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Comparative Quantitative Analysis of Leading Business Intelligence Software Platforms

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Abstract: In this study, the Business Intelligence (BI) problem domain is considered. A generalized stack of BI software architecture is reviewed, core techniques and capabilities of Business Intelligence are outlined. Among leading BI platforms were considered Power BI, QlikView, and Tableau, which were compared from the viewpoint of their BI capabilities. Different similarity measures were used to compare BI platforms and evaluate their rating based on user feedback.

Keywords: Business Intelligence, Software Platforms, Data Analytics.

1. Introduction

Along with Data Analysis, Data Visualization, and other buzzwords e.g. Dashboards, OLAP (On-Line Analytical Processing), Data Warehouse, etc., the term Business Intelligence (BI) almost always appears (see its architecture in Fig. 1).

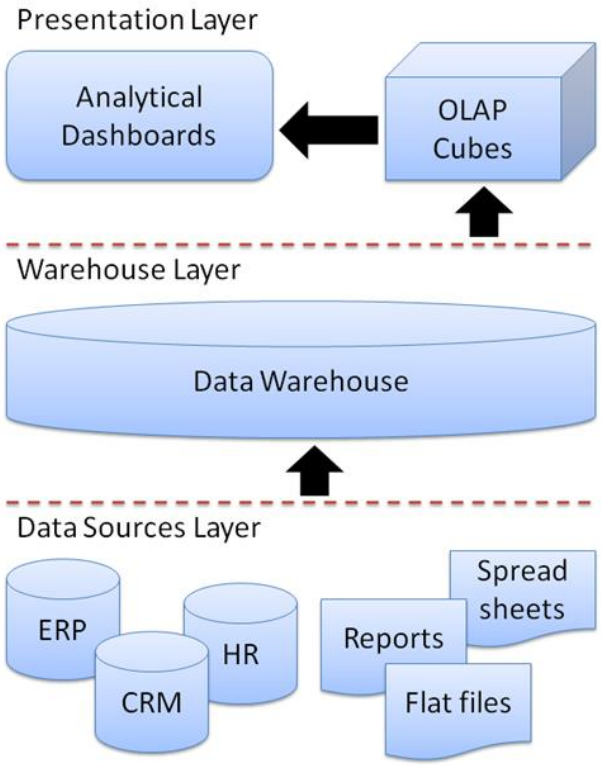

Fig. 1. The generalized stack of BI software tools [1].

So what does the BI mean? According to Gartner IT Glossary [2], BI could be considered as the umbrella term that includes the applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance [2]. Let us go along the

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common terms in the BI problem domain and consider the topics of Data Analysis and Data Visualization through the prism of Business Intelligence.

The major work of gathering together all of the related methodologies, governance practices, and the existing BI software tools is already made by Forrester Research [3], and presented in its architectural landscape of the BI Stack [3] (see Fig. 2).

