of using the words, the way how these influence the entities building.

For the orthogonality's study it is defined an orthogonality indicator included between the interval [0, 1], which takes the following values: 1, if the elements are orthogonal, meaning they don't have anything in common, respectively 0, if the elements are identical.

Therefore, it is followed the modality in which two entities are different or similar, both as frequencies of the words' appearance, content, and as signification of the contained data.

Another applicability of the orthogonality concept is that of identifying if certain workings belong or not to a reference domain. It is studied the similitude degree, the frequencies of using the words, and on the basis of the resulted indicator it is determined if the texts are similar or not. In the situation when the orthogonality indicator tends towards 1 that means the workings are completely different it is obvious that don't belong to the same domain. To identify precisely if two or more workings belong to the same domain, must identify the specialized words contained in the workings and their appearance frequencies, through constructing a thesaurus of words belonging to the domain.

To study the orthogonality are defined series of indicators which analyse the differentiation degree of the concepts and materials which make the object of the studied domain.

In the case of collaborative systems the orthogonality finds its applicability in studying the level of similitude of the information processed with the help of the collaborative systems and in establishing the way in which applications and implemented technologies cover the demand of presenting and adapting the information.

Through the implementation of the orthogonality concept is intended the growth of information processed' utility level

Constructing collaborative systems which don't find an activity object or which don't satisfy precisely the demanding which were made, although are respected the criteria which lay at the basis of their creation, leads to an reduced efficiency of the concept.

The orthogonality is studied on the basis of the orthogonality criteria. With the help of this criteria are emphasized the characteristics that have the same value for the studied systems and are determined the similarity levels.

The orthogonality criteria which are taken into account for studying the collaborative systems are:

- the informatics content delivered with the help of the systems;
- the applicability degree of the implemented concepts.

The informational content is studied in order to establish to what extent the information specific to each system were taken over and stocked in an accurate manner.

The applicability degree of the implemented concepts study the modality in which the collaborative systems succeed in realizing the demands for which were build. The concept implementation offer a general view over the manner of realizing the systems, over the manner of how interact the components and supply solutions for improving the application and for growing the integration degree of the component elements. The orthogonality identifies those components of the applications which must be revised in order to grow its efficiency, on the basis of the orthogonality criteria.

The orthogonality analyses the collaborative systems both from the point of view of the internal components, and through comparing with the external applications. The concept's implementation offers a general view over the manner of joining the component modules, over the manner of realizing the application, as well as over the manner of how the components interact and deliver solutions.

4. Conclusions

It is important to assure a complete process for increasing the orthogonality level, being interested in finite-products, and while is being created the opportunity of modifying the component systems in order to increase the level of orthogonality, this process is benefic. Regarding the collaborative systems it is important to assure a high level of orthogonality in order to process the information through all component systems at a high speed and precision.

The resulting data must be unique and with a high degree of applicability. Analyzing the collective systems through the orthogonality criterion has a big impact on the quality of the systems.

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Daniel MILODIN graduated the Economic Informatics department of the Faculty of Economic Cybernetics, Statistics and Informatics in 2005. He followed the master program "Project's Computerized Management" between 2005 and 2007. He has published several articles in specialized magazines, articles focused mainly on studying and implementing the concept of orthogonality: the orthogonality of the alphabets, of the Arabic digits, of the Latin alphabet, of the distributed informatics applications and of the structured entities. The dissertation paper within the master is placed on the same line of research, "The projects' orthogonality, conditions of entry into the assessment program", proposing to define the projects' concept of orthogonality, methods for determining the degree of similarity between two projects, and also to develop software products for identifying similar projects. Currently he is a PhD graduand within the Academy of Economic Studies, specialization "Economic Science", with the theme "The orthogonality of the structured entities".