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Opportunities of Semantic Recommendation Systems for Self-Service Business Intelligence

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ABSTRACT

The success of companies nowadays is increasingly dependent on data. The importance of transforming this data into information and integrating this information into decision making is now commonly accepted. One way to achieve this goal is by using Data-Driven Decision Support Systems (Data-Driven DSS). Among them Self-Service Business Intelligence (SSBI) Systems aim to accelerate the BI process by minimizing the intervention of IT experts in the process and empowering business people to create their own business reports. This way, companies benefit from a higher level of reactivity, which is crucial in the dynamic environment they face. However, due to their lack of technical knowledge and the limitations of self-service features of the current tools, business people encounter several difficulties in using the SSBI tools.

This short paper exposes our position on the current complexities of SSBI tools and the proposed approach to deal with them. This position paper highlights the complementarity between the problems faced by business people when using SSBI tools and the benefits provided by Semantic Recommendation Systems (SRS). To this end, the paper first develops the principles of Recommendation System (RS) and more specifically, of SRS. The potential of these systems will then be put forward by presenting some benefits of RS and Semantic Web Technologies (SWT) correlated to the current problems of SSBI. Some of the benefits generated by the integration of SWT within the RS are then described. We conclude this paper by evoking a few related works mobilizing the different concepts discussed in this work to position our approach in the existing literature.

Keywords: Data-Driven DSS, Self-Service Business Intelligence, Business User, Semantic Recommendation Systems.

INTRODUCTION

The benefits of Data-Driven Decisions Support Systems (Data-Driven DSS) have been widely demonstrated within companies [1]. Business Intelligence (BI) is one such system [2,3] in which IT expert transforms data into information and Business User (BU) uses this information to make decisions [4].

The standard BI is impacted by the increasingly dynamic environment that companies are facing. This new environment requires a high level of responsiveness in decision making [4,5]. To meet this requirement, the Self-Service Business Intelligence (SSBI) approach is a promising solution. The objective of SSBI is to minimize the involvement of IT experts in the creation of business reports by empowering BUs to create their own reports. Doing so, considerable time savings can be achieved and the responsiveness of companies can be improved [5,6]. Modern BI tools are increasingly focused on self-service functionalities [7].

SSBI tools do not currently meet all the requirements that are expected from them [4]. Indeed, these tools are at the moment inaccessible for a large part of BUs due to their lack of technical knowledge. They face several challenges in the process of transforming their business questions into information extracted from data [4,8] such as the choice of interesting data to explore or the most appropriate analyses for their business question [4].

Considering these BU challenges this paper enhances that different systems based on Artificial Intelligence (AI), and especially Semantic Recommendation Systems (SRS), offer relevant qualities to face them. Indeed, SRS provide many benefits aligned to the needs of BUs due to the two systems they mobilize, namely: the Recommendation Systems (RS) which are designed to support selection decisions and the Semantic Web Technologies (SWT) which integrate semantical aspects in technical systems. In addition, SRS are actually powerful RS. The knowledge base they use allows them to overcome many problems encountered by traditional RS.

This paper is organized as follows: Section 2 develops the background of RS. Section 3 explains the potential of SRS within SSBI. Section 4 briefly states different works related to the main concepts of this paper. Finally, section 5 concludes the paper and indicates our future works.

BACKGROUND ON RECOMMENDATION SYSTEMS

RS are tools that generate recommendations on items that are likely to be of interest to the user. These recommendations help the user to find the most useful item for him [9]. Two types of conventional RS are the following: Collaborative Filtering RS and Content-based RS [10]. Collaborative Filtering RS focus on the interactions between users and items. These systems use the past ratings of all users to recommend a specific item. Content-based RS are based on user profile attributes. These systems recommend items that are similar to those already liked by the user in the past or items whose attributes match those of the user [11].

