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NEW DIMENSIONS IN BUSINESS INTELLIGENCE

Summary of Doctoral Thesis



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We announce that on September 26, 2013 at 10:00 am, in Room 417 B, Building B FEAA, Ms Berta D. DORA - ANCA will defend, in public the doctoral thesis entitled NEW DIMENSIONS IN BUSINESS INTELLIGENCE, to obtain a doctoral degree in CYBERNETICS AND STATISTICS

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Keywords: Business Intelligence, Web, Social Business Intelligence, Semantic Business Intelligence

It is easy to see that for a company to be differentiated in a niche the quality product or service, its promotion and marketing strategy are not enough, a good product is promoted through an excellent marketing plan by adopting an aggressive policy, which is only a part of a successful sales process. The key to success depends on both the ability of the organization to perceive correctly the market rules, tactics and strategy and on the awareness of strengths and vulnerabilities of your own organization and your competition. To make best decisions over a short period of time, managers need useful information to be available continuously, and recently Business Intelligence seems to become a response to this challenges.

Recently, there has been an emergence and development of a new generation of Business Intelligence based on methods, tools and technologies different from those used until now, with the same purpose: to analyze both internal and external company data in an extensive virtual world.

So now, we can identify two dimensions of Business Intelligence:

a) Social Business Intelligence - in order to analyze data from social networks

b) Semantic Business Intelligence - moving towards aligning to new challenges of the Semantic Web.

Abstract

In the **first chapter**, the Introduction, we established the hypothesis, purpose, objectives and research methodology.

Thus, the purpose of this study is to investigate and highlight the changes that the WWW brings to Business Intelligence

The basic hypothesis of this research is descriptive in nature, designed to be tested by means of qualitatively analysis, and is formulated as follows:

H: There is a significant impact of the Web on Business Intelligence solutions.

General objectives to achieve this goal are:

O1. To establish conceptual boundaries for BI (definitions, approaches, classifications etc.) and the correlated concepts (eg SAD, Business Analytics, Competitive Intelligence, etc.);

O2. To establish the current level of knowledge in the field of study;

O3. To determine the perceptions of experts who produce BI applications;

O4. To analyze specific Web 2.0 and Web 3.0 technologies and the relationships between these and business intelligence;

O5. To describe the specific theoretical and practical elements of Social and Semantic BI (features, structure, functionality).

The thesis is divided in three parts, each part using a special approach, the order of approaches being the following:

- **The conceptual approach** to Business Intelligence, in general, and the existing research directions in Business Intelligence is in Chapter 2

- **The methodological approach** presented by the quantitative and qualitative research in Chapters 3 and 4;

- **The scientific approach** based on relevant articles and case studies shows the impact of the WWW on Business Intelligence, is highlighted in Chapters 5 and 6.

In the **second chapter**, entitled **Business Intelligence –A Conceptual Framework**, a theoretical framework was defined to describe and clarify the concepts of *Business Intelligence*, as well as those related to it.

In terms of BI terminology, there is a set of controversies, starting from the translation of the word into Romanian ("economic intelligence", "business intelligence", "intelligent business", "intelligence in business" "analysis and intelligent reporting" or "business research"), the relationship with the Support Decision Systems, definition, meaning, structure etc. To avoid confusion, we decided to keep the phrase

Business Intelligence in English. Regarding the belonging of BI to SDS class, it is considered that BI is a step up from the past, which is an evolution and at the same time a transformation of SDS.

Contrary to the SDS, BI is applicable at the whole organization, the extent and type of decision problem, the complexity of the application are just a few aspects that differentiate the two.

Concerning the delimitation of BI, we chose 30 definitions established in the literature that we have analyzed, and we concluded that BI can be seen as a process, strategy, managerial tool, application processing and synthesis of information, technology/group technology or an economic espionage tool. In our opinion, *Business Intelligence* is a term that defines a set of specific business computer applications used to analyze corporate data with the aim to transform them to transform into meaningful information for management decisions.

As we found several types of BI in the literature, we made a classification according to the following criteria: the type of decision, the cost, the Internet infrastructure, the implementation, the complexity, the shape of results, the relationship between BI and "AGILE" methodology, the relationship with other company software, analytical ability and method of information dissemination.