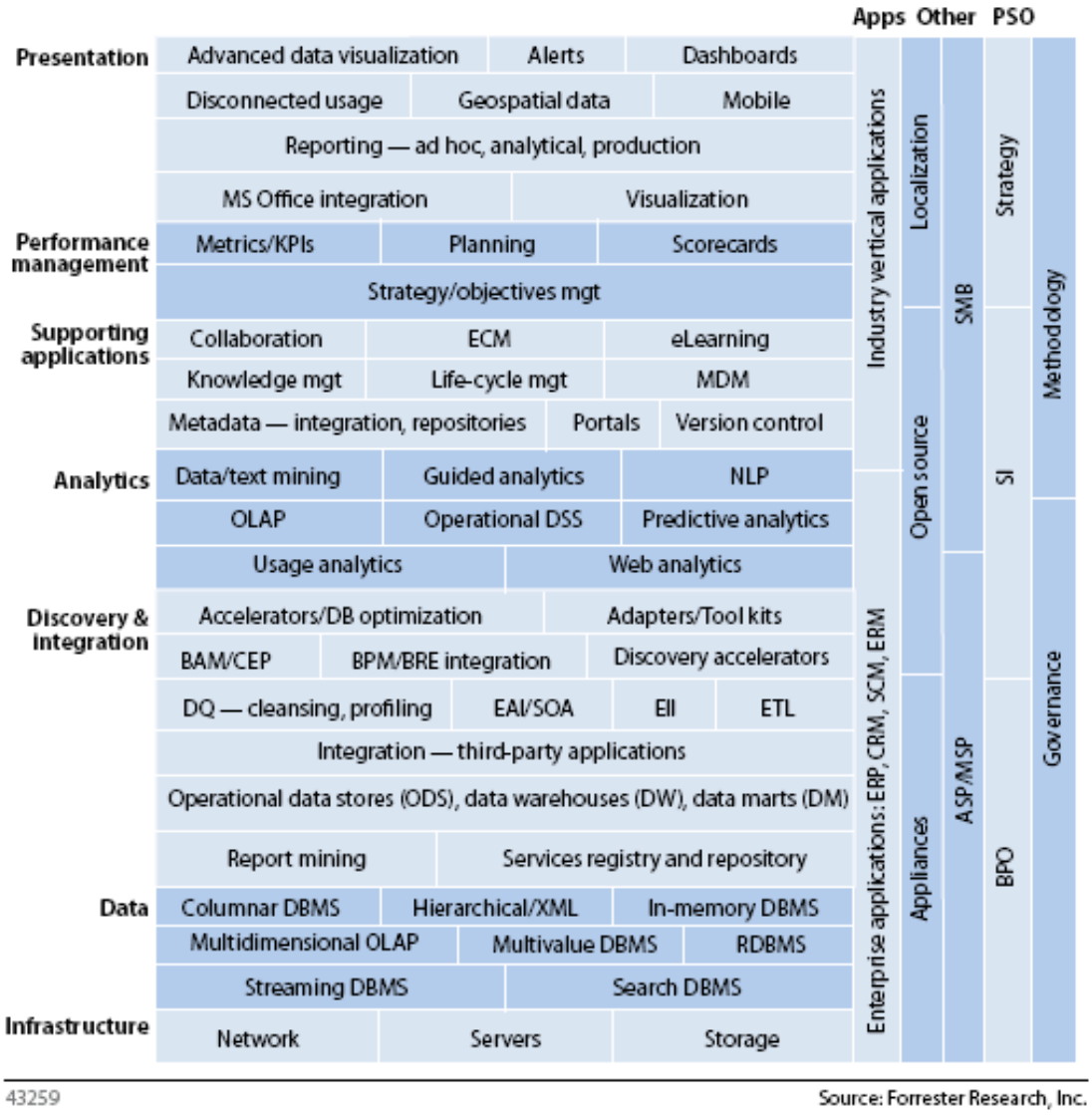

Fig. 2. BI stack according to Forrester Research.

However, we will not move along the all described layers and components, but focus on the topics in the presented list, which we consider as the most relevant and widely used in BI:

- Dashboards – multilayer applications (see Fig. 1) for measurement and monitoring of operational business performance [4].
- KPIs (Key Performance Indicators) – measurement instruments for tracking business performance toward target values [5].
- Scorecards – tools for tracking achievement of analytical and strategic goals [4].
- Knowledge Management – collecting and sharing knowledge for future reuse [6].
- Repositories – specialized, extensible domain-specific database applications [6].
- Version Control – a practice of tracking and managing changes to software [7].
- OLAP – a fast and flexible multidimensional data analysis for decision support [8].
- Predictive Analytics – the use of statistical models to predict future performance [9].

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- BAM (Business Activity Monitoring) – a technology for real-time business process monitoring [4].
- CEP (Complex Event Processing) – a technology for processing and reacting to the critical changes of KPIs on time [4].
- BPM (Business Process Management) – a set of methods and tools for modeling, execution, and analysis of organizational business processes [5].
- ETL (Extract, Transform, Load) – a procedure of extracting data from one or multiple data sources, transforming, and loading data to target storage [10].
- Data Warehouses – target data stores based on dimensional data models [10].
- RDBMS (Relational Database Management Systems) – source data stores [10].

1.1. Core Business Intelligence Capabilities And Techniques

Since the general definition of BI has been already outlined above, let us start its brief review with the three core BI capabilities:

- Data Extraction.
- Data Storage.
- Data Analytics.

By Data Analytics also referred to as Data Analysis we can understand Data Visualization, Data Exploration, Data Discovery or combinations of these approaches, or even all of these techniques together (see Fig. 3).

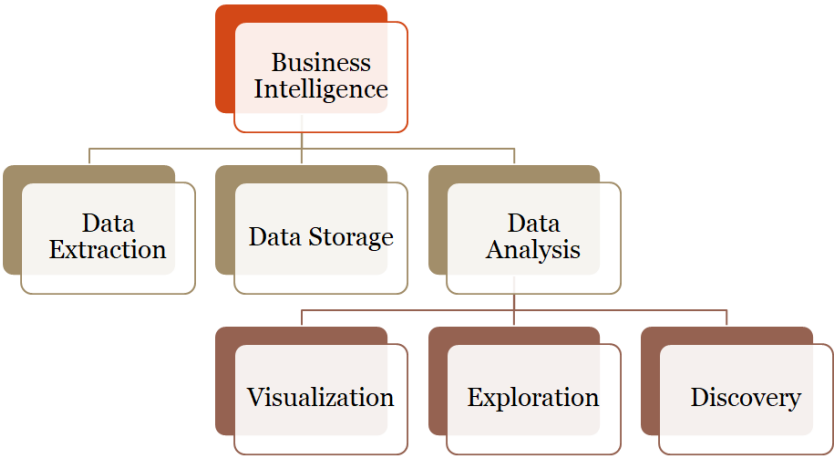

Fig. 3. Core BI capabilities.

