RELATIONAL CHARACTER OF THE DATA IN THE CONTEXT OF FUNCTIONAL MODULES OF THE SYSTEM SIMMAG 3D

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Abstract

Nowadays, decision support systems play an increasingly important role. On the one hand, they allow for complex design taking into account several boundary conditions. On the other hand, they reduce the risk of making mistakes that can have more or less serious consequences. One of these tools is the system SIMMAG3D developed under a project financed by the NCBR. The tool allows for designing and visualization in 3D of warehouse facilities. The article presents the functionality of the system SIMMAG3D and need for data of its individual elements. Due to the large amount of data and the fact that they come from different subject areas, the most convenient tool for their collection are databases. The article presents the concept of the database for the system with its structure and catalogs, from which will come data to the work of individual modules. In addition, we discussed relational character of data between different functional modules.

Keywords: SIMMAG 3D, databases. Technical specifications, warehouse facilities, designing

1. INTRODUCTION

Majority of currently implemented research projects are based on information systems. They are basis of banking systems, reservation systems, administrative systems, systems of civil registration, logistics, and systems for design supporting (including warehouses and warehouse processes designing), etc. The most commonly used tool for designing various types of information systems are database systems [6], [15]. They consist databases and database management systems.

Therefore, development of a modern tool for modelling and visualization warehouse facilities in 3D requires the development of specific databases. The major aim of this tool is to improve process of warehouse designing. It will allow to develop design procedures, estimate values of economic and technical indicators for various types of warehouse.

Database presented in paper is based on analysis of information system needs (information system to support modelling warehouse facilities), as well as analysis of information resources for visualisation in 3D. At designing that database it is important to consider selection of appropriate database model and system to its manage.

2. SIMMAG 3D AND ITS FUNCTIONS

The SIMMAG3D system which is developed within the project has many uses and functionality. Its main use is to support the management of storage facilities after connection with WMS. On the other hand, it is a powerful tool for storage facilities designing.

The SIMMAG3D system architecture was designed based on dedicated mathematical models, dedicated algorithms and optimization modules (e.g. the location of storage facilities), dedicated simulation module (simulation and analysis of selected warehouse processes). Providing data for the calculation lies with the

integrated database containing catalogues of internal and external transport, equipment of storage facilities or for example architectural solutions. The database includes libraries for objects graphic visualization. The module of graphic presentation in 3D - helps to identify the critical areas of storage facilities.

Therefore two main functions of the system SIMMAG3D are support in management of storage facilities and support in storage facilities designing.

Carrying out the above system functions results from the needs of real objects and real application, but also in research and teaching field. It follows the need to equip the system with advanced functional modules. Among them can be distinguished graphical user interface (GUI), interface WMS>SIMMAG3D, database (catalogues and 3D library), 3D visualizer, optimizer along with a simulator (and data generator). The overall diagram of the SIMMAG3D system is shown in **Figure 1**.

