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FEATURES OF BUSINESS INTELLIGENCE DEVELOPMENT IN THE CONDITIONS OF DIGITAL TRANSFORMATIONS

Yurchuk N.

Vinnitsia National Agrarian University

candidate of Economic Sciences, associate professor of the department of computer science and economic cybernetics

Abstract

The article explores the main trends of Business Intelligence development. It has been determined that business intelligence is used to effectively manage businesses. One of the tools of business intelligence is Business Intelligence. The Business Intelligence market is dynamically developing and growing.

The essence of the concept of Business Intelligence is analyzed. It has been established that the definition of business intelligence has been around for several decades, although there is no definitive definition in the scientific literature. It is established that Business Intelligence is a metaphor that has no literal interpretation and denotes a synergistic complex of automated tools for analyzing primary data and visualizing its results to support decisions.

It is determined that the main functionality of the VI platforms is integration, information delivery and analysis.

The classification of Business Intelligence platforms according to the recommendations of leading information-analytical agencies is considered. One of the most respected studies in Business Intelligence has been found to be Gartner's annual report on Business Intelligence and Analytics Platforms - the "Gartner BI Magic Quadrant", which provides a thorough analysis of VI vendors and major market trends in Business Intelligence and Analytics.

The basic tendencies of development of Business Intelligence are investigated. It is argued that modern analytical platforms are increasingly incorporating artificial intelligence, machine learning and natural language skills that make it easier to use and simplify their use to support decision making.

Keywords: Business Intelligence, Business Analytics, BI Systems, Big Data, Data Mining, Text Mining, Visual Mining.

Problem statement. The introduction of cutting-edge information technology, business models, digital platforms, the Internet of Things, artificial intelligence, in-depth analytics of huge data sets have a powerful economic effect, as economic growth and digital technologies are now strongly interconnected.

The processes of state formation and reform of Ukrainian society, which have been going on for more

than a quarter of a century, make significant adjustments to the mechanisms of sustainable development [8]. The basis for sustainable economic development is a systems approach and digital technologies. The digital economy is the basis for the development of society, the state, and business. Its development is a matter of national security and independence of every state, including Ukraine.

The digital economy is one of the technologies

used by many countries in the world to improve the efficiency of national economies and use modern information technologies to increase profitability [11].

At present, the share of the digital economy in Ukraine is 3%, and in the ranking of digital competitiveness in 2017, our country ranked 58th among 63 countries in Europe, the Middle East and Africa [17]. Digitization can be a key factor for Ukraine to increase the competitiveness of the Ukrainian economy and the well-being of Ukrainians.

The increasing importance of digital data is due to their specific properties. A data platform is an integration of mathematical programming, statistics, various problem solving methods, data filtering methods, and other algorithms. Various businesses are deploying data science research platforms to gain valuable insights from vastly structured and unstructured raw data.

Over the past period, experts have developed many algorithms, noted a number of laws and principles that neglect that can lead to a complete failure of the project and serious losses. This leads to the use of effective information systems based on business intelligence platforms, which will allow executives to turn the data into current situation information, and then information into business management knowledge. A recent Nucleus Research report states that companies receive \$ 10.66 in each dollar they invest in business intelligence. And the degree of implementation of business analytics payback is increasing [14].

The capabilities of analytical tools have long been questioned by top executives and company executives. A few years ago, business analytics were considered the prerogative of analysts and senior executives. Today, however, the popularity and increase of access to BI tools has caused a wider range of users. Most organizations are gradually becoming aware that access to timely and up-to-date information is needed by all decision-makers [6].

Increasing volumes of the digital information resource market create a problem for users to effectively find and use information. Today, businesses need to know not only the sources and the value of information, but also have the right technologies to access it to get it in a timely manner. Access to information resources is possible with the availability of both the software and

the appropriate systematic information retrieval software, which predetermines the use of business intelligence tools, in particular Business Intelligence.

Analysis of recent research and publications.

