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MEANS AND SPECIFIC CHARACTERS OF VIRTUAL SIMULATORS ENVIRONMENT DESIGN

In order to realize and combine all listed types of virtual simulators into one complex teaching unit it seems expedient to use the following means:

1. Cloud computing. As a rule, the realization of the whole complex of virtual simulators, which covers all sections of all disciplines within even only one specialty becomes too expensive for one university. In this case cloud computing, that allow different universities inside the "cloud" to use simulators, created by other universities, are of current importance. The problem of general management disciplines simulators design (such as basis of management, management history, organization theory and others) can be solved in that way. Cloud computing also allows universities to concentrate on the design of simulators that cover disciplines designated for studying by the peculiarities of the universities (such as timber enterprise economy, forestry management etc.).

2. Self-tunning fuzzy models. Working with a simulator, a student is provided by such reedom of action as if it were a real object. The student isn't limited by consecutive sequence of operations. Moreover, many situations, modeled within management disciplines (management, marketing, macroeconomics, HR management and many others) often include indistinct wordings and require decisions which are not evaluated in an exact numeral form, but formulated as fuzzy numbers or linguistic structures (for example, 'enhance product quality', 'increase professional qualification of staff', 'sell out a part of assets', 'reduce expenses not less than by 15%' and so on). Thus, with a view to mark the efficiency of a made decision and a realized task within a management situation virtual simulators must be provided by algorythms which can estimate the decisions, made by the students, under the conditions of indeterminacy or insufficiency of certain features. All this makes it neces-

sary to use self-tunning fuzzy models means for simulators design. Fuzzy models give possibilities of:

- Operating with fuzzy ranges of input data;
- Fuzzy formalization of нечеткой estimating and comparing criteria;
- Providing of qualitative assessment of input data and output results;
- Quick modelling of complex dynamic systems and their comparative analysis with assigned accuracy rating.

Visual Prolog language can be used as the means for fuzzy models design.

3. DBMS. In order to run virtual simulatorrs there is the necessity of storage and processing of large data volumes (different types of data, audio-visual information, arbitrary textes, geographical data etc.). In this case a professional DBMS ADABAS can be exploited. DBMS ADABAS provides possibilities of development of any data model. Virtual simulapors complex teaching unit design stipulates for creation of the following databases:

- Management objects parameters DB;
- Images DB;
- Audio data DB;
- Video data DB;
- Management situations models parameters DB;
- Testing questions and answers DB;
- Students' information DB (including personal information and teaching and examinations results);
- DB of membership functions for input and output parameters of fuzzy models;
- Fuzzy models rule DB;
- Secondary databases.

Applications design, databases inquiries, relations between BDs and visualization environment and fuzzy models, as well as main and secondary calculations (excluding calculations within fuzzy models) are executed by the means of Natural language.

4. Visualization environment. Nowadays, 3D-visualization, which allows imitating objects and related historical events at any accuracy rating is considered as a most perspective visualization technology. The means of visualization can relatively be divided into several categories:

– The means of representation of information about studying management object and its elements and processes conditions;

– The means of representation of theoretical information in forms of e-books, video and audio lectures;

– The means of interaction between a student and a simulator within testing procedures and examinations;

– Other means of visualization depending on virtual simulator specificity (for example, GIS and spatial analysis systems, learning modules of land cadastral valuation etc.).

Complex teaching unit which includes all listed within the article forms of virtual simulators can be represent as a scheme (picture).

Within picture the following notation conventions have been imposed:

$x_1 \ldots x_n$ – input values of parameters, associated with a student's actions during interaction with a virtual simulator;

$\mu_{1i}(x_1) \ldots \mu_{mj}(x_n)$ – membership functions of input parameters values $x_1 \ldots x_n$ to input fuzzy sets $1_i \ldots m_j$;

$\mu_{1i}(x^*_1) \ldots \mu_{mj}(x^*_n)$ – grade of membership of input parameters values $x_1 \ldots x_n$ to input fuzzy sets $1_i \ldots m_j$;

$\mu_1(y_1) \ldots \mu_r(y_r)$ – membership functions of output parameters $y_1 \ldots y_r$;

$\mu_{res1}(y_1) \ldots \mu_{res\ r}(y_r)$ – resultant membership functions of the model output parameters $y_1 \ldots y_r$;

Fuzzification – calculation of grade of membership to input fuzzy;

Inference – calculation of resultant membership functions of output parameters;

Defuzzification – calculation of output parameters values on the basis of resultant membership functions.