

Application of Business Intelligence Technology in Croatian companies: Preliminary research and Case study

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Abstract: - One of the main goals of each company is efficient management and decision process. Usage of IT and development of management support systems, based on a Business Intelligence (BI) technology, have a key role in achieving maximal effects of the management and the decision process. Application of BI system leads to conditions, procedures and mechanisms for creating quality data, information and business knowledge. By these the companies can efficiently respond to numerous pressures in complex environment. The main objective of the paper is to present the overview of business intelligence technologies, show the results of the preliminary research about the use of business intelligence technologies as management support system in Croatian companies and state of IS in part of data processing for business decision-making (case study).

Key-Words: - Business Intelligence, Data Warehouse, OLAP, Data Mining, Case Study

1 Introduction

Companies have always striven for a better access to data and information for a better understanding of business operation and successful management.

One of the reasons for letting BI user needs unsatisfied is that the development of BI system in many organizations is characterized by the disintegration and poor data quality despite significant expenditures for new information

technologies, as well as insufficient involvement of users and management support.

In the new generation of management support system, the information resources are unified from a business perspective and dispersed from a physical and technological perspective. The need for unified resource of information and knowledge for business management led to the data warehouse. Quality data and information alone are not sufficient; one of the distinguishing assets of successful companies is

knowledge. Usage of techniques and tools for extracting useful knowledge from the available data, knowledge discovery technology, is necessary for a company.

At the current stage of the knowledge discovery techniques, there are two widely used enabling techniques [20]: online analytical processing (OLAP) and data mining.

The data warehouse, OLAP and data mining are the most used business intelligence technologies. Often, people refer to data warehouse and business intelligence synonymously.

This paper is structured as follows. First, the study objectives are introduced. Next, the overview of the most important BI technology is presented in section 2. The section 3 shows the methodology and results of the research of usage BI technology in Croatian companies. The case study is presented in section 4. Finally, the last section outlines the conclusions and discusses some directions for further research.

2 Business Intelligence

The worldwide emergence of information revolution affects every type of industry and every part of business. The value of information increases with the number of users who can access that information, multiplied by the number of business areas in which the user works [15]. Despite a huge amount of information stored inside the companies' information systems deals with business partners and business transactions, it can rarely be exploited to its full potential in leveraging tactical and strategic decision making processes.

Companies need timely and relevant information and knowledge. For this purpose, companies are accumulating vast amount of data from disparate internal and external sources such as transaction systems, third-party agencies, Web, publications, research results, etc. Problems of capturing different types of structured and unstructured data relate to normalization (determination of common metrics), filtering, grouping, cleansing, and data enhancement. Next important question is how to extract useful information and valuable knowledge from the data with issues in consistency, exactness, timeliness, and data complexity. Implementing a business intelligence system is a common approach to the problem.

Many various definitions of the Business intelligence exist in literature [1, 2, 5, 9, 18]. We can define BI as a system comprised of both technical and organizational elements that presents

its users with historical information and analysis to enable effective decision making and management support, with overall purpose of increasing organizational performance [21]. BI offers to enterprises „one version of truth“, providing consistent and harmonised data to every department in an organisation [4]. The business intelligence technology has been rapidly expanded and improved and more and more complex business questions can be answered using these technologies: from the user friendly querying tools to the OLAP and data mining tools.

Business intelligence technology include: data warehousing, on line analytical processing (OLAP), extraction, transformation and loading (ETL) data, data cleansing, information portals, data mining, business modelling, etc. This paper is focused in the most widely used business intelligence technologies: data warehousing, OLAP, and data mining. These terms are described further.

2.1 Data Warehouse

Data warehouse [7,8,13] is an integrated, historical collection of detailed and summarized data that is fed by the spider web environment and external data sources. It is organized by business areas (subject oriented) and is user-friendly, especially for manager and user who is usually a business analyst.

The original label that pre-dates the data warehouse is still the best description of what we are designing: a decision support system [12].

Internal and external sources of data may be used to fill the data to the data warehouse. The share of external data is greater for higher levels of management.

Management support systems that are used by managers at different management levels are usually based and built upon data warehouses. The data in the data warehouse is extracted, transformed (according to the requirements of DW model), detailed, aggregated and improved in order to support analysis and decision process. This is the way to make data in the data ware house consistent (i.e. one version of the truth”), which enables easier and more efficient access and use of corporate data on all management levels.

