BI Tools Analysis According to Business Criteria as Data Integration Possibilities, Hardware Specification, Tools for Data Visualization and Comparison of Used Technologies

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Abstract. Business Intelligence (BI) is software tool that transforms raw data into information and knowledge, enabling managers to identify, develop or create new strategic business opportunities. Nowadays, BI tools are widely accepted, given that they provide direct access to users with intuitive information generated by real-time data, which can create a competitive advantage. This paper analyzes business intelligence software tools that are highest positioned at the Business intelligence Gartner's Magic Quadrant (QlikView, Tableau and Microsoft PowerBI) from a multi-criteria perspective in order to get an idea of the key performance indicators, such as: data integration capabilities, hardware specifications, tools for data visualization and comparison of the used technologies. The theoretical analysis is mainly based on the research from available literature on Internet and the visualizations are derived from the practical application of these software tools. The acquired knowledge in this paper will be particularly important for users interested for this kind of software to gain more knowledge when choosing the appropriate BI solution to meet their specific business needs.

Keywords: BI tools, data analysis, data integration, hardware specification, tools for data visualization.

1. Introduction

Business intelligence (BI) is the ability of an organization to collect, maintain, and organize data. Large amounts of data and information flood produced in the companies demands a proactive data analysis tools giving a new opportunities. Identifying these opportunities and implementing an effective strategy can provide a competitive market advantage and company's long-term stability [4].

BI provide historical, current and predictive views of business operations. Common functions of business intelligence technologies are reporting, online analytical processing, analytics, data mining, process mining, complex event processing, business performance management, benchmarking, text mining, predictive analytics and prescriptive analytics. [11].

The goal of modern business intelligence deployments is to support better business decision-making. Thus a BI system contains embedded part of decision

support system (DSS). The companies use business intelligence as umbrella term for many similar concepts, as competitive intelligence, taking into consideration that the both concepts support decision making. BI uses technologies, processes, and applications to analyze internal and external data, structured data and business processes. Competitive intelligence gathers, analyses and disseminates information with a topical focus on company competitors. If it is understood broadly, business intelligence include the subset of competitive intelligence and many others concepts.

An extended analysis in Business Intelligence is made by Gartner and reported as the Magic Quadrant for Business Intelligence Platforms, (Fig.1) [9].

As defined by Gartner, BI platforms perform, to wide range of users, from IT staff to consultants and business users, to build applications that help organizations learn about and understand their business. Taking into consideration criteria of evaluation of BI software tools, the additional analysis is made in this paper, considering business criteria as data integration possibilities of mentioned tools, hardware specification, comparison of used technologies and tools for data visualization.

Figure 1 – Gartner's Magic Quadrant for BI platforms [9]

The paper is organized as follow. Second section takes into consideration related works and previous researches in the area. Third section makes integration overview of mentioned BI tools, while fourth section compares the needed hardware specification.

The fifth section highlights the used technology for all considered tools. The sixth section clarifies the visualization tools available for each considered software tool. Finally, the concluding section makes some final conclusion about tools' suitability for BI and their convenience for data analysis and visualization.

2. Related works

Many researches and business analysist analyze the BI market share and describe that today's Big data analysis demands powerful tools to cope with the processes of gaining information from data. Using BI tools, decision makers are empowered with many excellent tools [10, 12] equipped with additional auxiliary tools for data extracting, transforming and load as well as for visualization. These tools perform easy transformation of raw data into valuable information [13], sometime capable to represent data in visual formats, desirable for the human beings [7, 8].

Many authors state that the decision making processes demand usage of BI tools in all management companies' levels [16]. Today, many authors links BI with Big data analytics because this area is increasingly important for business community in last decade, demanding capable and educated staffs with advanced analytical knowledge [5, 15, 18]. For these reasons, leading Universities focus new curricula to Data science, data mining and other analytics tools as well as BI and Business analytic knowledge to meet business requirements [14].

Many analysts companies as Ovum see the information as company's wealth [3] and BI as strategic tools. They analyze tools according to market share, technology, assessed services, user friendliness, execution and market fit [3]. IBM analyzes tools according to possibility to get "big picture" of corporate data and then to interactive analysis of selected parameters. For them, it is important to gain a "Big Picture" of corporate data that can be done with tools as BI Dashboards, reporting tools for Key performance indicators (KPI) and Historical data. They also use some new concepts as Rapidly Adaptive Visualization Engine (RAVE) with included libraries that contain novel visualization techniques, more informing for decision makers [6].

