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POSSIBLE APPLICATIONS OF BUSINESS INTELLIGENCE IN THE MINING INDUSTRY

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ABSTRACT

We are contemporaries of a new industrial revolution, whose driving forces are based on data and knowledge, digitalization, automation and the continuously developing information technologies.

The mining industry is no exception to this trend. In the last decade the big mining companies have implemented different types of mass information systems for management of individual production processes or the necessary modules from modern ERP systems. The volume of collected primary information naturally grows together with the development and integration of the technology. These are large and complex datasets that are difficult to be processed.

Business Intelligence offers a solution to these problems. BI is a set of methods for the acquisition, processing, analysis and visualization of data in order to extract quickly meaningful and useful business information.

An important feature of BI systems is their ability to process large amounts of data in real time, which makes them particularly useful in making management decisions in the dynamic conditions and processes in the mining industry.

Key words: Business Intelligence, Mining, Possible Application

1. INTRODUCTION

Nowadays almost all spheres of our activities are invariably associated with the collection, processing and presentation of data. The need for rapid processing and reaction stimulates the emergence of new digital products and services, the development of business processes and scientific methodologies. The trend is global and covers all areas – security, climate, health care, efficient use of resources, energy, intelligent transportation systems, smart cities, digitization of public services, etc.

The mining industry is no exception to this trend, as digital technologies have been massively introduced in the last decade.

All companies, including the mining ones, require flexible and real-time information to allow dynamic change of the business processes on the basis of effective business solutions. The strategic objective of any company is to achieve better results using less resources, or maximum optimization of business processes. [1]

The Business Intelligence (BI) systems, which include business analytical models, technologies, information and practices for making the most informed and optimal management decisions, help for the solution of this problem. Through extracting information and regularities, BI systems can evaluate the information received and on this basis to produce forecasts for the development of the company.

2. BUSINESS INTELLIGENCE – ARCHITECTURE AND SOFTWARE

In order to effectively use the basic functionality of BI, the presence of structured data stored in relational databases, NoSQL, Data Warehouse, Big Data, etc. is required.

The producers of BI systems need to achieve maximum acceleration of the analytical processes (if possible, in real time) via a high-performance combination of hardware and software. The standard relational databases are not flexible enough to meet the challenges of Big Data. The architecture of BI systems allows for connecting to relational databases, but also for serving large amounts of information that are not based on standard relational models.

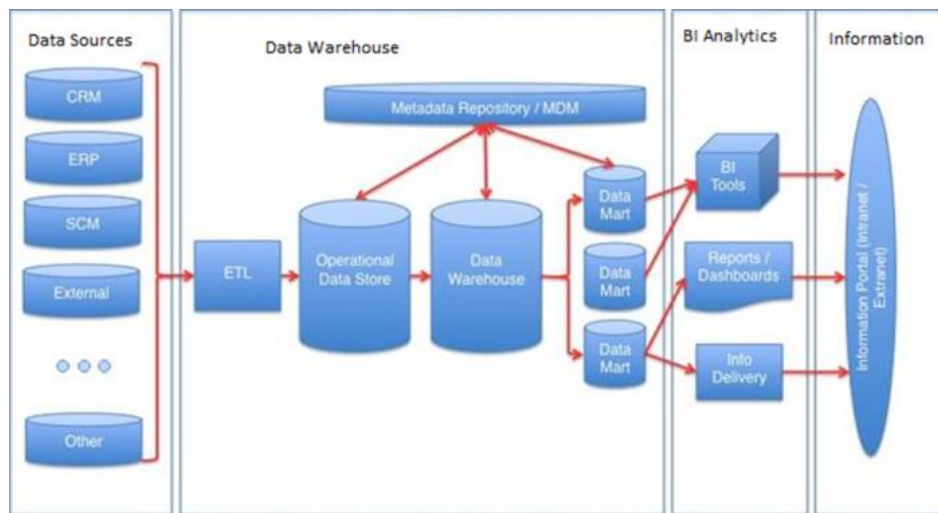


Figure. 1. Business Intelligence solution

BI systems rely on interactive Dashboards, which are equipped with very good graphical interfaces. They are used to easily cover the needs of the business and give summary information online. They also provide graphic visualization of data that reveals the regularities between them.

The advantage of Dashboards is that they provide monitoring of data from large-volume business reports on high level. In case of deviation from the key performance indicators (KPI) this allows the entering in the reference depth (drill down).

Another important advantage of BI systems is the ability to group the information by different criteria and dimensions, which transforms the report according to the specific needs of the business.

