Business Intelligence Systems Optimization to Enable Better Self-Service Business Users

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Abstract

The success of the enterprise depends heavily on its decisions. Therefore, companies use Business Intelligence (BI) systems to support managers in their decision making process. However, the acceptance and usage of BI systems by end-users (business users) don't reach the expected goals. This is because of the high complexity and the irrelevance of delivered information. Business users can't use these systems to get the right information without relying on power users. The financial and time costs behind the communication between business and power users are high. The goal of this work is to develop a new BI architecture to reduce the complexity of using BI systems and optimize their usage by business users. The proposed solution offers suggestions to business users during their navigation in BI systems. Offering suggestions helps inexperienced business users in performing complex analysis. This is done by transferring the knowledge of power users to business users.

1 Introduction

The enterprises adopt Business Intelligence (BI) systems to assist the decision makers in their decision making process. They don't only assist this process, but also they ease and improve the overall management decisions (Laudon, Laudon, & Schoder, 2010, p. 736). Nowadays, the demands for information as a production factor increase. Based on (Chamoni & Gluchowski, 2010, p. 4), the reasons why these demands are inevitable include that the internal and the external conditions of the current economic life are rapidly changing and they are often very complex. According to (Ranjan, 2009), enterprises consider information as their second important resource after their people. BI systems provide enterprises with timely and accurate information, which allows them to make deci-

sions and react quickly on customer needs and market changes. Therefore, BI systems promote the enterprises that apply them with superiority above their other counterparts. (Bain & Company, 2011) stated that the effective decision-making processes are the key to the company's success. In other words, the success of any enterprise depends heavily on its decisions and BI systems, in this context, play an important role to support the information-based decisions.

In 2011, the report conducted by (Gartner, 2012) shows the worldwide sales of BI platforms, analytical applications and performance management software. The market volume exceeded 12 billion U.S. dollars. Alone, the sales of BI platforms amounted to more than 7.7 billion U.S. dollars, with an increase of 16.3% in 2011. According to this CIO-survey, the important reasons for this strong growth is that BI and analytical systems have the highest priority for CIOs (Gartner, 2012).

However, the wide applications of BI systems in enterprises have still some drawbacks and don't fully meet the requirements of their utilization. Due to the high complexity and irrelevance of the supplied information, less than 30% of potential users can fully benefit from BI systems (Kurzlechner, 2011). Moreover, despite the large investments in BI systems, (Schmaltz, 2010, p. 2) shows in his dissertation that acceptance and usage of BI systems do not often reach the expected results. Additionally, the willingness today of the decision makers to attend advanced trainings for complex BI systems is very low (Knopf & Wortmann, 2011).

This paper suggests a new approach to optimize the usage of BI systems for wide variety of users based on transferring the knowledge from the skilled users to those who are less experienced. This is done by applying tracing methods on the skilled users to extract their analysis paths, which are used afterwards as recommendation to the less experienced ones.

The next section of this paper lists the basic foundations that are necessary to make the clear distinction of BI users and applications. Section 3 states the problem that the research behind this paper addresses. The followed research methodology is then explained in the fourth section. Details of the suggested approach are then explained in section 5. A list of related works to the proposed approach is then placed in section 6. Finally, section 7 concludes the main ideas presented in this paper and shows the potential future directions that can be derived from this research.

2 Basic Foundations

In order to have a common understanding of the used terms in this paper, the following two sections clarify the types of BI users, provide a classification of BI applications and explain the complexity of their usage.

2.1 Users of the BI Systems

In the literature, there are several contributions to classify BI users. On the one hand, (Gluchowski, Gabriel, & Dittmar, 2008, pp. 105 – 107) identified three user groups from the usage of BI systems perspective. These groups are information consumers, analysts and specialists. On the other hand, (Knopf & Wortmann, 2011, p. 29) distinguished three different user profiles based on their abilities of using BI systems. These profiles are user, power user and analyst. Finally, based on style of interacting with information for decision making, (Eckerson, 2011) classified BI users into power users and casual users. This paper tries to make a consensus among the aforementioned classifications of BI users. Thereby, two factors are taken into account to classify BI users. These factors are the user ability of using BI systems and the user's informative behavior[1]. Accordingly, two types of BI users are identified:

1. *Power Users or Information Producers*: These are business analysts, analytical modelers and IT professionals. They have the ability to generate reports, analyze data and perform flexible navigation options in the multidimensional data models (Gluchowski et al., 2008, p. 106). Such users are considered as information producers and they generate information that can be used either for their own decision or for the decisions of business users.
2. *Business Users or Information Consumers*: These are executives, managers and operations staff. They are considered more as information consumers. The main source of their information is the information provided by the power users. They consume this information to make their decisions. Furthermore, these users can only use the predefined standard reports or dashboards that don't require any technological or methodological knowledge.