The development and operation of business-analytical platforms are addressed by both scientists and practitioners. Analytical studies of business intelligence systems, Business Intelligence solutions are carried out by such global information and analytical agencies Gartner Group [15], International Data Corporation (IDC), Forrester, Business Application and others.

Drokina N.I., Darchuk V.G., Krizhko O.V. in [6] systematized the functionality of Business Intelligence software platforms.

Authors Kanteladze S.G., Belyaev L.V. [9] considered the features of business analytics systems and their role in management decision making.

The possibilities of Business Intelligence on information processing to support managerial decision making in the work of Shevchenko V.L., Kirpichnikov Yu. A., Fedorienko V.A. [16] are analyzed.

Using business intelligence tools for leading companies has become one of the management tools. However, Ukrainian companies do not take full advantage of the capabilities of BI-systems, so identifying trends in Business Intelligence updates this study.

Goals setting. The purpose of the study is to explore the features and trends of Business Intelligence development in the context of digital transformation.

Presentation of the main material of the research. Digitalization and the intellectual use of digital data is a key factor in BI development. Digital data is used as an economic resource in all spheres of public reproduction and is a major commodity in the digital economy because it is the key to understanding what is happening, how to predict the future and choosing the right development options.

In 2018, the global business intelligence and Big Data software market totaled \$ 60.66 billion. The United States, up 12.3% from 2017, as evidenced by a study by the internationally recognized consulting company International Data Corporation (IDC).

The market leaders in business intelligence and Big Data software are such companies as Oracle, Microsoft, and SAP (Table 1).

Table 1

Vendors in the global business intelligence and Big Data software market in 2016-2018

Vendors	Revenue, million \$ USA			Share in market structure,%			Deviation, +/-	
	2016	2017	2018	2016	2017	2018	revenue, million \$ USA	share in market structure,%
Oracle	6956,7	7420,0	7993,2	14,2	13,7	13,2	1036,5	-1,0
Microsoft	4771,2	5755,0	7112,8	9,8	10,7	11,7	2341,6	1,9
SAP	5484,7	5882,7	6318,5	11,2	10,9	10,4	833,8	-0,8

Source: Based on data [1].

Oracle is the largest vendor in business analytics in recent years, though its share in the structure has decreased by 1% to 13.2%. In 2018, revenue increased by \$ 1036.5 million. USA.

In the Ukrainian market of information technologies in the field of BI-systems are presented mainly companies-developers of software of foreign origin,

since in Ukraine such development is practically not carried out [9].

At the same time, according to the State Statistics Service of Ukraine in 2018 there were companies that worked with Big Data (Fig. 1).

