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BUSINESS INTELLIGENCE SYSTEMS YESTERDAY, TODAY AND TOMORROW - AN OVERVIEW[4]

ABSTRACT

Business intelligence (BI) represents the ability to understand and adapt to new business conditions, and to solve business problems. The BI system, based on the data collected from various business and public sources, aims to detect and determine the legalities that would simplify the decision-making process. BI combines operational data with analytical tools in order to present complex and important information to decision makers, business managers and planners. The main goal of BI is to improve the timeliness and quality of inputs in the decision process. BI is used to understand the possibilities available in business firms like market trends, future decisions and directions in the markets worldwide, different technologies, the regulatory environment in which the business firm competes and the activities taken by many competitors. BI pervades the entire business organization, improves operations and raises the level of business intelligence in all of its aspects. The paper presents an overview of BI, an analysis of its early development as well as its state today, and some predictions for the future. These are also the main contributions of the paper.

Key words: *system, information, business intelligence, data warehouse, big data*

1. INTRODUCTION

Information has always been crucial for running a successful business in all sectors of the economy, education, science, healthcare, state administration and other business areas. Modern organizations express the need for an effective business information system, which will enable the collection, preservation, processing and finding information when needed. An important characteristic of the modern world is the confrontation with many uncertainties and rapid changes. The complex business environment complicates doing a business activity and adaptability in various business organizations. Therefore, business managers are forced to look for instruments and mechanisms which will facilitate management and create good conditions for business success. Business

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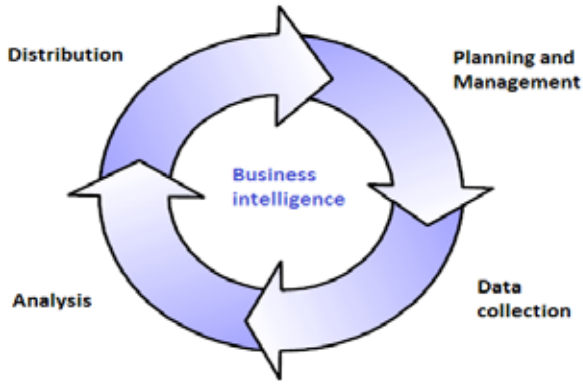
intelligence (BI) certainly belongs among such mechanisms. According to Rouse (http://searchdatamanagement.techtarget.com/), BI is a technology-driven process for analyzing data and presenting actionable information to help corporate executives, business managers, and other end users make more informed and high-quality business decisions. Also, Rouse (http://searchdatamanagement.techtarget.com/) states that BI encompasses a variety of tools, applications, and methodologies that enable organizations to collect data from internal systems and external sources, prepare it for analysis, develop and have queries about the data, and create reports, dashboards and data visualizations to make the analytical results available to corporate decision makers as well as operational workers. Since its development, the concept of BI is strongly imprinted in economies around the world. The purpose of BI systems is to help business managers to adapt and implement business decisions. Nowadays, without the implementation of BI systems business is unthinkable. Today's BI systems combine a broad set of data analysis applications, methodologies, technologies, and platforms for data storage (Data Warehousing), data mining (Data Mining), OLAM (On-line Analytical Mining) and data processing (On-Line Analytical Processing - OLAP). BI systems also include an ad-hoc analysis, enterprise reporting, real-time BI, open source BI, mobile BI, operational BI, collaborative BI, cloud BI, data visualization software, tools for building BI dashboards and other intelligence tools that will support some aspects of top management decision-making. The remaining sections in the first chapter describe the term of BI systems and their structure. The second chapter describes early development of BI systems, the third chapter describes its state today, and the fourth chapter gives an overview and analysis of previous research in the field. The fifth chapter gives some predictions for the future and the last chapter offers the conclusion.