Some researchers analyze ability and capabilities of tools for analysis and visualization of Big data in order to detect capabilities for business reports, business achievements and financial report according to KPIs, earlier defined [1, 2]. The latest attempt is made with intention to explain and highlight some KPI of Tableau and Qlik tools through comparative analysis for large number of KPI [20].

3. Integration overview

3.1 QlikView

One of the key principles of QlikView is a usage of a wide range of structured and unstructured sources of data and common associations between them (Fig.2).

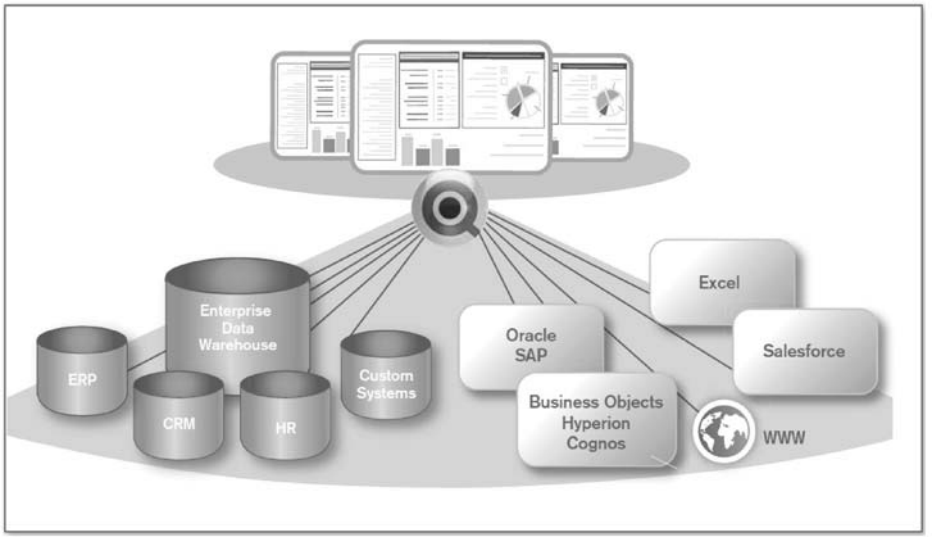

Figure 2 - QlikView can access data from a large variety of sources [17]

QlikView enables ODBC/OLE connections through a simple wizard to quickly extract data from source systems. QlikView uses standard SQL queries to read data and also use Store Procedures. It can provide access to many different types of unstructured data sources through a wide range of methods.

QlikView provides two connectors to extract data from two common data sources that do not provide typical ODBC/OLE drivers: Salesforce.com and SAP Netweaver. QlikView supports SharePoint and web parts and provide contents and document integration as objects from some portals, allowing users to get data and KPIs in dashboards along with other business content in order to provide data analysis.

QlikView also helps organizations reduce reporting costs by allowing them to rapidly develop dashboards and applications and to be flexible in dealing with business changes and demands. This include: Management integration using programmatic control of common management tasks through web service API, Automation & scheduling - Event Driven Execution (EDX) that allows a single reload to be launched and then polled for a completion status, Managing

documents and source control - a single QlikView file is a binary file containing a load script, data and multiple objects in the UI, Deployment control that enables easy roll-out of multiple QlikView applications to one or more environments/ QlikView Servers using a single action.

3.2 Tableau

Tableau connects single data source with a single view for large data sets as data warehouses, data marts or flat files. The view can be different as join of multiple tables from different data source as: relational database, OLAP database, Access MDB file, Excel spreadsheet, flat file or Hadoop database in HDFS using HIVE and Apache Hadoop from Cloudera.

Users have the ability to define join operations between tables as long as they are supported by the database. If all needed data are in a single database management system, such as Oracle, SQL Server, or Teradata, database administrator can create a database view pulling data together from various schemas or user's views.

Data can be stored in structure including transactional (3rd, 4th, or 5th normal form), de-normalized "flat" forms, and star and snowflake schemas. The Tableau view performance is directly related to the speed of the underlying structure of the database. While multidimensional databases generally perform best, a relational database with a clean star schema or an analytics-optimized database will perform higher than most other highly-normalized transaction-oriented databases.

3.3 Microsoft Power BI

One of Excel's strongest selling points are tools (Power Pivot, Power Query, Power View, and Power Map). Characteristic of them is that after usage of one tool for analysis, the others could provide further support.

Power BI is integrated with a wide range of data sources, including both cloud and on-premises solutions. With a wide variety of data sources, it can quickly and easily connect to SaaS solutions, on-premises data in SQL Server Analysis Services, Azure services, Excel and Power BI Desktop files. Using REST APIs, you can even connect to custom data sources, such as proprietary corporate data or external data services.

