

# **DATA WAREHOUSE AND BUSINESS INTELLIGENCE STRATEGIES AND TRENDS**

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**Abstract:** In recent decades following the evolution of information technology, decision support systems have played an important role by presenting the necessary information resulted from the operational systems processes. By continuing improvement of the methods as well as the contribution of technological advance the applicability of decision support systems is now generalized and has reached the status of complex systems of business intelligence. Business Intelligence is about creating intelligence about a business based on a cyclic flow which consists of capturing, analyzing, planning and implementation resulting in streamlining the organization.

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## **1. INTRODUCTION**

To deepen the concepts behind the decision support systems, the intrinsic link between the temporal evolution of the management and information systems must be emphasized. Management comes from Latin, the word "manus" meaning hand and means "handle" or "steer".

Management is defined as the science and art of leadership and organization of teams or organizations. Management aims to achieve the objectives of the plan and performance of organizational structures by optimizing and selecting all the intellectual and physical resources and the materials for the specific structure or project (Opran, 2002).

One of the key of management is the decision that can have two forms, namely the act itself and the decision making process. The difference between these two approaches is done by the complexity of the environment that involves a decision. Decision means, in fact, the contextual process of selecting from the multitude of possible alternatives, depending on the assumptions taken into account.

For the decision process the priority is represented by the type and complexity of reasoning, decisions can be taken in conditions of certainty, risk and uncertainty.

Decisions can be classified on the basis of numerous factors mentioning here:  
a) The approach and progress of the decision-making activities. G. Boldur-Latescu (Boldur-Latescu, 1992) identified five types of approaches: random, routine-based, through the use of analogies "almost mechanical" with situations encountered in the past, based on learning (or training), which adapts the earlier decisions according to the assimilation of new knowledge, paradigmatic-imitating decisions by making copies of

processes which led to remarkable results and based on systemic analysis and modeling;

b) The decision-making – R.T. Clemen (Clemen, 1997) remarks that the decision context is the framework of events that determine the set of objectives that actually matters (and nothing more or less) for a decider at the time of drafting the decision, even if the values remain relatively unchanged;

c) The number of participants and the collaboration;

d) The degree of structuring. This classification is based on various decisions that can be programmed or described as an algorithm or un-programmed.

The ideas exposed so far have shown the diversity and difficulty of adopting good decisions that will lead in a reasonable manner to proper results.

This illustrates the necessity of assisting the decision-making activities in an organization by means of systematic analysis methods using a specific class of systems – Decision Support Systems (DSS). It is important to notice that even if the decision support systems have an important role in the processes of decision the manager should initiate the process by choosing the appropriate set of requirements, only in this way problems are identified and resolved. The objective of a DSS (Filip, 2004) is to minimize the effects of the limitations and constraints in solving of a large and complex area of decisional problems by implementing automatic processes of decision support.

## **2. DECISION SUPPORT SYSTEMS (DSS)**

Decision Support Systems (DSS) are computer applications and tools for collecting and analyzing the information in order to assist managerial decision.

J.A. O'Brien defines DSS as those IT systems which are based on the use of analytical models, specialized databases, judgment and intuition of the decider and a process of interactive modeling which supports the semi-structured or unstructured decisions took by managers. The main objective of the decision support systems is to improve modalities for the decision adoption or creating a preparatory study for taking the best decision where the activities to be developed for this purpose are not programmable (O'Brien, 2004).

Different authors propose different classifications. Based on the relationship with the user, P. Haettenschwiler differentiates passive, active, and cooperative DSS (Haettenschwiler, 1999) . A passive DSS is a system that just collects data and organizes it effectively; it helps the process of decision making, but cannot bring out explicit decision suggestions or solutions. An active DSS can bring out such decision suggestions or solutions by processing data. A cooperative DSS allows the decision maker to modify, complete, or refine the decision suggestions provided by the system, before sending them back to the system for validation.

D.J Power suggests other criteria's for defining DSS taxonomy (Power, 2007). These include the model driven DSS, communications driven DSS, document driven DSS, knowledge driven DSS, web based DSS and data driven DSS.