1.1 The term of business intelligence systems

Information is the basic content that BI systems use to communicate with other entities within the organization. As stated by Javorović and Bilandžić (2007), BI system is a system that uses appropriate methods based on data collection from open and public sources and has the purpose to detect and determine the legalities that would facilitate decision-making. A BI system provides answers for various business questions, like what is happening in the business environment, why that is happening, what needs to be done, how to do something and what will happen next. According to Panian and Klepac (2003), the answers to those questions represent the core functions of BI. The core functions of BI are observation, understanding, reaction, anticipation and reorganization. BI systems process, store and provide useful information to users who need them. A BI system is an information system that employs BI tools to produce and deliver information to users. According to (Obeidat et al., 2015), BI transforms the raw and massive data collected from various sources into useful information. Business conditions in the world today prove that the implementation of a BI system is a means of achieving success in the business environment. According to Olszak and Zurada (2015) and Chen et al. (2012), BI enables organizations to make more informed, intelligent business decisions as well as to adapt to a changeable environment and to survive in the business world, while cooperating with

customers, suppliers and competitors. Modern BI involves the integration of intelligence methodologies and information technology that are applied to the business world. According to Bilandžić et al. (2012), in the economies worldwide BI is an institutionalized and separate business function to a large extent- it ranges from 73% to 96% in the European Union, and 87% at the global level. BI involves cyclic processes in which business data and information, collected by different techniques and tools are transformed into knowledge. Based on that knowledge, business managers make business decisions. The cyclic process is made up of various interconnected phases and each next phase can begin only when the previous phase is over. The cycle begins with management and planning (setting goals), followed by the collection of data that should be analyzed and ends with the distribution of the results of an analysis. Figure 1 shows the BI-cycle. It should be noted that the BI-cycle does not end with distribution (final phase), but it continues (there is never the final answer in business).

Figure 1. Overview of the cycle of business intelligence

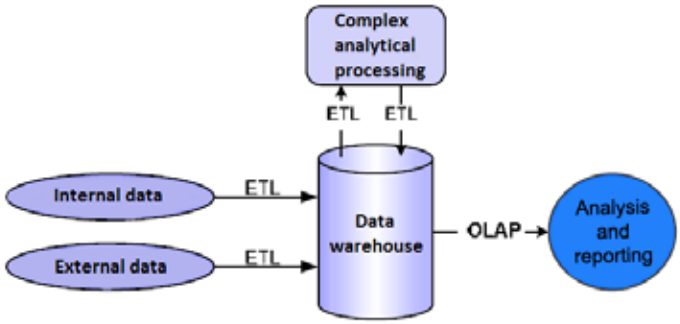


Source: Luetić et al. (2009)

1.2 The structure of business intelligence systems

A structure model of a BI system consists of information that reveals new knowledge, analysis and segmentation of information, personalization (where information is gaining in importance only if it is directed to the right user), delivery through multiple channels (wherein the process of serving customers with information all information solutions must be used), and action, interaction and transaction (where information is used in modelling of the conception of company development). In order to work properly, BI system must retrieve external and internal data that are collected in data warehouses. The interconnected data stores grow into a data warehouse. In terms of technology, BI systems consist of data marts, ETL processes, expert systems, OLAP tools and solutions based on fuzzy logic. A BI system consists of four basic components - infrastructure, functionality, organization, and business. Figure 2 shows a general BI system schema.

Figure 2. An overview of the business intelligence system schema



Source: Panian et al. (2003)

1.3 Advantages and disadvantages of business intelligence systems

We can emphasize some of the main advantages of BI systems: a) facilitation of the decision-making process, b) the unique structure of reporting enables faster and more efficient decision-making and contributes to the improvement of business processes, c) conducting a data analysis, it is possible to use collected data in the best way and increase the satisfaction of all users, d) providing users only with the information they need and timely expressed information that leads to better communication and e) providing opportunities to increase the value of information as a resource. However, some disadvantages can also be found: a) the high cost of implementation of BI systems, b) in order to obtain useful results, it takes a long period of time to do a data analysis, c) expensive and long training in their use and d) lack of adequate professional employees that can work in a BI environment in individual companies.

2. THE HISTORY OF THE DEVELOPMENT OF BUSINESS INTELLIGENCE SYSTEMS

The concept of BI has been practiced for thousands of years in different domains of social and economic life. According to Nadrljanski (2013), historical precursors of BI are military intelligence, protection of national security and protection of internal security. The first users of strategic knowledge were rulers, commanders and bankers, while today's modern BI users are business managers. The rapid development of BI systems begins with the automatization of business processes of individual companies with reference to their implementation of various transactional systems, which have proven to be generators of large amounts of data. That has lead to a huge explosion of data. New databases were created, but it was not easy to access them, so the data were not used in large quantities. Analogous to that, implementation of information systems in business that was focused on processing transactions was directed to the monitoring of production and sales, on employee records and processing of their salaries, etc. Over the years, those systems have evolved and started to serve the owners and managers of companies in support of making business decisions.

