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THE ROLE OF THE DATABASE DESIGN PROCESS IN AN AUTOMATED INFORMATION SYSTEM

Abstract. The article discusses the fundamental tasks and the main stages of database design facing the creation of an automated information system. The basic concepts of databases, automated information systems, data models and database management systems are described, as well as examples of basic approaches for determining the structure of the subject area. The database design process itself is presented as a sequence of transitions from an informal verbal description of the information structure of the subject area to a formalized description of the objects of the subject area in terms of a certain model.

Keywords: Automated information system, database, data model, database management system, database design, subject area, conceptual design, infological model, information and logical design, datalogical model, physical design.

Information and data in the modern world are important, key resources. Groups of analysts, designers, and software developers create information systems based on databases. Databases, in turn, allow you to save and sort the necessary information. Such information systems allow you to support any research, planning, production and decision-making processes.

Databases are used in all spheres of various branches of life. Thus, the modern information society every second turns to huge arrays of information containing personal information of millions of Internet users, corporate and other information [1, 2].

To begin with, it is necessary to understand the concepts of "automated information system" and "database".

An automated information system (hereinafter – AIS) will be understood as a set of software and hardware designed to automate activities related to the storage, transmission and processing of information. An automated system that organizes data and provides the requested data is an information system. In general, the information system is used for storing, searching and processing information and related organizational resources (human, technical, financial, etc.), providing and distributing information. AIS are of two types – knowledge-based (for example, expert systems, intelligent decision support systems) and data-based (for example, application systems that are actively used in enterprises, institutions). Two reasons for creating such systems are:

- development of methods for the design and operation of systems intended for collective use;
- the ability to collect, store and process a large amount of data about real objects and phenomena, that is, equipping these systems with "memory".

Database (hereinafter referred to as DB) is a collection of data stored in accordance with the data schema, which is manipulated in accordance with the rules of data modeling tools. In other words, an array of shared data in data-based systems is called a database. The

database is a model of the domain of the information system [3]. Thus, the database stores data, and the AIS searches for this data in this database. At the same time, database design is one of the most difficult and responsible tasks associated with the creation of this system. As a result of its solution, the content of the database, an effective way of organizing data for all its future users, and data management tools should be determined.

The designed database must store all data, provide information to the request of the information system, but at the same time the absence of duplication and redundancy of information, as well as data integrity (correctness) must be observed.

Fundamental problems that arise when designing a database:

1. Designation of the boundaries of the projected subject area of interest (assignment), construction of the data structure of the subject area – conceptual design (infological model).

2. Selection from various database management systems (hereinafter referred to as DBMS) the optimal DBMS for a given subject area. Description of the database in the DBMS language – logical design (datalogical model).

3. Definition of the types of data used and methods of access to them (queries, reports, forms) – physical design (physical model).

The main stages of database design can be presented in the form of the following diagram (Fig.1).

Figure 1 - Database design stages

At the 1st stage of database design, a system analysis of the subject area is performed. There are several approaches to determine the structure of the subject area – functional, subject and design using the "entity - relationship" method. The functional approach is applied when the functions and tasks of all categories of future database users are known, then a list of information needs of this circle of people is formed. Here the

minimum required set of objects of the subject area is clearly defined. With a substantive approach, the information needs of users are not clearly fixed. This approach is used when developers have a clear idea of the subject area itself and what kind of information they would like to store in the database, and the query structure is not defined or is not fully defined. Then the main attention is paid to the study of the subject area and its most adequate display in the database, taking into account the widest range of information requests to it. The database being constructed can solve various tasks, but the disadvantage of this database is the redundancy of information due to the large range of possible tasks. The Entity–Relation (ER–method) method was developed in 1976 by P. Chen and it is a combination of a functional and substantive approach to the infological design of a database. Therefore, the latter approach is more often used in practice in relation to a single database. So, the system analysis should be completed with a detailed description of the information about the objects of the subject area, the specifics of the tasks, precise algorithms and procedures for processing information, input and output flows of information.

At the 2nd stage of design, data modeling is performed. Data modeling is the process of creating a logical data structure.

