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REPORTING WEB APPLICATION FOR OLAP CUBES

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Abstract *In the article entitled "Web Reporting for Olap Cubes", the study was conducted in four parts. In the first part we made an introduction on the design of decision support systems and multidimensional modeling. In the second part we conducted a study on data warehouses, and in the third part we studied the Olap systems. In the fourth part we created an application to create a web application for reports and cubes.*

Key words:
Data warehouse, branch, olap system, uml
JEL Codes:
M1

1. INTRODUCTION

In the 21st Century, which is also the century of intelligence or intelligent affairs, businesses will only be able to achieve their goals if managers can use sufficient and quality information in their decision-making process.

Designing decision support systems in general and data-oriented in particular is based on the idea that quality information (in terms of content and presentation) is essential for decision-making and quality of decision making.

Tactical and strategic management research in particular has confirmed that decision-making processes at these levels are generally disordered and unstructured. The presentation of information focused on subjects rather than on the type of operational applications can provide effective support for decision-making at these levels.

At present, the major concern of IT specialists is to meet the growing demand of managers for information that will allow them to evaluate as quickly and accurately the performance of organizations they manage. Data-driven decision support systems can meet this demand for quality information and can improve the effectiveness of decision-making for managers.

Multidimensional modeling of existing data in organizations, based on managers' interest topics and multidimensional viewing of information, can provide effective information support to decision-makers regardless of the field of activity, and also provide a way to improve support systems decision-making.

The emergence of data-driven decision support systems (OLAP) has enabled managers to access a large amount of integrated information, view them from different perspectives, and analyze them online, in order to evaluate as objectively and accurately as possible organizations' performance and achieve a decision-making process based on analysis.

2. DATE WAREHOUSE

In each organization there are many transactional computer systems that automate the day-to-day operations of an organization, operations that are structured and repetitive and consist of short, atomic and isolated transactions. These systems allow organizations to operate efficiently and use detail data, current and real-time representations of company status, frequently accessed and updated. The size of the operational databases varies from hundreds of Mb to Gb, and the consistency of stored data is a fundamental requirement of transactional systems. Unlike transactional systems, decision support systems are used to manage and control the company. Data warehouses are intended for decision support. Historical data and aggregate data are more important than detailed data.

In 1995, Bill Inmon defined the data warehouse as "a time-based, non-volatile, data-based, data-based collection of data to support decision-making in an organization":

- Subject oriented. In a warehouse, data is organized according to important topics for the organization, such as customers, products and activities.
- Integrated. Data must be represented in the data warehouse in a consistent format to allow the analyst to focus on the use of the data in the warehouse and not on their credibility and consistency.
- Non-volatile. In the data warehouse, there are only two types of operations: initial data loading and data query. The data is no longer updated after it has been loaded into the data warehouse. When designing the data repository, treating anomalies is no longer an important factor.
- Time dependence. Data in the data repository is associated with temporal elements. In the data warehouse, the time horizon is between 5 and 10 years, while in transactional systems it can take values between 60 and 90 days. Also, the key structure implicitly or explicitly contains a time element.

Data warehouse technologies have been used successfully in many areas: production, retail (stock management), financial services (risk analysis, credit card analysis and fraud detection), transport, telecommunications (call analysis and fraud detection) and so on

Virtual data warehouses are considered a way to deploy a data warehouse faster. Users can access real-world data directly using complex networking tools. The disadvantages of these virtual data warehouses are:

- the quality and consistency of the data is not guaranteed, as no "data preparation" is performed;
- historical data is not valid;
- user access time is usually unpredictable depending on the availability of operational data sources, network load, complexity of demand, etc.

3. OLAP SYSTEMS

Since the 1970s and 1980s, computer systems have developed that allowed multidimensional analysis before being known as OLAP systems. The main efforts in the development of OLAP technology can be presented chronologically as follows:

In 1962, Ken Iverson, in his book "A programming language", described the first multidimensional language, called the APL language. This language was implemented by IBM on mainframes in the late 1960s. Many of the concepts of this language are used today (for example, Adaytum Planning and Lex 2000 use the APL language).