As a term, business intelligence was mentioned in 1958 by the IBM computer scientist Hans Peter Luhn. According to Heinze (https://www.betterbuys.com/), in his article titled *"A Business Intelligence System"*, he described the BI system as an automatic system developed to disseminate information to various sections of any industrial, scientific, or government organization. Today, he is considered the father of BI. In 1989, Howard Dresner, the analyst of the American consulting firm Gartner Group Inc. of Stanford, brought the phrase "*business intelligence*" in the vernacular. Further development in the field of BI has led to the development of the data warehouse that improves the flow of information. Heinze (https://www.betterbuys.com/) claims that data warehousing drastically reduced the time it took to access data. The data that had been stored traditionally in multiple places were now all in a single location. In the 1990s, came the development of supplemental facets of data warehousing such as ETL tools and OLAP software. That phase of development became known as BI 1.0. Also, Heinze (https://www.betterbuys.com/) states that BI has become a familiar concept in the late 1990s and early 2000s when dozens of new vendors hit the market. According to Heinze (https://www.betterbuys.com/), during that period, there were two basic functions of BI - producing data and reports, and organizing and visualizing it in a presentable way. However, two significant issues remained, holding back the development of the technology - complexity and time. As stated by Heinze (https://www.betterbuys.com/), the projects were owned by the IT department, meaning that most users were still not capable of executing BI tasks on their own. The existing BI tools had been developed only for professionals. For their use, extensive training in analytics was required. It took more time to deliver and formulate reports to all decision makers. Only experts were able to use advanced data analysis software. The beginning of the 21st century marked a milestone in the development of BI systems with the development of technology for solving complexity and speed problems, with which began phase BI 2.0**.** There was the occurrence of cloud-based programs that simplified and expanded the reach of BI platforms. According to Heinze (https://www.betterbuys.com/), BI 2.0 provided a host of different technologies such as real-time processing, which incorporated data from events as they happened into data warehouses, allowing companies to make decisions based on the most recent information available. Some other technologies provided self-service access for non-expert users. All employees could now complete their tasks and projects without interference from the IT department. The exponential growth of the Internet enabled and supported such technologies. According to Heinze (https://www.betterbuys.com/), it also provided a way for users to review methods and software, and more broadly disseminate a basic understanding of the different uses of BI. By 2005, the increasing interconnectivity of the business world meant that business firms and business managers needed real-time information, in order to deal with the competition on the market, and understand what their consumers wanted and what they thought of their business firm. With that, BI systems are becoming essential for business firms that want to stay competitive in an entirely new, data-driven environment.

3. TODAY'S STATE OF BUSINESS INTELLIGENCE SYSTEMS

Today's numerous possibilities of BI systems were deeply impacted by the development of personal computers. Development of IT caused migration of BI to the Internet and development of web applications that allow usage of BI, which are also available on mobile devices. According to Watson (http://www.business2community.com/), BI has entered its third generation and can be accessed from multiple devices. It is extremely user-friendly and collaborative. Growth in the development of special software has significantly contributed to the development of BI. BI systems are being developed into software packages that are compatible with knowledge bases and methods of artificial intelligence that are enabling simulation of decision-making in business. Companies evolve from information management to BI management companies, which are based on new software solutions, knowledge bases and expert systems that are helping in generating decisions that are most likely to be successful in future business. Methodologies, technologies and platforms for storing data, data mining and processing data are combined. BI systems are used in fields of electronic marketing, electronic trading, electronic banking, stock exchange, reservation systems and other fields. Companies like IBM, Oracle and Microsoft provide users with databases that are the basis for building a data store. They also offer tools necessary for the usage of BI systems. Besides the companies mentioned above, there are a few more important providers like SAS, Cognos, Business Objects and Micro Strategy that provide their users with tools necessary for the usage of platforms for BI systems. With the appearance of big amounts of data, a new business intelligence in *"Cloud"* (Cloud BI) and mobile business intelligence that enables their users to use BI on mobile devices have appeared. Their emergence enabled companies to optimize IT, which made them more competitive and productive in their business. Also, BI in the cloud provides the possibility of on-demand self-service, wide network access, elasticity, merging, and accessibility as well as performance measurement and use of service. According to (Alexe et al., 2014), Kwapien (http://www.datapine.com/) and Kiger (http://www.business2community.com/) today's trends of BI are mobile device diversity and management, mobile apps and applications, the Internet of Everything, hybrid cloud and IT as a service broker, cloud/client architecture, the era of personal cloud, 3-D printing, smart machines, web-scale IT, Software-Defined Anything (SDx), Big data, customer experience, innovations in marketing, sales + content marketing, workplace flexibility, predictive and prescriptive analytics, visual data discovery, innovative data virtualization, graph databases and graph analytics, data storytelling and data journalism, cloud analytics, democratization of data product chain, bootstrapping, etc.