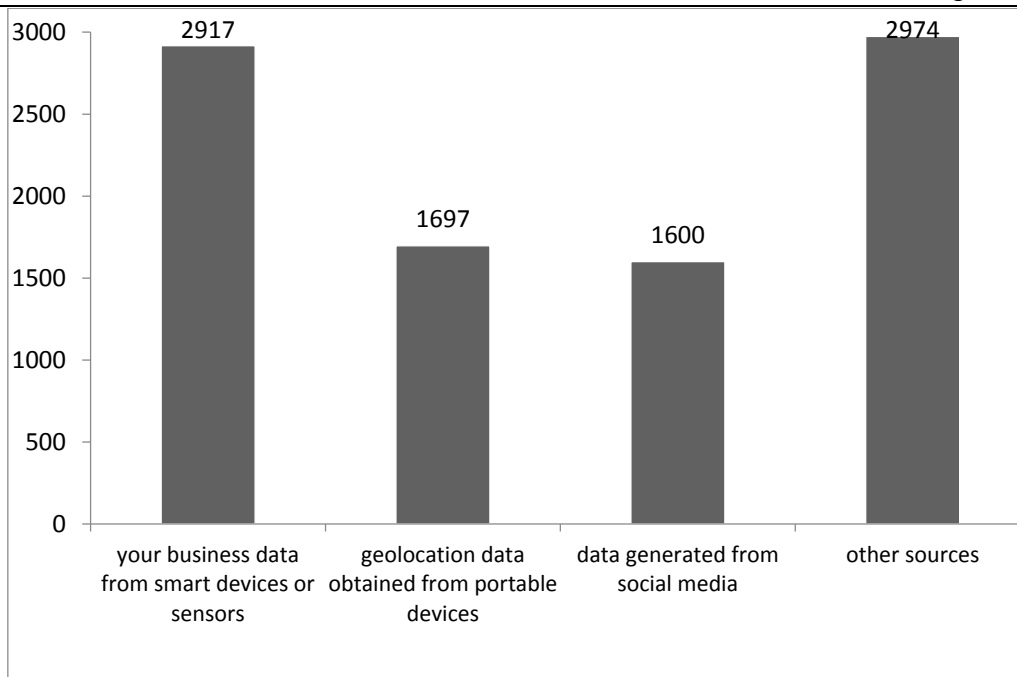


Fig. 1. Data sources for Big Data by Ukrainian enterprises in 2018

Source: Based on data [13].

Among ukrainian companies that analyzed Big Data, the most frequently used data were from other sources (2,974 enterprises) and their enterprise data obtained from smart devices or sensors (2,917 enterprises).

Business analytics can be seen as a process of analyzing information for business decision making, including: methods of gathering and processing information, risk assessment, modeling and forecasting using information technology [7]. One of the tools of business intelligence is Business Intelligence.

Business Intelligence aims to make effective business decisions by utilizing appropriate analytical tools, software applications and technologies to collect, store, analyze and access data. Such BI-systems are the main tool for any other business and play an important role in the strategic planning process of the company [9].

The definition of business intelligence has been around for several decades, although there is no definitive definition in the scientific literature.

Initially, the term "business intelligence" was coined by Gartner experts in the late 1980s as a user-centric process that contains public access to information, an overview of the data obtained, comprehension and an intuitive degree of cognition that lead to the most appropriate decision making.

Later, in 1996, there was an adjustment in interpretation, and "business intelligence" was interpreted as a tool for researching data, the ability to develop reports and queries that would help the analytics to go through a huge amount of data to obtain the necessary information - for today day, these tools are generally found in a group called Business Intelligence.

Considering BI as a system of methods, technologies, as well as means of acquiring and transferring knowledge, BI-systems act as a process of obtaining and analyzing the necessary information, developing

the initial level of intuition, as well as tools for understanding and using for their purposes various kinds of information [5].

According to Gartner experts, "business intelligence" is a generic term that includes applications, infrastructure, and tools, as well as best practices that allow you to access and analyze information to improve and optimize your decisions and effectiveness [15].

The terms "business intelligence" and "business analytics" are often used synonymously, but there is a difference. Business intelligence, other than BI, manages prepared data for analysis, uses statistical and quantitative tools to assess the current situation and forecast. Business Intelligence, by processing large amounts of unstructured data, cleans and consolidates information, converts it into an easy-to-analyze format, interprets a large amount of data, selecting from them significant factors that affect performance.

Business Intelligence (BI) is a metaphor that has no literal interpretation and denotes a synergistic set of automated tools for analyzing primary data and visualizing its results for decision support (Decision Support), which integrates specialized statistics, ad hoc query), OLAP rapid multidimensional analysis tools, special data mining tools for Data Mining and Visual Mining, special rendering tools (Dashboards, Scorecard), elements of expert systems, and may have special text mining tools for Text Mining, etc. Business Intelligence provides rapid retrieval of potentially useful non-trivial knowledge from the primary data and visualization to make more useful decisions that are not available without analytical workgroups of all sizes, intellectual strengths and experiences. The most useful results are BI tools based on data analysis in Data Warehouse, but they can also have useful effects in Data Marts, even for 100 datasets or less. The most effective Business Intelligence tools (OLAP, Data Mining, Visual Mining, Video Mining, Web Mining, and

Text Mining and Opinion Mining elements) require powerful hardware; some of these funds have been available since the 1990s and others since the second decade of the 21st century. Business Intelligence combines relational (now non-relational database - NoSQL) technologies with the most mature Artificial Intelligence technologies and advanced traditional statistics and analysis results [3].

