

FEASIBILITY OF INVESTMENT IN BUSINESS ANALYTICS

¹Mladen Varga, ²Miljenko Vuković

¹University of Zagreb, Faculty of Economics & Business, Zagreb, Croatia

mladen.varga@efzg.hr

²Primera, Zagreb, Croatia

miljenko.vukovic@primera.hr

Abstract: *Trends in data processing for decision support show that business users need business analytics, i.e. analytical applications which incorporate a variety of business oriented data analysis techniques and task-specific knowledge. The paper discusses the feasibility of investment in two models of implementing business analytics: custom development and packed analytical applications. The consequences of both models are shown on two models of business analytics implementation in Croatia.*

Keywords: *information systems, decision support, decision-making, business analytics, packaged analytical applications.*

1. INTRODUCTION

Every business system, such as an enterprise, strives to establish the decision-making support system to provide information/data necessary for its management. The paper discusses some issues of feasibility of investment in implementing various segments of decision-making support systems. It is organized as follows. Business decisions are considered in Section 2, the types of information preparation in decision-making process are discussed in Section 3, business analytics in Section 4, the role of information system in decision making in Sections 5, and the implementation of decision-support information system in Section 6.

2. BUSINESS DECISIONS

Management is the activity or skill of directing and controlling the work of an organization, and in essence, it is done by decision-making [6]. Decisions are usually classified as programmed and nonprogrammed. The programmed decisions are used for solving routine problems in repeating situations, in which the decision-making procedure is known. A programmed system, implemented in the transactional information subsystem, can “make” decisions instead of people. Nonprogrammed decisions are used for solving nonroutine problems in unrepeatabe situations in which the decision-making procedure or the decision-making model are unknown. Decision makers take full responsibility for their

decisions, but the decision support system may provide relevant data and can support the analysis of this data.

Regarding their importance, decisions are ranked as operational, tactical and strategic. Operational decisions are the simple ones covering elementary business processes. Tactical decisions cover the group of elementary processes, i.e. tactical business processes typical within specific departmental areas. The data needed is usually specific to that department. Some examples of tactical decisions are: “What is the right product mix to offer in a specific market?” and “Is there enough inventory on hand to fulfil the order?” Strategic decisions are usually made by upper management within the organization. They occur less frequently than tactical decisions and can impact many departments and functional areas within the business. Strong data analysis is recommended for strategic decision-making. The analysis often leads to additional questions and additional requests for data. The examples of strategic decisions are: “What distribution channel is suitable for the global market?” and “Is this an appropriate time to launch a new product on the market?”

3. INFORMATION IN DECISION MAKING PROCESS

Whoever business decision-makers are, they have to make decisions regardless of whether the information they receive is useful or not. Nevertheless, the quality of the business decision-making process is seriously affected by the quality of information necessary in the process. Better information gives better opportunities for choosing the best decision option. Information quality is subjective and can vary among users and among its uses. Information quality is confidence that particular information meets some specific quality requirements, such as [11]:

- Intrinsic information quality: accuracy, objectivity, believability, reputation
- Contextual information quality: relevancy, value-added, timeliness, completeness, amount of information
- Representational information quality: interpretability, ease of understanding, concise representation, consistent representation
- Accessibility information quality: accessibility, access security

To prepare the information needed in a decision-making process, a decision-maker may use a variety of different methods of reviewing and analysing data [9]. They differ by the character of data usage - from simple, i.e. reading and monitoring data, to complex, such as trend analysis, various aspects of ad-hoc analysis, statistical analysis, predictive analysis etc. It is important to understand exactly how decision-makers interact with data prior to making decisions to prepare the needed information. Table 1 shows what type of information preparation is used to fulfil which type of tasks.

