

## Business Intelligence overview

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*The need for information has always been present, but what defines the present time is the big amount of data available everywhere and the need to have all the answers we need in a very short time. Because of the agglomeration of markets and the dynamics of economic environment, the ability to collect data and turn it into useful information for decisional process may be the element which makes the difference. Thus, the term of “business intelligence” was first introduced by Gartner Group in the mid of 90’s, but it still exists since the 70’s, when the reporting systems were static, two dimensional, with no analytical skills.*

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### The concept of BI

**1** Business Intelligence can be defined theoretically as the use of high class software or business applications or the use of values to make better decisions for the company, as IBM confirms.

Technical and practical, Business Intelligence are tools for collecting, processing and analyzing data. This way, the company can evaluate the results and interpret them.

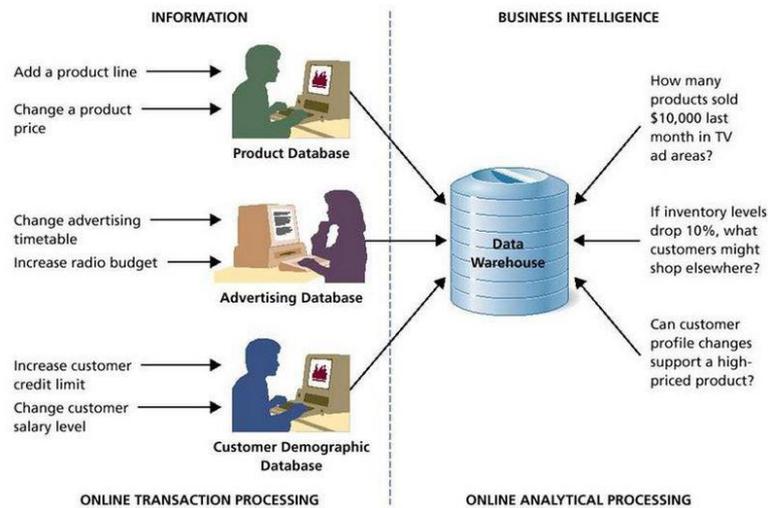
Based on the newest technologies, BI systems are essential for the decisional level efficiency, but also for improving relations with the clients, employees and suppliers by: facilitating the decisional process, increasing productivity of employees, lower costs, increasing the relationship with the partners and business development.

To understand the importance of the BI trend, it’s important to know what are the most relevant benefits after using this type of systems, as follows:

1. BI systems enable effective risk management: the value brought to

managers by using BI systems is given by monitoring the risks that may threaten the organization’s strategic objectives and financial losses.

2. BI solutions integrate all data for analysis: standard relational data, exports of texts, Microsoft Excel data up to XML data streams, which are stored in data warehouse or operational systems. This way, they are always available for the use in BI applications.
3. The costs for implementing a BI system are low, large investments are not required in hardware equipment and the training for the next users can be done in a short time, all of them being minor investments, which will be recovered in first months.
4. Decrease the influence of power games in the company
5. Avoiding decisional problems.



**Fig. 1** Business Intelligence Process

## 2. Choosing a BI solution

It's already known that today's economic activity can generate a lot of data volumes. Each one represents a tiny part of the business and it is found in various locations or departments, or often in different geographical regions.

With BI, as we've already mentioned, all data are collected, processed in information, information that will be well analyzed and used for the next decisions. Under the current business environment, the quality and timeliness of information is not just a choice between hard profit and loss, but a matter of survival and training.

The benefits of a BI system are obvious – analysts are optimistic, showing that the coming years millions of people will become regular users of the system. Around this concept however is now seeking the most appropriate strategy for choosing a business intelligence system and of course, this strategy will be customized to the needs of each organization.

A BI system without a clear end goal can certainly give a yield, however will never guide the organization where desired, because no one knows the ultimate goal. So, the first step in building a Business

Intelligence strategy is to know where the company wants to reach out and which are the effects expected after implementation.

To obtain the necessary information and to present them "user-friendly" is an important step to pass in desire to solve the problem of BI in an organization. For example, data difficult to understand may discourage users from using them. Here, it should be also noted that "dirty" data in the system must be identified, removed and replaced.

