Business Intelligence as a Key to Management of an Enterprise

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Abstract

The paper focuses on the Business Intelligence systems. At the beginning, knowledge as an important and strategic asset that determines a success of an enterprise is presented. Next, some characteristics of the Business Intelligence systems are discussed and their architecture is described. Purposefulness of applying such solutions in an enterprise is highlighted. An integrated approach to build and implement business intelligence systems is offered. The systems are shown in four dimensions: business, functional, technological and organisational

Keywords: Business Intelligence, knowledge, Balanced Scorecard, Case Base Reasoning

Knowledge as an Asset of an Enterprise

Contemporary economy is not based on natural resources any more. They are replaced by the intellectual ones. Intellectual capital – so called hidden assets – proves as important as financial capital while reaching objectives of an enterprise ("Knowledge Management", 2000). It enables better evaluation of enterprise abilities to generate potential profits than conventional standards. Hence, there are numerous proposals to apply more adequate systems of measuring potential of an enterprise in the era of knowledge-based economy. It is manifested in attempts to include intellectual capital (consisting of all that is found in the heads of enterprise members and all that is left in an enterprise when its members leave) in the balance sheet of an enterprise.

Size, development and position of an organisation on the market are conditioned not only by financial and material capital but also by the intellectual one understood as quality of knowledge, knowledge range and its contribution to the market offer (Figure 1). Knowledge is applied in all key business processes. It constitutes a prerequisite for the development of new products and technologies, volume of sale, reaching new customers and maintaining relations with already existing one. As a result knowledge determines market performance of every enterprise. Therefore, enterprises are characterised by their strong motivation for the most complete utilisation of knowledge and all their workers' intellectual potential. Such approach is realised, inter alia, by means of motivating employees to undertake creative and innovative actions and teamwork as well.

Knowledge in an enterprise may originate from many different sources. They include information systems, internal documentation, press, reports, domestic and foreign statistics, Internet, corporate databases, customers, suppliers or business partners. Knowledge of the employees is an unquestionable mine of information. It results from their experience and intuition.

Paper Accepted as a Short Paper

Financial and material capital		Intellectual capital
Financial assets	———	Ability to learn
Personnel quantity	———	Personnel quality
Market share	———	Personnel and contractors knowledge
Mass production	———	Constant innovation
Power of organisation	———	Organisational flexibility
Increase in the position of an enterprise on the market		

Figure 1. Financial, material and intellectual capital and the market position of an enterprise

The research on the sources of knowledge and their usefulness in business carried out in the largest Polish enterprises has shown that organisations enjoy relatively big awareness of the need to explore knowledge about customers, to tighten relations with them and to involve customers in the process of designing new products. Among enterprises that have been surveyed a large majority emphasises their co-operation with customers and evaluates such co-operation as useful or very useful. The research also proves that as far as an organisation is concerned other important sources of knowledge include knowledge of strategic investors and its own research and development departments. Enterprises are convinced that professional literature, congress and conference proceedings, co-operation with universities and new employees' knowledge constitute a minor source of knowledge (Mierzejewska, 2002).

Analyses that have been conducted suggest that a competitive advantage depends on two factors: access to adequate and reliable information in a short period of time and high selectivity in the creation and utilisation of information. Hence, searching for effective tools to create, aggregate and share knowledge in an enterprise becomes a key target of management. In this situation information systems play a significant role. However, practice shows that despite sophisticated information technology infrastructure a level of satisfaction out of delivered information is relatively low. There is frequently no correlation between generated information and reports and a strategy that is being implemented by an enterprise. Business Intelligence Systems (BI) make up a complex solution that allows meeting such needs. They are elements that fill in the information gap mainly in the field of strategic and financial analysis, analysis of customers' expectations, analysis of an enterprise and a particular market.

Business Intelligence in the Management of an Enterprise

BI is currently one of the fastest developing directions in information technology. It is supposed that in the future BI systems connected with CRM systems (Customer Relationships Management) and ERP (Enterprise Resource Planning) will provide an enterprise with a competitive advantage (Liautaud & Hammond, 2001).