In BI, there are a variety of potential technologies and approaches that support different types of users in the organization, according to the needs, budget, size, the type of activity and the importance of data of a business, this is the reason why we have discovered several structures of BI (Langseth, J. and Vivatrat, N., 2003, Eubanks, G., 2008; Vercellis, C., 2009, Ranjan, J., 2009). From these structures, we have chosen to describe in detail the one proposed Eubanks, that BI is composed of: Data Warehouse, Data Mining, OLAP, Balanced Scorecard and/or Key Performance Indicators, as this opinion is the closest to our perception of BI.

Chapter three, A Literature Review on Business Intelligence, is structured in two parts: in the first part, we provide a brief overview of the specialized literature on BI to obtain an overview of the level of development in BI research between 1993-2013. Thus, we have found that trying to follow the technology, Business Intelligence goes through several phases, extending its functionality to be used on a tablet or mobile phones, to Mobile BI, a socialization mobile being added, to Social BI – adding a cloud computing technology (Cloud BI) or adding specific Web semantic technologies - *semantic BI*.

Regarding the future of BI, experts see several directions for development. One of these directions for the development BI to a new concept, *location intelligence*, this represents the ability of BI to support spatial data, as well as to delineate the geographical contexts for data organization. Also, the concern of BI producers will be to introduce, as a component part of BI Technologies of the Big Data type and non-relational data management technologies. Companies realize that Hadoop and other NoSQL analytical databases can provide a solution for situations where the complexity of the analysis of the data exceeds the capabilities and limitations of the SQL language in their existing relational data bases.

In order to provide arguments brought up in the thesis and find out how articles are published on BI (e.g. predominant discipline of BI, the type and weight of the works according to the subject, the preference for publishing of authors based on content type, etc.), we conducted an exploratory study. Thus, we selected a number of 100 articles that were submitted to the MCA (Multiple Correspondence Factor Analysis) analysis.

Similarly, by analyzing the top of technology priorities of companies between 2005-2013, conducted by Gartner by comparing the frequency of the appearance of articles, we found out that there is an influence of the position in the top of technological priorities of companies and the number of articles in specialized literature.

As we wrote earlier chapters using information from secondary sources and opinions obtained are mainly theoretical, **chapter four, Business Intelligence in Practice**, intends to move towards practice. Thus, we investigated the perception of experts who produce BI applications on the creation of a BI application using specific tools.

The perception of specialists who produce business intelligence applications was determined using the in-depth interview, the sample considered, consisting of employees of a company that produces BI solutions for companies that operate in the IT, Mind Software Romania and a software company that provides telecommunications services, Cosmote Romania. Categories of employees targeted for the interview were: analysts, programmers/ developers and testers.

The conclusion we reached is that the BI applications in these companies are nothing but a class of more specific reports, with higher data aggregation capabilities and a graphical design which is more accessible and easy to interpret.

To demonstrate the capabilities of the technologies described in the previous chapters, we used a case study based on a large database in the field of mobile services management, the purpose of this study was to conduct a BI application in the form of reports. To produce, this application we used the following applications: Oracle 11g., an application for Data Integration - Talend Open Studio for Data Integration and an application to create the universe and reports for *Business Intelligence*, SAP Business Objects Edge Business Intelligence Series 3.1.

In recent years, Online Social Media, has attracted the attention of marketers, advertising agencies as well as of companies due to its popularity among users. **Chapter 5, The Influence of the Phenomenon of Online Social Media on Business Intelligence**, aims to investigate the alliance between the *Business Intelligence* and *Online Social Media* (OSM) by analyzing the social environment, through Social BI.

To see first hand what is the influence of social networks on business, we conducted a small study. We monitored the activity of some online IMM for a period of 21 weeks, being interested in their website pages and business promotion on Facebook. We chose Facebook, because in 2012, it was the most used social media tool by companies, at least, 49% of them used the socialization network Facebook to interact with their customers (Stelzner, M., 2013, p.5). The results showed that there is a correlation between a company's Facebook fans and the visits on the web it gets and we have discovered that the phenomenon can be explained in a proportion of 30%, which is quite normal: those interested in the website, visit it directly from browsers / search engines. Unfortunately, the limited number of companies we analyzed cannot support a generalization of this study, but we consider it a great starting point for a direction for future research.

