BIDM: The Business Intelligence Development Model

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Abstract: Business Intelligence (BI) has been a very dynamic and popular field of research in the last few years as it helps organizations in making better decisions and increasing their profitability. This paper aims at creating some structure in the BI field of research by creating a BI development framework that relates the current BI development stages .This framework can be used by organizations to identify their current BI stage and reach the desired one.

1. Introduction: BI & Maturity Modeling

In nowadays economy, organizations have a lot of information to gather and process in order to be able to take the best decisions as fast as possible. One of the solutions that can improve the decision making process is Business Intelligence (BI). BI systems "combine data gathering, data storage, and knowledge management with analytical tools to present complex and competitive information to planners and decision makers". Another interesting definition is the one given by (Eckerson, 2007) who believes that BI represents "the tools, technologies and processes required to turn data into information and information into knowledge and plans that optimize business actions."

We can see in both definitions that BI helps the decision making process by transforming data into knowledge by using different analytical tools. But, throughout time, BI has evolved from rather simple, fixed reports to real-time analysis. However, even if some literature about BI in general can be found, there is not much scientific research done regarding the evolution
Of BI and each of its development stages. A starting point for our framework is represented by the maturity models. Essentially, they describe the development of an entity over time,
where the entity can be anything of interest: a human being, an organizational function, an organization, etc.

Maturity models are characterized by a number of sequentially ordered levels with certain requirements that the entity has to achieve on that level. Moreover, two models that can be a starting point in assessing the BI maturity in a company would be the BI Maturity Model developed by (Chamoni & Gluchowski, 2004) and the Data Warehousing Institutes BI Maturity Model(2009).

We based our work on previous experiences, researches, articles and studies that we'd been developed. Thus, we followed the next classical steps: analyze, design, develop and applying for the project lifecycle the framework. For the implementation phase we used different BI techniques, like data warehousing, OLAP, data mining, portal and we finally succeeded to implement the BI system's prototype and to validate with the managers and executives in one national company. The system gathers data, using the ERP system, to extract data from different functional areas or modules such as: financials, inventory, purchase, order management or production. For the executives, the system is able to provide analytical reports and dashboards. As the storage solution we designed and build a data ware-house. The major problem is that there will be many more changes in the structure of the organization and the impact of these changes may affect the BI system. So, we need to find a solution, we defined a set of object-oriented extensions that can be used for modeling the components and requirements of a data warehouse. Also, we had to consider the system's development lifecycle that has to be flexible and easy to fulfill.

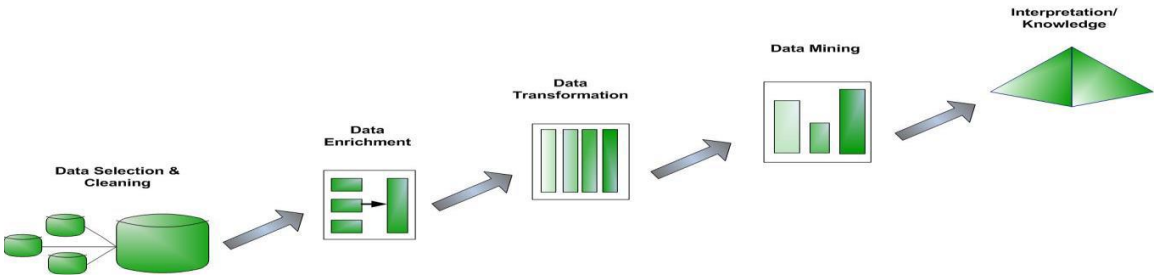

Fig: Knowledge Discovery Process Steps

2. Research Motivation and Methodology

Even if BI seems to play an important part in the present economy, scientific research in this field is limited, though research possibilities are many. Most of the available literature is about data warehousing (Inmon, 2002; Kimball et al., 2008) online analytical processing (OLAP)(

Chaudhuri & Dayal, 1997; Thomsen, 2002) and data mining (Fayyad et al.,1996;Holsheimer & Siebes,1994; William et al., 1992). However, in the last couple of years, new concepts such as real-time business intelligence (Azvine et al., 2006; Panian, 2007), data analytics (Seufert & Schiefer, 2005; Eckerson, 2007), embedded BI(Azvine et al., 2006; Davis& White, 2008) and business performance management (Golfarrelli, 2005; Nagpal & Krishan, 2008)have developed as research interests in this field.

Our BI development model will be developed using a design research approach is used (Vaishnavi & Kuechler, 2007). Hence, our research is structured into the following steps: - awareness of the problem, suggestions for the problem solution, development of an artifact problems solution, evaluation and conclusion. The first step was accomplished by doing a thorough BI literature research and examining professional magazines and websites. Based on this review, we realized that the BI field is very broad and it involves constant evolution. However, most organizations are not aware of all the possibilities that BI offers and how they can achieve great benefits from having a mature BI insight. In order to solve this problem, we developed the BI development framework. Finally, conclusions regarding our model and future research agenda.