It is essential that the organization should not forget the benchmarks for performance – measuring process will require both the company past and future. Visions must be very clear, so the measure progress must be easy to do.

Once established where the company is in the chosen moment for analysis, what does it want to be done, it's time to decide how to reach the established goal. The standards can be set, BI Competence Centers can be implemented, or BI in cloud or framework can be used, all according to the needs of the company.

## 3. BI solutions for organization management

Business intelligence applications include decision support systems, query and reporting tools, online analytical processing (OLAP) and data mining and forecasting systems. But ultimately the final results of implementing business intelligence are in depth analysis, refining and concentrating a large number of business intelligence in concrete performance indicators and ultimately, organizational knowledge. The business intelligence projects do not aim to teach managers how to make the right decisions - but they help to understand the figures and the decisions they take in their analysis.

Basically companies collect vast amounts of data through transactional systems (eg ERP, CRM, SCM) that have been implemented over time and which they use to perform daily a variety of corporate functions. The existence of such large volumes of transactional data creates opportunities for management and improves forecast accuracy.

Business Intelligence wants to eliminate assumptions and uncertainties in decision-making processes, both tactical and strategic level. At the tactical level, BI helps optimize business processes or product lines by identifying trends, changes or behaviors which need improving management and control functions. Regarding the strategic level, BI can provide significant value increased by different alignment of business processes and product lines with the strategic objectives of the organization through an integrated performance management framework and systematic analysis. It is essential to consider that Business Intelligence has tended to shift from reporting past events to forecast and prediction.

Defining BI solutions begins with strategic performance measurement requirements of the organization and not necessarily with the technical details related to it. In general, performance evaluation can be defined as key performance indicators

(KPI) for an organization or business in the form of questions that require specific answers and are based on facts. Some examples of key performance indicators include: the evolution of income, profits earned by a line of business, and cost projections regarding business questions including management problems with numerical answers: "how much are we buying from a supplier in one year?" and so on.

In defining business intelligence solutions within an organization, the focus should fall on functional analysis, the design solution and the outcome or information. One of the best strategies in the establishment of such a solution is the strategy of "top-down", which starts from the Executive Management that the company and their needs for information and ends with the information technology and integration of multiple data sources to meet the information needs of management.

However, research reveals that more than half of Business Intelligence projects hit a low degree of acceptance or fail. What factors influence the implementation negative or positive?

The most important factor is definitely the project sponsor, and this variable will be bet on the functions of the organization's needs. A Business Intelligence application is divided into three levels: operational reporting, analysis and strategy. If the beneficiary is defining realistic expectations that are based on clear objectives and requirements, they create prerequisites for a successful implementation. In addition, there are limitations related to human resources. Knowledge of business will be provided by the client. These projects involve a team from the implementer, and one from the customer consisting of user's key functional areas (finance, sales, middle management and top management) which, besides regular duties, should work with consulting solution implemented.

In terms of the defining trends of BI solutions in companies in the current year is important to note the following:

- Companies choose mobility - inflexible switching solutions that create static reports to user-driven BI solutions will accelerate as more organizations recognize the importance of obtaining data that each user be able to base their decisions. Therefore BI solutions adapt the way people work, giving them access to information wherever they are at any given time. For both the large companies and small ones the speed of the business world means that mobile business intelligence solutions are commonly used and not just occasionally. Business users want to be able to access information in the context of the natural flow of their day and not just when they are physical in their offices. Devices such as a PC Tablet for example, are ideal for mobile BI applications and they support and encourage collaborative decision-making process. The data brings out its secrets - is obvious that those organizations who use data obtained from daily activities to make decisions are more successful, while those companies that do not, see their market position threatened. If traditionally the data analysis process is the responsibility of an “analyst” expert, today this process counts more often as a responsibility of a regular user of business skills. The objective of the most successful Business Intelligence solutions today is to offer any user, regardless of their technological skills, the power to harness the valuable information hidden in large amounts of data at its disposal to make critical business decisions.
- Data from social media environment become useful tools for the business – more and more, social media is becoming an essential component for the presence of a company on the market and contributes to a more direct and authentic communication with the public. At the same time, however, beyond the number of likes or followers a company earns on various platforms of social networking, social media becomes a relevant source of information that helps measuring the reputation of the company in online market or it can reveal unexpected insights considering the composition of the audience.
- Moving to cloud – a few years ago, the cloud system was an interesting subject in almost all the segments of the software except for BI. 2014 will be, most likely the year when the cloud will become an important element of BI solutions. The change will be determined by the international market maturation and by the companies which realize that the costs of their own infrastructure are bigger than a cloud solution. Because the BI solutions are limited, the organizations prefer their people to spend time exploring data, testing new ideas and highlight business insights instead of being stuck with infrastructure activities and upgrading software.

