ASSESSING BENEFITS OF BUSINESS INTELLIGENCE SYSTEMS – A CASE STUDY

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Several arguments can be found in business intelligence literature that the use of business intelligence systems can bring multiple benefits, for example, via faster and easier access to information, savings in information technology ('IT') and greater customer satisfaction all the way through to the improved competitiveness of enterprises. Yet, most of these benefits are often very difficult to measure because of their indirect and delayed effects on business success. On top of the difficulties in justifying investments in information technology ('IT'), particularly business intelligence ('BI'), business executives generally want to know whether the investment is worth the money and if it can be economically justified. In looking for an answer to this question, various methods of evaluating investments can be employed. We can use the classic return on investment ('ROI') calculation, cost-benefit analysis, the net present value ('NPV') method, the internal rate of return ('IRR') and others. However, it often appears in business practice that the use of these methods alone is inappropriate, insufficient or unfeasible for evaluating an investment in business intelligence systems. Therefore, for this purpose, more appropriate methods are those based mainly on a qualitative approach, such as case studies, empirical analyses, user satisfaction analyses, and others that can be employed independently or can help us complete the whole picture in conjunction with the previously mentioned methods. Since there is no universal approach to the evaluation of an investment in information technology and business intelligence, it is necessary to approach each case in a different way based on the specific circumstances and purpose of the evaluation. This paper presents a case study in which the evaluation of an investment in on-line analytical processing ('OLAP') technology in the company Melamin was made through an

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analysis of users' opinions along with a strategic analysis based on identifying a cause-and-effect relationship between the benefits of OLAP technology and the company's strategic goals.

1. INTRODUCTION

Effective and timely business information is recognised as being essential for organisations to not only succeed but even to survive in today's rapidly changing business environment (Lönnqvist & Pirttimäki, 2006, p. 32). According to Pisello and Strassmann (2003, p. 13.), competitive advantages have shifted from those with expertise in how to implement new technologies, through those who know how to use technology to improve business processes, to those who know how to use technology to share, manage and increase the level of knowledge.

New informational needs have led to changes in decision-making processes within organisations. Managers seeking to preserve the competitiveness of their enterprises cannot and should not rely solely on intuition. Decision-making must be well supported by information about events within the organisation and in its environment. Organisations need reliable information systems that enable analysts and managers access to the information required for quality and effective decision-making (Puklavec, 2001, p. 1).

No matter what type of data is processed by an information system and how this is done, the objectives are largely the same: the information the user receives from the system must be high quality which, among other things, includes accuracy, timeliness and clarity. We can look at the importance of good information as the difference between the values of a good or bad decision where the decision is based on that information.

The greater the difference between the effects of good and bad decisions, the greater the importance of access to quality information (Thomsen, 1997, p. 5). Burn & Knight (2005) and Eppler (2006) have found about 30 conceptual frameworks of information quality that define and categorize quality criteria for information (i.e., terms that describe information characteristics which make information useful for its users) in various application contexts. Moreover, ensuring and evaluation of information quality can be facilitated through existing controls frameworks, such as COBIT and/or the IT Infrastructure Library (ITIL). The frameworks, as an umbrella concept, can provide standards,

benchmarks, and metrics that can be used by the information systems audit function (Merhout & Havelka, 2008).

To ensure a high-quality basis for taking business decisions, a huge amount of data must be converted into useful information. Moreover, it is exactly the ability to convert masses of opaque data into useful information in the shortest possible time that offers today's companies a significant competitive advantage. One of the technologies allowing managers to do this is business intelligence. In a broader sense, business intelligence is sometimes defined as a managerial philosophy, but in a narrower sense, it is information technology that helps organisations manage business information with the goal of arriving at effective business decisions.

In this context, business intelligence actually involves very little that is new as it solves old problems that managers have always been occupied with. It represents a basic managerial task – analysing a complex business environment in order to make the best possible decisions. However, a true novelty of business intelligence is its ability to present business information in a fast, simple and efficient way so that users can understand the logic and meaning of business information by employing a wide range of analytical possibilities and ad-hoc queries.

In literature, from the business intelligence field, it is argued that the use of business intelligence systems can bring numerous benefits. Business intelligence can offer certain competitive advantages to companies since it generally provides greater functionality in terms of the access to and analysis of data compared to enterprise resource planning ('ERP') systems. In the context of customer relationship management ('CRM'), business intelligence means the analytical processing of information about customers and their behaviour with the goal of optimising the management of relationships with customers by maximising their satisfaction and enhancing their loyalty and profitability. Integrated strategies for implementing business intelligence enable companies to develop excellence in their customer relationship management, thereby achieving a significant competitive advantage (Hall, 2004, pp. 1). However, it is also necessary to add that the introduction of business intelligence in practice requires many resources and that it is often very difficult to precisely define its benefits.

By looking for appropriate information solutions, modern businesses often face decisions associated with investments in information technology. A fundamental question concerning these investments, just like with any other

type of investment, is whether it is worth the money. Several methods are available to evaluate investments in general, such as the net present value ('NPV') method, the internal rate of return ('IRR') method, cost-benefit analysis, the total cost of ownership ('TCO') method and others. However, unlike many other investments, when evaluating investments in information technology, the effects are not seen directly in higher sales figures, profits, etc. and so the analysis should also include a substantial degree of forecasting the future (Turk, 2005, p. 153).

As a result, the economic justification of investments in information technology in general, and especially in business intelligence, is still a complicated topic that is open to discussion and different views. When evaluating investments in business intelligence systems, the specifics of this area must be taken into account. Namely, business intelligence provides information for more effective decision-making and management. The benefits of an investment in business intelligence are often very complex and difficult to measure. They range, for example, from faster and easier access to information for decision-making, through to improved public relations and a better reputation of the company in the eyes of business partners, a dimension which is largely very difficult to evaluate.

The purpose of the contribution is to fully address the issue of evaluating investments in business intelligence systems. By examining a concrete example of the introduction of OLAP technology in the company *Melamin d.d.* Kočevje, Slovenia and analysing the benefits, we will evaluate the justification of the investment in this technology.

Section 2 briefly presents business intelligence, business intelligence systems, and their characteristics where they are considered as an investment. The key categories of potential benefits are also described. Section 3 describes the purpose, problems and possible ways of evaluating investments in business intelligence. A case study in which we analyse the benefits of introducing a business intelligence system in the company *Melamin* is presented in Section 4. Section 5 contains summary findings and conclusions.

2. BUSINESS INTELLIGENCE SYSTEMS AS INVESTMENTS

2.1. Business Intelligence systems

With all the data available, at first sight it may seem surprising that managers often find it difficult to obtain basic business information such as

stock levels, pending orders, the history of individual customers, sales trends and similar. In many cases, key account managers need hours or even days to obtain the answers to such questions. Information about orders, for example, may be stored in a system for orders and sales processing, payment data in the accounting system, and information on past and planned activities and contacts with individual customers in the CRM system. These systems are often designed completely separately and an exchange of information between them is impossible, at least not in the short term and by the average user. Consequently, there is no simple way of non-technical users quickly obtaining the desired information.

The result is that the necessary information (usually in the form of different reports) must be obtained from various departments and employees. This often requires the co-operation of employees from the IT department, who are requested to make complex queries from different databases in order to provide the requisite data. In extreme cases, the collection of such information can take several days or even weeks, a period in which much of the information may become too old to still be useful. The remark that organisations are rich in data but poor in information seems completely appropriate. The challenge is how to transform data into useful information (Carver & Ritacco, 2006, p. 3).

