WikOLAP:
Integration of Wiki and OLAP Systems

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INTRODUCTION

Data Warehouse (DW) and OLAP systems are Business Intelligence (BI) technologies intended to support decision-making process by means of on-line and multidimensional analysis of large volume of alphanumeric data (Kimball, 1996). DW models represent data according to the multidimensional model, which organizes warehoused data in dimensions (analysis axes) and facts, described by measures (analysis subjects). OLAP clients allow decision-makers to explore/visualize warehoused data and trigger OLAP operators (Roll-Up, Drill-Dwon, Slice, etc.) by means of interactive pivot tables and graphical displays (Stolte, Tang, & Hanrahan, 2008).

A typical Relational OLAP (ROLAP) architecture (Kimball, 1996) is composed of a relational DBMS to store warehoused data; an OLAP server, which implements OLAP operators; and an OLAP client, which combines and synchronizes tabular and graphical displays to visualize and trigger OLAP queries. In particular, data collected by means of several heterogeneous data sources are transformed (e.g. renamed, aggregated, etc.) and loaded in the DW tier by means of Extraction, Transformation and Loading (ETL) tools.

Nowadays, several organizations (public and private) deploy DW and OLAP systems in order to improve their business activities and efficiency of human and technological resources. At the same time, the growing of organization actors numbers, and physical organizations offshoring cause that organizations structure usage of information rap-idly moves towards the so called "social structure" where information usage is based on Web 2.0 technologies (Anderson, 2007; O'Reilly, 2005).

These technologies, such as blogs, wikis, RSS, social networks, etc., are based on the principal of sharing dynamic and personalized information content by means of the Web, enabling the collaborative work. Collaborative work allows users to ex-change, produce, and share and modify information and knowledge without any physical location and temporal barrier. One of the most important, widespread and effective collaborative work tool is Wiki (Leuf, & Cunningham, 2001; Fiedler, Hauder, & Schneider, 2013) (e.g. Wikipedia). Wikis are systems that use dynamic Web pages to create cumulative information contents. They allow users to the possibility of saving a very large number of versions of the same page, and to revert to a former version. They are based on the concepts of users, with different kinds of permissions, to create knowledge by means a collaborative and a collective work ensuring continuous communication within working teams and a constant evolution of the contents (Nonaka & Toyama, 2003).

However, more data grow and more BI systems are deployed for a large number of organizations' decision-makers, who need to be able to share information about warehoused data, their analysis and results. Indeed, OLAP decision-makers are users with particular skills about specific application domains, and so they are able to explain results thank to their tacit knowledge. This tacit knowledge when externalized through collabora-

tive work tools, such as Wikis, can help other decision-makers for the same or for different decision-making tasks.

In this context, we propose a system, called WikiOLAP, which integrates a classical OLAP system with a Wiki system, allowing decision-makers to share information about OLAP queries. Indeed, contrary to classical Wiki tools, such as geowiki tools (Roche, Mericskay, Batita, Bach, & Rondeau, 2012), where wiki pages are associated to static data (e.g. database's tables, attributes …), our proposal allows users to define on-demand wiki pages for interesting OLAP queries.

The paper is organized in the following way: Section 2 presents related work, Section 3 describes the case study of the paper, Section 4 describes the WikiOLAP systems and conclusions and future work conclude the paper.

BACKGROUND

Pivot tables and graphical displays are main tools to explore, visualize and analyze warehoused data (Stolte, Tang, & Hanrahan, 2008). A lot of work has been done in order to improve OLAP clients by means of advanced visual analytics features, such as cartographic representations (Bédard, Proulx, Rivest, & Badard, 2006), 3D displays, complex graphical displays, etc. The usage of the context of the warehoused data into the multidimensional model and/or in the OLAP clients by means of documents and multimedia data (e.g. (Martínez, Llavori, Cabo, & Pedersen, 2008; Bédard, Proulx, Rivest, & Badard, 2006; Feki, Ben Messaoud, & Zurfluh, 2013) has been addressed in some works because sometimes results of OLAP queries make sense only when explained by non-dimensional data. In other terms, coupling warehoused data with contextual information is mandatory when dealing with complex phenomena to achieve an effective OLAP analysis.

In a preliminary work, (Bédard, Proulx, Rivest, & Badard, 2006) demonstrate how Spatial OLAP tools represent an effective framework

for participatory work since these systems allow decision-makers to define graphical reports, they do not require any computer query language skill and they are based on interactive user-friendly visual interfaces. However, existing work do not provide decision-makers with Web 2.0 collaborative tools, limiting discovery of knowledge issued from warehoused data, contextual data and tacit knowledge (Nonaka & Toyama, 2003) .

Indeed, recently several tools have been proposed allowing users to share, create and modify dynamic Web pages (such as wiki, blog, etc.). These user-generated Web pages represent a knowledge source since they allow users to explicit their tacit know-ledge about a phenomenon, achieving a common and shared result. One of the most used collaborative works are wikis (e.g. Wikipedia), which allow users to define Web pages in an interactive and incremental way. Classical wiki servers provide functionalities for only creating Web pages and associating them with multimedia files such as video, images, maps, etc. (Chu, Siu, Liang, Cau, & Wu, 2013; Bhatti, Baile, & Yasin, 2013). Some extensions to associate wiki to classical databases have been proposed in order to inject collaborative analysis possibilities offered by wikis into these OLTP systems. An example is Flickr that allows associating discussions to photos, which are uploaded in the database systems by users; (Rinner, Kessler, & Andrulis, 2008) show the integration of the Web 2.0 forum tool (i.e. comments and responses) to a geo-graphic information system improves the spatial decision-making process since forums allow users to debate about geographic objects and phenomena obtaining a common knowledge. In these systems, each element of the database is associated to a discussion wiki page that is further on incrementally modified.

To summarize, interactivity and usability of OLAP tools are necessary for supporting collaborative multidimensional analysis, however to the best of our knowledge they lack of real collaborative tools issued from the Web 2.0 technologies allowing decision-makers to share,

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