The main argument behind the aforementioned classification of BI Users is that the issues that are researched in this work are directly or indirectly related either to the power or to the business users. Based on that, we will propose an approach to transfer the power users' knowledge (skilled users) to the business users (unskilled users).

[1] What is meant by user's informative behavior is how BI user handles the information? The approach behind this paper answers this question and classifies BI users as either information consumer or information producer.

2.2 Business Intelligence Tools

This section gives short overview of the key BI tools. These tools cover a set of diverse requirements for different sets of user groups. The different types of these BI tools include scorecards/dashboards, ad-hoc reporting, complex analysis (OLAP) and data mining. Figure 1 illustrates the relationship between the user's analysis freedom degree and the usage complexity of these BI tools.

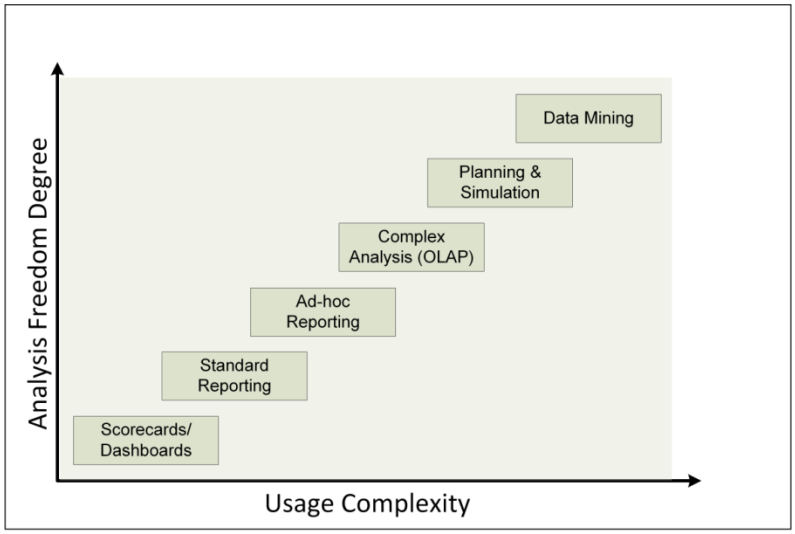

Figure1: Classes of Business Intelligence Applications (Tools)(Based on Figure 2 in (Bange, 2010, p. 141)

(Bange, 2010) indicated that the application usage complexity grows with the analysis freedom degree given to the user. Thus, business users can only use dashboards and standard reports, since its usage complexity is relatively lower than other BI tools. Consequently, business users are limited in their analysis freedom degree. In contrast to that, power users have the ability to use the different kinds of BI tools with higher usage complexity and more analysis freedom degree. Examples of such tools include complex analysis (OLAP) and data mining.

3 Research Statement

One of the main strategic business goals of any enterprise is to have a reliable reporting platform in which quality data are provided for analysis and decision making purposes. Having such platforms in production helps enterprises in overcoming traditional challenges in data integration among heterogeneous information systems and in dealing with data redundancy. Overcoming such challenges by the employment of one of these new reporting platforms makes this latter more complex due to data and application inter-

dependencies (Kulkarni, 2012). As observed by (Mertens & Krahn, 2012), the flexibility and powerfulness of BI systems let business users still face significant difficulties in carrying out ad-hoc analysis reports.

Business users normally lack crucial information to take proper decisions while using BI tools. This drawback comes from the missed or incomplete methodological and technical knowledge in using these tools. To help business users to overcome such challenge, the support of power users is needed in many cases. Figure 2 depicts the major communications between a business user and a power user. If a business user needs support to perform a specific task, which he can't handle, he sends a request to the power user. In turn, the power user processes the requests, however, with some time delay and then sends the result back to business users.