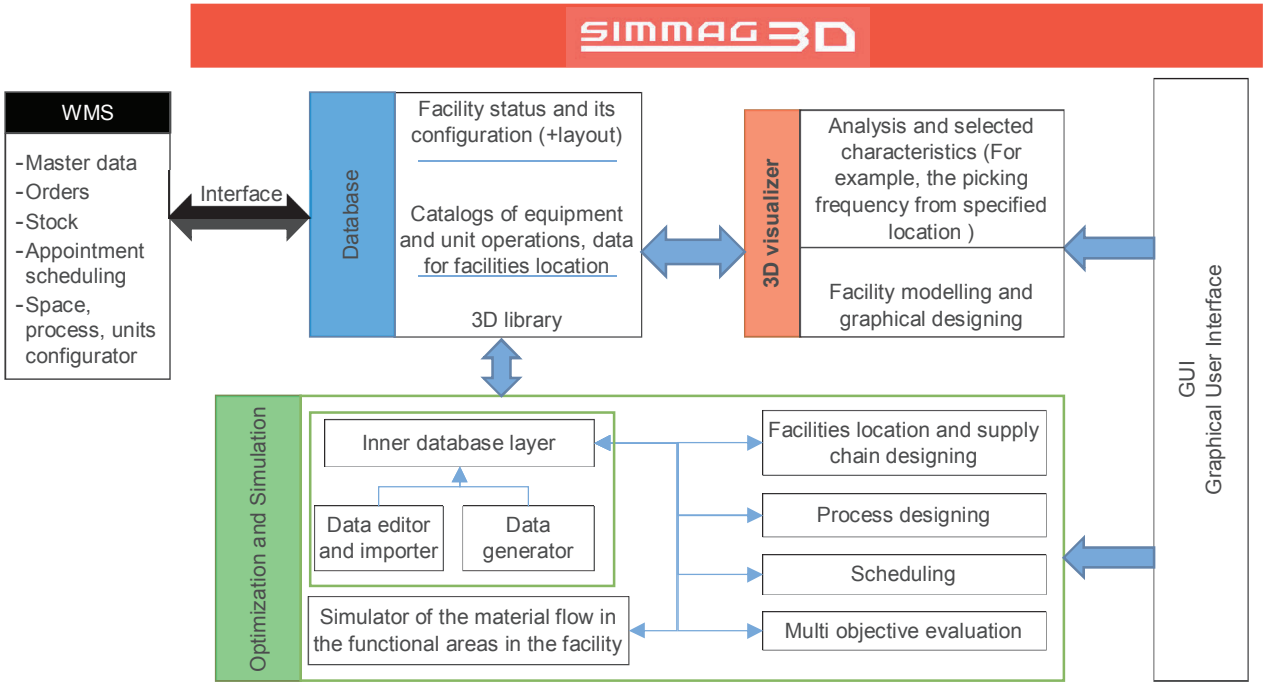

Figure 1 The SIMMAG3D system - overall scheme

The graphical user interface (GUI) is a base layer program. GUI consists of two main parts. One concerns the use Visualizer 3D, while the second refers to the part related to the optimization and simulation of warehouse processes. The visualization and optimization modules are integrated via an interface for data exchange which is done through the database. The interface WMS>SIMMAG3D contains tables of data exchange needs of transfer structures and data from WMS database. This allows for visualization and analysis of the current object or its reorganization, modification and finally allows for simulation to verify the improvements. The database is the layer that connects all components of SIMMAG3D system and is designed to store all input data, libraries, as well as the performance of the user. More information about database will be discussed later in the article.

The Visualizer 3D module is responsible for the visualization of the warehouse facility. It is possible to display the object mapped in the WMS and the object projected on the basis of the optimization and simulation module. The visualizer allows to graphical formation of the functional zones, sectors and whole areas of the warehouse. This is done by using the implemented structural model built on the catalogues. Visualizer also presents the functioning of the object in terms of state changes of its resources.

The simulator and optimizer is a module consisting a series of solutions for the design of new facilities, as well as reorganize and modernize existing ones. For the purpose of this module was implemented data generator which results from reason that the decision maker does not always have a complete set of data, especially in the design of new facilities. As the main elements of this module can be identified:

- warehouse facilities location [13], [14], [18] - in addition to the location of the object there can be adjusted the number of objects and material flows through the object, and also allows to specify some of the facility operational cost,
- warehouse process construction [8], [11] - mapping of processes occurring in objects having a time, the number and nature of the transformation, resources,
- scheduling and shaping [10], [12] - assign tasks of mapped process to increase the lead time of the object, determining the number of devices, people and evaluation of some indicators,
- warehouse processes simulator [16] - module based on the simulation mechanisms that allows to study different solutions in the system, for example the study on process time changes for different strategies of storage assignment,
- multi-criteria evaluation [7], [9] - support the user in performing multi-criteria analysis of investment (modernization) options and choose the most beneficial.

The functioning of each module required to provide relevant data. The system assumes the possibility of manually data insertion for each module. However, more important is the use of real data, as well as from the calculations and simulations performed by other modules of SIMMAG3D system. The needs for data are shown in the next section of the article.