4. RESEARCH IN THE FIELD OF BUSINESS INTELLIGENCE SYSTEMS

Research conducted in the field of BI is present in the world for years. One of the most important studies in the field of BI was conducted by Journal of Competitive Intelligence and Management in 2004. The results of the research were published by Susan Myburgh on the platform Academia.edu (https://www.academia.edu/) in 2004. In that research, authors were exploring the genesis of BI in

certain countries (Canada, Finland, Israel, Africa and the UK). According to Javorović and Bilandžić (2007), results of the research conducted in 2000 show that around 90% of problems in forming BI systems are caused by a human factor. Also, Bilandžić et al. (2012) state that research on a global level was conducted in 2005 by Global Intelligence Alliance (GIA) – an international professional organization with headquarters in Finland. As stated by Bilandžić et al. (2012), results of the research comprised terms that became representative when talking about BI in the economy. The research was conducted in 18 countries around the world on a sample of 287 companies. It has shown that BI has been applied to 73% of companies in Norway, 76% in the Netherlands, 79% in Canada, 89% in Mexico and Asian territory, 97% in Brazil and Switzerland, 95% in Finland to 96% in Germany and on a global level 87% of companies have applied BI. According to Javorović and Bilandžić (2007), one of the studies in the field of BI was conducted by Massachusetts Institute of Technology in 2004. The results gained by this American scientific institution show that a certain application of BI increases the efficiency of decision-making that decreases the risk of making bad judgments and wrong decisions. Also, according to Javorović and Bilandžić (2007), research conducted in 2002 by the European Union shows that 82% of companies whose annual revenues are higher than 10 million dollars have special departments for BI systems. Certain authors researched elements and influence of e-business on business activities of companies as well as how BI enables converting data into information and knowledge which can then be used as a base for quality decision-making. According to Bilandžić et al. (2012), in the Croatian economy one of the most important studies was conducted in 2005 by Mislav Jurišić and Darko Ivančević on a sample of 85 companies using online surveys. The surveys were completed only by 23 companies. Bilandžić et al. (2012) state that the results of the research showed that 9% of the companies have a separate department for BI (only 2 companies), whereas 44% implement BI into their usual business activities. On the other hand, 47% of companies did not consider using BI. Research on the application of BI was conducted by Ognjen Zebić in 2010 as a part of his postgraduate studies thesis at the Faculty of Economics in Zagreb. According to Zebić (2010), the research was conducted using a survey on a sample of 84 companies. The survey was completed only by half of the companies. According to the results of this research, 50% of Croatian companies in 2010 had a separate department for BI which was in charge of gathering and analyzing business information. In 2011, research was conducted on the application of BI in the Croatian economy and the results of this research were published in Bilandžić et al. (2012). The results indicate that most of the companies (57%) apply some activities of BI, 19% have the department for BI and 24% do not apply any kind of BI activity. Present research in the field of BI shows that its application in companies is a matter of rational choice and it also offers an array of benefits and improvements to the business. Today, BI is developing in the field of industry, education, energy and utilities, government, healthcare, media, manufacturing, banking and investment services, insurance, retail, security and risk management, sales, mobile BI, business process, etc. According to Terry (http://www.informationweek.com/) and Harvard Business Review (https://hbr.org/),an IDC Health Insights survey of 40 hospitals and 30 insurers showed that the goals of top hospitals in healthcare are *identifying at-risk patients* (66%), *tracking clinical outcomes* (64%), *performance measurement and management* (64%) and *clinical decision-making at the point of care* (57%). According to Ivan and Velicanu (2015), a Real-Time Healthcare Analytics Solution for Preventive Medicine, developed by SAP, is one of the best solutions in the present healthcare