In the late 1960s, John Little, a physics physicist, Len Lodish, a marketing specialist at Massachusetts Institute of Technology Sloan School and Glen Urban, dean of Sloan School, tried to use computers in mathematical and analytical applications. They tried to use analytics in marketing, especially in consumer goods marketing. This was an ideal area of investigation because there was a large amount of unprocessed raw data and the decision-making process could be improved by better understanding of the data. Their effort led to the emergence of Management Decision Systems in 1974. MDSs were especially used to create mathematical models for marketing analyzes. It was a complex programming work in Fortran, which resulted in a library of analytical functions and storage facilities for disk matrices. John Wirts considered that the library of subroutines could be generalized and that analytical facilities could be greatly improved for the end user by adding data management facilities. This was an important step in the development of the first OLAP systems.

In 1972 analytical functions and data management facilities were integrated into a language, the Express language. After 30 years, Express remains one of the main OLAP technologies used, the concepts and data model being unchanged.

In the early 1970s, Comshare chose financial analysis as a central activity. The company has acquired a financial modeling language called FCS from a British software firm (EPS Consultants). The company's specialists have sought to make the FCS language a language that satisfies users' needs for multidimensional analysis. In 1978-1979, Comshare considered it necessary to move on to a new generation of financial modeling language, combining analytical modeling functions with data management technology to manage much larger data volumes associated with the multidimensionality concept. The resulting tool was System W DSS, the first OLAP tool for financial applications that used the hypercub concept. Its main use was financial decision support, used in budgeting, forecasting and strategic planning. It introduced many concepts such as completely unprocessed rules, multidimensional data viewing, integration with relational data, etc. As Express has become an important tool in market analysis applications, System W has become a force in planning, analysis and financial reporting applications in the 1980s. Hyperion Essbase, although not a direct descendant of System W, uses many of the concepts used by System W (for example, the hypercub concept).

In 1984, the first ROLAP instrument, Methafor, used in marketing analysis. Introduced new concepts that became popular in the 1990s, such as distributed client/server computing, multidimensional data processing. Unfortunately, hardware and software costs were very high and did not use an open architecture and standard GUI interfaces.

In the mid-1980s, the term EIS (Executive Information System) appeared. In 1985, Pilot Command Center, the first EIS style OLAP tool, with client / server architecture, appears. The tool uses time series analysis, implemented on VAX servers and standard PC clients. The pilot has introduced many concepts used by the new OLAP tools such as multidimensional client / server processing. Some of these concepts have been implemented in Pilot's Analysis Server.

In 1990, Cognos Power Play became the first desktop-based OLAP tool for Windows. Cognos also offers versions for client / server architecture and the Web.

In 1991 Metaphor was acquired by Apple's consortium - IBM Taligent.

Arbor Software was established in 1991 with the unique purpose of creating a multi-dimensional and multi-user database server called Essbase. Essbase was introduced to the market in 1992 and launched under the OS / 2 and Windows NT operating system. In 1993 Codd introduces the term OLAP and the 12 OLAP rules. After seeing Essbase as a multidimensional database, she came to the conclusion that SQL language was never suitable for multidimensional analysis. He said there was a significant difference between multi-dimensional systems technology and transactional systems technology.

In 1994, the first ROLAP tool, Microstrategy DSS Agent, without a multidimensional engine, appears. All processing was executed with SQL (multipass SQL), a technique very often used for very large databases.

In 1995, the first OLAP hybrid, HOLOS 4.0, is available which allows access to both relational and multidimensional databases. Many of the OLAP tools use this architecture.

