

Cloud Business Intelligence: Contemporary Learning Opportunities in MIS training

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Abstract

The aim of this work is to present a possible way of teaching cloud-based Business Intelligence (BI) in Management Information Systems (MIS) course at Plovdiv University „Paisii Hilendarski“. In training students to analyze and monitor business performance, create reports, and visualize dashboards, we apply active learning methodology. Presented practical examples of data analysis with MS Power BI for Office 365 and SAP Cloud Lumira are actual cases from the university's Business administration (undergraduate) program. The conducted experiment demonstrates that the application of active learning in teaching cloud-based BI improves the technological and professional competencies of future decision makers for intelligent analysis of organization data.

Keywords

Management Information Systems, Business Intelligence, Cloud Computing.

1. A Brief Background Description

Improving operational performance is important for any organization in a dynamic environment. **Business Intelligence** solutions are essential in making business decisions that are both effective and efficient. “BI is neither a product nor a system. It is an architecture and a collection of integrated operational as well as decision-support applications and databases that

provide the business community easy access to business data. BI decision-support applications facilitate many activities, including multidimensional analysis, click-stream analysis, data mining, etc.” [Mos03].

According to another definition, BI is a set of theories, methodologies, architectures, and technologies that transform raw data into meaningful and useful information for business analysis purposes. Primary components of BI systems are: operational reports, query and analysis; dashboards and scorecards; online analytical processing (OLAP); data exploration; data visualization, data mining and predictive analytics [Get10].

The study of BI software systems aids management and administrative personnel in developing analytical skills and therefore, improve the process of decision making.

The growth of corporate databases and reduction in the cost of information technologies (IT) during the economic crisis led to the rise of a new way of their use – based on utility and consumption of computing resources. **Cloud computing** is a relatively new business model in the computing world. According to the official National Institute of Standards and Technology definition, "cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" [NIS11].

Combining both new technologies – **BI and cloud computing** organizations can gain synergistic effect in their integration. BI is about delivering the right information to the right people at the right time, and cloud computing provides a fast way to access BI applications.

Cloud BI's key benefits are similar to those offered by other cloud computing technology in general: ease of use, deployment speed, elasticity and accessibility.

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Ease of use – cloud BI applications tend to be easier for end-users to operate and set up. This translates into reduced IT involvement and costs.

Deployment speed – cloud BI applications are very simple to deploy, since they require no additional hardware or software installations. Thus, the business processes may be accelerated as the decisions are made in a much shorter time frame. Transition to cloud BI infrastructure is pragmatic and economically justified decision - in the Cloud is paid only for those resources that are actually consumed.

Scalability and elasticity – cloud systems are flexible - they meet the growing needs of companies without having to remodel and invest in additional equipment and new infrastructure.

Accessibility – cloud BI applications can be accessed from anywhere and at any time by authorized employees from a company. This accessibility via any web browser or on any mobile device is particularly important for modern business, which is becoming increasingly mobile.

Senior management, heads of functional units, business analysts, and data scientists need relevant information at different times and in different forms of presentation. Therefore, BI information systems (IS) play an important role in the training of future managers as a tool to actively study of patterns and exceptions in the company information.

The strength of cloud BI applications is that they are accessible on multiple devices and web browsers and therefore indirectly improve the organizational performance enhancing decision making process. Working with BI in a cloud is an economical alternative to actual software purchases. The responsibility for IT assets, their installation and maintenance are borne by the service provider. Implementation of cloud BI training at a university reduces IT costs and increases students' technological competence of students.

2. Contemporary Cloud BI Solutions

Although, the ideas of BI and cloud computing has been explored for several years, unfortunately the investigations on BI cloud are only partly addressed by any existing research [Ols14]. As a starting point in this study of cloud BI, we will use the last annual report published by Gartner in 2015 under the title “Magic Quadrant for Business Intelligence and Analytics Platforms” (Figure 1). In 2013, Gartner’s analysts

replaced the previous name of the Quadrant “Business Intelligence Platforms” with “Business Intelligence and Analytics Platforms”. The term „Analytics Platforms” is applied also by Forrester’s analysts. The change is necessary because, according to Gartner’s experts, many analytical tools have already evolved to such a level that in addition to traditional reporting and analysis instruments, they include advanced tools for information processing and integration mechanisms. In these cases BI can be regarded as a comprehensive analytics platform.