Business Intelligence first deals with the cleaning, consolidation of data, converting it into an easy-to-analyze format, then the task is to interpret a large amount of data, focusing only on the key factors that affect performance, simulate the outcome of different actions, track the results of decision-making.

BI's primary purpose is to make business decisions. BI supports many business decisions - from operational to strategic. Major operating decisions include product positioning or pricing. Strategic business decisions include priorities, goals and areas. The BI system is most effective when it integrates data obtained from the enterprise market (external data) with data from enterprise sources such as financial and production data (internal data). In combination, external and internal data give a more complete picture of business, that is, analytics that cannot be obtained from data analysis from only one of these sources [9].

The use of Business Intelligence provides quick retrieval of potentially useful knowledge and visualization to make better decisions that are not possible without analytical work groups of all sizes, intellectual strengths and experiences. Today, three generations of Business Intelligence have been identified - BI 1.0, BI 2.0, BI 3.0. Accordingly, three generations of DSS BI have been identified: DSS BI 1.0, DSS BI 2.0, DSS BI 3.0 (Cloud Computing) [12].

Currently, leading international intelligence agencies (International Data Corporation (IDC), Gartner Group, Forrester Research Incorporation, Business Application Research Center, Ventana Research and others) conduct research of business intelligence systems (Business Intelligence, VI) of various software vendors providing, in a different way, revealing the meaning of the concept and classification of VI [16].

Forrester, an independent analytical company, provides the following definitions of a Business Intelligence software:

first, in the broad sense: "a set of methodologies, processes, architectures and technologies that transform raw data into useful and meaningful information that is used to make decisions that are effective in the

strategy, tactics and operation of the company" (the traditional definition of "Business Intelligence").

secondly, today there is also an additional (narrow) definition of the term "Business Intelligence", which involves taking into account two segments of BI - data preparation (data preparation) and data usage (data usage), namely: "a set of methodologies, processes, architectures and technologies that use the result of the information management process to analyze, report, manage performance and deliver information" [10].

Business Intelligence, in a general sense, integrates the following autonomous technologies:

- technologies of relational (now non-relational databases - NoSQL) databases;
- the most mature Artificial Intelligence technologies;
- advanced technologies of traditional statistics;
- advanced technologies of visualization of results of the analysis.

In a more narrow sense, Business Intelligence combines the following autonomous and semi-autonomous tools:

- ETL (Extract, Transform, Load) tools;
- means of extracting, transforming and downloading information as before Business Intelligence and between subsystems;
- special statistical means;
- means of ad hoc query;
- OLAP rapid multidimensional analysis tools;
- special data mining tools for Data Mining and Visual Mining;
- special visualization tools (Dashboards, Scorecard);
- special tools for "excavation of texts" Text Mining now;
- elements of expert systems, etc. [2].

Thus, the main functionality of the BI platforms is integration, information delivery and analysis.

Let's take a closer look at the classification of Business Intelligence platforms according to the recommendations of the world's leading information and analytical agencies.

One approach to understanding the relationship between Business Intelligence and Business Analytics is the classification of consulting companies IDC, which in its annual report offers a taxonomy (classification) of software for Business Analytics Software Market Taxonomy, which is shown in Fig. 2.