3. SIMMAG 3D NECESSARY DATA

The selected SIMMAG 3D modules presented in the **Figure 1** require many input data conditioning their functioning [4], [17]. The first SIMMAG 3D system module refer to warehouse location. In order to locate the warehouse in the logistics network it is necessary to identify the warehouse suppliers and customers. Other characteristics that are required refer to the storage time and storage volume. The materials' technical parameters are important for the storage space definition.

Another module is the storage facility shaping module. The warehouse space shaping requires data about the possible land locations and the land costs as well as the warehouse building technical limitations. Warehouse designing also depend on the material flow volume, assortment structure, storage technology and the warehouse transport technology.

Similar data is required by the warehouse process shaping module. The basic data is related to the scope of the material flow transformation according to the customers' orders. Warehouse process designer also has to know the orders structure, the number of inventory items, physical and commercial characteristics and the material flow volume.

The module for the warehouse process dimensioning generally requires the tasks identification. To develop the warehouse process' schedule it is necessary to determine the allocation of people and equipment to the tasks at a time. Also the tasks limitations and unitary tasks costs are required.

Evaluation of the warehouse and the processes inside is the module which helps to decide which variant of the designed warehouse should be selected for the implementation. To perform such an evaluation, many warehouse parameters have to identified. After that each parameter is assigned with the weight to allow their importance. From the point of warehouse designing view these parameters should refer to technical and quality indicators such as efficiency, performance. The quantitative parameters refer to the warehouse cost and expenditures.

The visualization of the warehouse processes will require the historical data obtained during the simulation process. More over the assortment allocation and its stock will be uploaded from the warehouse management systems WMS.

4. DATABASE FOR SIMMAG 3D SYSTEM

Due to the large amount of data coming from different subject areas, the most convenient tool for their collection are databases [1], [2], [3]. In this tool data are stored according to strict rules, which allows for their complete processing. Database tools allows for sorting of the data according to specific criteria and searching for specific information in a particular place.

The concept of a database for the SIMMAG 3D system shown in **Figure 2** [4], [17].

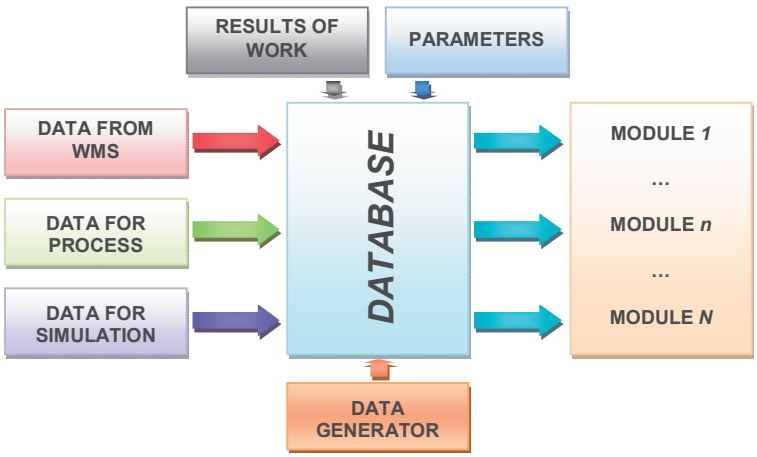

Figure 2 The concept of a database for the SIMMAG 3D system

The basic data sets stored in the database, which was developed for the system SIMMAG 3D are:

- data from the WMS (Warehouse Management System) - For proper operation of the system for designing and visualization of warehouse facilities in the 3D there are necessary data, which document the process of cargo flow in the Logistics facility. These data provide WMS systems.,
- data necessary for designing and visualizing of the warehouse process [5] - in order to properly preparation the warehouse process in the logistics facility it is necessary to introduce a number of input data for which the most convenient form of storage are database.,
- data necessary to carry out the simulation - system for modeling and visualization carrying out stimulations will allow to assess whether designed logistics facility allows for carry out tasks.

The second group of data are the results of work of individual system SIMMAG 3D modules. The result of the work of individual modules are values which should be stored. The best place to perform this task is also the database. Using this tool, we can not only store the results, but also make it available as input data needed for operating other program modules. As an example of such data we can indicate the results of the warehouse process and simulation.