In 1995 Oracle acquired Express. January 1995 also marked the formation of the OLAP Board, which played a key role in establishing OLAP systems as a more well-understood and well-known category of software. After eight months of work, four software vendors have created the OLAP Council (OLAP Council) to eliminate confusion and make OLAP systems more appealing on the market by setting open standards (OLAP APIs). The OLAP Council defined the concept of OLAP as a "category of software tools that allows analysts of managers and executives to understand the essence of data through quick, consistent, and interactive access to a wide variety of possible views of information that have been obtained by transforming data primary to reflect the real dimensions of the enterprise as perceived and understood by the user ".

In 1997, Microsoft OLEDB for OLAP, an OLAP API standard developed by Microsoft, appears as a set of COM objects and interfaces designed to provide access to multi-dimensional data sources through OLEDB. OLEDB for OLAP develops a cube and dimension model, provides MDD (multidimensional expressions) for calculating and viewing cubes and is used by over 40 companies.

In 1997, the MDIS (Metadata Interchange Specification) standard proposed by a group of companies (IBM, Sybase, Informix) provides a standard access mechanism and a standard interface to manage metadata.

In 1998, IBM DB2 OLAP Server, a version of Essbase, which uses data stored in relational databases (star schema), appears.

In 1999, Microsoft OLAP Services (formerly called Plato or Decision Support Services), using technology acquired from Panorama Software Systems and a complex storage architecture (ROLAP / MOLAP / HOLAP), appears in Microsoft Office.

In 2000, Microsoft renamed Microsoft OLAP Services as Microsoft Analysis Services.

In 2002, Oracle launches Oracle9i Release 2 OLAP that integrates all OLAP (Analytical Workspace) features into the Oracle relational database.

At present, there is no complete OLAP theory, unanimously accepted by all specialists. There are, however, a number of principles (rules) that highlight the potential of OLAP systems as a critical component in any informational infrastructure. These principles are simple but relevant and should not be ignored:

a) The basis of all the activities of a company is the processing of information.

This includes collecting, storing, transmitting and manipulating data. The importance of good information can be thought of as the difference in value between right decisions and wrong decisions, where decisions are based on information. The bigger the difference between good decisions and wrong decisions, the more important it is to have good information. Most companies invest a lot in computer technology. Good information must be accurate, current, complete and easy to understand. The first functional requirement of OLAP systems derives from these general information processing requirements: to provide accurate, current, complete and easy to understand information.

b) The theory of decision support systems lies at the basis of the theoretical foundation of OLAP systems. The definition of the decision support system: "Interactive, flexible and adaptable information system, specially designed to provide support in solving unstructured or semistructured managerial issues in order to improve decision making, using data and models, provides a simple and easy interface to use, enables the decision maker to control decision-making and provides support for all stages of the decision-making process "was a challenge for OLAP systems.

OLAP systems represent an important category of data-driven decision support systems (SSDOD). The functional requirements of OLAP systems stem from the objectives of data-driven decision support systems:

- Opportunity. An SSDOD must guarantee the following:
  - Basic data has already been processed or prepared for analysis.
  - access to data is quick;
  - calculations are quick.
- Accuracy. An SSDOD must ensure the precision of the underlying data and the accuracy of the calculations.
- understandable. An SSDOD must provide user-friendly or intuitive interfaces.

The main objectives of OLAP systems are:

- fast access and quick calculations, powerful analytical facilities (very fast ad-hoc analysis);
- friendly interface and flexible presentations;
- allow processing of large volumes of data (1-500 Gb), with many levels of detail, in a multiuser environment.

c) Fast access and quick calculations.

OLAP systems support ad-hoc analytical requests. The primary objective of OLAP systems is to provide a response time of five seconds or less, regardless of the type of application or size of the database, in a multiuser and distributed environment. For maximum effective access, OLAP systems must offer the right combination of pre-calculated and calculated results at the time of the query. OLAP systems store historical, current, detail, or aggregate data.

4. APPLICATION

Creating a multi-dimensional cube reporting web application using the Microsoft Analysis Services (AS) OLAP system for a multi-branch enterprise.