While Fig. 3 describes core BI capabilities in the context of methodology and governance, there are concrete software tools exist that support these capabilities by providing the following techniques and services.

Reporting. Taking raw data and turning it into information used to make business decisions.

Dashboards. Pages where reports, graphs, and charts can be placed to create a central location for critical business information.

Ad-hoc Querying. Real-time reporting to explore questions while looking through the data.

OLAP. Efficient multidimensional processing of large data volumes to provide fast and interactive answers to large aggregate queries.

Data Mining and Machine Learning. Serve to dig through huge amounts of data and come up with predictions.

Scorecards. Designed to help measure progress towards goals by various groups of measures.

1.2. State-Of-The-Art Of Business Intelligence Platforms

By using Gartner Magic Quadrant for Analytics and BI Platforms [11] (Fig. 4), we can define leading software vendors and their products, which are:

- Power BI by Microsoft.

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- QlikView by Qlik.
- Tableau by the same company.

Power BI. Various data sources can be connected to the system: there are third-party applications, cloud services, streaming data, and Excel workbooks. Through the API (Application Programming Interface), users can connect their applications to the service. Interactive dashboards are available on any device (desktop workstation or smartphone, or tablet) and can display real-time data. Users can share information in several ways. The service works on all platforms: cloud, desktop, and mobile [12].

QlikView. Provides the uniform analytics algorithm, which works in all versions. Qlik data visualization products provide fast and interactive data visualization. QlikView service can be used in collaborative mode by several members of the users' team, which can share any applications (dashboards or reports) created. Resolved visualizations can be used for samples and studies [13].

Tableau. Users can create software components for dashboards and analytics. The system works with all devices where there are data streams exist, so users and developers do not need to worry about hardware requirements or software requirements. Information panels have access to data warehouses. Applications for creating dashboards can be created by business users (or end-users) themselves. Several users can work on the Tableau report at once [14].

Fig. 4. Gartner Magic Quadrant for Analytics and BI Platforms [11].

1.3. Problem Statement

In general, considered BI platforms support heterogeneous data sources and, like Power BI are available as desktop, mobile, and cloud solutions. Moreover, all of these software platforms provide interactive data visualizations and shared usage experience by multiple software development or business users team members, for example, QlikView. And, finally, like Tableau, these software tools could be used by non-technical business users to create dashboard applications.

Therefore, the selection of the appropriate BI platform for data analysis and visualization could be a difficult problem, even using such reviews as Gartner Magic Quadrant or similar. Hence, in this paper, we are

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addressing the quantitative analysis of BI software platforms based on reviews by experts and stakeholders of the most widely used and popular BI software tools.

2. Materials And Methods

2.1. Evaluation Results Of Business Intelligence Platforms

Let us use the reviews of BI platforms stakeholders provided on the Gartner Peer Insights resource [15]. In accordance with the Gartner Peer Insights policy and reviewing procedure, each of the Business Intelligence platforms under consideration was evaluated by four criteria using the 1–5 range:

- Evaluation and contracting.
- Integration and deployment.
- Service and support.
- Product capabilities.

Evaluation results of considered BI platforms are demonstrated in Table 1 [16] – [18].

Table 1. Evaluation results of BI platforms.

Criteria	Power BI	QlikView	Tableau
Evaluation and contracting	4.4	4.3	4.4
Integration and deployment	4.5	4.4	4.5
Service and support	4.5	4.3	4.4
Product capabilities	4.5	4.5	4.6

Let us use the similarity distance metrics to quantitatively define rating values for each of the referred BI software platforms.