Model driven DSS consists of systems which are using financial models, optimizations and simulation models. A model-driven DSS is based on the access and handling of a model.

Communications driven DSS include network technologies to facilitate decision-relevant collaboration, communication and decision support. A communications-driven DSS is communication oriented DSS and is focused on the non-functional requirements of the organization.

A Document driven DSS help managers to manipulate unstructured information in a variety of electronic formats. A database with powerful engine may include scanned documents, hypertext documents, images, sounds and video.

A Knowledge driven DSS provides expertise in solving specific problems.

Knowledge driven DSS can suggest or recommend actions to managers. These DSS are using specialized models and patterns for data processing and identifying relationships between them.

Web based DSS are IT systems who deliver the necessary decisional information to managers based on web technology. Today interconnectivity is created between databases and applications as well as between different applications. XML (Extensible Markup Language) provides a way of exchanging structured and unstructured data between applications.

A Data driven DSS or data-oriented DSS is mainly a complex system in which the data is represented at both level, detailed and summarized with a well established structure on the basis of a specific data model to facilitate the both main functions, data loading and data analysis and presentation.

In the last two decades some other components of a data driven DSS framework like data warehousing, on-line analytical processing (OLAP) and data mining start to become the core for this type of systems.

### **3. DATA WAREHOUSE SYSTEMS**

As I already mentioned data warehouse systems are data driven decision support system. A data warehouse is a specialized database environment that is answering to specific needs and requirements of deciders on different levels of hierarchy within an organization. It includes complex data structures from the detailed to the aggregated data, extracted from external systems that could be file systems, on-line transaction processing systems, internet etc.

The concept of data warehouse is dating from 1988 when researchers from the IBM Corporation, Barry Devlin and Paul Murphy have defined the concept of information warehouse or business data warehouse (BDW) that shows the general architecture of the extraction, transfer and load of data from operational systems to data warehouse system (Devlin and Murphy, 1998).

Currently there are two main architectural approaches for a data warehouse: the Kimball Data Warehouse Bus (BUS) and the Corporate Information Factory (CIF) are considered the two main types of data warehousing architecture. P. Rob and C. Coronel (Rob and Coronel, 2007) remarks that W. Inmon theory is based on top-down approach and support the idea of transferring data from operational databases to a central database that is subject oriented, integrated, non-volatile and time-variant arguing that the data warehouse systems are focused onto a global function that is not addressing a specific department. Contrasting with the data warehouse where the data are normalized, each data mart is developed at the department level, data is non-normalized and summarized for a specific department.

R. Kimball theory is based on bottom-up approach, data marts can be contained in the data warehouse and in fact they represent the data warehouse and linked by a bus structure that should contain all the common elements used for data marts sites known as conformed dimensions and measures. The most common topologies is the star

schema and snowflake schema where dimensions tables are normalized and have their own dimension tables.

Data warehouse system is only one component of decisional support systems. A modern data driven decision support system, a business intelligence (BI) system consists of three main components: the data storage component, the extraction and filtration component and analysis component.

Analysis components of a data warehouse system are used to support tactical or strategically decisions by performing data retrieval, data analysis and data mining.

Analysis and Reporting can be done by following applications:  
a) classical reporting applications are applications that involve static reports. These kinds of applications that have minimal analytical requirements are based on relational databases and use SQL language;

b) ad-hoc query and reporting applications offer to the end users a high level of interactivity by using the techniques of navigation and selection of data;

c) analytical applications (multidimensional) can answer to more complex questions other than those for ad-hoc reporting and are based on multidimensional techniques;

d) applications for extraction and planning (data mining) - are designed in such a manner so the end users can discover new patterns based on historical data stored in the database.

#### **4. BUSINESS INTELLIGENCE TRENDS**

Before defining the concept of business intelligence I have to emphasize the differentiation and classification of organizational data types. The data represent objects, processes, states and events that can be represented in the abstract by text strings, static or dynamic images, vectors etc. The data may be located in a state of structured, semi-structured or unstructured. Information's are valuable and quality data or their matrices that have a role in the decision making process.