BI is a set of concepts, methods and processes that aim at not only improving business decisions but also at supporting realisation of an enterprise's strategy. Main tasks that are to be faced by the BI systems include intelligent exploration, integration, aggregation and a multidimensional analysis of data originating from various information resources. Systems of a BI standard combine data from internal information systems of an organisation and they integrate data coming from the environment e.g. statistics, financial and investment portals and miscellaneous databases. They are meant to provide adequate and reliable up-to-date information on different aspects of enterprise activities (Olszak, 2002).

BI tasks implicate an internal structure of these systems. The structure in question consists of the following modules:

- tools to extract and transfer data – they are mainly responsible for data transfer from transaction systems and Internet to data warehouses;
- data warehouses – they provide room for thematic storing of aggregated and already analysed data;
- analytic tools (OLAP) – they let users access, analyse and model business problems and share information that is stored in data warehouses;
- tools for reporting and ad hoc inquiring – they enable creation and utilisation of different synthetic reports;
- presentation layer – applications including graphic and multimedia interfaces whose task is to provide users with information in a comfortable and accessible form.

BI systems range and tasks require adequate approach to their designing, implementing and using. It seems indispensable to realise these processes taking the following four dimensions into consideration (Figure 2):

- involves a selection of management methods and techniques that include aspects of knowledge and can be used while building BI,
- functional – based on the function determination of the BI systems in an enterprise,
- technological – based on the selection of information tools, methods and solutions to build BI systems,
- organisational – based on the methodology determination of the BI systems implementation in an enterprise.

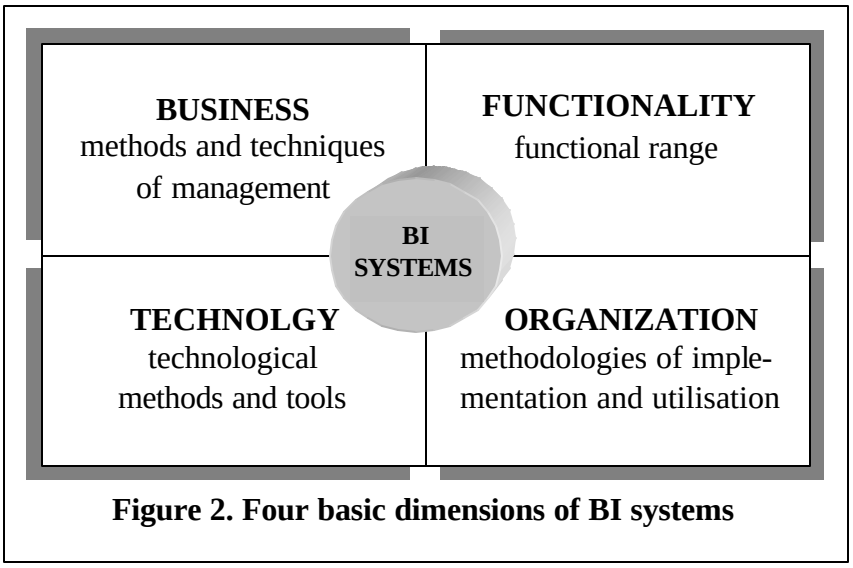

Figure 2. Four basic dimensions of BI systems

Business Aspect of the BI Systems

The BI systems idea provides for an integrated analysis and evaluation of an enterprise by means of utilisation of financial and non-financial indicators. Such complex approach supports shaping both development of an enterprise and its chances on the market.

However, it seems that the concept of the Balanced Scorecard (BSC) is one of the suggestions to be applied in the BI. It facilitates a multidimensional overview of an enterprise. BSC is based on the assump-

tion that the ability to reach objectives that have been set by an enterprise should be discussed in the following four basic dimensions (Kaplan & Norton, 1996; Kaplan & Norton, 1996a):

- financial (required financial standing of an enterprise to realise its mission),
- customer (the way an enterprise is perceived by customers to realise its mission),
- internal processes (which business processes are the most important to realise the mission),
- development and growth (which competencies and what kind of knowledge are indispensable to realise the mission).

Complying with the BSC provisions each of the already mentioned dimension consists of:

- objectives (what an organisation is going to evaluate, e.g. in order to improve financial liquidity, its image on the market, develop new products or increase employees' skills),
- measures to realise objectives (how to evaluate realisation of objectives, e.g. financial liquidity indicators, promotion expenditures, quantity of new products, trainings),
- current and expected value set for particular measures of objectives to be realised.