industry. The main benefit of this solution is saving time in healthcare analytics and can be easily customized for any medical case. Also, Marr (http://www.forbes.com/) claims that the recently formed partnership Pittsburgh Health Data Alliance aims to take data from various sources (such as medical and insurance records, wearable sensors, genetic data and even social media use) to create a comprehensive image of the patient as an individual, in order to offer a tailored healthcare package. This project will try to solve the biggest problem in the quest for data-driven healthcare - the huge amount of data in the medical industry that are often stored in archives controlled by different doctors' surgeries, hospitals, clinics and administrative departments. In addition, Marr (http://www.forbes.com/) says that Apple and IBM are collaborating on a big data health platform that will allow iPhone and Apple Watch users to share data to IBM's Watson Health cloud healthcare analytics service. As stated by Marr (http://www.forbes.com/), the main goal of that collaboration is to discover new medical insights into crunching real-time activities and biometric data from millions of potential users. Besides, Marr (http://www.forbes.com/) explains that BI and Big Data are helping in the fight against the spread of epidemics. For example, in Africa, mobile phone location data is proving in efforts to track population movements, which helps predict the spread of the Ebola virus and provide treatment centers for sick people. Also, researchers are beginning to use Big Data to find a cure for cancer. According to Marr (http://www.forbes.com/), the American Society for Clinical Oncology's CancerLinQ initiative aims to collate data from every cancer patient in the US and make it available for analysis in the hope that it will reveal patterns that lead to new insights.

5. THE FUTURE OF BUSINESS INTELLIGENCE SYSTEMS

In the future, we believe companies will be forced to rely on BI systems completely to keep up with the competition that is increasing on a daily basis. As claimed by Gabelica (http://imef.me/), we are aware of changes that are the result of improved IT and Cloud computing in business through the Internet, which are improving possibilities and are generating more and more data for companies. According to (Rafeeq et al., 2015), by having access to BI solutions that allow true self-service, in 2015 users will move from consuming data passively to using them actively to glean important information. Also, Gabelica (http://imef.me/) claims that big corporations and small companies will make large amounts of money purely on selling data in the future. There are already numerous web pages available where the user can buy data, which can produce information that will make their business decision-making easier through analysis. According to Radošević (http://www.tportal.hr/), mobility will become the first precondition for quality business because new conditions of business demand availability 24 hours a day, from both employees and the data they are managing. Availability of all data is ensured by Cloud business and this amount of data creates a new trend, *"Big data"*. According to Ienco (http://dataconomy.com/), Big data is one of the main leaders of the trend towards accessing analytics and BI through the Cloud. In addition, Radošević (http://www.tportal.hr/) states that social networks prove to be a platform for new business contacts and deals. According to (http://www.banka.hr/), experts from the A.T. Kearney company predict that global spending on software, hardware, and services connected to Big Data will grow on average

30% each year and that the total value of the market will reach 114 billion dollars. Also, Dokonal (http://www.banka.hr/) states that Big Data technology market will rise up to 50.1 billion dollars in 2015 while International Data Corporation estimates that revenues on this market will rise up to 23.76 billion dollars in 2016. According to Dokonal (http://www.banka.hr/), the European commission expects that 100 000 new workplaces will open in Big Data business. In addition, in the new program of the European Union for research and innovations, Horizon 2020, projects related to Big Data will be financed with half a billion euros. Also, more and more data is being generated by the appearance of the Internet of Things, which currently includes more than 10 billion connected devices and significant growth is expected in the next few years. According to Frinčić (http://www.progressive.com.hr/), the appearance of the Internet of Things will cause a revolution in optimization and rationalization of business processes as well as in familiarization with buyers. According to Frinčić (http://www.progressive.com.hr/), it is expected that the number of connected devices in the world will increase up to 26 billion until 2020. According to Bitner (http://www.kdnuggets.com/), time for the implementation of software and training will have to be shorter because of fast changes on the market that demand quick decision-making. Software will become flexible which means that there will be the necessity for adjustments according to business requirements, to grow with business as well as offer their users the possibility of changing their queries and sources of data in real time. BI systems will become simplified, specialized and personalized. We believe that solutions in the Cloud, intelligent applications, and software, as well as mobile devices, are the future, but they are already present in today's BI systems. In our opinion by investing in BI systems, companies will contribute to a safer development of business. Using Big Data technology in the future will surely contribute to the appearance of new possibilities in fields of education, medicine, economy, marketing, management, scientific research and other.