In recent years, the ability to obtain useful information in real time has become an extremely important, if not even a critical, factor of success for companies. The time managers have available for making business decisions has been drastically reduced. Competitive pressures require businesses to make intelligent decisions based on their incoming business data, and these decisions must be made quickly (Business Intelligence and Data Warehousing, 2005, p. 5). The usual problem is not a lack of data, but the opposite – a huge amount of data must be converted into useful information in a timely manner in order to provide managers a solid basis for their decisions. The ability to convert non-transparent data into useful information in real time can offer a company a significant competitive advantage.

The tool that enables managers to do this is business intelligence. Given the rapid pace of today's business environment, these systems have become an almost indispensable part of the success of an organisation. With the help of business intelligence, managers can quickly and effectively detect important trends, analyse the behaviour of customers and facilitate expedient decision-making.

Business Intelligence is a broad concept which includes the appropriate orientation of the entire organisation. It deals with the acquisition, management and analysis of large amounts of data about business partners, products, services, customers and suppliers, activities, and transactions between them (Lu & Zhou, 2000, p. 3). In other words, it is an organised and systematic process by which an organisation acquires, analyses and circulates information from internal and external sources which is relevant to its business activities and decision-making (Lönnqvist & Pirttimäki, 2006, p. 32). It is a comprehensive concept, whereby an entire organisation is committed to use the available information systems (including business intelligence) in the most effective way with the aim of obtaining quality and timely information for decision-making, thereby creating competitive advantages. Such a concept must be supported by the senior management of a company and extended throughout the organisation.

However, *Business Intelligence systems* include information tools which help users obtain the required information efficiently and easily. Examples of analytical tools for real-time data processing are *On-Line Analytical Processing* ('OLAP') and data mining tools. It encompasses software that allows users to convert masses of opaque data into useful information, at the same time allowing users to create their own inquiries, reports and viewing modes, which puts business intelligence systems one step ahead of classical transactional ('OLTP') information systems.

A business intelligence system is usually not a single application but consists of different components closely related to each other, enabling users to select and analyse data, make aggregations and display the results in a form that is easy to use and understand. From the architecture point of view, such a system consists of:

- Operational and external databases as data sources.
- *The Extract, Transform, Load* process, which includes: the collection of data from various sources, checking for errors, transforming into a unique form and saving to a data warehouse.
- *A data warehouse* (in various forms) represents the central database for an entire company for storing and accessing data and is separated from operational systems.
- *Tools for data access and analysis* (analytical tools): they translate the data into information. The most common types of analytical tools include: query tools, reporting tools, OLAP tools, data mining, control panels, advanced analytical solutions (What-if scenarios, optimisation, statistical analyses, etc.).

This article focuses on OLAP technology. An essential characteristic of OLAP is that users can constantly adapt analyses to their current requirements. OLAP is therefore important for management information systems as it allows in-depth analyses of data across different dimensions, providing high quality information from a pool of heterogeneous data. It should be noted, however, that the OLAP concept really means the user interface and not the form of data storage. The maximum effectiveness of these tools is achieved if data is stored in multidimensional databases.

2.2. Investments in Business Intelligence

The implementation of business intelligence and the corresponding data warehouses is a complex process, which differs from case to case. However, it is always important that the decision on such an investment be economically justified. It would make no sense to introduce such expensive systems just to stay in touch with the latest technology trends. Every planned business intelligence solution must be justified by the potential benefits (like increased profit or greater efficiency) it can bring to the organisation. The following four components of the justification of an investment in business intelligence are stated by Atre & Moss (2003, p. 31):

- *Business factors*: it is essential to identify the business reasons for implementing business intelligence ('BI'), the strategic goals of the company, and application goals of the planned solution. The goals of the BI solution must be in line with the strategic goals of the company.
- *Requirements of business analyses*: the information needed for achieving strategic goals and for decision-making must be defined. This information is intended for upper management.
- *Cost and benefit analysis*: an evaluation of the costs of implementation and maintenance of the BI system, and a definition of the expected benefits. Tangible and measurable benefits of BI must be financially evaluated, while intangible benefits and their positive effects for the entire organisation must be defined in a qualitative way.
- *Risk assessment*: a definition of risks regarding the technology, the complexity of the system, integration into the business and existing information systems, the project team and financial investment.

Investments in business intelligence have a closed loop connection with the strategic objectives of the company: in order to assure that business intelligence solutions can support the strategic objectives of the organisation, they should be part of the business strategy and have a clearly defined purpose. As stated by

Carver & Ritacco (2006, p. 19), one of the key criteria when making decisions about investing in business intelligence should be whether the investment supports the business strategy.

Two groups of factors affect the success of a company: factors from its internal and external environments. The company should know, for example, how much it is spending on research and development, what the life cycle is of its products, what its revenue and profitability levels are, how efficient the production process is, and how successful its employees are in sales and marketing. One can identify several key success factors that help management understand the situation within the company. The purpose of most business intelligence systems is exactly to provide an insight into and an understanding of the internal business environment. Already at first sight, it is clear that this is only part of the necessary information – the company must also be aware of its external environment in order to achieve strategic advantages.

As Jaklič & Popovič (2009, p. 2) state, various recent international studies show a high level of awareness of professionals about the potential benefits of business intelligence in their business operations. For the fourth consecutive year, business intelligence remains a top IT priority of major international companies, while improved efficiency and operational performance are a key business priority for the fifth year in a row. Many companies have positioned business intelligence and business performance management ('BPM') as their top strategic priority for 2009 and 2010.

2.3. Potential benefits of using Business Intelligence systems

Business intelligence technology enables users to quickly understand complex information so that they can make better and faster decisions and thereby efficiently achieve business goals. Key benefits that business intelligence aims to create are the increased efficiency and effectiveness of the organisation. Some business intelligence solutions enable a faster flow of and easier access to information within the organisation (for example, by facilitating the means of creating, modifying and distributing standard reports). Some other, more recent solutions are based on a more aggressive approach that in certain cases requires a redefinition of existing processes and their optimisation, which can create new, previously unknown possibilities and opportunities (Lokken, 2001, p. 1).

Users and experts generally agree that business intelligence systems give companies certain advantages and benefits that are difficult to define precisely.

Some benefits are more or less directly visible such as the greater flexibility of users by creating reports, faster access to and a better overview of data, and so on. Other benefits are less obvious and it is hard to determine whether they are actually a result of the use of business intelligence or something else (for example, it may be difficult to figure out what really contributed to the increased income in the last quarter). Of course, the truth may also lie somewhere in between, so a certain improvement could be partly the result of the use of business intelligence and partly the result of other factors.

Here, the question arises of how to measure the benefits of business intelligence, whereby there is already a problem of how to determine the benefits themselves. As we will see later, it is even more difficult to measure or evaluate these benefits in such a way that supports an evaluation of the justification of an investment in a business intelligence system. Similar problems arise with investments in information technology in general. In any case, let us now look at the commonly agreed benefits of business intelligence.