These traditional RS face several drawbacks such as the cold-start problem, rating sparsity and overspecialization. The cold-start problem is related to the lack of ratings of a new user or item. This leads to a lack of knowledge about the user's preferences and therefore an impossibility to provide recommendations and an insufficient rating for an item preventing its recommendation. The sparsity rating occurs when a user has rated only a few items and therefore cannot find similar users. Finally, the overspecialization problem corresponds to the recommendation of items very similar to the items already consulted by the user which are therefore irrelevant [10].

To face the major problems of these conventional systems, new RS have been developed such as those using SWT.

The Semantic Web (SW) is an extension of the current web whose objective is to provide a knowledgeable representation of information readable and understandable for both machines and people. This goal is achieved by clearly and formally defining the meaning of information [12]. To achieve this goal, different technologies have been developed to

represent and manipulate this information. One of the main technologies of the SW is RDF (Resource Description Framework) modeling. RDF models represent information by identifying the set of relevant concepts of a domain and the relationships that link them. To interact with these models, the SPARQL (SPARQL Protocol and RDF Query Language) language has been developed. This language allows to formulate different queries on the RDF models. In addition, other SWT describe in details all the data modeled in RDF. RDFS (RDF Schema) and OWL (Ontology Web Language) models are such technologies detailing the different concepts identified and represented in the RDF model [13].

RS based on these SWT are called SRS. These RS are, in fact, knowledge-based RS for which the domain knowledge base is represented via SWT. Some SRS use the OWL (Ontology Web Language) modeling mentioned before [10,12]. The information representation via this specific language is called Ontology. In the context of RS, an ontology must be constructed for knowledge about users, items and the relationships between the item and the user's need. Based on these ontologies, RS establish relations between users and items that are most likely to be suitable for them [10].

RS integrating SWT avoid a number of problems faced by conventional RS stated above. These advantages of SRS will be elaborated in the next section.

INTEGRATION OF SRS INSIDE SSBI

The integration of SRS within SSBI systems offers a number of benefits which can be grouped into three types of opportunities, namely: benefits of RS for SSBI systems, benefits of SWT for SSBI systems and benefits of SWT for RS. These three opportunities are elaborated below and motivate the relevance to exploit SRS within current SSBI systems.

Opportunity 1: Benefits of RS for SSBI systems

BU meet different challenges when using current SSBI tools for which RS is a potentially well-suited solution. These challenges are related to the different decisions that must be made during the BI process such as the choice of interesting data to study based on the business question [4], the columns of data to analyze in parallel [14], or the data analysis best suited to the BU's needs [15].

RS are perfectly suited to support these types of selection decisions that BUs face in their analytical process. By integrating the technical knowledge of IT experts into the recommendation's mechanism, BUs will be supported and guided in their different choices [16]. In this way, any incorrect analysis will be avoided by directing the BU to the appropriate functionalities. Moreover, a considerable time savings can also be achieved [15] by limiting the human-system interactions to the essential ones [16]. Finally, the manual effort can be reduced via the automatic generation of the successive steps to be performed by the BU [15].

Opportunity: Benefits of SWT for SSBI systems

A second set of challenges come from that BUs often have a limited understanding or even a misunderstanding of the SSBI systems and their databases, this can be addressed using SWT. Indeed, BUs are regularly confronted with technical notations and symbols in, for example, column names of the database used, in the values contained in these columns, or in the names of the SSBI system functionalities. Most of this technical jargon is meaningless for BUs [14] and therefore complicates their understanding of the available data and significantly decreases the usefulness of SSBI functionalities [14,4]. This understanding is even more complex as the number of available columns within databases is increasing and as the number of functionalities within SSBI systems is large [15].

SWT offer solutions to simplify human-system interaction by adapting current SSBI systems and complex databases to the BU. Indeed, these technologies can integrate the business jargon used daily by the BU instead of predefined technical notations and syntaxes that are not adapted to this user [14]. Moreover, the formal and structured representation offered by SWT, such as OWL modeling, can provide a clear and explicit understanding of the databases [17] or of the functionalities available within the SSBI system. This representation will facilitate the BU to locate the desired information [18].

Opportunity 3: Benefits of SWT for RS

Finally, conventional RS face several problems that can be avoided by integrating SWT. The main problems faced by RS have been mentioned above, namely: the cold-start problem, rating sparsity or overspecialization [10].