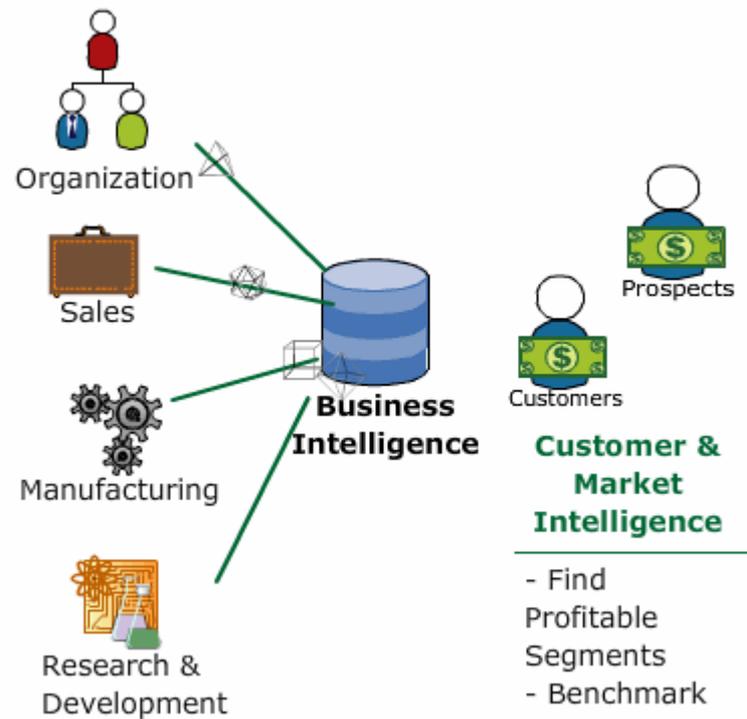


Fig. 2 Customer&Market Intelligence

**4. Life cycle of a BI system**

Business Intelligence is a strategic initiative which helps the organizations to measure the effectiveness of their plans on the market.

A successful company must know how to plan and how to address a BI strategy so

that the project or projects implicated in the process to have maximum profitability. Company managers with each project manager should adopt a specific methodology based on the needs they know they have.

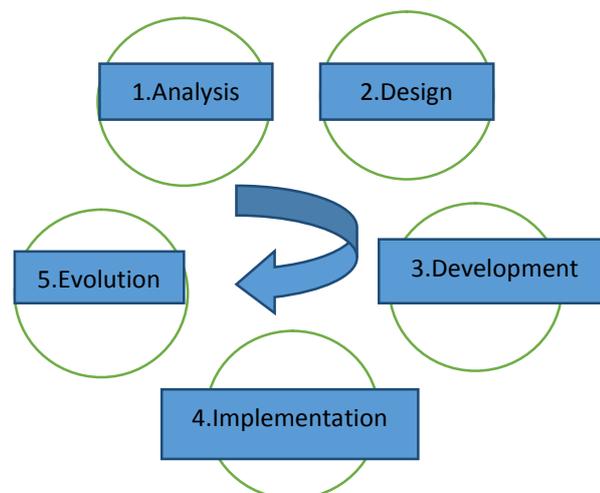


Fig. 3. The five main phases of a BI system

#### 4.1. The analysis stage

The aim is one of the most important things in any project, but sometimes it should be put aside and addressed in a different stage than the one in the beginning. Any project must be compared from a technical and an organizational point of view, but it must coincide with the primary aim of the company. This will be able to give a clearer view over what it is expected to be done during the following period of time.