As a result of market dynamics discussed in the research for this year’s Magic Quadrant, Gartner defines BI and analytics as a software platform that delivers 13 critical capabilities across three categories – enable, produce and consume.

According to Gartner researchers, BI will continue to grow and shift to the cloud. Adoption intentions have been consistent with those of last year. About 42% of respondents to Magic Quadrant survey (compared with 45% last year) said that they are either in the process of implementing or planning to implement their BI in either a private, public or hybrid cloud during the next year.



Figure 1: Magic Quadrant for Business Intelligence and Analytics Platforms. Reproduced from Gartner [Sal15].

This report indicates that major multidisciplinary software vendors are working very actively in the BI area, as they have been doing in previous years. Examples include the so-called MISO group” (Microsoft, IBM, SAP, Oracle).

The platforms from the MISO group continue to dominate, mostly through achieving status as the corporate BI standard within their customers’ organizations.

IBM offers a broad range of enterprise-grade BI, performance management and advanced analytics platform capabilities, complemented by a deep services organization that is ready to implement them in solutions for any domain, industry or geography [Sal15]. IBM leads in completeness of vision.

Oracle has a very large and diverse set of capabilities provided by the many products in its BI and analytics portfolio, which is most often used for large-scale enterprise deployments [Sal15].

Plovdiv University has long-term contracts for participation in the academic programs for two MISO group’s members - Microsoft and SAP which involve introduction of the latest software achievements of the IT industry in training. In this regard, we were able to use for the training of students the no-cost latest innovations of the two mentioned firms in the cloud based BI and track their effects on the learning process. We will present the results of our work with these platforms without prioritizing them over others and assuming that the results of the use of the platforms of the same quadrant would be similar.

Microsoft has delivered main data discovery capabilities in Excel. It has a strong product vision (particularly with natural-language query and self-service data preparation), and offers a better customer experience than the other mega-vendors.

However, the lack of a strong BI and analytics marketing and sales focus – combined with the complexity of on-premises deployments and the relatively limited functionality currently delivered through the Office 365 cloud — has limited Microsoft’s market traction and position to date. Its new updated Power BI product offering, which can be deployed as a stand-alone solution for business users to publish and share analytic content without the need for Excel 2013 or an Office 365 subscription, may change this trajectory in the future.

SAP has invested aggressively in Lumira with forward-looking capabilities around smart data discovery and self-service data preparation. It also has

a clearer road map on how Lumira integrates with the rest of its BI stack (HANA, Business Objects, etc.) [Dah15, Sal15].

In conclusion, the main features of BI software of leading vendors featured in last Gartner’s Magic quadrant are:

- Complexity of solutions, called BI platforms;
- Various options for extracting and combining data and knowledge from different sources;
- Modularity – they were developed to be composed of modules, flexible and adaptable to business conditions;
- Their implementation significantly increases companies’ competitiveness.

3. BI and Cloud Computing in FESS Curricula

The above mentioned features and benefits of cloud BI are among the reasons it is such an important part of the MIS curriculum for students of Business Administration. Providing training in this rapidly developing area is an indicator of the relevance and practical orientation of the course, and the overall flexibility and competitiveness of educational institutions [Chi12]. Building on this trend, some leading universities are not only offering courses in BI, but complete majors and minors, too.

An overview of the curricula of most Bulgarian universities shows that the problems of BI and cloud computing are not good yet covered in undergraduate programs and rarely appear in master’s programs.