Due to the wide applicability of business intelligence in both the internal and external business environments, organisations can enjoy many benefits. Thompson (2006, p. 1), for example, lists the following benefits business intelligence brings to companies: (1) faster and more accurate reporting; (2) an improved decision-making process; (3) improved customer satisfaction; (4) increased revenues; (5) savings in IT; and (6) savings in other areas (in addition to information technology).

There are, of course, many other definitions of the benefits of business intelligence. Carver and Ritacco (2006, p. 6), for instance, divide them into four groups: (1) lowering costs; (2) increasing revenue; (3) improving customer satisfaction; and (4) improving communication within the company. In addition to these four groups, one of the most frequently mentioned benefits of business intelligence is support for better decision-making, which Carver and Ritacco (2006, p. 11) actually include within the third group (increasing customer satisfaction). Similarly, Atre & Moss (2003, p. 39) categorise the benefits of business intelligence as: (1) an increase in revenue; (2) an increase in profit; (3) improved customer satisfaction; (4) a reduction of costs; and (5) an increase in market share.

With business intelligence, we can find the causes of certain problems as well as identify and analyse the key success factors. This process begins with an analysis of a broader report, like general sales figures, where we try to discover the causes (why?) of certain problem situations. This task requires several

stages before arriving at the essence of the problem (Figure 1). Users can drill down into the content of the original report and thus come to the smallest and most detailed information in order to reveal the underlying causes of individual events or the current situation. Once they know the cause, they can take effective action in the opposite direction either to correct problems or to maintain good practice and maybe extend it to other areas.
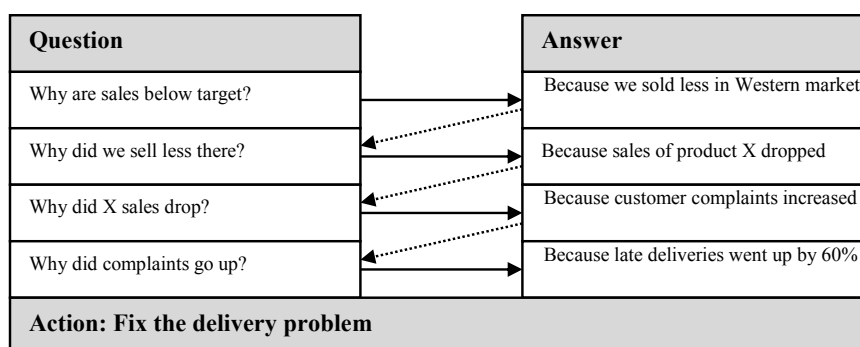
Question		Answer
Why are sales below target?		Because we sold less in Western markets
Why did we sell less there?		Because sales of product X dropped
Why did X sales drop?		Because customer complaints increased
Why did complaints go up?		Because late deliveries went up by 60%
Action: Fix the delivery problem		

Figure 1. The use of BI: Open questions into specific answers
(Carver & Ritacco 2006, p. 9)

3. EVALUATING INVESTMENTS IN BUSINESS INTELLIGENCE SYSTEMS

3.1. The purpose of evaluating investments in Business Intelligence systems

An important aspect of the question of what and how to measure and evaluate is to know the purpose of the evaluation. The evaluation of investing in business intelligence systems usually serves two main purposes: first, to prove that it is worth the money and, second, to help manage the BI process so that the BI solution satisfies the users' needs and that the process is efficient (Lönnqvist & Pirttimäki, 2006, p. 33).

The first and most common purpose of an evaluation is to demonstrate that the BI is worth the investment. The IT department, for example, reports to the management about the costs and benefits of various IT projects. Investments in IT, like all other types of investments, should be commercially viable in the eyes of management. The word ''economic'' can be understood very concretely here, namely, whether the investment is worth the money or not. All the complications of determining the economic viability of an investment involve

two problems: in most cases, the effects of an investment in IT are not seen directly in higher profits since the effects are often indirect.

One way to justify an investment is, for example, to calculate the *return on investment* ('ROI'). It is often hard to prove the rationality and justification of an investment in BI because it is a technology whose benefits are often difficult to measure and anticipate. Most experts therefore agree that classical financial methods such as ROI do not represent the best approach to justify investments in business intelligence, mainly due to the intangible nature of the benefits offered by business intelligence. These methods do not provide satisfactory results, which are also extremely difficult to obtain (Carver & Ritacco, 2006, p. 16).

The second purpose of measuring the effects of business intelligence is to provide information that helps manage the process of business intelligence, which means ensuring that business intelligence solutions meet the needs of users and that the process is effective. Business intelligence can, in fact, be very expensive if the information it provides is not accurate or does not match information needs. Such a follow-up of business intelligence effects should normally be carried out by IT experts, with the main purpose being a continuous improvement of products and the business intelligence process.

In addition, it is necessary to determine to whom the IT solution represents a value at all. The perceived value of IT solutions is very likely to vary according to the subjective assessment and needs of the individual concerned. Here, we look at the value of IT from the perspective of companies that use IT and BI solutions (e.g. increased profit as a result of using IT tools), as well as from the perspective of users (such as how they perceive the usefulness of BI). Besides, sometimes some want to show that IT as such does not represent any value at all because it creates value only as a result of the use of information tools when measures are taken and decisions made. This is actually the approach that says the value of IT can only be determined indirectly. In this context, we could speak of the conditional value of information technology: information technology must be integrated into decisions in order to determine its value (Lönnqvist & Pirttimäki, 2006, p. 34).

3.2. Problems of measuring IT benefits

Estimating the value of business intelligence requires answers to at least two questions:

- What are the costs of implementing business intelligence?
- What are the benefits that the implementation of business intelligence provides?

Costs and their role in assessing the value of business intelligence are usually not too problematic because, for the most part, they can be financially evaluated relatively well. The cost of the purchase and ownership of information technology represents a major factor in deciding on such investments, but a range of other costs should also be taken into account by the evaluation. The most important categories of costs that should be considered are (Remenyi, Bannister & Money, 2007, pp. 62-69):

- costs of hardware.
- costs of other fixed assets.
- costs of software.
- costs of data sources and
- costs of intellectual capital.

However, it is necessary to take into account some important aspects or conceptual problems when assessing such costs (Remenyi D., Bannister F., & Money A., 2007, p. 80):

- *Determining the total cost of investment*: it is necessary to identify all costs associated with an investment in information technology (including, e.g. the costs of external services, auxiliary materials, the corresponding part of the salaries of employees involved in the project, etc.). This task is not always easy because it is often difficult to distinguish the costs associated with the investment from those which are not.
- *Determining the current costs*: the costs of maintenance, upgrades, repair services, etc., in order to obtain an answer to the question of how much the system costs in one year.
- *Determining the boundaries of the system and the project*: in theory, the limits of each project should be clearly defined, but in practice, this is often not the case. Among other things, for example, various projects may share the same resources (people, equipment ...), related to different departments, etc. It may be very difficult to clearly identify the costs in such cases.