3. The Business Intelligence Development Model (BIDM)

Even though the available literature on BI is very broad, there is only one paper that describes a BI maturity model and it is in German (Chamoni & Gluchowski, 2004). It considers five BI maturity stages and analyzes them from three perspectives: people, technologies and organization. The basic idea for our framework is inspired by (Chamoni & Gluchowski, 2004) and by the BI maturity model developed by The Data Warehousing Institute (TDWI, 2009). The latter six-stage model shows the trajectory that most organizations follow when evolving their BI infrastructure (i.e: prenatal, infant, child, teenager, adult, sage). However, the TDWI model presents different perspectives of BI adoption by drawing several graphs: the BI Adoption Curve, the Local Control versus Enterprise Standards curves, the BI Usage, BI Insight and BI Business Value curves. Also, for each of the stages, some other interesting information is provided, such as necessary architecture, scope, type of system, analytics, users, BI focus and executive perception about the role of BI. Nevertheless, these concepts are not explained and they cannot be depicted very easily from the model. Also, there are more characteristics that could be determined in order

to create a better insight on the BI field. This is what our model tries to do. It involves six stages (i.e: predefined reporting, data marts, enterprise-wide data warehouse, predictive analytics, operational BI, business performance management) with several characteristics categories. Each characteristic can be assigned to one or more stages depending on the maturity of a certain stage. In this way, a company can assess its BI maturity as some characteristics are typical for lower maturity stages, whereas others are met only in very mature BI infrastructures.

4. Business Intelligence Conceptual Design Model

In order to gather data from various sources and ERP systems those are implemented in an organization from different functional areas or modules such as: financials, inventory, purchase, order management, production we need to analyze and design the business model and strategic requests. This model has to be mapped on a logical model and physical model in the data warehouse and also used for extracting and presenting data through OLAP technology. These models are known as multidimensional models and basically, they represent an extension of the relational model or ER schema or a multidimensional view over facts.

Multidimensional models are classified in two major types: models that are an extension of ER model are based on a star schema and consist in the relationship between some dimensions and facts or measures and n-dimensional cube based models that use a multidimensional view over an individual situation or data.

In Business Intelligence Systems, the multi-dimensional model that is used has to be able to overhear the business requests. All we need is a business vision over data structure so the star schema or the n-cube based models have to design and incorporate business aspects or demands not only the facts or the relationship between data. The managers and executives request a synthetic view over facts and indicators and these key performance indicators are built from the entire organizational data or even external data.

Also, the system have to provide a friendly graphical interface with advanced capabilities of slicing and dicing through data and easily get a new perspective over data by rotating dimensions and drill down or roll up over hierarchical levels. So we need a multi-dimensional model in which these operations can be made easily, in real time and that can it overhead the entire business model with relationship between dimensions, facts and hierarchies and it is based on the entire organizational data at operational level, tactical level and strategically level.

Based on these considerations we propose an extension of the star or the constellation schema but with aggregate data and hierarchies in fact tables not only in dimension tables. The model is structured over three distinct levels and we can call it a pyramidal model with the following structure.

- *Organizational level (or the base of the pyramid)* – containing dimensions and facts with an organizational scope, at a general level, that shape and are common to the entire activities. Such dimensions can be: <time>, <zone>, <product>, <currency> and facts: production, purchasing etc. Data are at a detailed level with multiple hierarchies over each dimension table.
- *Departmental level* – containing dimensions and facts for the departmental levels of the organization and particular activities in these departments or field of interests, group by data marts or data centers. Such dimensions can be: <account>, <client>, <vendor> and facts: stocks, payments, sales etc. Data are at a detailed and aggregate level with specialized hierarchies over each dimension table.
- *Strategically level* – containing dimensions and facts derived from the base dimensions and facts, with specific elements for the strategic analysis, like <intercompany>, <plan>, <budget> and facts: cash-flow, KPIs. Data are at an aggregate, synthetic level with specialized hierarchies over each dimension table.

  The main characteristic of the model is that between the dimension tables and the facts from different levels of the architecture can be establish a relationship and also the fact tables can have hierarchies and class attributes that can be used for drill down or roll up.