The main benefits of data warehouses are:

- better business intelligence,
- reduced time to locate, access and analyzing data/information,
- consolidation of disparate information sources (data integration).

Since much effort and high investments are required to build and maintain a data warehouse it is necessary to undertake a careful feasibility study.

2.2 OLAP and Data Mining

On-Line Analytical Processing and Data Mining are common methods for retrieving hidden knowledge from the data stored in a Data Warehouse [14].

On-line analytical processing (OLAP) tool is the combination of analytical processing procedures and graphical presentation (user interface). OLAP tools provide users with the ability to explore and analyse large amounts of data, their relationships, and present data in different perspectives (data visualization), involve complex computations, etc.

The key features of an OLAP application are [2]:

- multidimensional views of data,
- calculation intensive capabilities and
- time intelligence.

A multidimensional view of data that is usually used in OLAP applications provides quick and flexible access to data and information. Typical applications performed on multidimensional data views are [10]: roll-up, drill-down, slice and dice, and pivoting.

With OLAP application, more complex analyses are possible, such as time series, charting, forecasting, modelling, statistical analysis, “what-if” functionality and scenario analyse. Analytical processing procedures represent methods of detecting information and knowledge needed in the business management.

OLAP technology potentially provides several benefits to an organization [6]:

- increases the productivity of business managers, analysts, and whole organization by inherent flexibility and timely access to strategic information,
- enables developers to deliver solutions to business users faster, as well as to provide better services,
- provides the ability to model real business problems and respond more quickly to market demands.

Data mining, by its simplest definition, automates detection of key patterns in a database. Data mining is the exploration and analysis, by automatic or semiautomatic means, of large quantities of data in order to discover meaningful patterns and rules [3].

Gartner Group defined data mining as the process of discovering meaningful new correlations, patterns, and trends by sifting through large amounts

of data stored in repositories, using recognition technologies as well as statistical and mathematical techniques [19].

Since OLAP is retrospective in nature [20] and a user should understand how to navigate the data, data mining provides prospective knowledge discovery. It automatically discovers hidden trends and patterns in large volumes of data. A significant distinction between data mining and other analytical tools is in the approach used in exploring the relationships among the data.

Analytical tools usually support a verification approach, in which the user hypothesizes about data interrelationships and then verifies or refutes those hypotheses. This approach relies on intuition of the analyst to pose the question and refine the analysis based on the results of potentially complex queries against a database.

Data mining includes: association, classification, estimation, prediction, affinity grouping, clustering, description and knowledge discovery.

There are several techniques and algorithms used in data mining tools (Figure 2), from statistic analysis, through rule induction and nearest neighbor algorithms, to neural networks and genetic algorithms [11].

Data mining enables users to discover knowledge and provides them with greater depth and understanding of data than ad hoc querying and using of OLAP applications.

3 Business intelligence in Croatia: Preliminary research

3.1 The methodology of the research

Data for the research was collected using a survey based on the questionnaire. The research included the questions about three areas: general information about the organization, information about transactional (operational) information system (ERP) and business intelligence technology as support management support system. In this part of paper the main results of the last part are presented.

The research of the usage of business intelligence technology was related to adoption of the data warehouse, on-line analytical processing and data mining technology. It also analysed initiators, objectives and effectiveness of the business intelligence system, usage of BI at different management level, and key tools used in BI project development.

The questionnaires were distributed to 105 Croatian companies randomly selected from the list of "400 biggest" companies in Croatia [16] in the period from May 1 - September 30, 2013. The selection of the companies was based on their revenues. The size of the selected companies was analyzed according to the revenue and the number of employees in 2012.

The CEOs and IS executives were asked to answer the questionnaire, in order to ensure that the responses reflect the organizations' perspective of the business intelligence.

During the preliminary research 11 questionnaires were returned (which accounts for 10 percent response rate). In the future, the questionnaire will be uploaded to a Web server in order to continue the research.

3.2. The results of the research

Results of the research showed that the all (100 %) of the respondents are familiar with the data warehouse (DW) and OLAP and 80% with the data mining as the most widely used business intelligence technologies.

Even 82% of the respondents use data warehouse. More than 90% of the companies worldwide are currently using and/or developing data warehouse applications. The percentage of the DWs, which are used is lower in Croatian companies (82%), but is still satisfactory.

Probably the reasons for organisation without the data warehouse are the lack of knowledge about the data warehouse efficiency in supporting business management.