- *Preliminary costs*: the costs associated with project preparation, data collection, a feasibility study, etc., namely all the costs incurred before the decision whether the investment will be realised or not was made.
- *Opportunity costs*: by definition, these costs never appear in traditional bookkeeping accounts, as they are not actual costs, but rather the costs of alternatives which have not been pursued (the costs of opportunities not taken up). Managers often ask how much it would have cost had a different investment been chosen instead of the actual one. Opportunity costs are often a tool through which we compare various investment projects between themselves and, based on that, choose the one with the lowest cost.
- *Reduced benefits*: for example, those due to a poorly designed system, errors due to the inadequate training of users, declinatory reactions of users of the new system, slow system responsiveness, an inability to work due to system malfunctions, etc.
- *Cost of risk*: risk, for instance, is connected with the decision whether to opt for a more expensive solution from a renowned provider or for a cheaper solution from an unknown provider. The latter possibility is more likely to cause significant unforeseen costs in the future because of the poor quality, yet one can actually never know for sure. The price difference can also be interpreted as a premium for insurance against such risks – the question is simply whether we are willing to bear this cost.

Measuring the benefits of BI, however, represents an even bigger problem than measuring the costs. Many effects assumed to be created by BI consist mainly of non-financial and even intangible benefits such as the improved quality and timeliness of information. Although such non-financial effects should lead to financial outcomes (e.g. cost savings), there may be a time lag between the acquisition of information from BI and the related financial gain. Therefore, measuring BI benefits can be extremely difficult in practice (Lönnqvist & Pirttimäki, 2006, p. 34).

Business intelligence often has an influence on the quality of customer relationship management, customer satisfaction, and the search for new market opportunities, areas to which we often cannot attribute any specific financial value. How much is a satisfied customer worth compared with one slightly less satisfied? Is the increase in sales in a particular market segment the result of using BI, or would it have happened in any case? Furthermore, how valuable is the possibility that a general manager can produce a report by himself? Should we understand this as a saving of his time, or would it perhaps be more

beneficial for him and for the organisation if the report were prepared by someone else, leaving the general manager free to deal with 'more important' things? Such questions often raise dilemmas when it comes to assessing estimating investments in BI. Therefore, this remains quite a problematic and vague field. The benefits of business intelligence, along with information systems, in general, can be divided into four categories (Carver & Ritacco, 2006, p. 17):

- *Measurable (quantifiable) benefits* are those that can be clearly measured, for example, reducing the time needed to carry out certain tasks, savings achieved by purchasing one software solution instead of another, an increase in revenue and profit, and similar.
- *Indirectly quantifiable benefits* are usually related to customer satisfaction. Introducing new technology can improve customer service, which has a positive impact on their satisfaction, resulting e.g. in larger sales volumes, the increased loyalty of customers returning to purchase again, the winning of new customers, etc. Customer satisfaction is typically assessed by surveys, by monitoring the volume of business, the re-order ratio as well as other, less formal ways (e.g. by visits and dialogue with customers).
- *Non-measurable benefits* include a higher quality of work, the better motivation of employees, the effects of IT on an improvement of communication in the organisation, higher quality knowledge sharing between employees and so on. The main problem in assessing these benefits is that they may only be assessed in a subjective way, which does not provide reliable information about their real value.
- *Unpredictable benefits* can, for example, be new solutions and the ideas of creative individuals.

Since it is almost unrealistic in practice to expect to obtain accurate numerical estimates for the return on investment ('ROI') in BI, Carver and Ritacco (2006, p. 17) propose an approach whose advantage is that it takes both measurable and intangible benefits into account, and consists of the following steps:

- an evaluation of the expected measurable benefits,
- a description of intangible benefits in a qualitative way, as precisely as possible,
- making an assessment of the total cost of ownership ('TCO'), including the cost of hardware, software, internal resources, external consultants, maintenance fees and other costs,

- the following decision rule is then applied: (1) if the sum of directly and indirectly measurable benefits outweighs the total cost of ownership ('TCO'), then it is worth making the investment; (2) if the TCO is higher than the sum of directly and indirectly measurable benefits, it is necessary to also assess the intangible benefits in order to be able to make a decision.

Further, Carver & Ritacco (2006, p. 18) state that the users of existing business intelligence systems often believe that the non-measurable benefits are worth much more than the measurable benefits, so they must not be ignored in the evaluation process.

3.3. Theoretical models for evaluating investments in IT

In both the literature and business practice, several models for evaluating investments can be found. Some are based on a quantitative approach, while others rely on qualitative evaluations. The latter ones are especially worth considering when talking about evaluating investments in information technology and business intelligence.

3.2.1. *Financial methods for evaluating an investment*

Return on investment ('ROI') is a classic method for evaluating an investment. A problem seen when calculating the ROI on investments in information technology and business intelligence systems is that the *output* of the investment is represented by information obtained from the system, and the value of this information is very difficult to assess (Solution Matrix Ltd, 2009). The main reason for this difficulty is that the *outcomes* of business intelligence systems investment such as a redefined, innovative or more cost effective business process, increased level of the automation, faster business process execution, and market enlargement, are usually long-term and difficult to delimit from the outcomes from other investments.

The net present value method ('NPV') is one of the most commonly used methods for evaluating investment projects. With this method, the value of future benefits (future earnings) is discounted to the corresponding present value. The present value of future benefits is then compared to the cost needed to achieve these benefits in order to determine whether the benefits outweigh the costs (Turban, Leidner, McLean & Wetherbe, 2008, p. 564). The net present value analysis is considered as being effective when the costs and benefits are

well-known, tangible and measurable, so they can be easily converted into a monetary value.

The same applies to the calculation of the *internal rate of return ('IRR')*, which is defined as that discount rate at which the present value of the sum of expected cash inflows is equal to the present value of the sum of expected cash outflows from the project (Brigham & Gapenski, 1996, p. 218).

Cost-benefit analysis has long been used for evaluating a wide range of projects. With regard to projects in information technology, it is considered within the scope of the *feasibility study*, which has to be done before project planning, before a detailed analysis of the requirements and before any further steps are taken in the development of an information system (Turk, 2005, p. 157). A cost-benefit analysis represents the widest aspect of the economic analysis of an investment and it also involves hard work because there are no simple recipes for how to do it. In both theory and practice, many variations are found (e.g. the total cost of ownership method), which sometimes offer a simpler way to achieve quality decisions (Turk, 2005, p. 157).

If the net benefits of an investment in information technology in practice were to be evaluated as an absolute value (in terms of the impact on the value of the entire organisation), much work would be required to carry out the cost-benefit analysis. When undertaking a cost-benefit analysis of an investment in information technology, the investment should normally be compared with one or more competing investments or with the current situation (as if there were no investment). The analysis should only include those parts of the business on which the investment will have a noticeable impact (e.g. a change in existing processes, procedures, the productivity of certain employees or departments, etc.).

The total cost of ownership ('TCO') method is a variation of the mentioned cost-benefit analysis, but it can be used to identify and calculate all costs related to an activity or the purchase of equipment (fixed asset, software, etc.) over a certain time (TCO Special Interest Group, 2009). The TCO not only includes the purchase costs, but also all other expenses related to the use and maintenance of equipment within a given time period, which is usually the same as the lifetime of the asset. This method can be used for the purchase of any equipment of significant value that needs a thorough analysis of long-term effects and costs, including those that are hidden at first sight (Total Cost of Ownership, 2009).

3.2.2. Case studies

A case study is one of many research possibilities whereby an intensive and thorough study of a particular case is carried out. Based on systematic data collection and analysis, we come to certain findings and conclusions which can significantly clarify the researcher's knowledge of the studied case. On this basis, future studies can also be adjusted and improved. We could add that these studies generate and verify hypotheses. A case study is a research strategy that empirically examines a concrete example in its actual environment. It can involve a combination of qualitative and quantitative analyses, whereby the specific procedure depends on the characteristics of each particular case study. One possible approach to case studies in the information technology field is the comprehensive methodology for measuring the efficiency of investments in information technology, described by Rejc Buhovac (2005, pp. 223-229).