According to the Gartner Group's ranking [2], the two leading BI software products are *Tableau* and *Power BI*.

Both products have their advantages, which make them favorites for BI tools.

Tableau has been the market leader for the fifth consecutive year as it is one of the most dynamically developing BI solutions. Available in *Tableau Desktop*, *Tableau Server* and *Tableau Online*. [3]

Tableau Desktop is an application for the visualization of data and allows you to quickly generate interactive displays (dashboards), beautiful graphs and reports.

Tableau Server is a corporate platform for Business Intelligence that offers powerful tools for analyzing and visualizing data. It provides high availability and security and allows multiprocessor processing. It works on both physical and virtual machines. Tableau Server provides online multi-user platform, designed for sharing and collaborating with reports and visualizations.

Tableau Online is Cloud-based Tableau solution for Business Intelligence. It provides flexibility and ease of application for powerful data visualization. Since it is cloud-based, the need for expensive servers, management software and IT support drops off and it can be expanded according to the users' needs.

Tableau has an extremely scalable client-server architecture (Figure 2) that serves mobile, web and desktop clients.

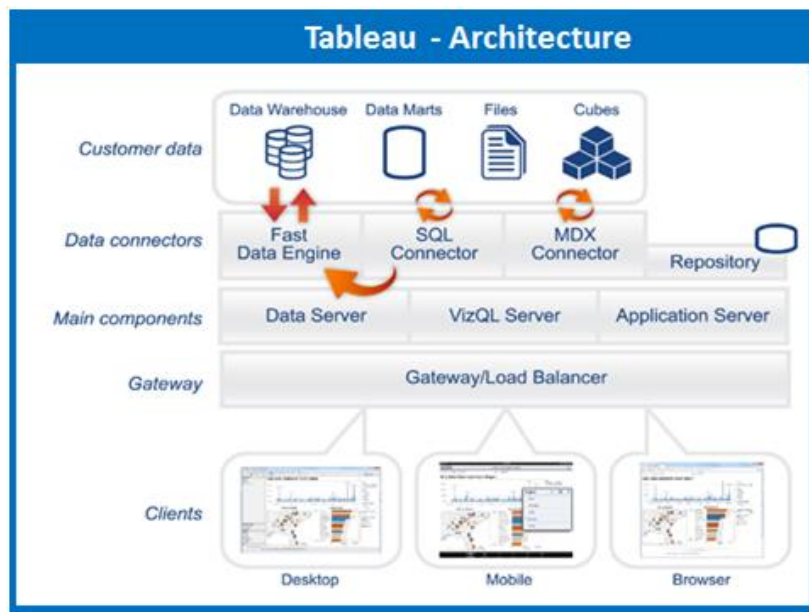


Figure 2. Architecture of Tableau

The methods for connection and retrieval of data are two in the Tableau – Live and In-memory. The users can determine what method to use.

Power BI is a cloud-based Microsoft product that provides business analytics services. The product is a collection of powerful intuitive tools and functionalities for statistical analysis and visualization of large data sets. Power BI is built on Azure, which is Microsoft's cloud service platform.

The Power BI architecture is based on two clusters - the WFE (Web Front End) Cluster and the Back End Cluster (Figure 3). WFE takes care of the initial connection and authentication, and then Back End processes all subsequent interactions with the user. [4]

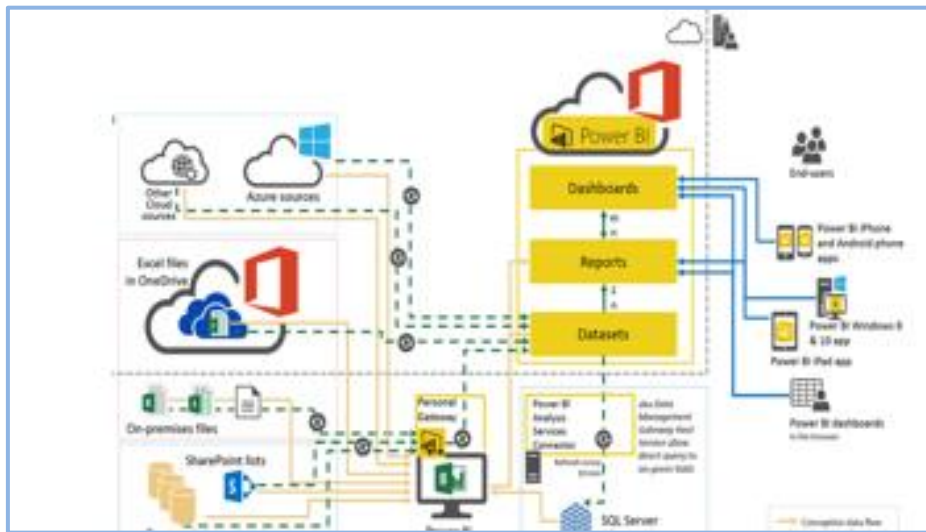


Figure 3. Architecture of Power BI

Power BI uses Azure Active Directory (AAD) to manage users, in addition it manages the data storage and metadata process via Azure BLOB and Azure SQL Database.