Table 1. Information and decision making

Purpose of information	Type of information preparation	Decision-making type
Reporting (static reporting)	<i>Based on rules:</i> execution of a standard predefined report at a specific period of time Example: product inventory report	<i>Operative decision-making:</i> business monitoring / reporting Example: product inventory
Simple	<i>Based on skill:</i>	<i>Tactical decision-making:</i>

(elementary) data analysis (dynamic reporting)	generating analysis / report the most often in interactive manner Example: multidimensional data analysis in data warehouse	tactical analysis of business, problem diagnosis Example: sales analysis products by markets, insight into reasons why sales decrease
Complex data analysis (knowledge discovery)	<i>Based on knowledge:</i> problem modelling, use of model / method, interpretation of results Example: data mining, simulation, optimization	<i>Strategic decision-making:</i> strategic analysis of business, problem insight Example: product basket analysis, buyers' behaviour analysis

3.1 INFORMATION PREPARATION BASED ON RULES

Reporting and monitoring are examples of data usage based on rules. Reporting technology is intended for information distribution in the context of the operative decision-making process. These are the tasks of operative analysis where programmed decision-making prevails. Both predefined and ad-hoc reports are addressed at information delivery, publishing and distribution. This is the technology of static reporting.

Programmed decisions, such as decisions regarding credit approval or inventory on hand, may be incorporated in the transactional subsystem. The transactional (or operational) subsystem is responsible for executing the transactions of the enterprise's business processes. A part of it is the management reporting subsystem consisting of a set of predefined and standardized reports based on transactional data. The important factor of the quality of the reporting subsystem is the degree of data integration across enterprise's functional areas. The successfully integrated enterprise's data is the main factor of the success of integrated information systems (Enterprise Resource Planning – ERP and Enterprise Application Integration – EAI, Enterprise System – ES).

Nowadays decision-makers are provided with predefined standardized and parameterized reports or are forced to make an ad-hoc query via the reporting tool to make necessary reports. However, the complexity of data, the variety in data encoding, calculation and the need to learn more advanced decision support tools often deter decision-makers from using advanced decision support tools. Consequently, business decision-makers demand more information on additional reports aggravating the reporting backlog problem. The majority of them are unsatisfied with the information they receive to support their decision-making process although they receive reports of all shapes. They leave with predefined reports and with no access to deeper information. They rarely feel to have the exact information needed for decision-making. The situation is described as “data rich but knowledge poor”.

3.2 INFORMATION PREPARATION BASED ON SKILLS

The preparation of information based on skills uses the process of simple data analysis. The process is usually done in the interactive manner where the analyst sets a query, analyses results, and repeats these steps until he/she obtains insight in the nature of the given business problem. These are the tasks of tactical analysis with a mix of programmed and nonprogrammed decisions.

The dimensional analysis of data, such as On-line Analytical Processing (OLAP) in data warehouses, is a good example of simple analytics. People intuitively look at business through dimensions or perspectives. The managerial question “What are the sales data on products, time and markets” implies business dimensions *product, time and market*; and

sales attributes referred to as measures. The multidimensional (analytical) data structure is in many aspects more visual than the table structure used in the operational (transactional) information subsystem. In addition, the dimensional structure is capable of showing interesting interrelationships between dimensional attributes, such as product, time and market, which are not seen in the table structure. These interrelationships among dimensional attributes may result in valuable business information.

Analytic solutions are different from reporting solutions as they are intended to facilitate the analysis of information such as inspection, exploration etc., in order to assimilate and understand information. Menu items in analysis tools facilitate information exploration, information patterns, historical content analysis etc., as well as use advanced data visualization to help users evaluate the relevance of the information. The analytic system must help the decision-maker understand the information and the information insight. It assists the user in getting the answer “why” and “how” behind the information given in an analysis report. An example of this kind of analysis is “The sales are lower than before, why? Is it because of a specific product, a specific market, a specific customer or a combination of all of them?” The part of information system enabling corporate decision-makers to supply information and thus navigate the complex business environment is the analytical process that is often referred to as business intelligence (BI).

3.3. INFORMATION PREPARATION BASED ON KNOWLEDGE

Information preparation based on knowledge uses various methods of modelling a business problem and utilizing some method of complex data analysis. This is the main difference from previous types of information preparation where models and methods are not used and where information is obtained by using queries. The tasks based on knowledge are fulfilled in strategic analysis where nonprogrammed decision-making prevails. The typical models/methods used are data mining methods, optimization methods, simulation methods, expert systems etc.