2.2. Quantitative Analysis Of Business Intelligence Platforms

There are the following of the most popular distance metrics that could be considered.
Euclidean distance [19]:

$$dist(X^i, X^*) = \sqrt{\sum_{j=1}^{n}\left(x_j^i - x_j^*\right)^2}. \quad (1)$$

Cosine similarity [20]:

$$cos(X^i, X^*) == \frac{\sum_{j=1}^{n}\left(x_j^i \cdot x_j^*\right)}{\sqrt{\sum_{j=1}^{n}\left(x_j^i\right)^2} \cdot \sqrt{\sum_{j=1}^{n}\left(x_j^*\right)^2}}. \quad (2)$$

Jaccard index [21]:

$$J(X^i, X^*) = \frac{\sum_{j=1}^{n} \min\left\{x_j^i, x_j^*\right\}}{\sum_{j=1}^{n} \max\left\{x_j^i, x_j^*\right\}}. \quad (3)$$

Here in formulas (1) – (3):

- X^i is the vector of evaluation results of the i-th BI platform;
- i is the number of BI platform, $i = \overline{1, m}$ (see Table 1);
- m is the number of evaluated BI tools, $m = 3$ (see Table 1);
- X^* is the vector of the so-called "perfect" BI platform, each of which elements are the following: $x_j^* = 5, j = \overline{1, n}$;
- j is the number of evaluation criteria, $j = \overline{1, n}$ (see Table 1);
- n is the number of used evaluation criteria, $n = 4$ (see Table 1).

Other similarity measures (Tversky index, Minkowski distance, etc.) can be used as well.

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3. Results And Discussion

Metrics calculated using formulas (1) – (3) are demonstrated in Table 2.

Table 2. Rating values of BI platforms.

Measure	Euclidean	Cosine	Jaccard
Power BI	1.0536	1.0000	0.8950
Tableau	1.2610	0.9998	0.8750
QlikView	1.0630	0.9998	0.8950

Obtained rating values were placed onto a bar chart (Fig. 5) to visually describe, compare, and give recommendations on the BI platform that could be selected for deployment.

By analyzing obtained results, the following recommendations could be given:

- Euclidean distance demonstrates quite diverse results, which are more sensitive for used criteria of BI tools evaluation.
- Cosine and Jaccard's measures resulted in almost similar values for each of the evaluated BI platforms, which are not relevant to the real user rating.
- Using the most relevant Euclidean distance, we can summarize that QlikView is the most preferable by user audience BI platform according to Gartner Peer Insights [15].
- The remaining BI platforms Power BI and Tableau are almost 16% less preferable by users while having almost similar rating values (see Table 2).

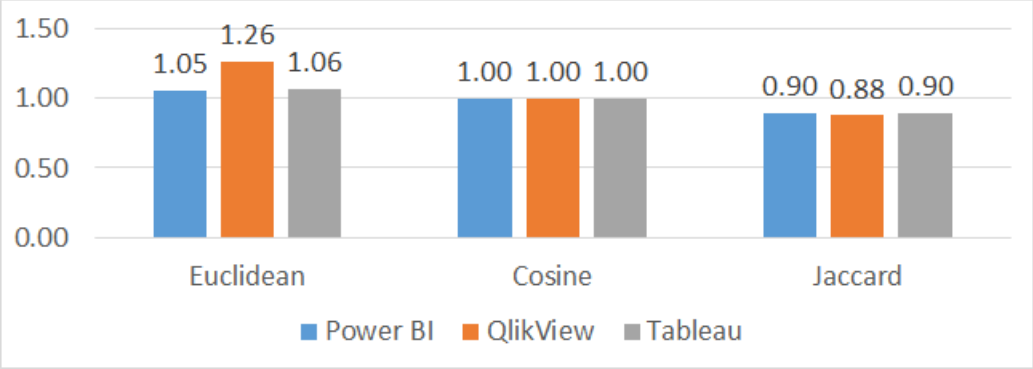

Fig. 5. Comparative analysis of BI platforms.

4. Conclusion

In this study, we have reviewed the Business Intelligence problem domain, including the main capabilities of BI and its core techniques, and approaches. The software architecture stack common for modern BI platforms was considered, as well as the reference stack of Business Intelligence in the enterprise was considered using the Forrester Research materials [3]. Core BI techniques from this reference architectural stack are considered the most widely used and valuable for BI problems.

Core BI capabilities were outlined, as well as the generic capabilities of the modern Business Intelligence platforms were formulated and briefly described. As the leading BI platforms, we have considered Microsoft Power BI, QlikView, and Tableau. These tools are given as leaders of the market by Gartner Magic Quadrant [4]. All of these software tools were briefly described taking into account their features, and the user ratings from Gartner Peer Insight were used to compare and quantitatively analyze considered BI platforms. We used Euclidean distance, cosine similarity, and Jaccard index to measure the general rating for each of these BI platforms. As the result, we have obtained that QlikView has the best rating value, while Power BI and Tableau are preferred by users at the same level, for 16% less than QlikView.

In the future, the proposed technique should be generalized to make it available for evaluation of various software products from different industries. Also proposed approach should be refined, other similarity measures could be considered, and the respective software component could be developed.

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