The first step in the Social BI area was done by the emergence of Social CRM, their role being to analyze the online social customer. Once this step has been taken, there was only one more step towards Social Business Intelligence solutions.

The best known solutions for Social Media data analysis are: Radian6/Salesforce Cloud, Lithium, Collective Intellect, Sysomos, Attensity360, Alterian SM2, Crimson Hexagon, Spiral16, Webtrends, Converseon, attentio, Visible Technologies, Cymfony, Buzzcapture, BuzzLogic, Meltwater Buzz and Brandwatch, SocialMention. Analyzing these solutions, but also literature, we concluded that Social Business Intelligence is limited to track and analyze opinions found online about a brand or product. Unlike traditional BI tools, which focus on what happens inside, a BI Business Social on the current market, offers a different perspective, providing information on the outside, what customers, suppliers and business competition say and do. In other words, in this chapter, we have proposed a possible structure of Social BI, starting from the idea that it should include in its composition, in addition to the traditional BI application where business data is stored and analyzed, the "listening" tools of the social Web that will store, and also analyze data from web sources like social networks, forums, blogs, etc., that could be accomplished if, in our opinion, creating a data Mart dedicated only to these data and subsequently integrated into the organization of data Warehouse.

The role of **chapter six, The Semantic Web and Business Intelligence**, was to identify, describe and analyze the impact of the Semantic Web on Business Intelligence solutions, embodied in the emergence of a new generation of BI, generically called *Semantic Business intelligence*.

In the first part of this chapter, we described some aspects related to the terminology associated with the Semantic Web. The Semantic Web technologies have been developed as a premise process automation and improved service that enables data integration and interoperability by adding a semantic part. The most known and used semantic technologies, each technology has exhibited a distinct role: to describe the data and create controlled vocabularies: RDF, RDFS, OWL, SKOS, to query semantic data, SPARQL, to automatically extract information from pages Web-GRDDL and to complete the exchange rules between semantic data - RIF.

The principles of the Semantic Web have begun to be applied since 2007, when part of data began to be published in accordance with preferences, in this way, in 2012 it reached more than 50 billion triples interconnected by more than 200 million connections). Such a large amount of data entails a growing interest in applications of semantic analysis to business data, so that the interests of producers of BI is moving towards a new kind of BI application, generically called Semantic BI. The scholarly interest in Semantic Business Intelligence began with research projects (e.g. Musing, CUBIST and Monnet) developed by prestigious universities around the world in partnership with private IT organizations. On the solutions market, two products are Semantic BI: Business Intelligence Semantic Model of Microsoft and SAP BusinessObjects BI 4.0 SAP. In our opinion, neither of these solutions seems to be Semantic Business

Intelligence, since they do not employ semantic technologies and they do not directly address the semantic data integration.

Conclusions, contributions, limitations and future research directions

The topic, by its nature, is interdisciplinary, being at the confluence of several research areas: IT, marketing, management and behavioral sciences. Thus, besides the business informatics approach presented in all the chapters, in the second chapter we find elements of management theory, in Chapter 5 the Online Social Media intertwines with marketing and behavioral sciences, and chapter six, where we discuss the relationship between BI and Semantic Web has an abstract nature, specific to pure computer science.

After studying specialized literature, it is clear that BI can be seen as a set of technologies and at the same time, as an ability of an organization to convert the data it holds into specific information that are always at the disposal of decision makers and that can create a competitive advantage for the organization, and that BI can be a technique of economic espionage.

With the view of defining the current state of knowledge, the more precisely we established part of literature review through an exploratory study based on a sample of 100 articles. Thus, using graphs after applying Factorial Multiple Correspondence Analysis, we found that the new trends in BI are preferably presented in conferences, whereas the traditional BI appears in journals. In addition, the study showed that the greatest interest of researchers is still in the area devoted to traditional BI.

Regarding the major new trends in BI, "dimensions" as we called them in our study, we identified and examined two of them influenced by the evolution of the Web : Social BI and Semantic BI.