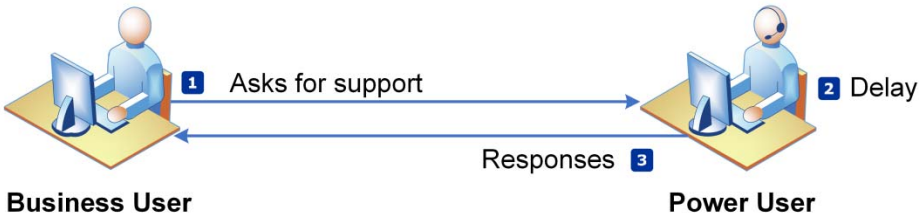

Figure 2: Communication between business users and power user

Based on discussions with experts, managers, and industrial stakeholders we have discovered different scenarios after performing the communications in the figure above. These scenarios include:

- Business users realize that the information sent by power users does not exactly meet their expectations.
- Business users don't understand some of the results' values.
- Business users require additional information about a specific department or organizational unit.

It is noticed that in these three scenarios, business users in most cases should send again new requests to the power users acquiring new information or asking for support to provide more meaning for a subset of the information they received. Consequently, such communication among business and power users can occur in a repeated manner or in iterations and this creates considerable extra overhead from the power users.

These scenarios have been presented again to some experts, managers in the German Lufthansa Systems company. The BI experts in this company stated that in every department or organization unit, there are one or two power users, who are responsible of supporting many business users. As a result, each power user will be overloaded with a large number of requests coming from many business users.

High Communication Costs

The above-described communications have high costs on enterprises. These costs can be classified into the following two types:

- *Time costs:* Business user should always wait for processing his request by one of the busy power users. On the one hand, it is always crucial for the managers to get the information they need in the right time during the decision making process (Spahn, Kleb, Grimm, & Scheidl, 2008). On the other hand, power users must interrupt their own work to process the requests of business users instead of focusing on activities that are more valuable. Examples of such activities include developing new applications, expanding data in data warehouses from existing and new sources, improving data quality processing, or incorporating new technologies to improve performance (Imhoff & White, 2011).
- *Financial costs:* While the time runs, the value of any decision decreases. This loss can be expressed in companies in term of money. Sales will be reduced, and more cost in human resources or logistics will increase. Moreover, enterprises need excessive number of power users to cover the large amount of business users' requests. Such situations make pressure on enterprises' managers to increase their IT budget accordingly.

This kind of cost classification is just to clarify how different kinds of costs might arise. At the end, every kind of costs is going to be paid in any enterprise in form of money.

Based on the previous discussion about the communication between business and power users and the accompanying costs, enterprises need to react to such situation by reducing the number of communications between their business and power users as much as possible. This requires more innovative alternatives to the actual existing ones. The proposed approach tries to overcome this challenge by minimizing the communication between business and power users. This will indirectly decrease the costs by relying on the harvested knowledge of the existing power users. Another added value in applying such new approach is to provide business users with the information they need in a timely manner and without having a direct connection with power users (Spahn et al., 2008). One of the central requirements of business managers, as explained in (Knopf & Wortmann, 2011), is the analysis flexibility. However, as discussed before in the second section of this paper, this flexibility often leads to more usage complexity. Relying on the concepts and

ideas of self-service BI (Imhoff & White, 2011), the proposed approach tries also to encounter such situation by empowering business users with necessary knowledge to perform their analysis and create their reports. The focus here is to move business users to a higher layer in the BI's analysis freedom degree (like OLAP in Figure 1). This is done by promoting more self-service business users with minimal interactions with power users.

The major objective of this work is the conception and development of an enhanced BI system in which the knowledge of power users is extracted and transferred to business users. This new BI system should offer suggestions to business users to help them in their analysis. This work will concentrate on OLAP as a complex analysis application[2].

4 Research Methodology

Our research follows the design science research, which has its roots in engineering science. In contrast to behavioral science research that seeks to develop and justify theories that explain human or organizational behavior, design science is fundamentally a problem-solving paradigm. It seeks extending the boundaries of human and organizational capabilities by creating new and innovative artifacts (Hevner, March, Park, & Ram, 2004). Business Intelligence as a research field of Business Information Systems is especially marked in Germany with a strong practical relevance as well as a design-oriented research discipline (Baars, 2011).

