

Intelligent Systems, Databases and Business Intelligence

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Abstract: *The development and use of intelligent systems within economic entities allow managers to use stored knowledge to solve complex problems within the entity and to take strategic decisions. Nowadays, the multitude of networks such as Internet, Intranet, Extranet and of other telecommunication networks enables global interconnectivity and therefore planetary manifestation of the entities. Since globalization, the modern enterprise must satisfy the needs of global business in a global informational society so that applications from any point on the globe to be able to access and process the data and knowledge necessary in the worker's knowledge activity. On the other hand, the use of intelligent systems that are permanent, do not go on strike, do not apply for leave, can store, view and process large volumes of data and knowledge and can work 24 hours in 24, provides an independency of management from employees and puts accumulated knowledge available to all managers assisting them in solving complex problems and making decisions.*

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1. Introduction

The category of systems that offers support in decision making processes can be defined by the term "business intelligence". Business Intelligence means making information available to all company departments so that each manager can carry out its own analysis and be able to monitor the evolution of performance indicators in the segment of interest. It concerns all the tools that bring a plus of "intelligence" to the business process. The integration of traditional, operational applications with a broad range of data analysis programs or from expert systems category provides an efficient basis to assist the decision-making process. Intelligent systems offer the possibility of exploitation of knowledge by combining the potential of database technology with knowledge base technology and of expert systems, being pointed out the technology of intelligent databases (Andone, 1997). Considering these aspects, the intelligent enterprise, the expert enterprise, the knowledge-based enterprise (Andone, 2001), was defined as that entity in which it is used currently intelligent systems to solve all difficult problems, "the organization that works in an intelligent manner is the organization that captures knowledge from human experts, stores it in a form accepted by the computer and uses it with specialized programs to solve problems".

2. Decision steps when using Business Intelligence solutions

The future's enterprises called by McHugh & all (Tacu, 1998) virtual companies will be propelled to success by a common vision and management will be achieved through

intuitive processes and techniques and through logical and rational methods which are currently used.

In the process of decision making based on business intelligence solutions can be identified four basic steps:

Analysis - is filtering data from useful information consistent with the business model and identifying performance indicators, analyzing the information in different contexts to identify trends;

Discovering causes - Explaining the causes of certain phenomena that do not correspond to the business model;

Action - Making decisions based on the information analyzed. These decisions are based on projected future effects an action will have (for example, growing sales of a particular product as a result of a promotion). The human component plays an important role in decision-making: he evaluates which of the alternatives will lead to the result. Business Intelligence assists in decision-making through the ability to simulate effects;

Measuring results - In this last step we can evaluate whether the decisions were correct or if the results are exactly as expected. After measuring the results it can be identified the direction in which action must be taken to improve them.

The designing of the Business Intelligence solutions must be based on the requirements of the users who will use it. It must not be taken into account only the management team but any user who will need - in one form or another - the information from that system to develop his activity.

In the Business Intelligence system can be distinguished three types of users:

Users of information - only require certain reports or performance indicators. They use standard reporting and don't need analysis capabilities of information;

Consumers of information - they need opportunities to analyze the information in different contexts and require functions for dynamic data query;

Analysts and experts - are the ones that need the multivariate analysis to identify trends and make major decisions. They need ad-hoc analysis and free access to any type of information from the system.

To get an accurate picture of the categories of system users and meet their requirements, designing the solution must consider the following two fundamental elements:

a. *Locating the information on which the analysis is performed.* These data will be found usually in various existing operational systems: applications Line of Business (LOB), Enterprise Resource Planning systems (ERP), Customer Relationship Management (CRM), human resource management (HR), management of distribution networks (supply chain). All these systems have some common characteristics, among which the most important is that they are transactional systems. Another issue that often prevents the use of data for analysis is that the systems are isolated, and they communicate very little with other systems, and the data are not correlated. When we want to achieve a solution for the analysis of information it must be found a way to integrate data from all these systems.

b. *Users of the system and the types of information needed.* It will be created users' profiles followed by realizing the design of the system and planning the system's capacity based on these requirements.

3. Database technology

Database technology envisage transaction processing, which involves the storage, maintenance and access of large volumes of data representing facts organized in appropriate structures by means of specialized software (SGBD). Systems designed for automating

processes within an organization handle operational related to daily operations. These systems oriented towards transaction processing known (Connolly, 2001) as the OLTP

systems (On- Line Transaction Processing) generate operational data that are object-oriented. Over the years, organizations have accumulated large amounts of data stored in their operational systems. In recent years, attention is focused on how to use the operational data stored in databases and archives, to support decision making process in order to win competitive advantages. Therefore, it is considered the problem of transforming data archives in sources of knowledge that present the user a unified view of data organization. In this sense it has been defined repository or data warehouse known as *data warehouse* that feeds with data from multiple operational data sources and provides the opportunity to achieve a system capable of supporting the decision making process of the organization, using special techniques called OLAP (OnLine Analytical Processing).