Features and features of the application:

- the application will allow users to create reports with multidimensional cube data source created using the OLAP AS system;
- reports will be displayed using pivot tables;
- The system will allow multidimensional cubes to be recorded on various OLAP AS servers that can be used by users as the data source for the desired report;
- The system will have three types of users: administrators, branch managers and end-user users;
- Depending on the category it belongs to, a user's view / change rights on a report will be restricted;

  • regular users are the least-privileged users who can view only their own reports and those shared by other users;
- Branch managers are users who, besides the rights of regular users, can create reports at the

branch level, that is, reports that can be viewed by all the managers of that subsidiary;

- Administrators are users with full rights to reports and users; they have the task of creating / deleting users, registering cubes in the application, granting / withdrawing rights to users on a particular cube;

sections:

- Authentication - the first page of the application where the user must log in using his / her username and password;
- branch reports - reports specific to a particular branch, created by the managers of the respective subsidiary and visible only to them and to the directors;
- user reports - private reports, visible only to users who created them and administrators;
- common reports - a section where a user can view reports shared by another user;
- user administration - a section where administrators can add / delete users and add / withdraw their rights to certain cubes;
- cubes management - a section where administrators can record / delete cubes from various AS servers;
- Branch management - a section where administrators can add / delete subsidiaries;

  • report administration - a section where a user can change the properties (name, description, etc.) of a report and can share it for other users;
- cube comparison - a section only available to administrators and branch managers, where two reports can be viewed simultaneously;
- user report groups - a section where a user can create report groups;
- report creation - a section where the user can create a report;
- logout - option by which the user can leave the application;

The application was developed using the following technologies and programming languages: HTML, CSS, PHP, JavaScript, Microsoft SQL Server and ActiveX Pivot Table v10, which is part of the Microsoft Office Web Components (OWC) suite that needs to be installed . The application also needs an Apache web server to run. An alternative to the PHP and Apache pair could be the ASP programming language and the IIS web server.

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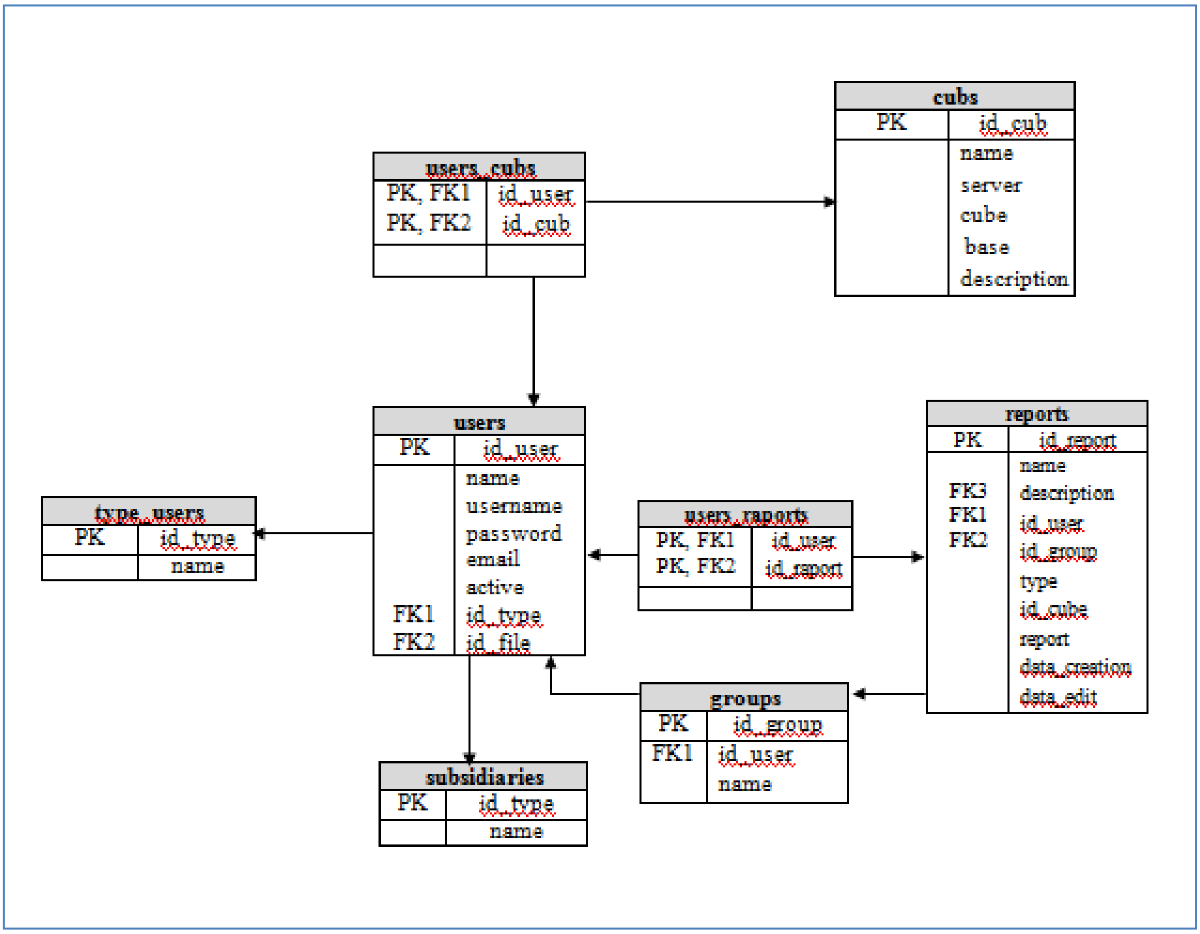