Any BI project has to clearly justify the cost and the benefits of solving a business problem. The analysis is carried out by a predefined set of key performance indicators (KPI) and it is requested by the end users. The analysis stage produces the design of different components of the solution with the relevant information sources. Because of the dynamic nature of BI projects, the changes in the objectives, people, estimates, technologies, users and sponsors can have a serious impact in the success of the project.

#### 4.2. The design stage

Based on the complexity of the solution, the BI technologies are carefully chosen. One of the usual methods of trying out solutions is building prototypes. This way, it is possible to adjust the requests based on the expectations.

The key performance indicators should be defined without taking account of the current informations, the aim is to capture the business needs, even though the support for these needs is unavailable at the time being. The plan should include a high level design of different components of the solution, including the relevant information sources. Then, the team members of the project, including the key managers and the IT department should all agree in a formal way over the plan and the success criteria.

The projection stage should include the adequate selection of BI technologies, based on the needs of the users and the complexity of the implementation. The

selected instruments should be jointly managed by the Center of Excellence (COE) and the IT department (according to the BI architectural standards) and it should include the active participation of the end users, to make sure that the expectations are the same with the needs. The plan should also decide what information sources are necessary to support the solicited key performance indicators, including their quality, as well as any other necessary transformations for the analysis.

#### 4.3. The development stage

In this stage, all the information flow from the organization must be modeled. It is critical to create the prototypes and a testing environment to verify and compare the target objects of the company.

The data infrastructure could count as much as 70% in the effort and the costs of this stage. The previous stage, as well as this one, are usually the ones who consume the most time and resources during the development cycle. The workload involved in building the solution after all the data is in place depends on the complexity of the project. Only a simple configuration could be necessary or a full customization may be needed.

The specification that gives us what kind of data we need for the development and must be stored can be grouped in a metadata model. Further more, the specification needed for the delivery of the metadata to the clients must be analysed.

If a metadata deposit is acquired, this will have to be extended with characteristics solicited by the BI applications. If a metadata deposit is built, the database must be designed based on this deposit. The database design schema must coincide with the access specification of the business.

According to how precise the data and the requests for data transformation during the analysis, an ETL instrument may or may not be the best solution. In both cases, preprocessing the data and writing the

extensions for the instruments are frequently necessary. The real challenge for the BI applications comes from the BI that is hidden in the data of the organization, that can only be discovered with data mining instruments. Developing metadata deposits becomes a subproject of the main BI project.

#### 4.4. The implementation stage

After all the BI components were thoroughly tested, the application is implemented at user level. Regardless of the technology used, the success of a project will depend on the training done at the user level and the support of a dedicated team, especially in the first stage of implementation. This phase requires an iterative approach with extra training sessions so that customer needs are met. This step also requires a preliminary development of specific reports and analysis for the business users type. This will create a foundation for future advanced analysis.

All support and guidance operations will be provided by the IT team and the users will serve as consultants during the execution of this stage. Of course, the IT team will have to train the

technical support department for a better guidance of the end user.

#### 4.5. The evolution stage

This stage can be called, contrary to the title, the consumption stage because the user uses the information received to change the business and make decisions.

The main goals of this stage are:

- Measuring the success of a project
- Extending the application to the enterprise level
- Increasing the exchange of information between business and functional, both internally and externally.

Business-oriented aspects are often ignored at this stage - since the BI solution is technically capable, the user is free to make any decision. Many projects stalled in this phase because responsibility of passing to the user is not officially sent to a business manager. Therefore a good study is dividing this stage in several sub-phases to show more clearly how this methodology can lead to the end of a life cycle of BI.