The boundary of our research will be explained based on the information systems research framework of (Hevner et al., 2004). In this framework, the problem space is defined in the environment, which includes people, organizations and their exiting and planed technologies. In this context, both BI business and power users represent the different roles of the people in any organization or enterprise that use BI systems as a decision support technology. The business need, which is defined in Section 3, assures the relevance of our research. Design science addresses research through the building and evaluation of artifacts designed to meet the identified business needs. The enhanced architecture of BI Systems is considered as the resulted artifact of the research. The research rigor is achieved by appropriately applying foundations and methodologies from the exiting knowledge base. To evaluate this artifact, the proposed architecture should be implemented as a proof of the concept. The last phase is the evaluation of the results prototypical implementation using some evaluation methods like the evaluation research

[2] OLAP stands for Online Analytical Processing. It is widely used in enterprises as part of business intelligence and data warehousing suits (Chamoni & Gluchowski, 2010, p. 199).

method of (Österle et al., 2010). This phase is realized via discussions with BI experts from different organizations.

5 Enhanced BI Architecture

This section explains the proposed approach in details. The main idea is the conception and development of a new architecture for BI systems. This architecture extends the typical existing architectures. New components are added to implement new functionalities that are not available in the existing architectures. Figure 3 illustrates the proposed architecture of BI systems.

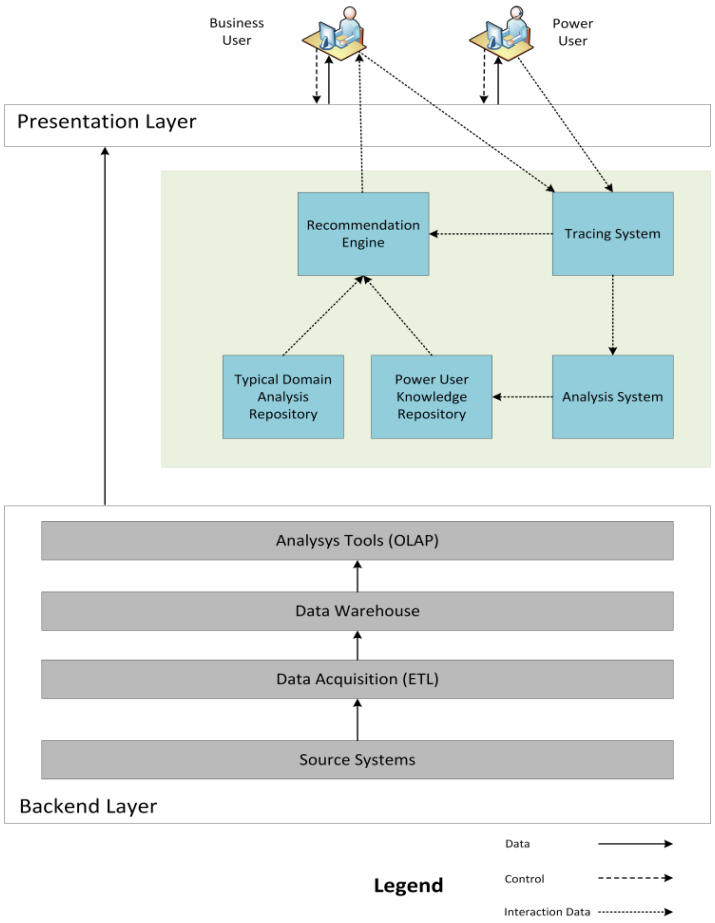

Figure 3: Enhanced BI Architecture

In the following, the main components of the depicted architecture and the main interactions between them are described. Besides the typical BI architecture's components:

source systems, ETL[3], data warehouse, analysis tools and presentation layer the enhanced architecture has the following new components:

- *Tracing System*: This component is responsible of tracing the actions of the power and business users while they use a BI system. The power user's actions should be stored in a proper storage medium like a database or log file. Two important points must be taken into consideration in the design time of this component. Firstly, after applying a proper observation on power users' actions, what are the criteria to select specific actions to extract the knowledge from power users? Secondly, the representation of the actions in from of storage shall be identified to enable the application of a proper knowledge extraction algorithm to power users' actions. This data representation includes basic information, such as timestamp, unique identifier, and name or description of the action.
- *Analysis System*: This component applies a set of algorithms to the tracing data collected by the tracing system. The output of these algorithms is specific patterns that represent the knowledge of the power user (based on a predefined business needs). Each pattern represents one analysis path[4]. In this way, the knowledge of each power user can be collected after aggregating all his/her possible analysis paths. To do so, the intention is to use time series analysis or to develop new algorithms, if the result of the time series algorithms is not appropriate.
- *Power User Knowledge Repository:* This component stores the power users' analysis paths extracted by the analysis system. To enhance the quality of the analysis paths, they should be classified into active or inactive analysis paths based on their repetition. The analysis path is considered active, if the power user repeats it for at least five times. Otherwise, the analysis path is considered inactive and it will be ignored as long as it is not repeated more than five times.
- *Typical Domain Analysis Repository:* This component is responsible of providing recommendations to business users regarding a specific domain if the tracing system component detects information related of such domain while the user executes some actions in the BI tools. Typical domain example is the human resources domain that includes information about salaries, training costs, travelling costs, etc.

[3] ETL stands for "Extraction, Transformation, and Loading". The ETL process is the sequence of applications that extract data sets from the various sources, bring them to a data staging area, apply a sequence of processes to prepare the data for migration into the data warehouse, and actually load them (Loshin, 2012).

[4] Analysis path in this paper represents a specific sequence of steps accomplished by the user while interacting with a BI-System.

- *Recommendation Engine:* This component has the responsibility of offering suggestions to business users based on the stored actions in the power user's knowledge repository and typical domain analysis repository. This component has an interface with the tracing system to get information about the last steps done by the business user (the system consider now just the last three steps). Then it compares these steps with the stored analysis paths in the power user's knowledge repository. The result of this comparison should lead to one analysis path. Based on that, the recommendation system should offer the business user suggestions following the found analysis path. These suggestions will help the business user to advance in performing the analysis.

6 Related Works

It was explained in the article of (Baars, 2006) how to distribute BI knowledge. The analysis result and templates should be accessed from other users in the enterprise using knowledge management systems. Analysis result can avoid the double works by the same information need. Analysis template includes basic information that enables BI users performing the analysis in any context. This approach has several technical and organizational challenges. These include the requirement of combining different interfaces and formats. However, this work lacks the need to motivate users to explain and distribute her/his skills to the knowledge management system.

The approach of (Mertens & Krahn, 2012) "Knowledge based business intelligence for business user information self-service" is based on a semantic metadata layer which is capable to import and manage modeled semantic metadata. The provided metadata is supposed to be used for further analysis in order to allow the self-service business user. This approach requires an explicit deriving and modeling of analysis and domain knowledge of experts and power users. Then this knowledge has to be imported to the Analytical Information System.

Advantages of the proposed BI architecture over existing work:

The first advantage of our approach is the automatic extracting of power users' knowledge in which the knowledge repository sub-system of the proposed architecture is kept always up-to-date. This knowledge extraction process was done in some of other related works like (Mertens et al.) in a manual manner. In addition, there will be minimal dependencies among business and power users. The second advantage is the real time offering of suggestions to business users. In many cases, business users are stuck in processing complex analysis in BI tools and they are in a need for some aid by power users. Embedding the knowledge of power users in the knowledge repository will enhance the

overall BI architecture to provide this knowledge in form of suggestions. This will decrease the overhead on the power users and expose implicitly their knowledge to the business users to perform complex analyses independently.

7 Conclusions and future work

In this paper, the focus was to introduce a new BI architecture that enables business users in getting information and performing complex analysis without interacting with power users. This is done by extracting the knowledge of power users by applying tracing method on their actions while using the BI tools. This knowledge is then offered, in from of suggestions, to business users while they try to perform complex analysis.

In our future works, the provided suggestions to the business user will be evaluated. Besides that, we will consider the issue of refining the proposed architecture. Moreover, as a proof of concept, a prototype will be implemented to show the practicability of the overall concept. For this purpose, we will concentrate on open Source BI systems to extend it to conform to the objectives of this work.

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