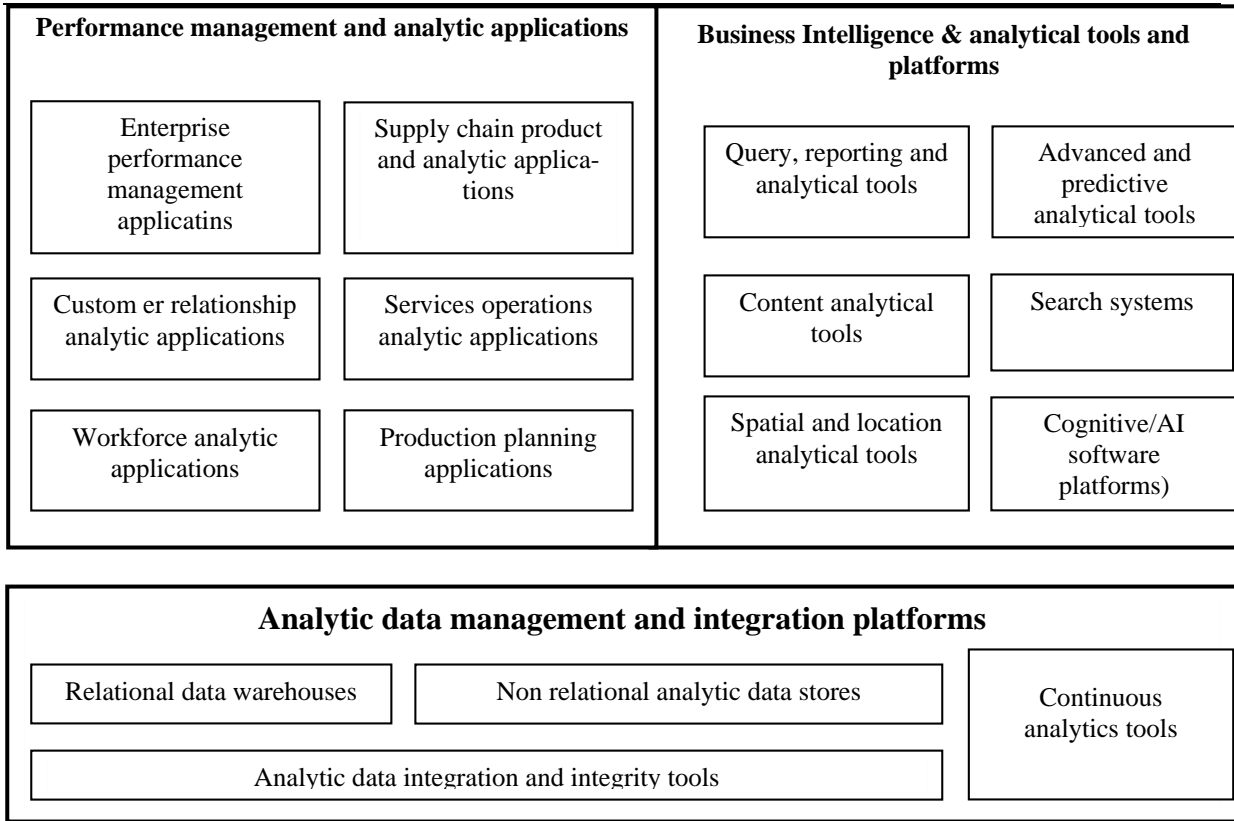


Fig. 2. Classification of business intelligence software by IDC methodology, 2018

Source: Based on data [1].

We see that Business Intelligence tools are the analytical foundation of Business Analytics.

In Business Analytics Taxonomy, its Performance Management and Analytic Applications subsystem is linked to Business Intelligence tools.

All Business Analytics Taxonomy subsystems are built on analytics management and data integration platforms where the primary data is stored.

The classification by Gartner of Business Intelligence-type software is based on the method of functional tasks, where the software products of each class perform a certain set of functions or operations using special technologies [4]. At the same time Gartner distinguishes a set of BI software products, which are shown in Fig. 3.