Shown below it is presented the schema of the evolution stage subdivisions:

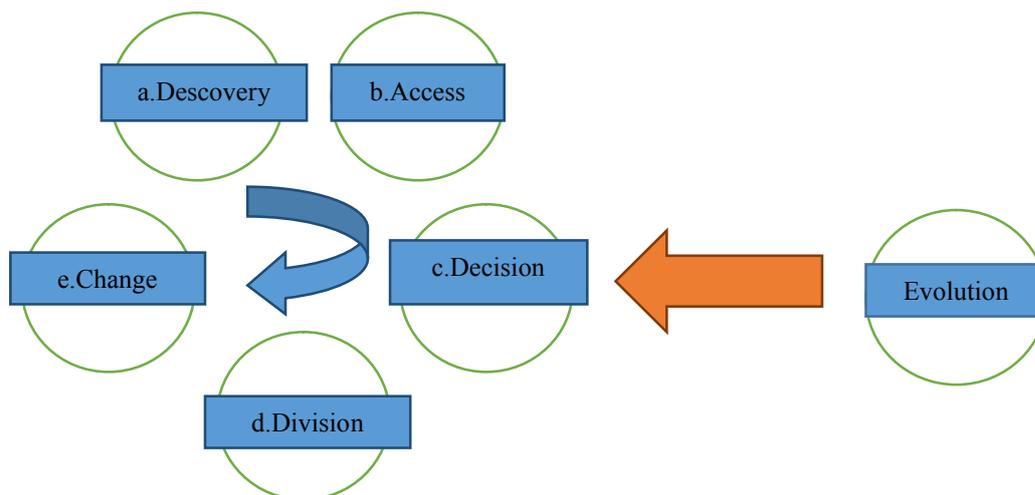


Fig. 6 Business cycle.

#### a. The discovery stage

Often the organization does not understand how the solution can lend itself to the exact needs of the customers. End users along with the first version of the solution should create the main environment for using an effective solution, but for there has to be a mutual agreement over a basic system where the solution can run at first.

#### **b. The access stage**

Having identified the indicators and the valuable information during the discovery stage, the end users begin to follow, understand and manage the information leading to deeper perspectives in the chosen business solution. The users can ask for assistance or contact the organization for further clarification.

#### **c. The decision stage**

The end users make definite decisions based on the newly obtained information. The Center of Excellence (COE) may be involved in verifying the solution so that the user will make a better decision.

#### **d. The division stage**

The decisions and analyzes made are distributed in the company to better analyze whether the BI solution given to the user was indeed a good one, and if

### **5. BI Components: OLAP, Data Mining**

The relational model is the most common model in the representation of databases. Although it has its strengths, it does not handle complex queries on large data sets. The concept of Business Intelligence can be divided into three parts, data collection, data analysis and reporting. The main tool for data analysis is the cube, which is a multidimensional data structure built on a data warehouse. The cube is used for data clustering on multiple dimensions and selecting a subdomain of interest. The selected data can be interpreted with data mining tools, a concept used to find trends and patterns in data structures.

In the following sections we will analyze an approach that uses cubes, OLAP

something did not come out as expected organizational changes can occur.

#### **e. The changing stage**

Changes made can trigger a fundamental process of reengineering. On this stage all technical resources together with COE shall review the issues and help resolve them.

Any BI cycle that ends should start again from the first stage, but the methodology approach will have a new level of focus:

- The analysis stage
- The reevaluation stage
- The modifying stage
- The optimization stage
- The adaptability stage

This determines that the benefits of the experiences should be added again to a process and maintain the relevant BI cycle. Using a BI methodology helps the organization to understand and produce a sequence of steps to develop and implement a successful Business Intelligence site. Some methodologies may serve as a guide for consuming the resources effectively and/or funding from other successful companies.

(Online Analytical Processing) as well as the data mining concept.

#### **a. OLAP**

According to [5], OLAP is an interactive technology that allows the user to make the following operations:

- Fast and dynamic analysis of aggregate data;
- Viewing the information from multiple perspectives and dimensions;
- Analysis of trends during significant time periods;

An OLAP application is designed to allow users to browse, retrieve and present specific data of the business. The tables in the relational model use only one or two dimensions, which does not correspond to

the complex data of a company. In the OLAP concept a cube is a model specifically designed to work with data stored on multiple dimensions. The concept of a dimension used with the OLAP technology refers to a characteristic of the data, not an actual dimension in space.