The best example of data usage based on knowledge is data mining. Data mining [3] is an analytic process designed to explore usually large amounts of business data in search of consistent patterns and/or systematic relationships between variables, i.e. this is an information extraction activity whose goal is to discover hidden facts contained in databases. Data mining is a combination of machine learning, statistical analysis, modelling techniques and database technology. According to [3], the process of data mining consists of three stages: (1) initial exploration, (2) model building or pattern identification with validation/verification, and (3) deployment, i.e. the application of the model to new data in order to generate predictions. The exploration stage involves cleaning data, data transformations, selecting subsets of records and variables. Depending on the nature of the analytic problem, this stage usually involves a wide variety of graphical and statistical methods known as exploratory data analysis, with the purpose to identify relevant variables and general models that can be used in the next stage. At the model building and validation stage various models are considered. Test best is a model with predictive performance which most accurately explains the variability in question and which produces stable results across samples. This stage may be a very elaborate process using a variety of techniques developed to achieve that goal. Different models may be applied to the same set of data and then compared to choose the best. These techniques are referred to as predictive data mining, statistical learning, etc. At the deployment stage the best model selected in the previous stage is applied to new data in order to generate predictions or estimate the expected outcome. Data mining has the most direct business applications. Typical

applications include market segmentation, customer profiling, fraud detection, evaluation of retail promotions, and credit risk analysis.

Other methods that facilitate finding optimal solutions to various problems, such as optimization and simulation, are used too rarely in the business decisions-making process. Here are examples of some methods used in supporting the decision-making process. The linear optimization methods, such as linear programming, integer linear programming, transport problem, etc., help finding the optimal solution to the problem described by linear functions. Multi-criteria decision-making methods, such as Analytic Hierarchy Process (AHP), are used in selecting alternative solutions to the problem. Simulation methods, such as discrete event simulation and system dynamics, are used in complex systems with a great number of mutually connected elements and time variant behaviour. They solve problems which cannot be modelled with mathematical methods. Expert systems can solve a narrowly defined set of problems using information and reasoning techniques normally associated with a human expert.

4. BUSINESS ANALYTICS

Although business users are experts in their business domains, they are unlikely to be experts in data analysis [4]. Usually business users rely on a data analyst who employs analysis applications to extract information from data. Business users have to impart their domain knowledge to the analyst, and then wait until the analyst organizes data, analyzes it, and returns the results. Since there are usually open questions regarding the results, several iterations are necessary before business users can act on the results of the analysis.

Business analytics allows organizations to go beyond traditional business intelligence by providing an integrated, enterprise-wide view of information and a higher level of predictive insights and optimization. The key challenge is to deliver this knowledge through solutions that are pertinent to specific business processes, enabling decision-makers to achieve greater return on investments and organizational efficiencies. For example, marketing analytics may help create precise segmentation strategies using all relevant data, including historical, financial, demographic, and syndicated data to execute highly effective up-sell, cross-sell and retention campaigns. It may also help create compelling customer dialogue through individually targeted, event-based marketing communications based on customer life event changes, purchase behaviour, service history, or predicted response. It may also track and analyze marketing campaign performance and help marketers make timely course corrections based on which offers and messages are driving the highest response rates. An enterprise's information assets, such as customer data, can be vast. Too often they are thrown away in information silos and never used. The goal of business analytics is to turn these marginalized data resources into information that allows business managers grasp the dynamic state of their business.

Analytical applications, which incorporate a variety of data analysis techniques, pre-built metrics, reports and alerts must therefore provide recommendations to business users of how to best analyze data and present the extracted information for specific business problems. From the business users' standpoint, business analytics must rely on solving specific business problems, i.e. it must incorporate task-specific knowledge, and must not rely exclusively on data analysis techniques. This is the reason why this type of analysis is called business analytics. The most known are:

- Business Performance Management (BPM) / Enterprise Performance Management (EPM) Analytic Applications / Corporate Performance Management (CPM) BPM, also known as EPM and CPM, involves monitoring and managing an organization's performance, according to key performance indicators such as revenue, return on investment, operational costs, etc. It includes the combination of planning, budgeting, financial consolidation, reporting, strategy planning, business scorecard and other tools. Managing enterprise performance involves monitoring the strategic focus of an enterprise, whose performance is measured from the analysis of data generated from a wide range of interrelated business activities performed at different levels within the enterprise [1]. It involves consolidation of data about business performance from various sources, querying, and analysis of the data, and notifying corporate decision-makers of the results. It helps businesses discover the efficient use of their business units, financial, human, and material resources.
- Customer Relationship Management Analytic Applications (CRM)

CRM includes all aspects of interaction a company has with its customer that help an organization manage customer relationships in an organized way.
- Supply Chain and Operations Analytic Applications (SCM)

SCM is the management of the entire value-added chain, from the supplier to manufacturer to the retailer and final customer. The goals of SCM are to reduce inventory, increase the transaction speed by exchanging data in real-time, and increase sales by implementing customer requirements more efficiently.