One of the advantages of Power BI is that it provides access to all data from a single location, regardless of where the data resides. This hybrid approach delivers a number of benefits: (1) fast time to insight with direct connections to popular SaaS solutions; (2) secure, live connectivity to existing, on-premises data sources, such as SQL Server Analysis Services tabular; and (3) a scalable BI solution that does not require to move any on-premises data to the cloud [19].

4. Hardware specification of QlikView, Tableau and Power BI

The basic system requirements for QlikView, Tableau and Microsoft Power BI are given in Table 1. System requirements do not differ a lot. The main differences are that QlikView and Microsoft Power BI cannot run on Mac-computers. QlikView requires much more RAM memory because of its in-memory technology.

Table 1

	QlikView	**Tableau**	**Microsoft Power BI**
Platforms supported	Available for both 32 bit & 64 bit	Available for both 32 bit & 64 bit	Available for both 32 bit & 64 bit
OS Supported	Windows 7 x64 Windows 8.1 x64 Windows 10 x64 Windows Server 2008 x64 Edition Windows Server 2008 R2 Windows Server 2012 Windows Server 2012 R2 Windows Server 2016	Microsoft® Windows® 10, 8, 7, Vista, or XP sp3; or Server 2012, 2008, or 2003 (on x86 or x64 chipsets)	Windows 10 , Windows 7, Windows 8, Windows 8.1, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2
RAM	4 GB minimum Memory requirements are directly related to the quantity of data being analyzed.	2 GB	1.5 GB
HDD	300 MB total required to install	1.5 GB minimum	169 MB to download the software file and another 500 MB to install the software.
CPU	Intel Core 2 Duo or higher recommended	Intel Pentium 4 or AMD Opteron	1 gigahertz (GHz) or faster x86- or x64-bit

Starting with Tableau 10.5, new versions of Tableau will only run on 64-bit operating systems. Release of Tableau 10.4 is the last version of Tableau Desktop, Tableau Reader, and Tableau Public to support 32-bit Windows operating systems.

5. The Used Technologies

4.1 QlikView

The engine behind associative search is QlikView's next-generation in-memory architecture. It virtually eliminates the problems and complexity plaguing traditional, slow, disk-based and query-based BI tools that deliver more than static, prepackaged data. With QlikView, all data is loaded in memory and available for instant associative search and real-time analysis with a few clicks.

QlikView breaks out of the gridlock of the traditional BI world, where business users and developers spend months documenting and coding these requirements into dashboards, analysis, and reports, using different products for each output. Pulling data into QlikView takes just minutes because data is not required to be staged or stored in intermediary formats such as data warehouses or cubes (although QlikView can source data from these systems).

QlikView integrates both the building of the back-end underlying analytic calculations with the front-end user interface. With this complete BI solution, developers have one place to build, instead of having to use separate BI tools for dashboards, analysis and reports. QlikView application provides powerful associative search and data visualization capabilities that allow business users to view their own slice of the underlying data.

4.2 Tableau

Tableau provides two modes for interacting with data: Live connection or In-memory. Users can switch between a live and in-memory connection as they choose.

Live connection: Tableau's data connectors leverage existing data infrastructure by sending dynamic SQL or MDX statements directly to the source database rather than importing all the data. This means that if it is invested in a fast, analytics-optimized database like Vertica, the benefits of that investment by connecting live to data will be obtained. This leaves the data detail in the source system and send the aggregate results of queries to Tableau. Additionally, this means that Tableau can effectively utilize unlimited amounts of data. In fact, Tableau is the front-end analytics client to many of the largest databases in the world. Tableau has optimized each connector to take advantage of the unique characteristics of each data source.

In-memory: Tableau offers a fast, in-memory Data Engine that is optimized for analytics. You can connect to data and then, with one click, extract data to bring it in-memory in Tableau. Tableau's Data Engine fully utilizes entire system to achieve fast query response on hundreds of millions of rows of data on commodity hardware. Because the Data Engine can access disk storage as

well as RAM and cache memory, it is not limited by the amount of memory on a system. There is no requirement that an entire data set can be loaded into memory to achieve its performance goals.

4.3 Microsoft Power BI

Microsoft Power BI has long been providing BI platform technologies such as SQL Server Analysis Service (SSAS), but has long been absent from delivering client or presentation layer technologies such as Online Analytical Processing (OLAP). Excel Pivot tables have been around for a while and can facilitate simple multi-dimensional analysis, but Excel's flexibility threatens data integrity, Excel's memory limitations limit data set volumes, and this type of solution falls far short of enterprise data warehouse capabilities.