For a data model to be defined, it is necessary to define the model structure (the objects of the model and the relations between them), the operators (those acting on the structure), and the integrity constraints (rules and constraints imposed to ensure the correctness of the model). The structure of the model consists of dimensions (structures spanning different hierarchical levels that the data are grouped by) and tables of facts (containing measures and foreign keys to dimension tables). A time dimension, for example, may include days of the week, months, or even years.

Generally in Business Intelligence there are used three types of schemes: star schema, snowflake schema and multidimensional cube. In a star schema type (Fig. 5), there is a table of facts, of which the dimension tables are connected to. Dimension tables are not connected among them, otherwise the scheme would be called snowflake. A star schema does not correspond to the third normal form, since the dimension tables are made up of several adjacent tables. But this is preferable, due to the loss of performance when the schema is in third normal form and running operations on large data sets. If it is wanted a variation in the third normal form, a snowflake schema can be used. [6]

Given the fact that the users who use the OLAP technology want quick answers to questions like "How many bikes have sold to customers in Amsterdam in the last four months?" several queries are performed on large databases and united, in order to provide an answer. For this reason, it is preferred to use a multidimensional model, the Cube. A cube is consists of as many

dimensions as are needed for the business model. For dimensions with large number of records, hierarchical dimensions are made. They use a field named "parent" which groups all fields of the same type. For example, if a store sells shirts with three colors, red, green and purple, instead of having one field named "Color", there will be a parent-field called "Shirt" and the child-fields will be "Red", "Green" and "Violet".

There are two main models for implementing cubes, MOLAP (Multidimensional OLAP) and ROLAP (Relational OLAP). MOLAP assumes that a cube is multidimensional and has the data stored in a multidimensional way. Thus, the data is copied from the data-store to the data-store of the cube, and aggregates of different size combinations are pre-calculated and stored in the cube at a given vector. This means that the response time will be very short, but there is a possibility that explosion of data could occur when all combinations of size aggregations are stored in the cube. ROLAP, as the name suggests, uses the relational model and considers that it is for the best to keep the data stored in the data warehouse. As in the MOLAP, the data can be aggregated and pre-calculated using materialized views. [6]

#### **b. Data-Mining**

Data Mining is the process of finding hidden patterns and associations, constructing analytical models, achieving classification and prediction and presenting the obtained results. In other words, the process of data mining can be viewed as examining past data to find useful information that can be used as a guide for the future. Thus, data mining gets the answers to questions like "What happened in the past?", "Why it happened?" and "What is likely to happen again in the future?"

To be effective, the process of data mining needs "clean" and organized data, therefore preferring them to be stored in data warehouses, because they have

already been cleaned, processed and organized by ETL processes.

According to [7], data mining process is divided into the following steps:

1. Defining the problem - as in any Business Intelligence process, first up, is the fully understanding of the problem and the questions need answers. It is recommended to focus on what we want to ask, not how we will respond.
2. Preparing data - once the necessary information is well defined, the data is being prepared. Data mining algorithms are very intelligent in solving the problem, but will fail if they receive the data in a foreign format. As mentioned, it is recommended that the data should be retrieved from a data warehouse.
3. Exploring Data - to understand the result of the data mining process, the data must first be covered and studied. This is usually done using one of the two methods :
  - a) Means and extremes: on different sets of media numbers, the means are calculated and the standard deviation from the mean too. Also, the minimum and maximum values are determined. This process helps to understand the data range used for working.
  - b) Basic statistics: different data sets are taken and simple statistical operations are performed.
4. Creating the data mining model - queries are created using DMX language (Data Mining Extensions) or using a software wizard.
5. Exploration and validation of the model – once the model is build, it should be explored to see the trends and patterns that the model produces and validate it, to ensure

that trends and patterns found, answer the questions defined in the first stage .