5. INFORMATION SYSTEM IN DECISION-MAKING

Probably most information used in the business decision-making process can be found in the organization's information system. The information system [2] is a subsystem of the organizational system, whose task is to link processes at the operational, management and decision-making level. Its goal is to improve performance efficiency, support good quality management and increase decision-making reliability. The information system is a complex system that has to cover all informational tasks needed to service operational, management and decision-making activities of the enterprise [7]. It may be decomposed into three information subsystems: operational or transactional subsystem oriented to business process execution, analytical or decision support subsystem oriented to decision-making processes, and collaborative subsystem oriented to collaboration and communication processes [8].

Regarding decision-making processes Fig. 1 shows information system's layers. Data is generated within the business domain, settled and structured in the data layer. Various aspects of data processing are done on integrated data in the data analytics layer. The data analytics layer summarizes static reporting, dynamic reporting and complex analysis. Unfortunately, business users are not satisfied with pure data analytics. They are experts in their business domains but they are unlikely to be experts in data analysis. Business analytics, which incorporates a variety of data analysis techniques, must also provide recommendations to business users on how to best analyze data and present the extracted information for specific business problems. From the business users' standpoint business analytics must rely on solving specific business problems, i.e. it must incorporate task-specific knowledge, and must not rely exclusively on data analysis techniques.

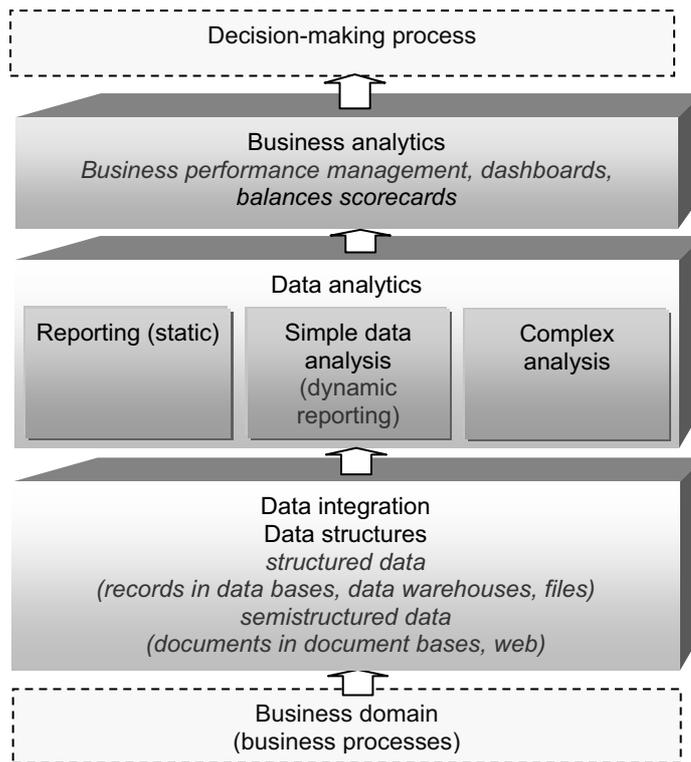


Figure 1. Information system's layers

Analysis functions are now being incorporated into information systems, instead of being outside the system. Depending on the type of data analysis, they are incorporated into the decision support subsystem or even into the transactional part of the information system. Integration of data from multiple data source is very important. Analysis is more effective when data is available from multiple sources. As an example, customer data is more powerful if overlaid with demographic data. Another example is integration of Supply Chain Management and Customer Relation Management that allows enterprises to integrate demand and supply chains in an optimal manner.

Two important questions [5] connected with data analytics are: "How to turn discovered information into action?" and "How to know the effect of each action?" It is necessary that solutions use analytical results as a starting point towards the next steps of action and measurements of the result. Integration between analytics and operational system is the key. For example, analytical application is identified as a cluster of customers who respond to a promotion, and the operational system responds with the distribution of catalogue with optimized promotions.