Figure 1 - The main schema of the database

subsidiaries contain the fields: id_branch, name

user types contains the fields: id_type, name

groups includes:

- the reports groups of each user separately
- fields: id_group, id_user, name

cubes contain:

- Data that connects to an OLAP cube in the AS, that is, the data source underlying a report;
- fields: id_cub, name, server, cube, base, description

users contain:

- users who have the right to login to the application;
- fields: id_user, name, username, password, id_type, email, active, id_file

users_cubes contains:

- user-cube mail, which contains the user rights of the cubes registered in the application;
- fields: id_user, id_cub

reports contain:

- user reports;
- fields: id_raport name, description, id_user, id_group, type, id_cub, report,

date_creation, date_edit

users _report contain:

- user-report correspondence, which allows users to share their reports;
- the fields: id_user, id_raport

The following objects are also included in the database (Figure 3.3.2): the menu table and the branch_menu, menu_propriies, menu_community and user_menu, which are used to build the main menu of the application.

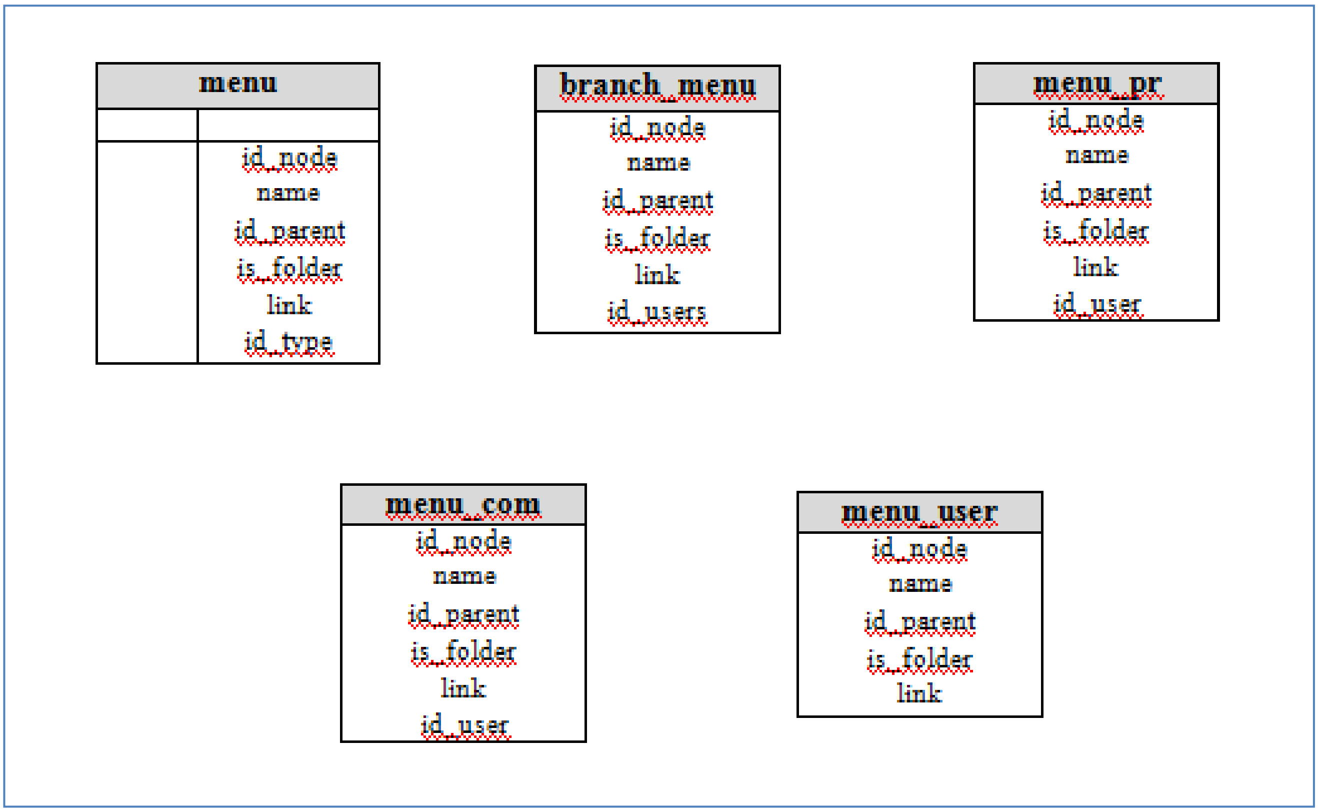

Figure 2 - Database objects that are used to build the menu

The application can be divided into three main modules:

- Login. The login module is present on the first page of the application (index.php), where the user must enter his username and password. If authentication is successful, the user can access the rest of the application.
- Administration. The administration module contains the following submodules: comparison of cubes, branches, report groups, password, reports, users and logout.
- Reports. The report module is available to logged-in users and consists of sub-modules for viewing reports and creating reports.