Tableau and Power BI provide powerful tools for extracting, processing, and displaying data. Both products offer a wide variety of connectors to different data sources such as relational databases (MS SQL Server, MySQL, PostgreSQL, Oracle, etc.), spreadsheets (MS Excel), Web analytics services, data Warehouses, Big Data Solutions.

Both products support programming languages by which users can create their own graphs or apply specific methods for deeper statistical analysis of data in order to retrieve business-friendly information. These are the R and the Python (Tableau only) languages.

Tableau Desktop and Power BI interfaces are intuitive and easy to use. Through cloud services, users can access their reports from different devices at any time. They are available for Android OS, iOS, Windows OS.

3. APPLICATION OF BI IN THE MINING INDUSTRY

Mining companies cover vast areas, and sometimes the different branches of a large company are located not only in different countries but also on different continents. There is a natural need for the important information resources to be accessible from every point in the company. For this reason many big companies build their own information networks, uniting different types of information systems.

It is typical for the mining industry that the information process is very dynamic, and the data obtained is continuously supplemented with new elements. This leads to the accumulation of huge volumes of data that are difficult to process with classical analytical methods. The so-called "unnecessary data" that further complicates the processing and extraction of knowledge that will quickly support or justify a particular management solution is another problem.

Nowadays, on a global scale, the mining industry faces many different challenges - both operational and because of the changing regulatory requirements.

One of the most important challenges is the constant change in the prices of metals, which requires the use of innovative technologies to maintain or reduce their costs. At the same time, they must also comply with the country's legal, regulatory and environmental standards, which are an important requirement when expanding into new regions and countries.

To deal effectively with all these challenges and to be competitive in the metal market, many mining companies around the world and in Bulgaria already use the BI tools. These tools provide them flexibility in making management decisions maintain job efficiency, while at the same time reducing costs.

BI systems in the mining industry can be successfully applied in:

- Monitoring the quality and grain size of the raw material extraction,
- Tracing the parameters in the mineral processing factories;
- Monitoring the characteristics of groundwater and surface water;
- Optimization of the mining and transport mechanization used;
- Optimization of both the individual processes and the mine work as a whole;
- Optimization of the administrative processes inside and outside the mining company;
- Tracking and optimization of critical manufacturing processes;
- Compliance with the established standards;
- Human resource planning and others.

The main advantage of BI systems is that they enable fast (real time) trend analysis, which is particularly valuable in making strategic decisions for the development of mining companies, where the return on investment is over a relatively long period of time. [5, 6]

BI solutions can find new business directions for companies. An example in this regard is Pulse Mining Systems, which provides ERP solutions for the mining industry. Since the ERP system database used an older technology, this challenged the company when it needed to retrieve and visualize information. Using the Tableau BI system, they were able to create clearer and better visualizations of the processed data. [7]

Rob Parvin, Manager of Visualization and Analytics, claims that thanks to BI, Pulse Mining Systems managed to create a new business segment that is a precedent for the company. With the help of Tableau, they managed to create a single solution for water quality reporting across the overall mining organization. This stimulates the emergence of further initiatives for which the company receives new funding.

4. CONCLUSION

Nowadays, we are witnessing the continuous development of information technology. New sources of raw data are emerging that need to be processed.

The mining companies already have high-tech management systems, resource allocation and high security standards that generate huge amounts of data.

The choice of a particular BI product depends on the specifics of the work and security policies.

If the data is strictly confidential, the user should choose the BI solution of the Tableau. Although the initial costs are relatively high, the data is stored locally (on-premises) in the company and the security level is higher, and the prepared reports and dynamic dashboards can be viewed with Tableau Reader.

If a company uses Microsoft products and platforms, the best choice would be Power BI as one of its key advantages is that it integrates easily into your ERP and CRM systems of Microsoft.

BI systems give us the ability to understand what "the data tells us" through detailed and interactive data visualizations. Information processed through the BI system helps in making the right decisions, strategies and forecasts that drive businesses forward, ensure competitiveness and stable market positions.

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