Tasks and initiatives are assigned for each objective. Responsibility for its realisation is determined. Some attention is also paid to cause-and-result-relations that are observed among particular objectives and tasks. A need for co-operation of all employees at all managerial levels while creating a balanced scorecard for particular departments and persons in an enterprise is highlighted (Figure 3).

The BSC method highlights intellectual resources management as an important and integrating factor in the realisation of an organisation's strategy. In practice classical BSC approach is frequently modified to the character of an enterprise and its environment.

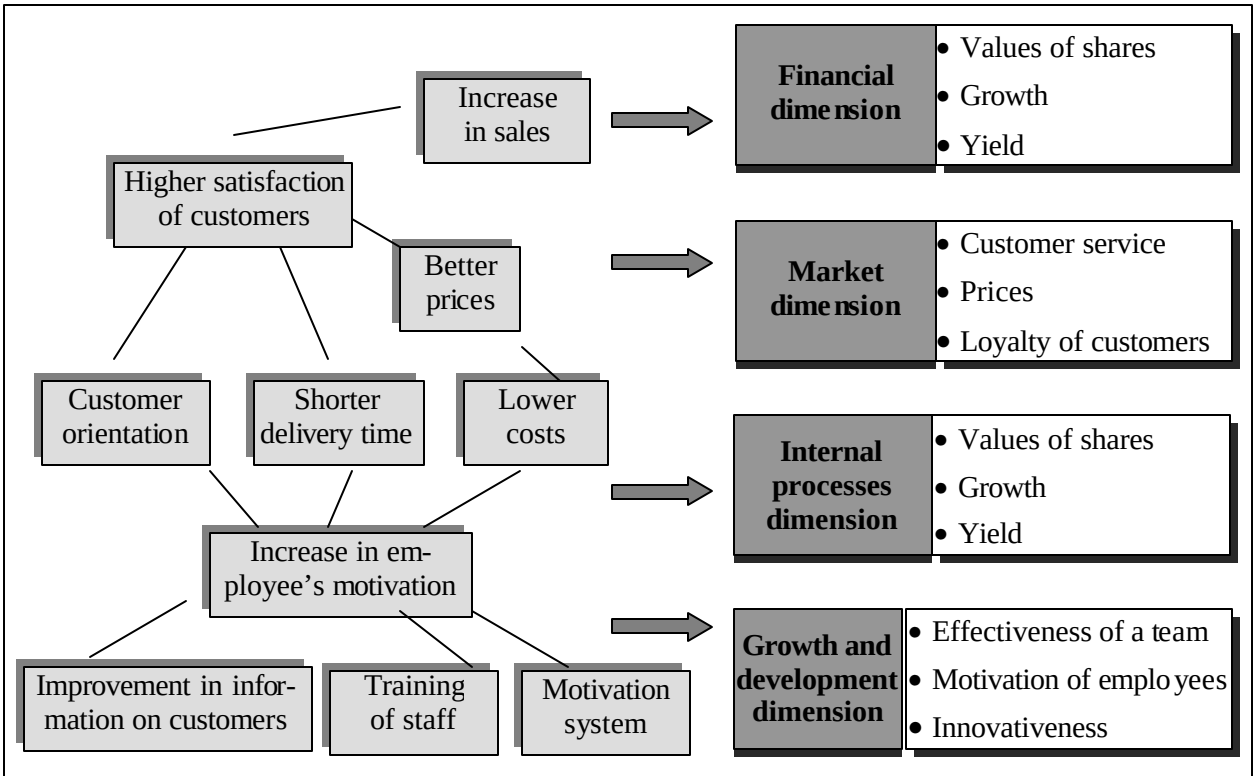

Figure 3. Cause and result mechanism of BSC (Dzurak & Stanoch, 2002)

Functional Aspect of the BI systems

System of the BI standard should be analysed taking into consideration all the benefits their implementation in an enterprise is likely to generate. Case studies show that BI may be utilised mainly for:

1. Strategic planning including first of all:
   - modelling different variants in the development of an organisation,
   - informing about the realisation of an enterprise's strategy, mission, goals and tasks,
   - identifying problems and 'bottlenecks' to be tackled,
   - providing information on the enterprise's environment and market trends.
2. Improving relations with customers and in particular:
   - providing sales representatives with adequate knowledge on customers so that the reps could rapidly meet their customers' needs,
   - following the level of customers' satisfaction together with efficiency of business practices and identifying market trends.
3. Analysing profitability of products and services manifested inter alia in:
   - providing analyses of "the best" and "the worst" products, employees, regions (as far as sales, costs or results are concerned).
4. Analysing internal processes and operational efficiency of an organisation by means of:
   - providing analyses of deviations from the realisation of plans,
   - providing knowledge and experience emerged while developing and launching new products onto the market,
   - exchange of knowledge among research teams and corporate departments.
5. Controlling and management accounting and in particular:
   - analysis of actual costs and financial flows.

Due to solutions that fulfil all the functions mentioned above, management of an enterprise gains new quality and, what is more an organisation is bound to become intelligent.

Technological Aspect of the BI Systems

Technological aspect of the BI systems primarily involves methods of knowledge creation, sources of knowledge and information technology tools.

Knowledge in order to be utilised effectively in the process of decision-making should be stored and created according to already tested research methods. Solutions based on artificial intelligence including fuzzy logic, intelligent agents, genetic algorithms, processing of a natural language or CBR are nowadays of particular significance.

Case Base Reasoning (CBR) is one of numerous available suggestions. It provides for solving of new problems by means of adopting solutions that have been previously applied to solve similar problems (Aamondt & Plaza, 1994; Bergmann, 2002; Kolodner, 1993; Leake, 1996). Briefly, Case Base Reasoning consists of the following stages:

1. Remembering current experiences and cases (in the memory of a human being or computer).

2. Solving a new problem:
    - retrieving similar experiences and situations from the memory,
    - reusing given experience in the context of a new problem: complete or partial utilisation or revising for a new problem,
    - retaining new experiences in the memory (learning).

Such approach may definitely be applied in the BI due to its advantages including:

- reduction of much effort related with knowledge acquisition,
- decrease in effort necessary to retain knowledge,
- perfecting, improving and enhancing of a problem-solving process by means of re-utilisation of experience,
- taking advantage of already gathered and analysed data,
- rapid adoption of experience to a particular problem.

Event sequence analysis is a useful approach to collect and create knowledge in the BI. According to the principles of this method it is possible to collect a sequence of events that provide a complete description of key processes in an organisation. This method distinguishes some stages (Agraval & Srikant, 1994; Kania, 2002; Parthasarathy, Zaki, Ogihara & Dwarkadas, 1999):

1. Technological integration of information based on the mining for adequate data in the source systems (e. transaction systems or Internet) and identification of importance of particular data stored in the source files.
2. Fixing a common description of each event and rescheduling activities on the common time axis according to which arranging of particular data hierarchy and its integration takes place.
3. Matching information on events with particular persons, processes and moments of time when each record on the time axis takes a form of:

    x = {events, person, case (process), time}

    Each of these values has its detailed description:

    person = {name, surname, position, competencies...}

    case = {name of a customer, kind of a customer, type of case, case description}
4. Exploration of data utilising all classical tools of OLAP.

Knowledge acquired this way is characterised by such desired features as (Kania, 2002):

- manifesting and gathering information on particular employees' and their groups' skills,
- finding critical resources and knowledge centres – persons possessing key knowledge to complete a particular type of a process - in an organisation,
- determining a sequence of activities carried out and time intervals they are realised in (both in the calendar meaning and in the time that has passed since the last activities were undertaken),
- possibility of explaining events taking place in an organisation by means of inter alia determining informal sources and centres of knowledge,
- possibility of cataloguing subsequently appearing cases.

Referring to the question of knowledge centres, it is difficult not to appreciate the role of Internet, Extranet and Intranet. Extranets bind an organisation with its customers, suppliers and constitute an electronic platform for the development of e-economy. They are used to get a rapid localisation and contact with branch experts who have knowledge on already existing analyses and expertise. Due to this, it is easier to utilise knowledge and offer new products. On the other hand, common utilisation of knowledge within an enterprise i.e. access to catalogues, databases, information services, etc. may be considerably facilitated by means of private computer networks, so called Intranets.