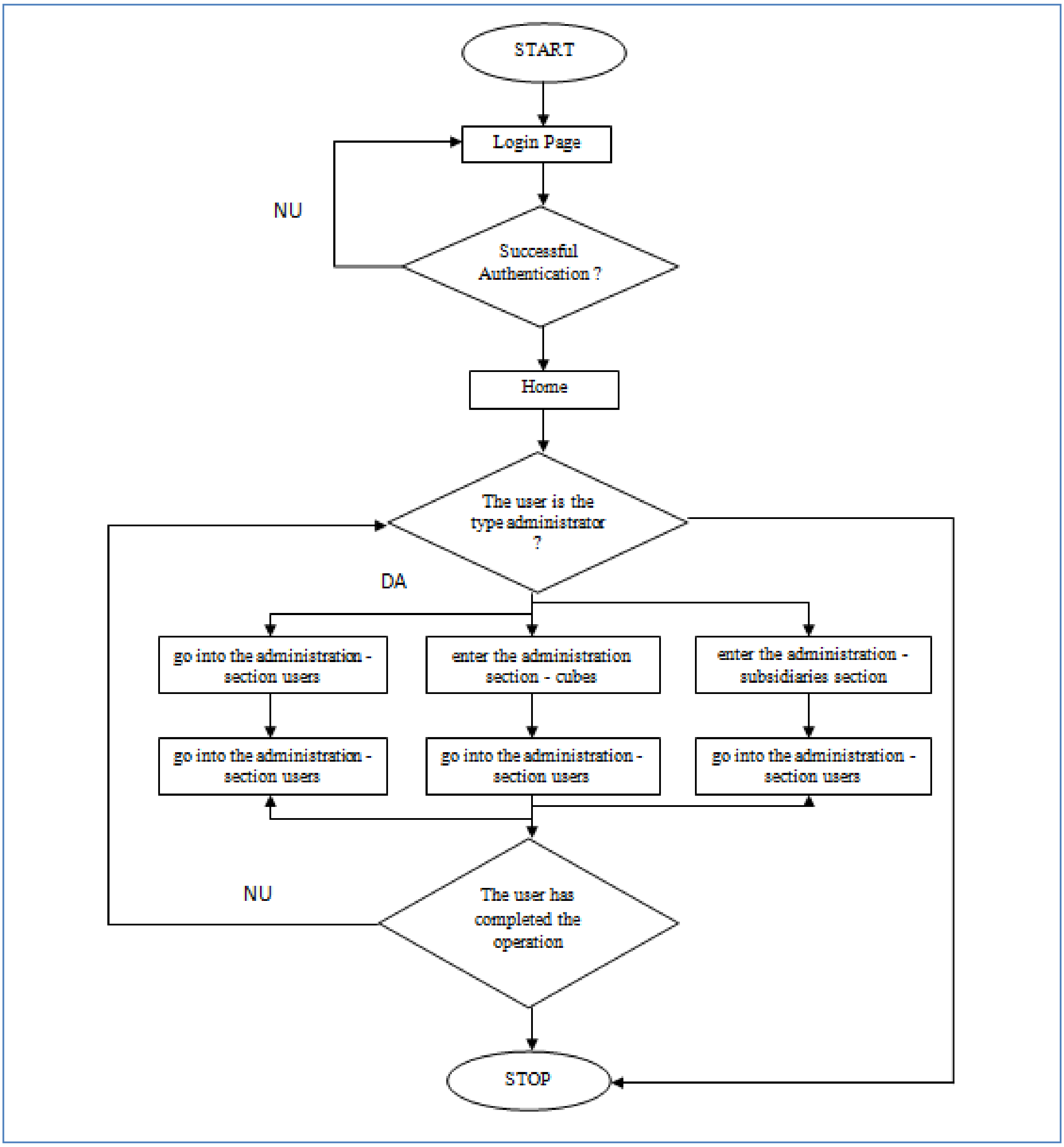

Figure 3 - User / Cubic / Branch Administration

4. CONCLUSIONS

Multidimensional databases and multidimensional modeling are a challenging alternative, in some situations, for spreadsheets and relational databases. Tabular spreadsheets (using pivot tables) provide a suitable analytical support for small data volumes (with a small number of non-linear dimensions) and not for complex data analysis. Relational databases can store and process large volumes of data, high complexity, with numerous optimizations, including retrieval. However, when other manipulation operations are not required, but only intense recovery for complex data analysis, from very large data volumes, relational systems are no longer dealing. The relational model does not provide adequate support for defining hierarchical dimensions. The solution is to integrate relational databases with multidimensional databases.

Data analysis is an increasingly pressing requirement of our day. The desire of organizations to keep up with the speed and complexity with which businesses have to be driven has led to the need to deploy OLAP.

The multi-dimensional cube reporting web application is very useful within an organization that uses Microsoft's OLAP Analysis Services system. It offers a number of advantages:

- For accessing data, complex software is not required, but a simple Internet Explorer browser installed on the client station;
- The user authentication module provides the security required for the confidential data view process;
- Through the pivot table component, the application is an intuitive interface for accessing multidimensional data, without requiring users to know the MDD (Multidimensional expression language) query language;
- The modular structure of the application allows the development of new sections and functionalities that can be added in the future, depending on user requirements.

The application made in this paper is a very useful tool with a high degree of applicability for all users within an organization who need to access data from the Microsoft Analysis Services OLAP system. Following analysis based on the reports created in the application, users can make decisions that lead to success in their activities.

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