All kinds of information can be gathered and aggregated in information systems, but if there is no context and if business has no advantage to generate a good business strategy, then information is worthless. Information system's data must be integrated vertically and horizontally, users must know the data stored in the information system and the data must be documented. Not only internal data has to be integrated, this must be true for both interior and exterior data.

The classical transactional systems are designed to shorten the business process cycle. Nowadays, business intelligence and business analytics shorten the decision-process cycle and increase the productivity of expert and knowledge workers.

6. IMPLEMENTATION OF DECISION-SUPPORT INFORMATION SYSTEMS

Decision-support systems in companies are typically based on data warehousing systems. Such systems are usually an ideal platform for medium and more complex data usages, like ad-hoc queries and trend analysis. Furthermore, their de-normalized and integrated structure is usually the perfect source of data for data mining as well. That is why business intelligence projects are closely related to the implementation of data warehousing systems, which will serve as infrastructure for most decision-support needs.

A data warehouse is a subject-oriented, integrated and time-variant collection of data in support of management decisions. It is subject-oriented because it focuses on natural data groups, not applications boundaries. It is integrated providing consistent formats and encodings. It is time-variant organizing data by time and storing it in diverse time slices.

There are two ways of acquiring business intelligence and data warehousing systems. The first refers to the systems developed specifically for the company's needs. The second refers to packaged analytic applications. They usually come with a predefined data model, front-end application as well as with numerous reports and advanced analytics. They are based on the best practices in data analysis, and are typically divided in modules based on business areas – e.g. supply chain and operations analytic applications, customer relationship management analytic applications, product and service intelligence applications, finance intelligence applications etc.

6.1. CUSTOM DEVELOPMENT

In [4] Kimball proposed today's most used method of development of data warehouses and business intelligence systems. A slightly modified diagram is shown in Figure 2.

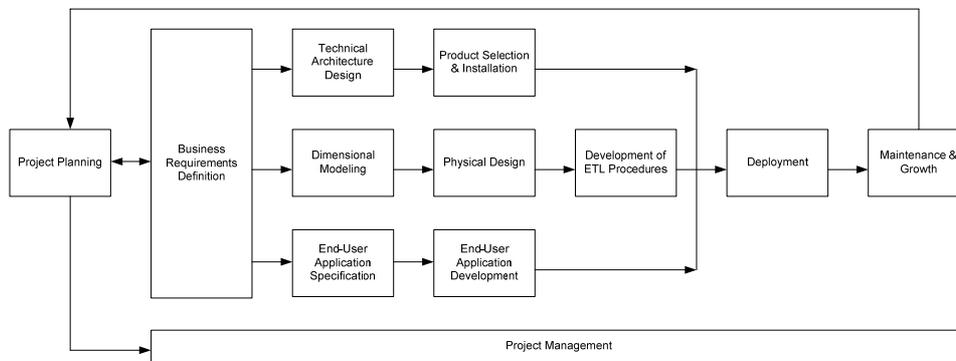


Figure 2. Data Warehousing and Business Intelligence Project Lifecycle diagram

Project planning is one of the most important parts in the project's lifecycle, because it addresses project scoping and business justification. It should also result in a detailed project plan and definition of all the resources required.

For the success of a business intelligence project, it is of vital importance to understand the business and requirements of end users. That is the main reason why business

requirements definition is the initial step for all three parallel tracks on the diagram – technology, data and end user applications. Business requirements heavily affect the project scope – that is why the arrow between project planning and business requirements definition is bidirectional.

Technology track begins with technical architecture design. Business intelligence and decision-support projects typically require integration of various technologies. Technical Architecture Design should define overall architecture framework and vision. The three main factors that influence such a design are business requirements, existing technical environment and technological strategy for the future.

Under the constraints and framework of technical architecture design, standard evaluation tests are developed for the selection of each architectural component. Such components typically include hardware platform, server operating system, database management system, ETL (extraction, transformation, load) tool, and data access (i.e. front-end) tools.