The methodology is based on a model with four dimensions: inputs, processes related to information technology, results of the investment in information technology, and financial effects of the investment in information technology. The dimensions represent a cause-and-effect relationship between the activities and results. The methodology thoroughly examines individual elements in the model's cause-and-effect chain, offering carefully selected indicators to monitor these elements. At the same time, it shows through a number of practical examples how to include all the costs and benefits of an investment in information technology and calculate the return on investment.

The method intends to measure the effectiveness of investments in information technology in general, for which it gives a very comprehensive and systematic approach, but it does not deal specifically with the evaluation of investments in business intelligence. The requirement of proven financial effects appears to be particularly problematic with investments in business intelligence since business intelligence solutions offer companies a wide range of indirect benefits (such as decision support), which are difficult to financially evaluate.

3.2.3. Subjective evaluation

The subjective evaluation of effectiveness is an alternative approach based on observations of users and can fairly accurately show the outcomes of business intelligence. In practice, evaluators pose questions to the users of information tools about their effectiveness. These questions may, for example, relate to how the level of user confidence in decision-making has increased as a

result of the information obtained from the business intelligence system, or to the users' satisfaction regarding the availability and timeliness of the related information. A positive aspect of this approach is that the results show how effective the business intelligence solutions appear to the users. On the other hand, this approach does not provide evidence of the financial value of the effects of an investment in information technology.

3.2.4. Strategic analysis

The main problem of evaluating investments in information technology usually involves the measurement and financial evaluation of the tangible and intangible benefits of this technology. Moreover, certain benefits manifest themselves in the form of discovering new opportunities that companies can use, but may also not use (Turban et al., 2008, p. 565). A useful approach may, therefore, be the strategic analysis, in which the following are particularly assessed (Turban et al., 2008, p. 570):

- strategic objectives of the investment in information technology,
- support that information technology provides by achieving the company's strategy,
- support to the management,
- goals of ensuring competitiveness and
- long-term costs and benefits of the information technology.

This type of analysis is chiefly based on a qualitative approach, which can to some extent replace traditional (financial) methods of evaluating an investment.

4. JUSTIFYING THE INVESTMENT IN OLAP TECHNOLOGY IN *MELAMIN*

The following section of the paper presents the evaluation of an investment in OLAP technology by the Slovenian company *Melamin*. The investment has already been implemented and, therefore, there is no need to provide support for the decision whether or not to carry out the investment, but rather to provide an assessment of whether the already realised business investment is justified.

4.1. Basic facts about the company, vision and strategy

The *Melamin* chemical company produces various types of synthetic resins. It is relatively well-known in the European market as a supplier of resins for the paper and construction industries, along with impregnated decorative

papers for the furniture industry. Globally, it is becoming more and more visible with products for industrial paints and lacquers, and the rubber industry. In particular, significant progress has been made in recent years in the field of synthetic resins based on hexamethylol-melamine (HMM), for whose production the most advanced continuous production technology was recently introduced. The company has approximately 200 employees and is organised as a joint-stock company. *Melamin* holds the quality system certificates ISO 9001:2000 and ISO 14001:2004, and is also a member of the Responsible Care initiative.

In recent years, except during the ongoing economic crisis, turnover was constantly rising. With a clearly defined vision and strategy, the company aims to become one of the leading producers in the niche of modified melamine resins (Melamin, 2008, p. 1).

Companies operating in today's chemical business face many challenges. The chemical industry has become an extremely difficult business area, and the same is happening with the market. Industrial applications that represent a market opportunity for *Melamin* are usually subject to very strict quality control within companies themselves, while the related legislation is also becoming ever more demanding.

Chemistry has become an industrial area which many people look at with a great deal of scepticism; on one hand, because in everyday life we are too often under the influence of chemical preparations in various forms (such as additives or ingredients in cosmetic products, medicines, food preservatives and additives) while, on the other, manufacturers are very well aware of the risks connected with their business.

No producer can afford to produce and sell a product that is medically or in any other way questionable. Chemistry is thus a very difficult area, not only in professional and technical respects but also increasingly in legal and administrative respects. The chemical industry is also very capital-intensive since production requires high-tech equipment, complex chemical reactors, measuring devices and sensors, as well as complex computer systems to manage and control the manufacturing processes. *Melamin* is a relatively small company, yet its competitors are often big multinational companies with more technical, financial and human resources available to invest in research and development ('R&D') and the modernisation of production.

The main features that define today's chemical industry around the world are:

- strong competition (technologically advanced and companies with large operating capital),
- mergers and acquisitions,
- vertical integrations,
- demanding and time-consuming access to new customers and
- chemical and environmental legislation.

According to the experience *Melamin* acquired during its many years of business activity in international markets, the following *success factors* can be identified:

- increasing revenue,
- customer loyalty,
- cost-effectiveness,
- quality and effectiveness of products and
- compliance with the law and other (e.g. ecological and safety) regulations.

Melamin's vision is to become a major producer of modified melamine resins and impregnated decorative papers in Central Europe. At least 30% of its revenue should be created by products with high added value (according to established internal criteria). A high-tech continuous production process for etherified melamine resins will be implemented (which is largely in place already). The cost-effective production of large quantities of impregnating resins and resins for construction will be established in a new modern production facility. A modern process for the production of powder resins will be introduced. With at least two product types, the company will rank within the top three producers in the world and thus become an active player in the market. In the first stage, this should be realised with binder for rubber and lacquer components based on HMM. The return on equity will rise to at least 10%, and *Melamin* will be ranked among the 100 largest exporters in Slovenia, which should be achieved in about five years.

Since it is important to know something about the business strategy before undertaking a strategic analysis of the justification of the investment in business intelligence, that strategy is thus briefly described below.

Overall strategy: the company will follow its vision via accelerated investments in new technologies. The share of investments should be between 6-8% of the annual turnover. Sales activities in new markets will be intensified. In particular, through products with a higher added value, which represent the central part of future production (e.g. highly etherified resins based on HMM), an own brand will be developed. Long-term contracts will be made with suppliers of the key raw materials. Investments in research and development will rise to at least 3% of the annual turnover.

Sales and markets: A satisfied customer is a fundamental approach and the primary objective, which allows the company's stable and long-term existence and has an indirect impact on all of its other objectives. The company anticipates achieving an export share of at least 80%, and 8% average annual growth of turnover. Activities will take place mainly in the direction of increasing sales of products with higher added value. Sales will be boosted especially in fast-growing markets outside the EU. The optimisation of the product structure in terms of production volumes and profitability will be a permanent process.

Indicators of effectiveness and efficiency: to successfully exist in the global market, the company has to achieve and maintain the following indicator values over the next five years:

Gross value added per employee:	EUR 45,000
Sales per employee:	EUR 200,000
Return on equity:	10%
Share of investments in total revenue:	8%
Investment in R&D:	3%
Share of exports:	80%
Share of strategic products in the world niche:	5-10%

Quality and ecology: the company will build and maintain the quality systems ISO 9001 and ISO 14001, while the business process will be improved to the level required by the criteria of the European business excellence model.