The situation in Plovdiv University is similar. What is the experience of the Faculty of Economics and Social Sciences (FESS) in brief? In 2011, a new MIS course was included in the Business Administration curriculum for undergraduates. The course provided fundamental knowledge and practical skills in IT as separate topics that were dedicated to BI and cloud computing environments. Such topics are: concepts, basic features, design and capabilities for use in business organizations.

Students gained detailed knowledge of the components of the BI: extract, transform and load data; essence, architecture and design of data warehouses; nature, structure and organization of the process for data acquisition; the use of online analytical processing and data mining in business organizations. The purpose of the topic of BI is to acquaint students with the application of IS, methodologies and best practices in

the field of BI to support decision making in organizations and achieve their strategic objectives.

The topic of "Cloud computing and environments" was included within the same course. It analyzes the current state and main problems associated with cloud computing and the latest generation of corporate business IS. The technological dimensions of cloud computing are clarified, as are its benefits and risks for the business. Models for the deployment of cloud computing (private, public and hybrid cloud) and their opportunities for integration in corporative information environment are also considered. Practical issues in the transition to cloud computing are discussed. The purpose of the inclusion of this topic is to familiarize students with the required body of theoretical and practical knowledge about the technologies of cloud computing, skills and habits for the realization of their advantages in business organizations.

Augmenting the Business Administration program curriculum to include a study of new information technologies such as BI and cloud computing improves the quality of training and the education product offered by FESS. This process is in accordance with user requirements – those of undergraduate, graduate, doctoral students, employers and partners in terms of the changing needs of globalizing national and European labor market.

4. Advantages of Cloud Based BI with Power BI and Lumira

As noted in Section 2, the analytical platforms of Microsoft and SAP are among the market leaders in the Gartner's Magic Quadrant for BI for yet another year.

Microsoft Power BI for Office 365 is a new platform for business analysis through shared access, data management of and querying data from a variety of sources including the cloud.

Starting with Excel 2013, users create workbooks containing data models, reports, business formulas, KPIs, and visualizations by using one or more of the following self-service BI tools: Power Query, Power Pivot, Power View, and Power Map.

Then users can share, explore, and manage these workbooks online by using the following Power BI for Office 365 features: Power BI sites, Power BI Q&A, Query and Data Management, and the Power BI application. The data models stored in the workbooks can use a single data source or combine multiple disparate data sources obtained from web sites or cloud base data storage (Figure 2) [D'An14].

SAP Lumira (formerly SAP Visual Intelligence) is a self-service, data visualization application for business users. Using Lumira analysts can alter data structures and their correlations, without the help of their IT department, then push the data back into the system so it can then be consumed by more casual users in tools like Business Explorer. Lumira can either be used in conjunction with the SAP HANA in-memory platform or without it.

Lumira Cloud is a cloud-based solution that lets users analyze data and collaborate with colleagues on datasets, stories, and other BI artifacts from web browsers or mobile devices. With Lumira Cloud, users can do the following: upload, download, and share different documents, and create, explore, and share datasets and stories.

Growth of company information and reduction in the cost of hardware (multicore processors, RAM, etc.) create new opportunities for development of BI systems. Using Power BI and Lumira Cloud many organizations are taking advantage of the benefits of cloud computing such as lower capital expenditures and increased agility, while still maintaining data in on-premises data stores.

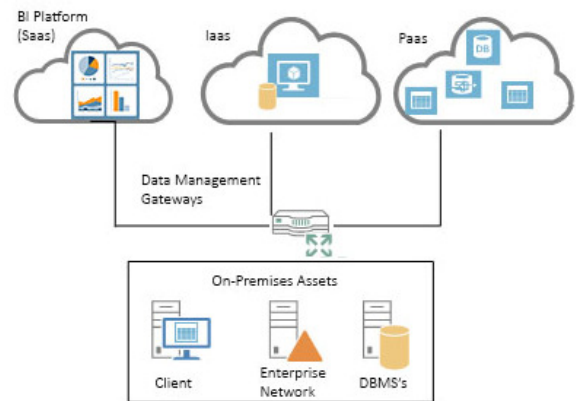


Figure 2: Common cloud BI architecture (based on [D'An14])

The main managerial tool in both BI software products are dashboards. They are interactive real-time user interface, showing a graphical presentation of the current status and trends of an organization's key performance indicators to enable instantaneous and informed decisions to be made at a glance [Das15].