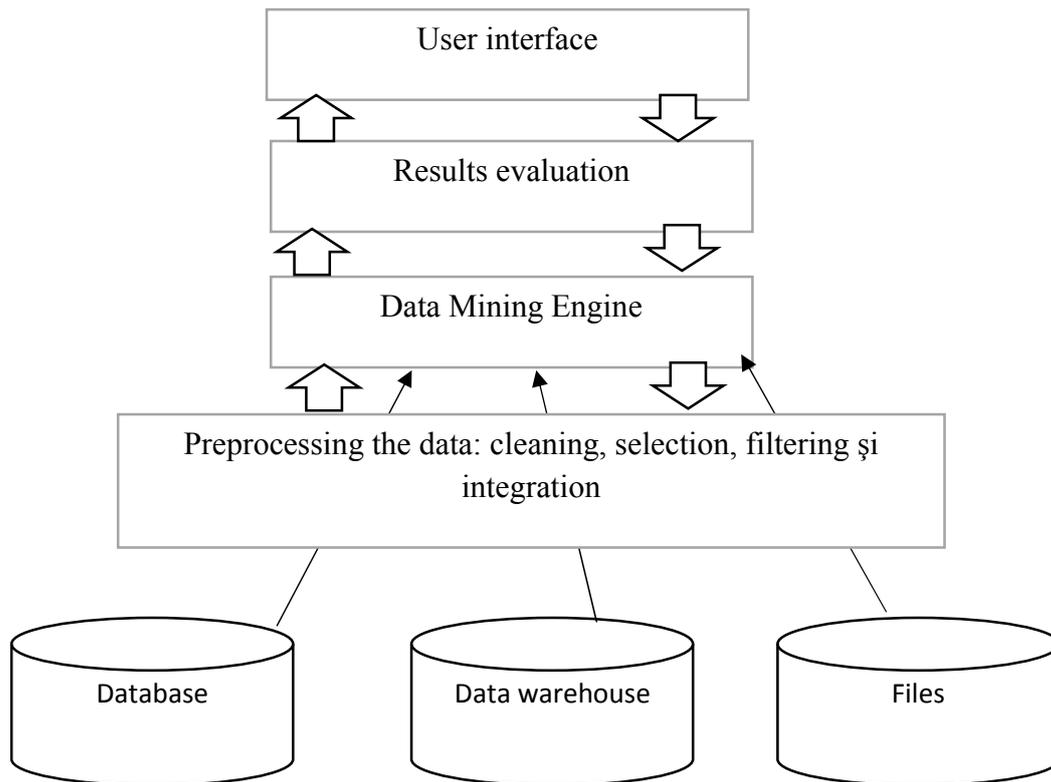
6. Launching and updating the model – in the last step, the model is launched in execution so that the users can use it. While in use, it is possible that a new set of questions which need to be answered could occur and the model must be modified.

The functions that a system based on data mining process performs, are:

- Classification - maps data into predefined groups and classes
- Clustering - groups similar data into clusters
- Analysis of linkages - discovers relationships linking certain data
- Finds data that misbehaves from the general behavior of the data.

A natural question is "why data mining?". Data mining can be successfully used in data analysis processes and support of decision making. For example, in a system of marketing and management analysis, the first elements that are studied, are the modes of the origin of data (transactions, payments, gift vouchers and so on). The second step is to find clusters of customers who have common features (ways of spending the money, income, etc.). Further, operations marketing analysis can be performed, establishing associations and correlations between product sales so that predictions based on these assumptions can be made. Also, by clustering and classification, the types of customers that buy certain products can be determined and may make assumptions about what factors will attract new customers. [8]

A data mining system is generally the architecture shown in Figure 7.



**Fig 7** The architecture of a data mining system

## 6. Building a Successful BI

There is no certain recipe or template for success on how to build a business, as well as building a model of Business Intelligence does not have a classified number of standard steps. This depends very much on the company, market, people involved, and defining the problem. According to [8], there is still a lot of ideas that can help a company to go right into creating a successful BI.