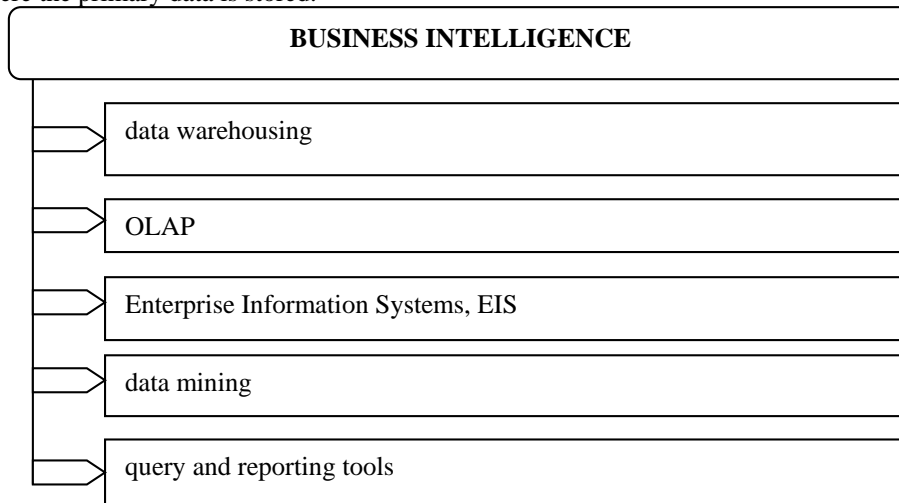


Fig. 3. Gartner Business Intelligence Classification, 2019

Source: Based on data [4].

One of the most respected studies in Business Intelligence is Gartner's report on Business Intelligence and Analytics Platforms, which is published annually in February. The Gartner analysis is presented as a

“Gartner BI Magic Quadrant” report (Figure 4), containing a thorough analysis of BI vendors and major market trends in Business Intelligence and Analytics, based on in-depth interviews clients and our own research with years of analytical experience.



Fig. 4. Gartner Business Intelligence Magic Quadrant 2019

Source: [15].

The Gartner methodology involves a thorough evaluation of each vendor by criteria such as functionality, product development strategy, and customer feedback.

Each BI-system is evaluated on two scales:

X-axis: Completeness of vision, which includes:

- understanding of the market and complex needs of analytics users;
- marketing strategy and its accessibility to users;
- sales strategy, including affiliate network maturity, pricing, bundles;
- a product strategy focused on the future needs of users, including flexible deployment infrastructure, native connectors for Hadoop, Spark and other NoSQL tools, data management with support for a comfortable BI self-service, augmented Data Discovery model, text and voice search in natural language, a chatbot to access analytics; convenient exchange of analytical discoveries;
- sectoral strategy as far as the BI platform is suited to the tasks of companies of different industries;
- innovation;

- geographical strategy (whether the vendor operates in other countries through its local offices or only through partners).

Y-axis: Platform perfection (Ability to execute), which includes:

- platform competitiveness and comfort of BI-product integration into workflow;
- product and vendor viability;
- customer comfort in the process of sale and pre-sale cooperation;
- speed of reaction to market changes;
- technical support, errors, complexity of transition from version to version;
- user experience of working with BI-system (from simplicity and accessibility of training to results obtained from implementation).

Actually, the Gartner BI Magic Quadrant contains four classes:

1 class. Leaders are well-performing vendors that have been able to anticipate and stand firm (upper right quadrant). The 2019 report identifies 4 companies as leaders - Microsoft, Qlik, Tableau, ThoughtSpot. In

2019, ThoughtSpot was added to the leaders that were in previous years.

2. Challengers - Vendors who feel good, perform well, or can dominate a large segment of the market, but do not demonstrate an understanding of where the market is going (top left quadrant). In 2019, as in the previous one, the applicant was 1 vendor (Microstrategy), in 2017-2016 there were no applicants at all.

3. Visionaries - Vendors who have a vision of where the market is going or how to do something that will change the market or the rules in the market, but they are not doing well enough yet (right lower quadrant). In 2019, 5 seers companies were introduced to the market - Tibco Software, SAP, SAS, Salesforce, Sisense.

4. Niche players are companies that are successfully focused on a small segment, but not innovative enough to outplay other players (bottom left quadrant). In 2019, 11 vendors are listed as niche players (Looker, Domo, GoodData, BOARD International, Yellowfin, Logi Analytics, Oracle, IBM, Information Builders, Pyramid Analytics, Birst) [6].