Table 1 shows the initiators of the data warehouse project. In most cases, initiative came from the management, but only in 3% of cases from the general manager. In 45% of cases, such an initiative came from the IS department. This results show that management, finally, is truly aware of the importance of data warehouse and benefits of business intelligence system as effective management support.

Table 1 Initiators of Data Warehouse project

Initiators	Percentage
General manager	3%
Top management	36%
Line management	55%
IS department	45%
Other	4%

The organizations that have and use the data warehouse, indicated that the main reasons for implementing the data warehouse were the reduction of time needed to find, access and analyze data (100%) and data integration (91%).

Analysis of the data warehouse development tools presents a large variety of used tools; however, Oracle, IBM and Microsoft solutions were used in most organizations.

The respondents (companies who have data warehouse) were asked about the use of OLAP and data mining technologies/tools. The results are presented in Figure 1. As evident from Figure 1, OLAP tools are in use in 73 % companies and data mining technologies are only use in 10% firms.

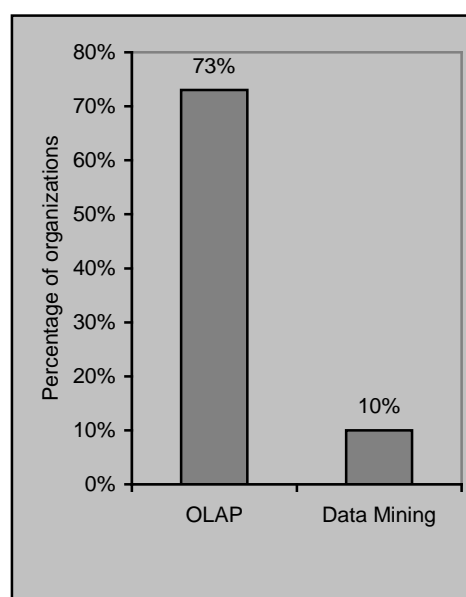


Figure 1 Usage of OLAP and data mining tools

It was expected that the level of OLAP tools usage is somewhat similar to the state of the data warehousing, as these two technologies are complementary [6]. Some organizations do not use OLAP tools, mostly because they don't have appropriate data sources, or because the management doesn't support it.

The data mining tools and techniques are not widely used in Croatian organizations. Probably the reasons for this are that tools are expensive and not easy to use and companies are small or medium size.

The respondents are not informed about the development of information technology in the data mining area, since almost 18% of them do not know what data mining is.

Table 2 shows the proponents of using OLAP/DM technology/tools. As evident, the

OLAP/DM initiative, in most cases, came from the IS department. But, in 20% and 37% of cases, such an initiative came from the top and line management. It was expected that the initiative never came from the general manager.

This result shows that (finally) management understood and accept the importance of easy and fast access to information and knowledge by using BI technologies.

Table 2 Proponents of using OLAP/DM

Proponents	Percentage
General manager	-
Top management	27%
Line management	55%
IS department	63%
Other	4%

In the rest of this chapter, results about the implementation of management support system based on BI technologies are presented.

Participants in the business intelligence project are shown in Table 3.

Table 3 Participants in the BI project

Participants	Percentage
Top management	27%
Line management	55%
IS department	63%
Consultants	45%

The respondents were asked which management level (e.g. operational, tactical and/or strategic level) uses the data/information provided by the management support system based on BI technology. The results are presented in Figure 2.

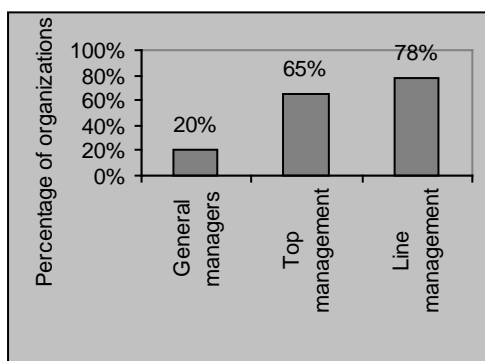


Figure 2 Usage of management support system (BI) at different management levels

Respondents were asked about the effectiveness of the management support system based on BI system. All respondents rated their BI effective. The most of them estimated (73%) that their BI is good and 27% of them as very good. Results are shown in Table 4.