From our research, *Social Business Intelligence* is limited to monitoring, analyzing, and monitoring Web 2.0 data, also called Social Web, the data presented in the form of consumer displays generically named social clients. Unlike traditional BI tools, that analyze data inside a company, Social BI shifts its focus to the outside of the company, to what customers, suppliers and competitors are saying and doing.

Although it is still at the beginning, at the stage of the concept, Semantic BI will be a promising field because, for the moment at the theoretical level, it seems to change its structure by integrating new components and technologies, very different from those incorporated in the structure until now. The diverse data format is one of the reasons that led to the emergence of this new generation of BI, because BI solutions used until now, only apply for structured data that are significantly less than unstructured data.

Then, the analysis of unstructured information can reveal data hidden at first glance, which is also the purpose of BI applications, an additional motivation to be supported by the integration of unstructured data. But for now the road is long and difficult, since the transition from Web 2.0 to Web 3.0 has not yet occurred.

In trying to summarize the structure and evolution of BI in conjunction with the Web, we graphed in figure1 the technologies specific to Web generations that have influenced BI, creating new generations of solutions. Thus, the basic hypothesis from which we started, according to which " there is a significant impact of the Web on business intelligence solutions" is confirmed. Regarding the major new trends in BI, "dimensions" as we called them in our study, we identified and examined two of them influenced by the evolution of the Web : Social BI and BI Semantic.

Our research, Social Business Intelligence is limited to monitoring, analyzing, and monitoring data Web 2.0, also called Social Web, the data presented in the form of consumer displays generically named social clients. Unlike traditional BI tools that analyze data inside a company, Social BI shifts its focus to the outside of the company that customers, suppliers and competitors are saying and doing.

Although it is early - stage concept, BI Semantic be a promising field because, for the moment at the theoretical level, we announce the trade structure by integrating new components and technologies, all of different àfait those incorporated in the structure until now. The diverse data format is one of the reasons that led to the emergence of this new generation of BI, because BI solutions used until now only apply for that are significantly fewer structured data that unstructured data.

Then, the analysis of unstructured information can be hidden at first glance data, which also proposes to make BI applications, an additional motivation to be supported by the integration of unstructured data. But for now the road is long and difficult, since the transition from Web 2.0 to Web 3.0 has not yet occurred.

In trying to summarize the structure and evolution of BI in conjunction with the Web, we graphed in figure 1 the specific technologies that have influenced generations Web BI creating new generations of solutions. Thus, the basic assumption of this approach, according to which " there is a significant impact of the Web on business intelligence solutions" is confirmed.

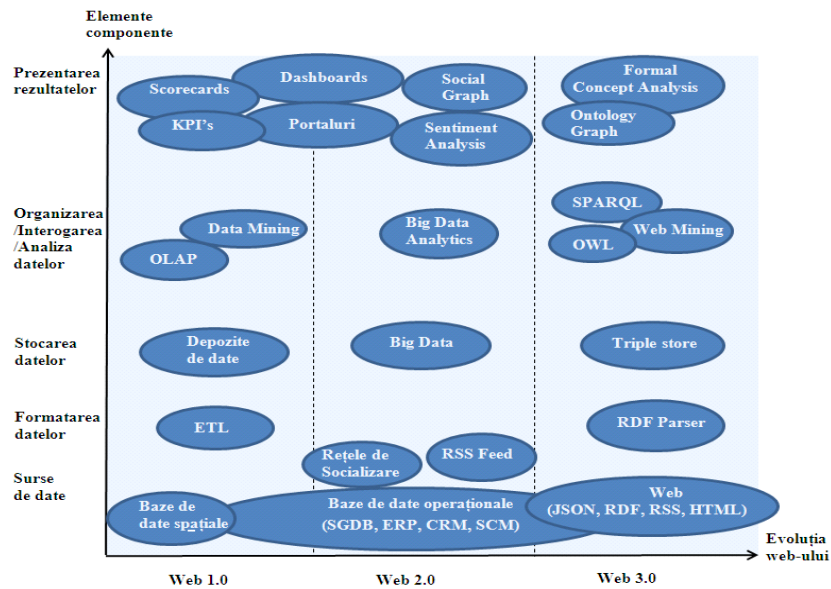


Figure no.1 BI technologies incorporated reported period of development of the Web

According to what we have already discussed, we believe that at this time BI is booming, as new technologies appear they are assimilated into this complex and we believe that this step will cover a wide period of time, as with the development of technologies for storing very large volumes of data that will also develop technologies capable of processing these data to provide to the user their meaning in a synthetic format and guide users in making effective decisions.