1. Choosing good key performance indicators (KPI - Key Performance Indicators) - start from the question "How do you measure a company's success?". KPIs are metrics and measurements that can indicate whether a company is successful or not. It is known that if we started with the right KPIs selected, the business will benefit in the long term.
2. Adjusting recipe - there are plenty of tips, or even complete BI solution, ready to be used. But, so far, there hasn't been invented a size that can fit for everyone. Each company is complex and has its own terms and objectives.
3. Understanding complexity - although it may seem easy on paper, a Business Intelligence solution is complex and this must be understood from the beginning, in order to avoid unpleasant situations that may arise later.
4. Creativity – sometimes it is needed to look at things from another perspective. This is especially important in BI, where a book cannot ensure success. If a team can come up with new ideas that do not comply with a pattern defined by someone else, this should be encouraged.
5. Choosing a good team - as a sequel to those mentioned in the previous paragraph, choosing a team that has

a good grasp of knowledge about the data problem, is a step towards to finding the best solution for the company.

6. Study technologies - Business Intelligence is a rapidly evolving field, there are numerous books, studies, or blogs about this area. It is encouraged to keep up with new appearances.
7. Learning from mistakes - sometimes there are pitfalls and mistakes that cannot be avoided. The key is to remember what happened, how it happened, why and how the problem can be avoided in the future. This applies to any field, but is especially
8. important in Business Intelligence, is avoiding to repeat the error.
9. Understanding the company - every company is different and before starting the development of Business Intelligence is necessary to know in detail how the company works. How the company is split, how decisions are made, how the employees work, are things that must be included in the planning process.
10. Creation of well-defined phases - opportunities for Business Intelligence solutions are endless. Executive management has less patience for huge projects and prefers to see small results over time, rather than at the end. Therefore, the vision of business intelligence should be divided into several phases. Each phase must contain a well-defined purpose, achievable goals and benefits that can be demonstrated to all.
11. Support from the executive - as Business Intelligence solutions touch several departments of the organization, this may be seen with skepticism. An influential person in the company who understands the importance of the solution can

convince those skeptical persons of the importance of implementation.

## 7. Conclusions

Organizations today can store and access a big piece of information gathered over the last decade. Business Intelligence is the ability to bring to account the true value of this information and this is becoming increasingly important. Unfortunately, not all companies today have developed this part of the organizational strategy.

Following the steps mentioned, having a center of excellence, plus a BI strategy based on certain standards and methodologies chosen correctly, companies can reach the top. They can recover their investment through different suppliers, they can reduce costs and they can especially learn how to use the company's capital.

As possibilities in business intelligence get to be a top management priority, companies will need more flexible IT solutions that meet the needs of the BI, not only in short term, but also with the company's growth they need more complex solutions.

There are three main factors to be taken into account when selecting a business intelligence solution:

- Involvement of business intelligence across the enterprise - BI solutions that make work easier for all employees must be found, not just for a few, in order to work, partake, understand and interpret the data and information in the organization.
- Integration with other systems and applications - BI solutions must be sought to integrate well with the rest of the enterprise business systems in order to be used in the future.
- Flexibility of business intelligence - when requirements change or when new functionality is added, BI solutions that mold on such changes must be researched.

You don't have to make the main purpose of a company to implement Business Intelligence, but this should be the way to

guide the company towards an ideal of success.

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**Vlad MATEESCU** - My passion for informatics has started in high school and it continued after graduation, as I've attended The Faculty of Automatic Control and Computers within the Politehnica University of Bucharest (between 2008 and 2012) and the Business Support Databases master program within the University of Economic Studies (between 2012 and 2014). I am currently working at an IT company as a software developer, cultivating new skills every day, both professionally and personally. Although my job consists in creating software applications, I am interested in all the stages of a project and would like to work as a software analyst one day. In my free time, I enjoy travelling, photography and live music.



**Iulia MUNTEAN** - The passion I have for IT has started 2 years ago, during a project I made for school. That's the moment when I decided I would love to work in this domain. Since then, I started to learn everything about programming. I am currently working as a web programmer and I love this job. Every day is a new day to apply what I learned theoretical in the past and see it's working. In my spare time, I like reading historical books, travel and don't miss any chance to learn something new.