Business intelligence is a term used to describe an integrated set of methods, applications and processes used to capture, collect, integrate and analyze data to present information used for management decision.

As already indicated business intelligence systems are modern data driven decision support systems using leading edge information technology like data warehouse or data mart, ETL tools, data query and analysis tools, data presentation and visualization tools, components that could be included in service oriented architecture.

H Dresner (Dresner, 2001) emphasizes the fundamental importance of a business intelligence system: Doing business is information-intensive. Enterprises are being pushed to share information with increasingly more audiences. The business intelligence imperative insists we elevate BI to a strategic initiative now, or risk disaster! (Dresner, 2001)

Within organization, information management plays a critical role. Even if there is recognition of the role played by business intelligence solutions and value of information is recognized, even though, there is no full maturity of this area (Richardson, Schlegel, Hostmann and McMurchy, 2009). Based on several BI implementations and Gartner forecast, the following trends are emphasized:

a) Performance - information generated by various organizations continue to increase. The primary objectives will be the Performance and Capacity Management processes in order to ensure that adequate capacity and sufficient performance exist in the IT infrastructure to support day-to-day operations in a cost-effective manner. One

solution is to implement a flexible data warehouse framework using an inter-layers model that will show interdependencies between information requirements, overall architecture and performance and capacity of the system

b) Technology

Standardization of BI tools

Innovation from new like virtualization, search, SOA, SaaS

Adoption of open-source BI platforms will grow faster than adoption of commercial platforms

c) Architecture

- Interconnectivity of OLTP applications with BI tools for a decision support in real time.

- Increasing the role of unstructured data such as mail, presentation, documents, various stored assets.

- Master data management (MDM) - an integrated framework that address methods, processes and techniques for the identification, definition, analysis and management of data from a global perspective to ensure the unity of the information organization

- Increasing role of operational data store (ODS) - subject oriented, integrated, volatile, current valued repository

d) Customer Centric

- Needs-base Customer segmentation - decision support systems aiming to predict consumer behavior should not leave out the psychological aspect. No matter how close consumers are to a brand or a company, no matter how often professional research studies are conducted, no matter how many loyalty systems or promotional actions get implemented, customer behavior may at any time surprises marketers and it is the task of business intelligence to take into account this element of unpredictability and minimize its effects when designing marketing programs

- Customer Experience Management Implementation should be focus also on emotional aspects. The scope is to create a system that address both marketing and sales and take a 360 degrees view regarding customer behavior and include both functional and emotional terms.

I have to emphasize that the basis of a business intelligence systems is the need to optimize costs by managing and shaping a complex organizational environment. The business intelligence solutions should be able to support different hardware and software technologies, to be able to meet both functional and operational requirements. All the services must be combined into a unified architecture based on the analysis and design stages so the organization's business requirements should be fulfilled. In fact for a proper design of a data warehouse, a flexible framework must be considered, a framework that considers interdependencies between information requirements, design and performance of the system.

The business intelligence systems must integrate a foundation scalable infrastructure, a data warehouse model and a wider vision of business intelligence to enable advanced management information including detailed analytics, protecting organization investments in skills, efforts and infrastructure.

## 5. CONCLUSIONS

The ideas exposed so far have shown the diversity and difficulty of adopting good decisions that will lead in a reasonable manner to proper results. This illustrates

the necessity of assisting the decision-making activities in an organization by means of systematic analysis methods using a specific class of systems – Decision Support Systems (DSS).

The trends figured shows that business intelligence, component of DSS systems has become integral to day-to-day operations, propelling the technology into mission-critical status.

At the same time, a number of factors have increased the complexity and changes of business environments. The global business requirements reveal the need for many unique and interlinked key business attributes based on main criteria's like relevance, impact and feasibility.

This article considers the business intelligence environment an integrated framework and emphasized the linkage between the functional and operational processes. The organizations must adopt an enhanced, integrated and flexible business intelligence enterprise model that considers various business, functional and operational requirements and linkage between all the data warehouse components.

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