Future research directions will cover Cloud Computing applied Business Intelligence and Mobile Business Intelligence. In addition, although for several years, the Semantic Web has been on the agenda, in practice things are largely at the concept stage, we consider that this will attract the attention of researchers for a long period of time, 10-15 years. It is difficult to present a clear future direction of research on this topic, but two topics of major interest are emphasized: automatic methods to define the data using ontologies and semantic integration between applications possibilities.

After the completion of the research, we can say that the topic is far from being exhausted. The constant evolution of technologies will also influence BI, which reinforces our belief that our research is only the beginning of a series of research projects regarding the new trends in BI.

Reference

The research was based on 468 literature sources organized into several categories:

- 72 books
- 168 articles indexed BDI and Thomson Reuters
- 28 PhD theses and dissertations

Dissemination of research results

The research was valued by the publication of a number of 12 items as follows:

Articles published in the proceedings of the Thomson Reuters ISI indexed conferences:

Berța, D.-A., Business Intelligence in education, The 8th International Conference eLearning and Software for Education, Bucharest, 26-27 Aprilie 2012 (ISI Proceedings - indexat in Web of Science);

Berța, D.-A., Robu, M. I., Law of Intellectual Property Rights in Knowledge Society, The 8th International Conference eLearning and Software for Education, Bucharest, 26-27 Aprilie 2012 (ISI Proceedings - indexat in Web of Science);

Scientific articles published in the volumes of conferences under the review of ISI:

Berța, D.-A., The impact of semantic Web to Business Intelligence, The 19th International Economic Conference - IECS 2012, The Persistence Of The Economic Crises: Causes, Implications, Solutions, Universitatea "Lucian Blaga", Sibiu, Romania, 15.06 - 16.06.2012;

Berța, D., A., Social Business Intelligence: A New Step Beyond Traditional Business Intelligence Through Online Social Media?, The VIth International Conference Globalization and Higher Education in Economics and Business Administration, 18-20 Octombrie 2012, Iași;

Berța, D.-A., Cloud Business Intelligence, The 12th International Conference on Informatics in Economy, Education, Research & Business Technologies, 25 - 28 April 2013, București;

Berța, D.-A., Study Regarding the Perception of the Concept of "Business Intelligence" Among Application Designers, The 2nd World Conference on Business, Economics and Management (BEM-2013), 25-28 Aprilie 2013, Antalya, Turcia;

Scientific articles accepted for publication in the ISI indexed conferences:

Berța, D.-A., Stofor, O.-I., Analysis of Websites' utility for promoting insurances, Emerging Markets Queries in Finance and Business Conference, Tg.Mureș, 24th-27th, October 2013 (under submission) (ISI Proceedings);

Berța D.A., Patrichi M.C., Social Revolution in Manufacturing Environments, The 7th International Conference INTER-ENG 2013 Interdisciplinarity in Engineering, Tg. Mureș, 2013 (under submission) (ISI Proceedings).

B+ Rated scientific articles (indexed in minimum three recognized BDI)

Airinei, D., **Berța, D.-A.**, „Semantic Business Intelligence - a new generation of Business Intelligence”, Revista Informatică Economică, București, Vol. 16, no2/2012, pp. 84-91;

Berța, D.-A., „From Marketing Viral to Social CRM”, Analele Universității Ovidius, Seria: Științe Economice, Nr. Vol. XI, nr. 2/2011, Ed. Ovidius Press, 2011, pp. 89-96;

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Berța, D., A., Online Social Media and Business Intelligence, a perfect symbiosis for Decision Making, Conferința Națională a Școlilor Doctorale, Universitatea „Al. I. Cuza”, Iași, 19-20 Octombrie 2012;