4.2. Implementation of OLAP

Before implementing OLAP technology, the company used an *on-line transaction processing* (OLTP) system. Before bringing in the new solution, an analysis of the existing situation had to be undertaken and certain questions had to be answered, as described below.

Expectations the company had about OLAP mainly concerned the faster and easier acquisition of information for business decisions. The new information system had to be easy to use so that users would not dislike the new solution, which could lead to exactly the opposite effect to what was desired.

Users of the OLAP system were especially meant to be upper and middle management, including directors of business units, purchasing and sales managers, the sales team and occasionally the employees of financial and strategy-management departments. The number of potential users was estimated at 25, also depending on the level of actual usability and benefits of the OLAP solution in practice. *The users' required skill level* was not a very demanding issue – users would be dealing with the same types of data as in the OLTP system, but what would be new was the additional functionality of the OLAP system and its user interface. The appropriate training of future users was required; first, as a presentation of the planned new solution which was undertaken by its supplier and later, in the form of internal educational training organised by the company's own IT department.

The data that needed to be included in the OLAP system were mainly defined according to the needs of management and sales. Before creating a multidimensional database and implementing the OLAP system, together with the IT department and the supplier of OLAP, its future users defined the core requirements the system would need to fulfil. The goal was to ensure a complete view over all data which could serve as a basis for sales analysis and support decision-making. The OLAP system and its multidimensional database therefore includes *dimensional data* about *items* like business units, business partners, recipients, products, document types, insurances, commercial team, financial items, time periods and identification numbers of commercial documents. The *measures* are quantity, value (in the original currency), the value in EUR, bookkeeping values, and prices.

Required hardware and software: the new system required a server suitable for facilitating a multidimensional database. Such a server was already in place so no new investment was needed for that. The personal computers of the future OLAP users, connected to the company's local area network ('LAN'), were all relatively new so the installation of OLAP clients was possible without any hardware upgrades.

Data loss prevention: a database backup system was already in place, which allowed efficient periodical backups of the relational database of the existing OLTP system. If a loss of data in the new multidimensional database

were to occur, it would only need to be rewritten with data from the source (relational) database, which contains data for the current year (and is also regularly archived), while data for previous years would need to be extracted from archive files. Based on an analysis of the existing situation, the software tool ProClarity Professional was chosen as it enables multidimensional data analyses with numerous possible views (tables, graphs, decomposition trees, etc.) and functions concerning data (sort, filter, eliminate, isolate, etc.). Data can be drilled down into details, which enables one to look for patterns or connections between different items, and they can also be aggregated (drilled up) in the opposite direction. These and many other functions represent a powerful tool for complex analyses, which can often lead to useful information.

4.3. Evaluation of OLAP benefits

The investment in OLAP technology has brought certain benefits to *Melamin.* However, are these benefits big and significant enough to say that the investment was justified? The method of evaluating an investment usually depends on the purpose and type of the investment (Table 1). Given that one of the main goals of this investment in business intelligence was to improve the company's competitive advantages and business success, which is obviously strategically important for the company, the strategic analysis method was chosen as being the most suitable for this evaluation. Classic financial analyses like ROI would be less appropriate here as it would be very difficult, if not impossible, to financially evaluate all the costs and especially the benefits of the investment.

Table 1. Purposes and types of investments, and evaluation methods

Purpose of investment	Type of investment	Evaluation method
Business survival	Essential	Continuation/ Termination of business
Increase in efficiency	Vital	Cost-benefit analysis
Increase of effectiveness	Critical	Business analysis
Competitive advantage	Strategic/Reputation	Strategic analysis
Infrastructure improvement	Architectural/Organisational	Long-term impact analysis

Source: Remenyi D., Bannister F., & Money A., 2007, p. 107.

Based on the purpose and type of the investment, strategic analysis was the method of choice for *Melamin's* case. Below, the investment will be evaluated in the sense of a qualitative analysis of the realised benefits, which is also considered to be an adequate indicator for management of whether the cost of

the investment in the OLAP technology was justified. The analysis involves two methods:

- a subjective evaluation from the users' side and
- a strategic analysis with elements of an analysis of a cause-and-effect relationship between the activities and results.

4.3.1. Subjective analysis of users' opinions

Within the subjective analysis, we collected the users' opinions about the advantages OLAP brings them, what was their satisfaction and experience with the use of the OLAP technology, whether their expectations were met, and what benefits or advantages of the system they deem most important for their work. A summary of the findings is shown in Table 2.

Table 2. Benefits of the OLAP technology according to user experiences

Ease of use
Simpler to use than the OLTP system
Unified access to sales and purchasing data for all three business units
The data warehouse that enables easier access to historical data
Time-saving
Shorter time needed to produce reports
Significantly faster sales and purchases analysis → less time needed for analyses → more time available for decisions
Savings in IT
Less support needed from the IT department, which means a reduction of its work tasks and thus greater availability for the resolution of other problems
Improved decision support
Rich possibilities for different analyses and graphic visualisations of data
Better transparency of analyses because of the numerous possibilities of the graphical visualisation of results
Possibility to export data to Excel
Improved communication for the faster, simpler and more transparent exchange of reports
Negotiations support (the graphical analysis and display of data shows buyers and suppliers that business with them is seriously monitored, which is a strong argument in defending one's own standpoint in negotiations)
Flexibility
Greater flexibility by preparing reports (much more 'freedom' for users, the possibility of ad-hoc queries)
Better possibilities of analysing sales by geographical areas, product groups (analysis of competing buyers) etc.
Possibility of preparing data 'to go' (local cubes and briefing books)
Possibility for publishing certain information on the intranet and/or Internet
Quick reactions make positive impressions on business partners
Better business monitoring enables customer-adapted and timely communication with customers, which in the longer term contributes to growing revenues and improving customer satisfaction
Possibility of aggregating data
Possibility of drilling into data
Increased productivity of the sales team as a result of fast and tailored analyses and consequent focus on what is important for the organisation

The users of the OLAP technology in *Melamin* are mostly representatives of senior and middle management, directors of business units and sectors, and sales managers in individual units who need quality and timely information for decision-making, as well as an effective tool to track sales and events in different markets. At the time of the study, there were 17 users of OLAP, eight of whom were regular users, while the others used the system occasionally or as needed.

4.3.2. Benefits of OLAP technology in connection with the company's vision and strategy

One of the main indicators justifying an investment in BI is whether certain types of benefits of BI contribute to the realisation of the company's business strategy. The analysis relies on the categorisation of potential benefits (Atre & Moss, 2003, p. 39) presented in Section 2.3, which are connected to the realisation of the company's strategic goals. Table 3 briefly describes the role of OLAP technology for each benefit category, and for each possible way of achieving these benefits.