The underlying Power BI technology is an in-memory analytics engine and columnar database that supports tabular data store structures used by Power Pivot. This achieves a balance between performance and ease of use (as compared to three dimensional cubes which require more complex assembly and query languages, such as MDX (multidimensional expressions) for SSAS).

6. Tool for data visualization of QlikView, Tableau and Power BI

Comparing the tools for data visualization of Tableau and QlikView, the conclusion is that both software have many visualization tools. Standard charts (bar chart, line chart, pie chart, area chart, and scatter plot) are available in Tableau and QlikView. Additionaly, Tableau can visualize other chart such as histograms, box-and-whisker plots, filled maps, packed bubble charts and word clouds which are not available in QlikView. QlikView gives the possibility to make gauge charts, funnel charts, grid charts and Mekko chart.

Word cloud is a visualization method that displays how frequently words appear in a given body of text, by making the size of each word proportional to its frequency. In this paper as a body of text we used word from abstract and introduction of this paper, (Fig.3).

Funnel charts is often used to represent stages in a sales process and show the amount of potential revenue for each stage. This type of chart can also be useful in identifying potential problem areas in an organization's sales processes. For these reasons, this type of visualization is shown (Fig.4). The visualization shows the total revenue per country.

Power BI offers a variety of visualization options such as: bar, line, area, waterfall, treemaps, donut, pie charts, stacked charts, bubble charts, geographical charts, and gauges based on a percentage value as well as card visualization. Microsoft has made the source code for the Power BI visuals publicly available and is enabling developers to build custom visuals for Power BI.

In this paper we decided to present this type of visualization, (Fig.5) because currently is only supported in Power BI. A chart contains data for certain cities, as well as a picture of the flag of the country in which the city is located. The image is obtained through the URL that is saved in a separate column in the table.

Mapping is also integrated in the Tableau software with geospatial and thematic maps that overlay. Tableau maps do not use 3D charts and do not have movie/video recording like Power Map. Microsoft Power Map has 3D, flat thematic mapping, heatmap visualizations, data layer overlay mapping and unique movie/video recording features. Mapping is not standardly integrated in QlikView. To visualize data on a map it requires to purchase an additional extension such as GeoQlik.

Tableau and QlikView both offer the ability to do statistical analysis and forecasting, while Power BI has yet to add this capability.

Figure 3 – Word cloud visualization created in Tableau

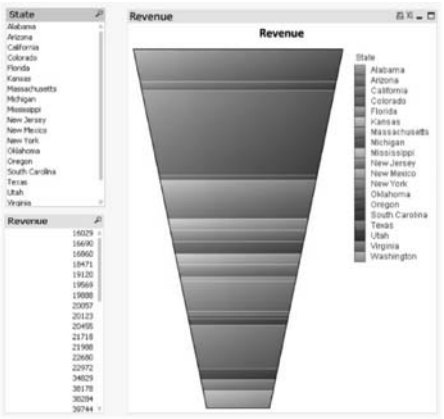

Figure 4 – Funnel char in QlikView

Figure 5 – Card visualization in Power BI

Conclusion

The paper presented analysis considering business criteria as: data integration possibilities, hardware specification, comparison of used technologies and tools for data visualization taking into consideration Tableau, QlikView and Microsoft's Power BI. These software are competitive market leaders in BI, positioned in the group of leaders according to world's leading information technology research and advisory company Gartner.

From our theoretical and practical view, QlikView enable users to gain business insights by understanding how data is associated and what data is not related by in-memory architecture which addresses the problems by the traditional disk-based and query-based BI tools. Users with sufficient processing power can analyze enormous amount of data, but is not really meant for people who are not programmers.

Tableau's has user friendly drag and drop capabilities allow non-technical users to easily create and develop their dashboards. From the other side, Tableau still has weaknesses in the area of data integration across data sources. Tableau supports a diverse range of data connectivity options but offers a low level support when it comes to integrating combinations of these sources in preparation for analysis.

Microsoft Power BI offers a competitive advantage with its insightful reporting and sharing capabilities, simple visualizations, and integration into the Microsoft packages. Microsoft was ranked in the top quartile of Magic Quadrant vendors for user enablement (only Tableau ranked slightly higher), with high scores for online tutorials, community support, conferences and documentation. Microsoft capabilities for advanced analytics within Power BI are limited. Even simple forecasting must be done externally within Excel.

From our practical application for the purposes of this paper we separated three visualization: Word cloud in Tableau, Funnel cloud in QlikView and Card Visualization in Power BI.

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