SRS, combining RS and SWT, provide recommendations whose accuracy has been demonstrated to be superior [19], which will therefore reinforce the power of SSBI systems integrating them. Indeed, the main problems of cold-start, rating sparsity and overspecialization are absent in RS since these systems are mainly based on domain knowledge rather than on ratings [10]. In addition to these major problems, SWT also offer other benefits such as a guarantee of interoperability of the system resources, homogeneity in the representation of information or a better description of the system logic.

RELATED WORK

Before implementing our approach, we position our proposition by exploring the related works. This section presents briefly two works realized in each of the principles mobilized within our proposed solution, namely the integration of RS within BI, the use of SWT in BI systems and the development of SRS in other domains than SSBI.

First of all, RS have already been investigated within BI systems. For example, [16] have developed RS with the objective of supporting BU in their analysis paths. They implemented the system by transferring the knowledge of IT experts. After evaluation, this proposal has been recognized as a real help for BU, providing user-friendly recommendations and also improving the analytical skills of BU [16]. Other RS have also been developed in the context of BI by [20] whose objective is to identify the interest of the person interacting with the BI system in order to recommend further interactions. This work also demonstrated the beneficial impact of RS on BUs [20].

Secondly, SWT have already been mobilized in the existing literature in the BI context. For example, [21] propose a transformation of the data warehouse into a database using RDF semantic modeling. This proposal is provided not as an improvement of traditional BI tools but as a complement to them. In practice, it appears that users appreciate and consider the modeling as useful and providing new insights on the data [21]. Another work [14] has integrated ontological engineering techniques within BI to represent the structure of the BI system. Through this ontological modeling, the interaction between the user and the system is business oriented and no longer technological, which makes it more suitable and user-friendly for the BU. This proposal has been considered valuable to support a more user-friendly, flexible, adaptive and automatic BI integration and analysis in the real world [14].

Finally, SRS have not yet been studied in the SSBI context as far as we know. However, these specific RS have been explored in very different fields. In the education sector, [9] have proposed an ontology-based RS. This system aims at helping students to choose their higher education courses at university. To achieve this, an ontology of the domain was created describing the different courses, students and jobs. On this knowledge base was then applied

two traditional RS. Compared to other recommendation approaches, the proposed solution provided higher user satisfaction and better accuracy [9]. Furthermore, [22] also developed an ontology-based RS but in the e-commerce domain. Based on an ontology of different users and products, the applied RS provided more varied and relevant recommendations for users than traditional RS [22].

This short literature review enables to compare and position our proposal among the work already done. The objective of our approach is not to mobilize only one of the components of the SRS, namely the RS and the SWT but rather to integrate a complete SRS within the SSBI. The SRS will, in fact, assist the BUs in the various decisions required within the BI process, from the choice of data to the choice of adequate visuals. These systems, because of their semantic nature, will allow to map several ontologies specifying different business needs, database's features and SSBI functionalities. Due to the semantic representation of the system components, the recommendations given will be of superior quality. Moreover, our approach provides BUs with a tool that is more adapted to their business world and therefore more in line with the self-service perspective while mobilizing and exploiting all the Self-Service Business Intelligence functionalities.

CONCLUSION AND FUTURE WORK

This position paper elaborates about the opportunities that RS represent to address the limitations of current SSBI systems. The benefits of RS, SWT, and the integration of SWT within RS will make SSBI tools more suitable for BUs and increase their usability.

This preliminary work confirms the relevance of the proposed SRS-integrated SSBI approach, and it opens many avenues for future research on the discussed areas. Our future research objective is, indeed, to develop SRS in the SSBI context. To reach this objective, we have already defined different steps to be taken. The first one concerns the development of a knowledge base on which the RS will be based via SWT. To do so, we will mobilize the Ontologies to represent the different concepts of the SSBI, the available data and the needs of BUs. The second step will consist in developing SR that will use semantic links to provide the BU with data analysis adapted to its business needs.

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