Table 4 Effectiveness of management support system based on BI

Management support system effectiveness	Percentage
Insufficient	-
Sufficient	-
Good	73%
Very good	27%
Excellent	-

4 State of IS in part of data processing for business decision making: Case Study

Data for the case study was collected using a survey based on the same questionnaire as preliminary research (general information about the organization, information about transactional (operational) information system (ERP) and BI technology as support management support system). In this chapter the results of all three areas are presented.

A detailed survey of the current situation in the processing of data for business decision-making was conducted in the company, which operates as an organizational group with more members and represents, according to the nomenclature, big enterprise in private property. Generally, all members of the business group are among the 400 biggest Croatian companies according to rankings based on official data available for publication [17]. The respondents, the company's employees that work in managing information and communication technologies and controlling consider this subject to be a successful company, financially stable and the market leader in relation to the competitive position.

They believe that the information system can be seen through all three related subsystems, meaning that in the successful application are an operational respectively transactional information system, the information system that is used as a support to the management and communication system.

The integrated information system uses the Oracle database. The information system supports

all major business functions: accounting, finance, procurement, production, storage, sale and management of human resources. Most of the information system is made of the acquired Croatian software solution, but in the system are also partly implemented solutions from other countries. Although it is difficult, without specific parameters, to determine the effectiveness of the integrated information system, it can be concluded that this is a very good system that needs some finishing but generally meets the challenge regarding operational business. The main modules of the information system existed for a long time and in recent years have been upgraded or replaced with new solutions of the same manufacturer of software or other technologically more advanced solutions. The development of an integrated system typically includes all control segments of the organization.

The main modules of the information system exist for a longer time and in the recent years have been upgraded or replaced with new solutions of the same software manufacturer or other technologically more advanced solutions. The development of an integrated system typically includes all managing segments of the organization.

In the part of the support to the system organization management hasn't implemented data warehouse (Data Warehouse - DW) although its implementation has been submitted by the management structures and expert staff hired in the organization. Generally, in the work aren't used other techniques; OLAP (On-Line Analytical Processing) and tools for data mining (data mining tools) than pivoting. Among the analytical applications, the ones that are used are for the managing business performance and the customer relationship management (CRM). In the reporting part are typically used pre-defined reports, unchangeable reports and only partly variable and ad hoc reports by using OLAP tools. The support managing system is implemented as finished Croatian solution, intended only for the operational level of managing. Its effectiveness in relation to the needs of the organization has been assessed with a mean score of good, and it was emphasized the need to improve the existing system at the operational level, but also said to approach the implementation of such a system to tactical and strategic level.

By examining the description of the existing system it can be concluded that the system of managing management reports allows users to easily organize by folders and reports definitions. Since the system of managing reports by its appearance is quite similar to the program "Windows Explorer",

the work with the system in the beginning, is close to many users.

The reporting system uses specially designed reporting tables separated from the transactional data. Reporting tables are created by the software vendor. Filling the tables is typically done automatically, according to the agreed time. If necessary, filling tables is started at the user's request. This mode provides static data, by which the comparisons are facilitated because the current transactions do not affect the results of the report. In addition, it is possible to create new reporting tables within the existing transactional database at the user's request.

The existing reporting system can be viewed as static in its functional area of business analysis and the use of advanced analytical functions. As it was pointed out earlier, the functionality that the current reporting system is using has reduced to the "pivoting" and is used for data retrieval, while the analysis of operations is carried out in Excel or Access.

To conclude, this is a system, in the opinion of experts, who are employed in the organization, suitable only for data retrieval and tracking of current operations without assigning new conditions and criteria, and by most of the users in the system is used in this way. Data retrieval in case of change of criteria requires re-launch of the report which is sometimes due to the weather criteria, the nature of reporting and the time required for retrieval can be an aggravating factor, which ultimately negatively affects the user experience.

Currently, the reporting system is on the same base, while the data that are calculated by night procedures are in separate tables with a day late. It was stated, if necessary, for the purpose of performance systems can be separated within a separate database. Each data source is a complex table filled with a combination of the posted data in other modules or from the transaction tables, and tables of the master data and definitions.

A selection of table is important with sale reports. There are two tables related to the sale:

- Sales by the warehouse documents - data are retrieved from the storage of documents (delivery note, MP delivery, internal delivery and their cancellation)
- Sales by the financial documents - data are retrieved from the financial documents (bill, MP account, house account, a notice of posting).