Data track starts with dimensional modelling. Simply said, dimensional modelling is the process of connecting key measures of a business process with dimensions which define it. These dimensions will later be used in data analysis – for data filtering, organizing, displaying, pivoting etc. The inputs for this process are business requirements, but source systems should also be considered in order to understand the availability and quality of the needed source data. The result of dimensional modelling is usually a simple document that defines logical design of decision-support system's underlying data warehouse.

Physical design establishes physical structures needed to support the logical database design. In this stage we also define the database environment, naming conventions, indexing and partitioning strategies.

The last phase is the development of ETL procedures. This is a very demanding and unpredictable stage in the project's lifecycle. Complex data transformations are often needed in order to integrate the data from various sources and prepare it for data analysis. Furthermore, a framework for tracking execution and errors in ETL process should be developed as well.

Application track starts with end user application specification. Here we define report templates, user driven parameters and required calculations, in order to ensure that the development team and users have the same view on the applications to be delivered.

End user application development includes the development of an initial set of reports, analytical frameworks etc. The extent of this work should be defined by project scope, while in the long run the development of reports and analysis should be defined by business users (with the exception of the most complex cases, like statistical or predictive analysis).

Deployment means convergence of technology, data and user applications on the user's desktop. This usually requires extensive planning in order to ensure adequate education, timely user support and good communication strategies between the development team and end users.

Maintenance and growth is a very important phase because business intelligence projects are usually very iterative in their nature. They are often performed in small steps, and if they are successfully implemented that is usually just the beginning of constant evolution. That is why adequate resources should be planned for that phase as well.

Project management ensures that the project is performed in time, within the planned budget and defined scope. Such projects are exposed to many risks. Good communication and common understanding between the development team and business users are necessary throughout the project. That is why proactive and dedicated project management is critical for the success of such a project.

6.2. PACKAGED ANALYTIC APPLICATIONS

The main difference between the implementation of a custom-tailored and packaged solution comes from the fact that great part of the packaged system is predefined. The initial phases of the project are the same, as well as the technology track. However, if the packaged solution is chosen as the one that suits our needs best (or has other advantages), it will usually mean that the data model is already defined. The same goes for the end user applications, which are already delivered based on the best practises for analysis of that particular area of business.

The virtual absence of some phases in the project's lifecycle should not suggest that the amount of work needed to implement such a system is significantly lower than in custom developed solutions. We still have to develop complex ETL procedures in order to fill the model with data, and this can take up to 70-80% of project time. Furthermore, it usually takes longer for end users to adapt to the predefined solution than to the one that is tailored specifically to suit their needs.

Packaged solutions usually take significant entry licensing cost. However, recent studies suggest that packaged solutions are more and more popular, with comparable if not better return on investment when compared to custom developed solutions.

6.3. COMPARISON BETWEEN THE TWO MODELS – CROATIAN CASE

The vast majority of business intelligence solutions in Croatia are custom-tailored and the situation can be compared to transaction systems' market about 10 years ago. At that time, most transaction systems were custom developed. Since then packaged ERP (Enterprise Resource Planning) systems have gained a significant market share.

The companies that own ERP systems are likely to be the first to implement packaged analytic solutions as well. There are three main reasons for such a conclusion. Firstly, leading ERP vendors usually offer business intelligence modules that can be interpreted as packaged analytic solutions. Secondly, leading independent vendors in analytic applications' market usually have standard interfaces towards the standard ERP systems. Thirdly, loading data from the ERP systems in a custom developed business intelligence system can be extremely costly both in terms of labour and licences for ETL tools. That is why many companies that own standard ERP systems are likely to choose the packaged analytic solution.

When costs between the two options are compared, the comparison shows that custom-tailored systems are usually more labour-intensive, while packaged solutions are more expensive in terms of licensing. The reason why most companies in Croatia still prefer custom developed solutions is because human labour is still significantly cheaper than in Western countries. However, packaged solutions offer many other advantages, like implementation of best practices in decision support, standardisation of business processes, and improved company image.

One of the methods for evaluating decision support initiatives is the calculation of return on investment (ROI). To explain it, we must introduce basic financial measures used in the calculation.