The main goal in designing the data warehouse is to support queries by making complex economic analysis that would use the entire amount possessed by collected data to provide information necessary for strategic decision making. There are two ways you can put value on the information from the data warehouse:

- Multidimensional analysis (OLAP On Line Analytical Processing);
- "Mining" the data (Data Mining).

Theoretical OLAP technology was defined by researcher EFCodd ("father" of relational database) since 1993. Codd realized the OLAP manifesto which included a set of 12 rules that should be considered with priority in implementing this new technology. From these the most important rules concerned: unlimited number of dimensions and levels of synthesizing data, transparency of operations of data accessing, consistent support to realize reports, intuitive method of data mining, support for achieving multidimensional queries, client / server architecture and multi-user support. The practical application of these theoretical elements was carried out from 1998 to 1999. An important step was made in early 1999 when IBM and Oracle realized the standardization of OLAP technology at the Institute ANSI. During the year 1999 there were made different versions of DB2 and Oracle (e.g. Oracle Express Server) that opened the possibility of using these new facilities. OLAP functions were gradually included in other relational systems.

To meet the needs of the query in OLAP tools, the SQL language has been expanded with a number of specific functions for processing and analysis of data from the data warehouse. Therefore, the OLAP amendment was made to the standard SQL, the new functions available for supporting OLAP technology offering a lot of new possibilities for the synthesis of data and at the same time significantly improving the tools provided by SQL. The main features offered by the new technology are ROLLUP and CUBE. ROLLUP function adds to the set resulted after executing a standard Select operation, grade tabulation for each grouping level established by the GROUP BY statement. Degrees of tabulation are presented from the lowest level of the hierarchy and then continue to its upper levels. To achieve a multi-dimensional analysis through which to result all possible combination between different dimensions it is necessary to use the CUBE statement.

OLAP assumes the existence of a relational database system capable of executing queries more complex than the ones from the usual databases made on the basis of standard options in the SELECT statement. These operations are performed through multidimensional data structure (visualization is made according to several criteria) through the use of new clauses in SQL statements (such as ROLLUP or CUBE).

In the OLAP technology there are used multidimensional data structures to store data and relationships between them, structures which are visualized in the form of cubes of data

and cubes within cubes, each face of a cube representing a dimension. The information contained in relational databases is thus represented by two essential elements, namely:

- *dimensions* - represents descriptive categories on the basis of which aggregation and grouping of data are realized;

- *values* - represents the data on which operations are performed such as summation, average, minimum, maximum, or any other statistical or mathematical operation allowed by the management system database. .

It is also defined the term *hierarchy* representing the levels of detail for a given dimension of data.

The representative example of multidimensional analysis is represented by database sales.

Thus, in this database, organizing information to achieve queries via OLAP assumes the existence of two elements:

- *dimensions* - represented according to the needs of analysis on the geographical structure (region, county, city, client), or on the structure of the products sold (model, model features, date of sale);

- *values* – represented by the quantity or value of sales (turnover) over which it will be applied statistical and mathematical functions to strengthen data (sum, average, min, max, etc.).

4. Fundamentals on data warehouses

The data warehouse must serve the needs of managers by providing quick responses and in accordance with the requirements of query and presentation. For this, a data warehouse must provide a number of general characteristics shown below:

- a. Physical separation of operational databases.* This requirement aims, on the one hand, providing operatively the information necessary in the decision-making process and, on the other hand, avoiding disruption of operational applications that must meet certain standards relating to response time and security operations;

- b. Orientation towards research theme.* Unlike operational database – centered on functions or applications, data warehouses are organized to target certain subjects of interest to managers, such as customers, products, activities;

- c. Data Integration without exception.* This translates into uniformity of rules used to define data and measurement units used;

- d. Chronological analysis of the data.* Unlike operational data, available only when accessing, data contained in data warehouse are available anytime. From this derives the following features: time horizon of 5-10 years (up to ten days when operational); access code structure that contains the item "time" (day, month, year); prohibiting modification of data stored properly at some point of time;

- e. Historical character of the data within the data warehouse.* This translates into cutting types of operations allowed to just two: initial loading and data access, as opposed to when operational, in which there are performed a variety of insertions, deletions, and updates at a single registration. The consequences of these features are diverse. First there is no potential danger of wrong updates, secondly, it can be achieved the physical design to optimize access without taking into account the requirements of normalization and non-redundancy and, thirdly, there is no need to use complex techniques to ensure data integrity.

5. References

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