In addition, Gartner, in its Gartner Business Intelligence Magic Quadrant 2019 report, identified trends in Business Intelligence development [15]:

1. Business intelligence systems and Business Intelligence have become mainstream. Modern analytics and business intelligence systems are focused on flexibility, privacy, scalability and advanced analytics. The market for advanced analytics and business intelligence platforms is growing faster than other areas, and many manufacturers are now incorporating these tools into their solutions. Intuitive software supports analytical processes ranging from data preparation to data generation, and typically does not require IT activity like traditional Business Intelligence platforms.

In the past, manufacturers developed Business Intelligence solutions that either focused on data prediction or data. As more and more clients search for a single solution that covers both processes, developers are forced to develop appropriate solutions, but at the same time there remain many more solutions that are focused on only one process. Customers who currently need a single solution have limited capabilities, such as using a single portal, a similar portal or a hub to access multiple platforms.

2. Advanced analytics will become a focal point. Expanded analytics will lead to a new acquisition of Business Intelligence software in the coming years. By Gartner's definition, advanced analytics is an artificial intelligence and machine learning technique that transforms, develops, consumes, and shares analytics. It also automates various research processes such as data preparation, model development and information discovery.

Vendors are adding advanced analytics to their platforms at different speeds, with only a few offering new features such as augmented notification and anomaly detection.

3. Natural language processing will increase accessibility. One of the most popular features of advanced analytics is Natural Language Processing (NLP), which allows users to access and interpret data through voice commands and queries. Users can ask

complex questions that can be answered from different data sources. Gartner predicts that by 2020, half of all data requests will be generated automatically or through voice commands.

In addition, conversation analytics can develop narratives for key performance metrics and graphs. Data-telling features automatically apply best practices for visual data perception, present results as history, and combine a variety of formatting and infographics.

According to Gartner analysts, NLP will facilitate the implementation of Business Intelligence, especially among front office workers. Businesses will need to focus on hiring data and analytics experts with communication skills, not just IT professionals.

4. Business analytics prices will decline. Although Business Intelligence vendors are showing revenue growth, software prices are experiencing a downward pressure from two factors:

- companies are transitioning from perpetual licensing to subscription licensing models.

- Microsoft and other major vendors are now offering state-of-the-art tools as part of the maintenance fee.

As a result, several vendors have offered lower prices for BI solutions in 2018. In particular, Tableau released Viewer software, and Qlik introduced a dual-use license so that QlikView clients could also use QlikSense.

Almost all vendors now offer a subscription-based pricing system, as 54% of customers prefer this licensing model. Although subscription licensing can reduce the initial cost to customers, in the long run it increases the total cost of ownership over a long period.

5. Data privacy requirements are increasing. For many businesses, data loss can lead to financial and reputational losses. In addition, companies may also face legal problems as leading countries adopt privacy laws, such as the adoption of a General Data Protection Regulation (GDPR) in the European Union, several federal and state regulations in the US.

Business Intelligence developers do not provide enough data security features. Many solutions cannot classify information as private or cleared elements of certain data. Only some tools offer privacy features, such as preventing personal data from being exported to PDF or spreadsheets. Today, data security remains a weak spot for most manufacturers in the market.

Thus, the main trends in business analytics include the further introduction of technologies such as advanced analytics, continuous intelligence, artificial intelligence, advanced data management, natural language processing, blockchain, graphical analytics, data factories, commercialization of artificial intelligence and machine learning, nonvolatile memory.

Conclusions. Digital transformations in the global realm today define business performance that is not possible without the use of business intelligence tools. The growing role of analytics for business activities, the increase in the amount of information being processed, the development of data processing information technologies are driving the expansion of the Business Intelligence software market.

Today, there is no single interpretation of the

concept of Business Intelligence. At the same time, the most successful is the definition of Gartner, which offers Business Intelligence to understand a generic term that includes applications, infrastructure and tools, as well as best practices for accessing analysis and analysis of information to improve and optimize decisions and efficiency.

BI solutions market is growing and developing dynamically. Modern Business Intelligence platforms include artificial intelligence, machine learning, and natural language skills that make it easier to use and easier to use to support decision-making.

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