The total value of ownership (TVO) calculates the cumulative benefit of the BI initiative from the inception to the retirement of the solution. The cumulative benefit is usually defined as total cost savings and revenue enhancements achieved by the organisation:

$$TVO = \sum (\text{Cost savings} + \text{Revenue enhancements})$$

The total cost of ownership (TCO) is the cumulative cost of BI initiative from the inception to the retirement of the solution. The cumulative cost consists of hardware, software licences and labour required to design, develop, implement and maintain a BI solution:

$$TCO = \sum (\text{Hardware} + \text{Software} + \text{Internal Staff} + \text{External Services})$$

In order to compare year to year cash flows (i.e. savings + revenues – costs), we use the calculation of net present value (NPV):

$$NPV = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \dots + \frac{CF_n}{(1+r)^n}$$

where n is the number of years for which NPV calculation is applied, and r is the discount rate (also known as investment yield rate). CF is cash flow for each year that NPV is to be applied to. The net cash flow in this model is the difference in the costs of BI solution and the costs of the existing reporting environment (which is assumed to be more expensive in order to get similar results).

The payback period calculation determines the number of years that are required for the discounted cash flows (determined by the NPV calculation) to equal the initial investment:

$$\text{Payback period} = \frac{\text{Initial Investment}}{(\text{NPV of TVO}/n)}$$

Finally, return on investment (ROI) is defined as the net present value of the total value of ownership (in the chosen period of n years), divided by initial investment:

$$ROI = \frac{NPV \text{ of TVO}}{\text{Initial Investment}} * 100$$

ROI Calculation in Croatian conditions will be shown on some cases with various parameters. The key premise is that the implementation of business intelligence solutions (analytic applications in this case) will set free some human resources. The model focuses on savings because revenue enhancements are much harder to predict. Discounted savings in the period of 5 years should equal the initial investment in order for investment to be considered justifiable.

Table 2 shows one of such cases. The implementation of analytic applications is assumed to cost 3,000,000 kn and to last for one year (year 0). After that, the costs of maintenance of the solution are assumed to be 20% a year (600,000 kn), which results in the total costs of 6,000,000 kn. The cost of an engineer that works on reporting in an existing environment (prior to the implementation of analytic applications) is assumed to be 300,000 kn a year. The data in the table demonstrates that the solution should replace at least 5 such engineers in order for initial investment to be returned in the period of 5 years. The discount rate is assumed to be 10%.

Table 2. An example of ROI calculation

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Cost of Analytic Applications	3,000,000	600,000	600,000	600,000	600,000	600,000	6,000,000
Cost of existing reporting system / 5 people	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	7,500,000
Savings		900,000	900,000	900,000	900,000	900,000	4,500,000
Discounted savings (10% rate)		818,182	743,802	676,183	614,712	558,829	3,411,708

Such a case could be further enhanced by using sensitivity analysis, in order to include the risk of failure in ROI calculation. Business intelligence projects are considered to be projects with a significant risk of failure, caused by problems in implementation or simply because they are not accepted by end-users. The probabilities are assumed to be 60% for the success of the project, 30% for partial success and 10% for failure. In the case of success, the gain is the same as the one calculated in table 2. In the case of failure, initial investment of 3,000,000 kn will be lost. In the case of partial success, it is assumed that savings will equal costs, so the outcome will be 0. After multiplying all the outcomes with their respective assigned probabilities, total expected savings will equal 1,747,025 kn. In other words, the inclusion of risk in the calculation reduced the expected savings. With risk included, we will need to replace the work of 7 engineers in order to cover the initial investment in the observed period of 5 years.

Table 3. An example of Sensitivity Analysis

Outcomes	% Probability	Gain/loss	Weighted Outcome
Successful	60%	3,411,708	2,047,025
Partially successful	30%	0	0
Failure	10%	-3,000,000	-300,000
Totals	100%		1,747,025

Table 3 shows the minimum number of engineers working on the existing reporting systems that need to be replaced in order to justify the investment, based on the calculation demonstrated. For further discussion of the parameters used, see [10]. The table demonstrates that, for various scenarios, 2-14 engineers need to be replaced in order to financially justify the investment in the packaged business intelligence solution. The discussion could be furthered with arguments that business intelligence today becomes the infrastructure of enterprises, and such arguments favour business intelligence solutions even if they do not yield short-term positive ROI. However, such a discussion is beyond the scope of this analysis, which focuses purely on financial aspects.