Table 3. The role of OLAP technology in achieving different categories of benefits

Ways of increasing turnover	The role of OLAP technology
Identification of new markets and niches	Transparent analyses of sales and identifying markets in which the company is not yet present. Rich possibilities of graphic presentations of data, modules for geographical analyses, such as *MapInfo MapX ®* plug-in for ProClarity, a crosswise presentation of data on markets, customers, products etc.
A more efficient sales process	Simple and clear monitoring of sales with analyses of time-series, customers, markets, members of the sales team etc., as well as with drilling down into data and discovering the causes of the present situation.
Faster recognition of new opportunities	Compared to the OLTP system OLAP offers significantly clearer possibilities of displaying and comparisons of different data dimensions. A high degree of adaptability of analyses to suit the needs of users.
Faster adaptation of marketing activities	More transparent analyses enable the faster discovery of trends and deviations in sales dynamics, which enables faster reactions and instantaneous adaptation of sales activities to market conditions.
Ways of increasing profit	**The role of OLAP technology**
Better focussed advertising messages	Faster and better quality analyses, a better view over sales, also because of the many possibilities of graphically presenting data.
Earlier warnings of a sales drop	Time-series analysis, easy monitoring of sales trends according to different criteria (markets, customers, products etc.).
Identification of less profitable products and product groups	Drilling down into data enables a fast search and identification of products that differ from the expectations (e.g. do not sell well, bring a small profit etc.). The *Performance Map* tool enables transparent graphical analyses and comparisons of different measures like turnover and profit.

Identification of internal inefficiencies	An analysis of sales based on members of the sales team, business units etc. can discover internal inefficiencies and opportunities for improvements.
More efficient management of the product portfolio	An analysis of the sales and profitability of products enables the efficient monitoring of product life cycles and the timely adaptation of the sales assortment.
Ways of improving customer satisfaction	**The role of OLAP technology**
Better understanding of customers' preferences	Easier monitoring of an individual customer's purchases, possibility to monitor the order dynamics in different time units (e.g. by years, quarters, months etc.). An analysis of sales by day of the week, for example, can help to optimise the organisation of supplies and arrangements with carriers, which can improve the timeliness of deliveries and hence customer satisfaction etc.
Better harmonisation on the customer-product level (adapting the product to the customer's needs)	Drilling down into data and the use of performance charts enable the identification of various links between different categories of data. Possibility to discover changes in the structure of sales by products and markets, and thus adjust marketing approaches to the phases of the product life cycle.
Increase in the number of regular (return) customers	Monitoring the dynamics of individual customers' orders, an analysis of trends and time series enables the timely detection of deviations and an immediate response, e.g. visits to a customer when sales drop (if this is detected on time, it can prevent the loss of a customer and increase the re-order frequency).
Faster solving of complaints	Fast searches for information on previous deliveries, invoices, delivery dates etc. In case of complaints regarding the timeliness of deliveries, e.g. a fast and easy analysis of supply dynamics by days can be done, which helps detect the causes of deviations (seller's or carrier's responsibility etc.).
Ways of decreasing costs	**The role of OLAP technology**
Optimising the stock levels	The creation of multidimensional data cubes in the field of stock control offers the potential for a complex analysis of current state and stock turning, which enables optimisation and thereby reduced stock costs.
Reduction of quantity of bad quality products and products with an expired shelf life	A comparison of average stock levels with information about production and sales levels by product enables a better production-demand adjustment, and fewer products of improper quality and an expired shelf life.
Reduction of time needed for business analyses and reports	OLAP technology enables the quick and simple execution of complex analyses. Therefore, users have more time available for other, more productive tasks.
Fewer requests to the IT department for tailor-made analyses and reports	The high level of flexibility of *ProClarity* enables users to create queries and reports by themselves. This means faster access to information and time-saving for OLAP users as well as for IT specialists, who can dedicate more time to other, more productive tasks.
Ways of increasing the market share	**The role of OLAP technology**
Increase in the number of new customers	Improvement of customer satisfaction, which is one of the benefits of OLAP, also has a positive influence on the acquisition of new customers.
Higher degree of customer loyalty compared to 'before' and to the competition	Efficient possibilities of historical data analyses (sales dynamics, customer orders etc.) enable the early detection of deviations from trends, and fast responses.
More transparent market monitoring and detection of new market niches	Thank to the numerous transparent graphical display modes, the detection of new market niches is much easier than with the tabular presentation of data in 'traditional' reports.

Given that the mentioned benefits of OLAP technology are provided in a descriptive form and not in measurable form (by quantified values), it is important to ask, in the context of justifying investments in this technology, whether and how these benefits help achieve the fundamental long-term strategic goals. First, the criteria to help us make a final evaluation of the justification of the investments in business intelligence must be defined. Such questions are:

- What are our main strategic objectives?
- In which way will we try to achieve them?
- How to use business intelligence to contribute to achieving the long-term strategic objectives?

Figure 2 (see below) shows the cause-and-effect relationship between the properties of the OLAP technology and the benefits it brings to the company. In addition, it shows the relationship between the OLAP benefits and the achievement of the company's strategic objectives. The arrow links show that the individual characteristics of OLAP can generate multiple benefits for the user, and that some benefits may result from several different properties of OLAP. For example, we see that the faster analyses enabled by OLAP bring benefits to the company, reflected in five areas:

- an increase in profit due to better support for decision-making and due to time-saving,
- an improvement of customer satisfaction as a consequence of the faster response times to their requests and expectations,
- a cost reduction due to time saving and reduced work tasks of the IT department involving the creation of reports that the OLAP users can now prepare by themselves,
- an expansion of market share due to the possibility of the transparent monitoring of sales volumes, structures and trends, as well as the easier detection of areas with poor sales, deviations from past trends and similar,
- faster decision-making, which may be critical to the survival of the company in a strong competitive environment.
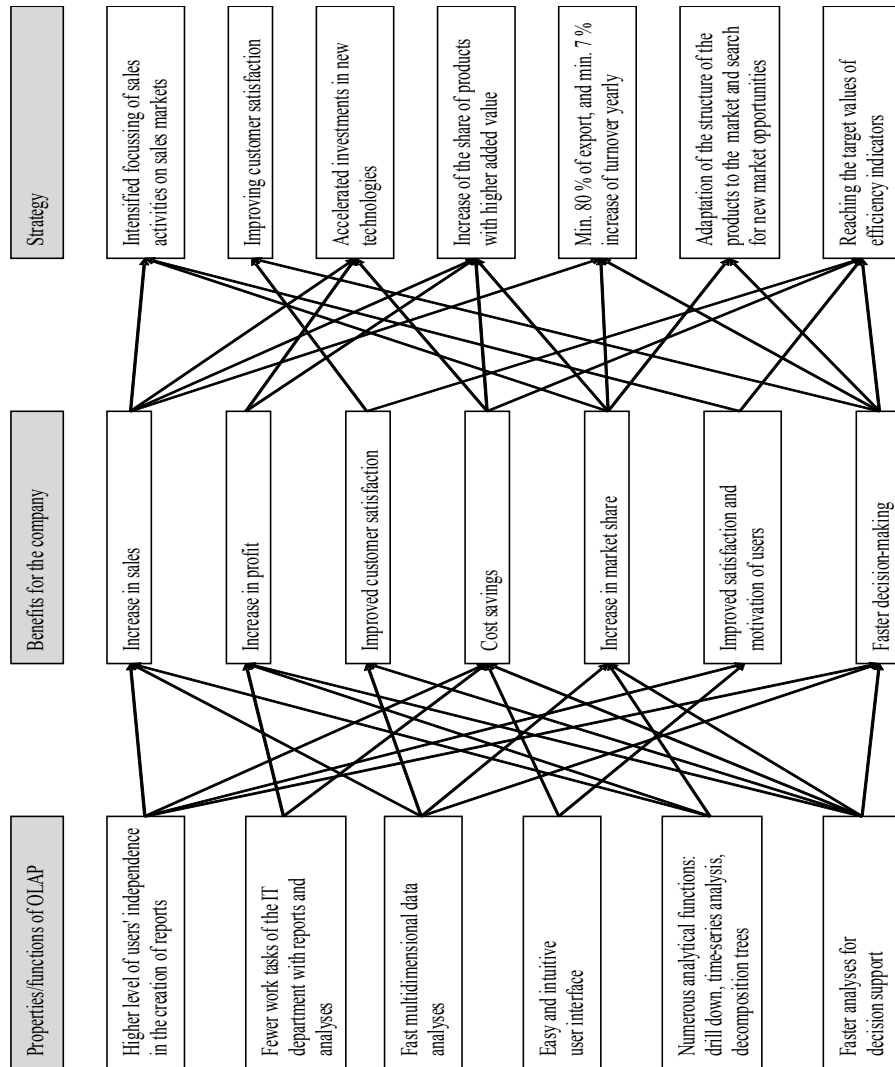
Figure 2. Cause-and-effect relationship between the OLAP properties, benefits for the company, and its strategic objectives