The Group Support Systems (GSS) and CRM systems provide a precious source of knowledge for an enterprise. The former offer procedures to generate new ideas, rapid and flexible exchange of knowledge among employees, group work on a document and some co-ordination of activities simultaneously overcoming barriers of time and space (McNurlin & Sprague, 1998; Turban & Aronson, 1998).

It turns out that relations of an organisation with customers may constitute an important source of knowledge. Customers become partners in the development of knowledge and stimulation to undertake innovative activities. CRM systems provide aggregated intelligent knowledge on customers, competitors, their preferences, etc.

Creating systems of a BI standard requires application of adequate information technology tools. It is a data warehouse that is a core of the BI system. Such a warehouse stores aggregated and historical data. Taking utilised data into consideration a warehouse may mostly take a relational form (Relational On Line Analytical Processing – ROLAP) or a multidimensional one (Multidimensional n Line Analytical Processing – MDOLAP). The former is built on the basis of the relational system of database management equipped with mechanisms of effective processing enquiries of an OLAP type. Such a data warehouse is usually of a star or snowflake structure. On the other hand a data warehouse designed by means of the MDOLAP technology utilises multidimensional tables containing preliminarily processed data originating from various sources. An exemplary solution to service a data warehouse may be offered by e.g. an IBM product DB2 Warehouse Manager or Oracle Warehouse Builder.

Intelligent exploration of data and setting key relations and interdependencies among studied objects is facilitated by 'data mining' tools. They allow for knowledge acquisition mainly on the basis of statistical methods, mathematical modelling and artificial intelligence technology in particular including neurone networks, expert systems, CBR systems, genetic algorithms and intelligent agents. A tool to explore data may be provided by e.g. software SAS Enterprise Miner or Statistical Enterprise.

Alternatively, a multidimensional analysis of data originating from various areas of enterprise's activities is provided by tools of On-Line Analytical Processing (OLAP) standard. OLAP technology is characterised by multidimensionality – its key feature. It is achieved by applying special operators whose tasks include inter alia: pivoting (indicating a measure and determining dimensions of a measure to be presented), drilling down (exploring hierarchy of a particular dimension), drilling up (operation opposite to drilling up), rotating (presenting data in different combinations), slicing and dicing (adjusting analysed data to selected dimensions), ranking (arranging information in a given dimension and according to values of selected measures). An example may be provided by e.g. an OLAP category product Oracle Express Analyser.

Organisational Aspect of the BI Systems

Creating a BI system is a complex undertaking that requires many actions involving, first of all, determination of business goals of an enterprise. These goals set a framework of the present and future demand for knowledge in an enterprise. Next, it is recommended to analyse and design key processes, positions (Karagiannis, Junginger & Srobl, 1996), responsibilities, and streams of knowledge flow, etc. that are crucial as far as realisation of accepted goals is concerned.

Suggested analysis proves helpful while determining sources and ways of acquisition of information that is subsequently imported to a data warehouse. Acquired information should serve to create a model of information system adjusted to business specifics of a given enterprise.

Next important stage of building the BI requires setting selection criteria of data warehouse implementation, tools supporting both a process of a multi-criteria analysis of data and data exploration. It is obvious that technologies that have been chosen ought to support management of an enterprise.

Before providing a user with the BI system, its parameterisation is necessary. Parameterisation involves feeding knowledge that is necessary for the correct system performance (employees, customers, suppliers, co-operators) into the system.

Then, it is time to train users i.e. develop their skills of identifying, modelling, verifying and of coding knowledge and their need to store, utilise and expand knowledge.

It has to be highlighted that creation of the BI systems requires people who can build adequate models that depict the most important business processes, customer behaviour, etc. by means of such tools. Implementation of the BI technology depends on the organisation's skill to overcome cognitive barriers and its ability to share knowledge. Research shows that in Polish enterprises major barriers of knowledge sharing include competition among employees, unsatisfactory awareness of benefits, lack of motivation and competition among departments of an enterprise (Mierzejewska, 2002).

Final Remarks

BI systems pose a chance for the effective management of an enterprise. However, they require analysts', designers' and users' high business, information and organisational culture. Skills to identify, model (in the processes and organisation structures) and share knowledge constitute only some factors that determine a correct development of the BI systems.

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