6. CONCLUSION

In this paper, we presented an overview of business intelligence, its early development as well as its state today and some predictions for the future. Implementation of BI systems is a never-ending project. As competition becomes more aggressive, the environment and the future more unpredictable, systems of analysis are faced with demands that are more complex. In the time of industrial revolution, human knowledge was adapting to the work of machines, existing processes, and products. The role of knowledge was to increase the productivity of human work. In today's market, supply is much higher than demand, which means that a competitive advantage is not affected by a number of products but their quality. This causes the evolution of the economy from industrial to the economy of knowledge and its integration with IT. In a modern economy, knowledge has become the most important business resource and modern business becomes dependent on a concept of BI as a process of gathering significant external and internal data and their conversion into useful information for business decision-making. Tools of BI systems are adapting to every business subject and their needs. Business intelligence as a discipline

comprises of strategic elements, management accounting, business analysis, marketing and IT. Companies that apply concepts of BI in their business activities are establishing better control over information, are making quality decisions and through that they are creating a competitive advantage and new forms of revenue. In the future, we believe BI systems will be present in all companies and their activities. The appearance of an improved information business system in Cloud will provide companies with better and safer possibilities in business. We believe mobility will become the first precondition for quality business activities. The global market with an active Big Data trend will experience quick and steady growth. It is expected that the business segment in Big Data trend will open 100 000 new workplaces, which comes as a big motivational factor for young people while searching a job in the future. The Internet of Things will cause a revolution in optimization and rationalization of business processes. The time of software implementation and training will become shorter because of fast changes in marketing. Solutions in the Cloud, intelligent applications, software and mobile devices will become the future of BI systems. Implementation of BI systems into companies will ensure more quality and safer development of business. Today's BI systems are still in the phase of development and we do not have a particular clue how exactly our future will be like. Many questions considering business intelligence still need to be answered. We believe that we will find those answers in years to come due to further development. Finally, we should prepare for the near future, which will start a new age of BI systems as an unavoidable part in all business aspects.

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SUSTAVI POSLOVNE INTELIGENCIJE JUČER, DANAS I SUTRA - PREGLED[4]

SADRŽAJ

Poslovna inteligencija (BI) predstavlja sposobnost shvaćanja i vještog snalaženja u novim uvjetima poslovanja, te sposobnost rješavanja poslovnih problema. Sustav BI-a, na temelju prikupljenih podataka iz različitih poslovnih i javnih izvora, ima za cilj otkriti i utvrditi zakonitosti kojima će se olakšati donošenje poslovnih odluka. Poslovna inteligencija kombinira poslovne podatke s analitičkim alatima kako bi predstavila složene i važne informacije donositeljima odluka, poslovnim menadžerima i planerima. Glavni cilj BI-a je poboljšati pravovremenost i kvalitetu inputa u procesu odlučivanja. Poslovna inteligencija se koristi za razumijevanje mogućnosti koje su dostupne u poslovnim tvrtkama poput tržišnih trendova, budućih odluka i uputa za tržišta širom svijeta, različitih tehnologija, regulatornog okruženja u kojem se poslovna poduzeća natječu te djelovanja mnogih konkurenata. BI prožima cijelu poslovnu organizaciju, poboljšava poslovanje i podiže razinu poslovne inteligencije u svim njenim aspektima. U članku je prikazan pregled BI-a, analiza njegovog ranog razvoja kao i njegovog stanja danas te neka predviđanja za budućnost. To su ujedno i glavni doprinosi rada.

Ključne riječi: *sustav, informacija, poslovna inteligencija, skladište podataka, veliki podaci*

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