An important group of data, which also will be located in the database are parameters. They concern two groups of issues. The first is the location of a storage facility in the logistics network. For this issue, it is necessary to introduce a number of parameters. The second group of issues are directories of internal transport, external transport, non-mechanical equipment and reloading infrastructure. Each of these objects has a set of parameters such as load capacity and speed of the drive with the load.

The last group supplying database in specific values are data generators. In the case that impossible or very difficult is to obtain data concerning the problem, e.g. in the field of supply structure and characteristics of the assortment (especially in terms of actual data from the warehouse management systems WMS) it is necessary to generate them. This will help to carry out stimulations of the warehouse process, which will allow from the one hand on checking the operation of the system SIMMAG 3D, and from the other hand on the presentation of the functionality of the program.

Data from the database supply various program modules (see point 2) in the necessary data to their work. **Figure 2** shows the general concept of database. While **Figure 3** shows the structure of the database in the field of exchange technology of data between modules.

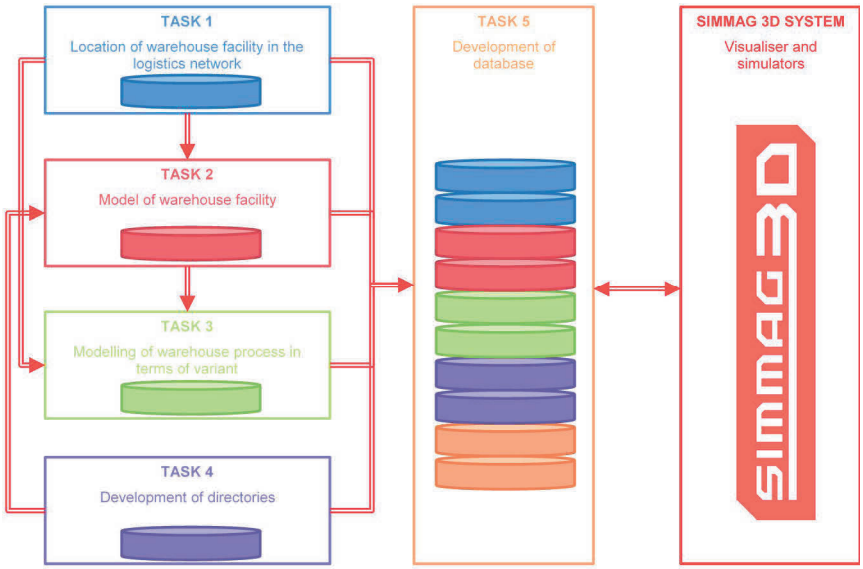

Figure 3 Structure of the database in the field of exchange technology of data between modules

Data in the database are powered by the effects of the implementation of specific project task (**Figure 3**): Furthermore, the individual tasks 1- 4 "exchange" data - the results of work of the task can be used as input data to another task or input to the second task can also be input data for the third task. Data from task 1 feed the work on the realization of the task 2 and 3. Data of the task 2 supply work on a task 3. Data from task 4 are necessary to complete the task 2. However, data from tasks 1, 2, 3 and 4 are necessary to complete the task 5. Data from the task 5 supply directly the SIMMAG 3D system and store the data, which are the result of its work. Described structure corresponds to the relational data model, which is implemented in the system for modelling and visualization of warehouse facilities in 3D - 3D SIMMAG

5. SUMMARY AND CONCLUSIONS

The main result of the project (an element of which is database discussed in paper) is an innovative tool for efficient designing warehouse models with pre-defined objects, as well as its graphical presentation in 3D. Catalogues and database, prepared by the project (containing parameters and characteristics of warehouse facility equipment) allow to optimally design warehouse facility or (if they already exist) to appropriate organize and rationally use its work resources.

Development of databases containing such detailed information will affect small and medium-sized design companies. Companies, that will be use the SIMMAG3D tool, will be able to implement more projects without increasing human resources. This will significantly affect the financial results of these companies.

ACKNOWLEDGEMENTS

The scientific work carried out in the frame of PBS 3 project "System for modeling and 3D visualization of storage facilities" (SIMMAG3D) financed by the National Center for Research and Development.

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