Advantages of Model:

- *Flexibility* – New elements or objects like new dimensions or facts can easily be included in the model without affecting the existing architecture or remodeling the system and the loading process for a specific level can be made without refreshing the whole data;
- *Real model of business requirements* – The three level architecture is based on the real model of business requirements thus this model can be mapped on the each level of the pyramid;
- *Performance in the drill-down or roll-up operations* – Because the dimensions and facts are separated at each level we can easily navigate through hierarchies from a level to another;

- *Incremental development* – The model can be built in stages and each stage can be validated and used before the next stage;
- *EIS, MIS and DSS support* – The top level can be used to implement an Executive Information System (EIS), the bottom and middle levels can be used for design and realized a Management Information System (MIS) or a Decision Support System (DSS) because these systems can use the specific dimension and fact tables from these levels.

Disadvantages of Model:

- *High complexity* – Because it is containing three different levels, the business model need to be careful analyzed and designed in order to identify the proper and suitable dimensions and facts and also the hierarchies at each level. An inadequate choice can have a major effect on the performance of the entire system;
- *Moderate performance of the interrogation process* – In order to perform a complex query the model need to establish many relationships and joins between the fact and dimension tables and this can reduce the performance of interrogation;
- *Top-down and bottom-up development* – In order to overhear the entire aspects of the business process we need to build the systems in two directions: first top-bottom to model the strategic requirements and second, bottom-up for validating and setting up the hierarchical flux of data. The pyramidal model is suited for business needs and can be developed and implemented through an object oriented approach, defining classes for dimensions and facts, following the rules of the Object Oriented design. The prototype will have the main functionalities of the business model and when there will be any change in this model and a new business requirement appear then new functions or new attributes can be added to the main classes to complete the demands.

5. Criteria for Evaluating Business Intelligence Systems

A problem of BI systems is measuring success. There are some case studies evidencing benefits generated by organizations that are successful with the use of BIS, but with limited empirically validated measures. There have been several studies calling for the development of a measure for evaluating the business performance effects of BIS. In deploying a BIS there are many risks involved: system design, data quality, and technology obsolescence. System design risks stem from poor conceptualization of an enterprise's true business needs before the

technology is deployed. Data quality risks relate primarily to whether or not data has been properly cleansed. Technology obsolescence refers to the failure on the part of the vendor to anticipate new technologies. Large budgets and strategic information are involved in deploying BIS systems – this is the reason to establish rigorous criteria for evaluating such systems. These criteria are discussed below.

- *Decisions based on business process*

BIS should not be viewed only as a data repository or a large set of data. Instead, system's implementation should be concern on conceptualizing new data models, processes, and indicators that form the content of BIS; also it should provide extensive understanding of the benchmarks that are useful to evaluate business processes.

- *Performance*

This feature typically refers to the response time that a system provides to its users. Most responses should range from a few seconds to a maximum of 30 seconds for routine queries. Response times depend on the complexity of the database and the queries being requested.

- *Flexibility and scalability*

Flexibility determines whether a BI solution can continually adapt to changing business conditions after the system has been delivered. BIS should be able to accommodate changes in any type of business process and functions like personnel, services, and processes, as well as new mandates, laws, and regulations requiring the capture of different types of data. BIS should be expandable to accommodate data growth and changes to organizational structure. EIS also should allow contributed content to grow without a slowdown in performance.

- *Integration*

Integration involves two types of issues: *data integration* and *system integration.*

Data integration is the ability to access data from much different type of systems, so BIS will be particularly effective if it can overcome the challenge of information fragmentation, allowing executives to measure features of business processes that involve information from inside and outside of the organization. System integration refers to two things: the ability to extent the BI software with new capabilities and modules and the system's ability to coexist with other enterprise solutions.

- *Friendly user interface*

BIS should be designed to allow managers who are not trained to use query languages and advanced technologies, a fast, easy, and understandable way to navigate into data and identify trends and patterns. BIS should permit the user interface to accommodate different degrees of technical knowledge.

6. Conclusion:

BI systems have a powerful impact on strategic decisions quality to reduce the time for making decisions and thus these systems must have the ability to allow managers to view data in different perspective, to drilldown and rollup to aggregate levels, to navigate and online query data sets in order to discover new factors that affect business process and also to anticipate and forecast changes inside and outside the organization. BIS improve the quality of management in organization through new type of technology and techniques for extracting, transforming, processing and presenting data in order to provide strategic information. One of the major risks in the process of developing a BIS is the system design that stem from poor conceptualization of an enterprise's true business needs before the systems is deployed and for every change in these requirements the prototype must be also revised. A solution for covering this risk is object oriented modeling of a data warehouse that helps us to improve the designing phase and the development cycle and also we can reuse some parts of the prototype that it was implemented in an organization in order to design and implement another prototype in other organizational environments. So, object types can store structured business data in its natural form in object tables and then allow applications, such as OLAP applications, to work in a multidimensional way using the object oriented properties and facilities.

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