In addition, the existing reporting system consists of following tables:

- Acquisition by the warehouse documents - data are based on the receipt and return of goods to the supplier (cancellation receipt)
- Revenue by the warehouse documents - commodity-storage documents taken into account
- The state of stocks - for the current year is possible to get a state of the day, and for the previous year on the last day of the month

In addition, for the purpose of reporting the separate module controlling who has similar functionalities is used as well as the above-mentioned system, but leaning exclusively to financial and accounting tables.

4.1. Improvement of existing IS in part of data processing for business decision making

By the end of the project of improving the current situation of the information system in the part of data processing for business decision-making in the part of the implementation of the Data Warehouse and Business Intelligence solutions should be built:

- Data Warehouse technology solution respectively the necessary technology platform and database for the implementation of Business Intelligence business process
- Internet Portal for Business Performance Monitoring to improve operational excellence and efficiency in all key business segments
- Business intelligence business process based on modern technological tools and business methodologies for the data collection, processing, and analysis.

In the first phase of construction of DW and BI is recommended forming of the DW base, the launch of the ETL process of filling the database and building BI portal with a finite set of pre-defined reports and data analysis. Eventually, over DW base it is necessary to allow efficient implementation of the methods for data mining (principle of sorting through large amounts of data and picking out the relevant information) and forecasting (the process of estimation in unknown situations by using Time series methods, Sausal / econometric methods, Judgmental methods or other simulation, prediction or probabilistic methods).

From BI Server should be expected support for the option of scheduling the automatic generation and publication of all reports and analysis. Scheduling for an automatic generation should be allowed only to authorized users, a DBA (database administrator) should have a tool for easy and efficient control of the schedules of all automated

operations. Through the design of a Data Warehouse base is necessary to create a relational model database, OLAP cubes, End- User Layout model database, and the logical data model that will be seen by the users of the database, to set the rules of data security and define software packages that will be part of DW base, and serve to support elements of ETL processes and support operations DW and BI solutions.

A set of expected BI portal functionalities must form the BI dashboard, BI tools for ad-hoc analysis, tools for publishing and distributing reports and analysis, tools for integration with office applications and tools for the development, control and management of BI portal.

5 Conclusion

Business intelligence plays a key role in helping companies optimize their decision-making process and management and achieving competitive advantage.

Quality (correct and prompt) information becomes an important resource for efficacious decision-making and management. Management support system based on the information technology, can provide data and information needed for management of business processes.

However, quality data and information alone are not sufficient. Usage of technologies for extracting useful knowledge is necessary for a company. There are two widely used enabling techniques of the knowledge discovery: online analytical processing (OLAP) and data mining.

The preliminary research in Croatia included tree business intelligence technologies: data warehouse, OLAP tools and data mining. Results of the research showed that many organizations are aware of the meaning of business intelligence (all, 100% of the respondents are familiar with the term data warehouse). Approximately 82% of Croatian companies are currently using data warehouse applications. Taking into consideration that Croatia is still less developed country and one of the countries in transition, the state of the data warehouse technologies is satisfactory.

OLAP tools are in use in 73 % organizations (somewhat similar to the data warehouse). This result is expected. The data warehouse and OLAP tools are two complementary technologies, so it could be expected that the level of the OLAP tools usage is somewhat similar to the state of the data warehousing. Data mining tools and

techniques are in use in only a few organizations, while even 18% of IS executives don't know what data mining technologies are.

The question is have the managers, finally, realized the importance of quality information for making business decisions and successfully management? Results show that managers are often among the initiators of data warehousing projects. Satisfaction with the management support system based on business intelligence technologies is high (good and very good) and it is much higher, if the initiator and participant of the business intelligence project was a manager. This was expected, because manager support and user involvement play a key role in the success of an IT project, especially in business intelligence project.

We plan to carry out the research next year and compare the results.

The case study shows results about usage of information technologies in data processing for business decision-making.

Although support management system is not based on the data warehouse, OLAP and DM tools, the respondents assessed their information system as very good that generally meets the challenge regarding operational business. Relatively high rating information system stems from the use of analytical applications, such as business performance management (BPM) and customer relationship management (CRM). However, the data warehouse implementation has been submitted by the management structures and expert staff hired in the organization to improve management support system and business performance. Furthermore, the company management recognized benefits of business intelligence system as effective management support and plan to improve business performance by implementation of Business Intelligence business process and Internet Portal for Business Performance Monitoring.

By the end of the implementation project of the Data Warehouse and Business Intelligence solutions we plan to investigate the improvement of existing IS in part of data processing for business decision making.

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