The main requirements to the dashboards are: in order to explore data relations they must be either operational or analytical; they must be focused on a single subject area per tab and interactive, e.g. the user must be able to act on the data.

Business users have to plan and make their dashboards relevant to their audience with different needs and display metrics that are of value to different departments/teams.

The two cloud based BI toolsets described in this section enable access to a variety of data from any cloud source from any type of device. Using these BI solutions, managers can fulfill their responsibilities such as assessment, analysis, planning and control. In addition to discovering, analyzing and visualizing data, conventional and mobile users have the functionality to find and share data dependencies using natural language in Power BI for Office 365. Business users can organize data in a variety of ways to show the relationship of the general to the particular using dashboards. To explore multidimensional data, there are different report types: drill-through, drilldown/up, sub-reports, and nested data regions, etc.

5. Learning Cloud BI by Doing

Our main objectives in teaching cloud-based BI IS in FESS are:

- Integrate pieces of knowledge that students have been exposed to in earlier courses, and provide the new relevant background from the fields of BI, cloud computing, data mining algorithms, etc.;
- Compare new decision making methods with current practice of managers through lectures and in-class discussions;
- Introduce new software packages for cloud based decision making in the main business functions – marketing and sales, operations, finance, and human resources;
- Demonstrate the strengths and weaknesses of contemporary BI tools in a cloud by discussing their applications to current problems in management domain, such as building and evaluating models, and managing business performance;

- Provide practical experience with these BI tools in the form of homework assignments, and demonstrate their strength in class.

To achieve the training course objectives, we apply modern teaching methods. The process of incorporating new training methods and technologies is not new in FESS. A variety of applications of modern learning techniques in faculty's education have been described in [Iva12].

The teaching technologies chosen for this MIS course combine modern pedagogical methods and achievements of IT with a focus on constructivism [Jon02] and active learning. Students learn more and knowledge is retained longer if they are active participants in the learning process, making things rather than being passive receivers of information and knowledge [Aus06].

During seminars based on active learning methods, students are key actors as they define tasks themselves and the teacher takes the role of a coordinator. He only plans and guides learning activities toward a pre-defined goal. Students participate in the design of activities to be carried out in order to solve the formulated tasks and discuss their importance – so students take greater responsibility for their education.

Another feature of such seminar activities is their group character. This suggests both collaboration and competition among students. In this way, students prepare themselves for the labor market, where getting a job requires applicants to have the skills to work in cooperation in a competitive environment.

Since defining a problem is much more important than solving it, we propose the following work schedule: students receive a detailed description of a particular real economic object, and they determine what is given and what is to be found.

Marketing management example

Let sales volumes and revenues of company X are given by dates, items, customers, regions and sales representatives. What questions can be asked, so that solvable problem can be formulated? Define the tasks and determine what you can solve!

Here are some of the proposals made by students:

Why did sales in a certain region decrease?

What will next quarter sales be?

What factors would need to change so that sales forecast would increase?

Which products are customers buying together?

What type of customers could be expected to purchase a certain product?

Which transactions are fraudulent?

What factors distinguish valuable customers from the rest?

How would customers react to changes in the product portfolio?

How would our new product position on the market?

Manufacturing management example

In Manufacturing management examples students visualize SLA performance, operations budget (actual and planned), production to order and capacity, pending orders, spending, etc.

Finance management example

Finance management examples include income statement analysis, revenue and income trends, revenue analysis, etc. Figure 3 and Figure 4 demonstrate a part of obtained solutions – one made by Power BI, and another by Lumira Cloud.