At the 3rd stage, the designer selects a DBMS. DBMS is a set of programs and language tools designed to manage data in a database, maintain a database and ensure its interaction with application programs. The DBMS provides two groups of functions – providing access to the database to application software and managing the storage and processing of data in the database. At this stage, the designer makes a decision based on the reliability and convenience of the system in operation, system performance parameters, the cost of the system and software, the type of data model supported by the DBMS, further opportunities for AIS modernization, etc. In practice, developers are guided by such factors as:

- the type of data model supported by this DBMS, the adequacy of the data model to the structure of the subject area under consideration;
- DBMS performance characteristics;
- the stock of functionality for further development of the information system;
-the degree of DBMS equipment with tools for data administration personnel;
- convenience and reliability of the DBMS in operation;
- availability of specialists for working with a specific DBMS;
- the cost of the DBMS and additional software.

The next step is to design a datalogical (logical) database model. At the stage of logical design, the infological model of the subject area, presented in the form of an ER diagram, is transformed into a logical (conceptual) database schema. When forming a datalogical schema, each of the entities defined in the conceptual schema is displayed in a table, which is one relationship. Relational databases with various sets of relationship schemes are more often used, which, in turn, model abstract objects of the subject area and semantic connections of these objects [4, 5].

The last stage is that all of the above steps are applied to a specific DBMS, databases. The basis for physical design is the database schema obtained at the previous stage. Physical design consists in linking the logical structure of the database and the physical storage environment in order to place data most efficiently. The issue of placing stored data in memory space and choosing effective methods of access to various components of the

"physical" database is being solved. The results of this stage are documented in the form of a storage schema in the data definition language. The decisions made at this stage have a decisive impact on system performance.

During the operation of the system, it becomes possible to measure its real characteristics. If a situation arises when the system does not meet all the requirements imposed on it, then the system is reorganized, undergoes modification of its original project.

In conclusion, it should be added that with proper database design, the main and complex task of creating an automated information system is solved, which will allow you to operate with data, create the necessary queries and perform various operations with input and output data. All this will increase the productivity of working with information, shorten the response time to the requests of the information system, as well as facilitate the solution of everyday tasks in various spheres of human activity.

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АВТОМАТТАНДЫРЫЛҒАН АҚПАРАТТЫҚ ЖҮЙЕДЕ МӘЛІМЕТТЕР БАЗАСЫН ЖОБАЛАУ ПРОЦЕСІНІҢ РӨЛІ

Аңдатпа. Мақалада автоматтандырылған ақпараттық жүйені құру алдында тұрған мәліметтер базасын жобалаудың іргелі міндеттері мен негізгі кезеңдері қарастырылады. Мәліметтер базасының, автоматтандырылған ақпараттық жүйенің, мәліметтер моделінің және мәліметтер базасын басқару жүйесінің негізгі түсініктері сипатталған. Сондай ақ пәндік саланың құрылымын анықтаудың негізгі тәсілдерінің мысалдары келтірілген. Мәліметтер базасын жобалау процесінің өзі белгілі бір модель тұрғысынан пәндік саланың ақпараттық құрылымының бейресми ауызша сипаттамасынан пәндік саланың объектілерінің формальды сипаттамасына ауысулар тізбегі түрінде ұсынылған.

Түйінді сөздер: автоматтандырылған ақпараттық жүйе, мәліметтер базасы, мәліметтер моделі, мәліметтер базасын басқару жүйесі, мәліметтер базасын жобалау, пәндік аймақ, тұжырымдамалық дизайн, инфологиялық модель, ақпараттық-логикалық жобалау, даталогиялық модель, физикалық жобалау.

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РОЛЬ ПРОЦЕССА ПРОЕКТИРОВАНИЯ БАЗЫ ДАННЫХ В АВТОМАТИЗИРОВАННОЙ ИНФОРМАЦИОННОЙ СИСТЕМЕ

Аннотация. В статье рассматриваются фундаментальные задачи и основные этапы проектирования базы данных, стоящие перед созданием автоматизированной информационной системы. Описаны основные понятия баз данных, автоматизированной информационной системы, модели данных и системы управления базами данных, а также приведены примеры основных подходов для определения структуры предметной области. Сам процесс проектирования базы данных представлен в виде последовательности переходов от неформального словесного описания информационной структуры предметной области к формализованному описанию объектов предметной области в терминах некоторой модели.

Ключевые слова: автоматизированная информационная система, база данных, модель данных, система управления базами данных, проектирование базы данных, предметная область, концептуальное проектирование, инфологическая модель, информационно-логическое проектирование, даталогическая модель, физическое проектирование.

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