As also shown in Figure 2 (see above), the benefits from using the OLAP technology also help in achieving the company's strategic orientation. Within the qualitative analysis of the justification of the investment in business intelligence, it is important that the existence of such a cause-and-effect relationship in fact confirms the correctness of the decision made by the company's senior management to implement the OLAP technology. Moreover,

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in this case study, a two-way relationship between business intelligence and corporate strategy has been confirmed:

- business intelligence, with the properties and benefits it offers users, helps achieve the strategic objectives of the company; and
- at the same time, another long-term (strategic) objective of the company is accelerated investments in new technologies (including information technology and business intelligence) in the future.

This two-way relationship, in fact, also suggests the concept of continuous improvement, which is one of the primary orientations of the ISO 9001 quality management system.

5. CONCLUSIONS

The benefits of business intelligence are often greater than what appears at first sight. In addition to measurable and indirectly measurable benefits, it also brings certain benefits that are difficult to measure or are even unmeasurable, as well as some unpredictable benefits that are only revealed after a certain period of using business intelligence. One of the key purposes of business intelligence is to improve support for business decisions. Investments in IT should be aligned with the strategic objectives of the organisation. On one hand, this means that investments in modern and efficient information technology should be an integral part of the company's strategy and, on the other hand, the information technology should help the company to achieve its strategic objectives. Managers in conjunction with IT departments and users should try to ensure that this is indeed the case.

Investments in business intelligence and information technology in general are, of course, associated with certain, usually non-negligible costs. Evaluating the cost of an investment in business intelligence may at first glance seem easier than the task of evaluating the benefits, although here too we encounter many difficulties and challenges. It is often difficult or even impossible to determine where the boundaries of the project are and what costs should be included in the analysis. Questions are raised, for example, like how to evaluate the cost of data sources and intellectual capital, how to evaluate the time savings as a result of the more efficient technology, whether to take opportunity costs into account or not, and so on.

In this case study, it was determined that the implementation of OLAP technology offers users in the company Melamin some advantages compared to

a transactional system. The benefits can be primarily identified in the form of the increased autonomy and flexibility of users, when it comes to creating reports, quick and simple analyses, improved decision support and operational efficiency, as well as a range of new analytical functions (drilling in the data, analysis of time series and trends, aggregation, sorting and separation of data, etc.). Another result of the increased autonomy and flexibility of users is that the IT experts are less occupied with the creation of reports and analyses, so they have more time to devote to other tasks and projects. The *performance criterion* is thus satisfied since the selected OLAP tool enables users to perform all the necessary analyses and queries by themselves in less time than with the previous tools and methods. In addition, new opportunities arise from the use of OLAP technology in other business fields (finance, service and maintenance, manufacturing, human resources, possibility of connecting with the CRM system, etc.).

We also found that the main categories of business intelligence benefits (increase in revenue, increase in profit, improved customer satisfaction, reduction of costs, increased market share, improved satisfaction and motivation of users, and faster decision-making) can be successfully linked to the defined long-term business strategy. The investment therefore helps the company achieve its strategic objectives which is, according to Carver and Ritacco (2006, p. 19), one of the crucial criteria for deciding whether the investment in business intelligence is justified or not. Users of the business intelligence solution detected certain very specific benefits which may be summarised as: ease of use, time-saving, improved decision support, flexibility, and positive reactions of customers due to faster responses. There was no particular reluctance to use the new tool as the users were mostly very satisfied with its ease of use and intuitive user interface. This also means that the *criteria regarding the complexity of use*, user's education and training, and the time needed for executing individual tasks are fulfilled. Regarding the *costs*, this case is an example of the favourable realisation of an OLAP solution since it was implemented completely within the planned annual budget dedicated to IT. Therefore, we conclude that the investment in the business intelligence and OLAP technology described in this paper practically entirely fulfilled the expectations and was thus completely justified.

This case study shows that qualitative methods such as a strategic analysis and an analysis of users' subjective assessments are appropriate for evaluating investments in business intelligence.

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PROCJENA KORISTI SUSTAVA POSLOVNE INTELIGENCIJE: STUDIJA SLUČAJA

Sažetak

Nekoliko argumenata iz literature o poslovnoj inteligenciji ukazuje na višestruke koristi od sustava poslovne inteligencije: primjerice, u njih se ubrajaju brži i jednostavniji pristup informacijama, uštede u području informacijske tehnologije (IT) i veće zadovoljstvo kupaca, pa sve do povećane konkurentnosti poduzeća. S druge strane, većinu je koristi od poslovne inteligencije vrlo teško mjeriti, s obzirom na njihove indirektne i odgođene efekte u poslovnom uspjehu. Dodatna poteškoća u opravdavanju investicija u informacijsku tehnologiju, a posebno u poslovnu inteligenciju, vezana je uz činjenicu da menadžeri, u načelu, žele znati isplati li se investicija, tj. je li ekonomski isplativa. U pokušaju odgovora na ovo pitanje, koriste se različite metode za procjenu investicija, kao što su klasične metode povrata na investirano, analize koristi i troškova, neto sadašnje vrijednosti, interne stope rentabilnosti, itd. Međutim, u poslovnoj je praksi

isključiva uporaba navedenih metoda nepogodna, nedovoljna ili nemoguća za procjenu investicije u sustave poslovne inteligencije. Stoga se za ovu svrhu koriste pogodnije metode, zasnovane uglavnom na kvalitativnom pristupu, a u koje se ubrajaju studije slučaja, empirijske analize, analize zadovoljstva korisnika i druge metode koje se mogu neovisno koristiti i koje mogu pomoći u dobivanju ukupne slike, kada se u obzir uzmu i klasične, prethodno opisane metode. S obzirom da ne postoji univerzalni pristup procjeni investicije u informacijsku tehnologiju i poslovnu inteligenciju, potrebno je svakom slučaju pristupiti na drugačiji način, uzimajući u obzir posebne okolnosti i svrhu evaluacije. U ovom se radu opisuje studija slučaja u kojoj je provedena evaluacija investicije u tehnologiju On-Line Analytical Processing – OLAP, u poduzeću *Melamin.* Pritom se koristi analiza mišljenja korisnika, praćena strateškom analizom, zasnovanom na utvrđivanju povezanosti između koristi od tehnologije OLAP i strateških ciljeva poduzeća.