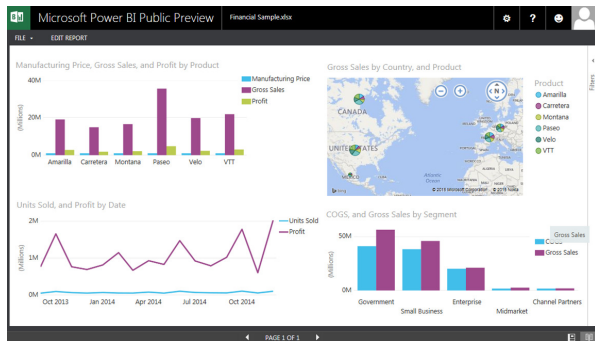


Figure 3: Power BI financial sample dashboard

Human resource management example

In solving human resource management problems, students try to construct employee dashboard for revenue per employee, training courses completed and scores, total sales and unit sold by territories; analysis dashboards to visualize employee satisfaction and turnover rate, actual vs. target labor, headcount, open/filled positions; and build summaries showing firm's recruitment activities, occupational health expenses, benefit expenses, staff absenteeism costs by

department, professions, time periods.

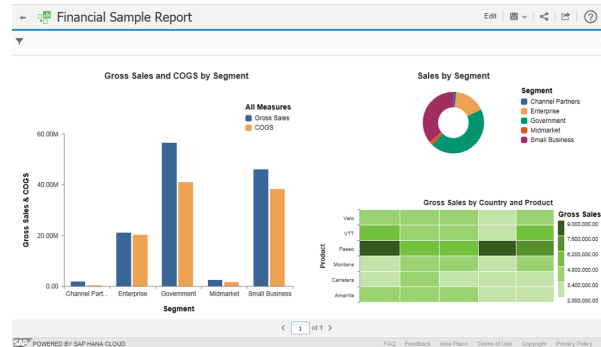


Figure 4: Lumira Cloud financial sample dashboard

In our e-commerce management example students see percent of users buying, type of device used for shopping, total sales by device type and OS, sales by period and territory, etc.

Using cloud BI products such as Power BI and Lumira Cloud, students can access data from different data sources (sales, marketing, operations systems, finance, or HR); collaborate and share real-time reports and dashboards; drill up and down into data and identify important trends with an intuitive drag-and-drop interface. BI software is a key to addressing bottleneck business processes in the company and making the most effective decisions in every time and situation.

To determine whether the use of active teaching methods influence the level of learning, we used a statistical analysis of the results of the following experiment:

Two identical in size and equivalent in complexity topics were selected from the curriculum. One topic was taught by classical methods only and the other one was taught by combined methods. We conducted separate tests for each topic and evaluated the knowledge acquired by students. We applied F-test [Ree01] on a representative sample of students and determined that the variances of estimates from both tests at 5% significance level. This result gave us a reason to compare means m_1 and m_2 of estimates of two trials testing by t-test on equal variances (Table 1). According to the values of the sample means ($4.0686 < 4.4372$) we verified the main hypothesis $H_0: m_1 \geq m_2$ against the alternative $H_1: m_1 < m_2$.

Table 1: t-Test (Two-Sample Assuming Equal Variances)

	Variable 1	Variable 2
Mean	4.06862069	4.437241379
Variance	0.35108374	0.421284975
Observations	29	29
df	56	
t_{stat}	- 2.25874065	
P(T<=t) one-tail	0.01390637	
$T_{critical one-tail}$	1.6725223	

The statistics $t_{stat} = - 2.2587$ falls within the critical region $(-\infty, - 1.6725)$ of the H_0 . This means that the increase in estimates after applying the combined training methods is statistically significant at the 5% significance level.

6. Discussion and Conclusions

The main advantages of the MIS course in FESS are its modern content and blended learning which combines classical and active didactical methods. Active learning techniques motivate students to participate in various activities. The main emphasis in training students in new cloud-based BI is on developing practical skills as well as high level mental skills such as data analysis, model synthesis and its evaluation. Students' creative thinking is sharpened by practical examples from the real economic environment. The actual learning content and intensification of educational activities are accepted well by students and improve the quality of education in Business Administration.

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