Table 4. Analysis of Investment in Analytic Applications for various scenarios

Yearly cost of 1 Engineer	Total 5-year costs of Analytic Applications	% recurring/ initial costs	Min. number of engineers replaced for ROI to be > 100%	ROI
300,000 kn	6,000,000 kn	20%	7	103.72%
		40%	6	103.72%
	12,000,000 kn	20%	14	103.72%
		40%	12	103.72%
900,000 kn	6,000,000 kn	20%	3	149.21%
		40%	2	103.72%
	12,000,000 kn	20%	5	115.10%
		40%	4	103.72%

7. CONCLUSION

Business intelligence and business analytics deal with supplying information for the decision-making process. Their applications try to put the right information at the right time into the hands of the right user. They try to transform data into information; and information into knowledge in order to make the right decision and finally gain profit.

Current trends show that business analytics applications must incorporate task-specific knowledge, vertically connected across the organization. Business analytics information is desired to be in a visually acceptable form, even through wireless devices. Analysis functions have to be integrated into information systems, and integrated with actions and result measurements. Business intelligence and business analytics apply various data processing methods in order to help the organization to reach intelligent behaviour in the turbulent business environment. Unfortunately, this cannot be bought; it has to be built up patiently.

Business intelligence and analytics tend to reduce the number of management levels by cancelling middle level managers. Business intelligence designers have a hard task to synchronize the procedures and data between the strategic and operational management levels, and to exclude the requirements of middle management who want to reproduce the network of unnecessary relationships.

We have demonstrated how packaged applications could be feasible in Croatia if it sets free enough engineers who are currently working on operational reports (trying to compensate for the lack of the business intelligence solution). Since the licensing and implementation costs for the packaged solution are still high compared to the costs of human labour to develop the custom solution, it is still cheaper to develop the custom-tailored solution in most cases. However, a parallel could be drawn between standard ERP systems (vs. custom tailored) and packaged analytic application. In the future, more and more companies will quite possibly seek brand-name packaged solutions. This is due to a variety of factors, like their interfaces to standard ERP systems, introduction of best practices in the company and improved market value and image of the company introducing the packaged solution.

REFERENCES

- [1] R. Bose. Understanding Management Data Systems for Enterprise Performance Management. *Industrial Management & Data Systems*, vol. 106, no 1, pp 43-59, 2006.
- [2] J. Brumec, A Contribution to IS General Taxonomy. *Zbornik radova Fakulteta organizacije i informatike Varaždin*, vol. 21, no. 1(22), 1-14, 1997.
- [3] Data Mining Techniques, Statsoft Inc., <http://www.statsoft.com/textbook/stdatmin.html> [2005-01-28]
- [4] Kimball, Ralph; Reeves, Laura; Ross, Margy; Thornthwaite, Warren. *The Data Warehouse Lifecycle Toolkit – Expert Methods for Designing, Developing, and Deploying Data Warehouses*. John Wiley & Sons, New York, 1998.
- [5] R. Rohavi, N. Rothleder, E. Simoudis, Emerging Trends in Business Analytics. *Communications of the ACM*, vol. 45, No. 8, p. 45-48, 2002.
- [6] P. Sikavica, B. Bebek, H. Skoko, D. Tipurić. *Business Decision-Making (in Croatian)*. Informator, Zagreb, 1999.
- [7] M. Varga. Motivation Issues in the Framework of Information Systems Architecture, *Journal of Information and Organizational Sciences*, vol. 27, no. 2, pp. 109-118, 2003.
- [8] M. Varga. A Contribution to Information Systems Courses Taxonomy. *Proc. of the 15th International Conference on Information and Intelligent Systems*, p. 61-68, Varaždin, 2004.
- [9] M. Varga, Trends in Data Processing for Decision Support. *Proc. of the Mipro 2005, 28th Int. Convention (Conf. on Business Intelligence Systems)*, 21-26, Opatija, 2005.
- [10] M. Vuković. *Feasibility Study of Analytic Applications in Company Management*. Master thesis (in Croatian), University of Zagreb, Faculty of Economics & Business, 2006.
- [11] R. Wang, D. Strong. Beyond Accuracy: What Data Quality Means to Data Consumers. *Journal of Management Information Systems*, vol. 12, No 4, p. 5-34, 1996.

Received: 25 October 2007

Accepted: 02 December 2007