

DECISION SUPPORT SYSTEMS DEVELOPMENT AND BENEFITS OF BUSINESS INTELLIGENCE SYSTEMS USAGE

I.

The developers and technologists of information systems design and explore decision support systems over 35 years. They emerged at the beginning of the distributed computer processing, but their history is not so straightforward and linear. That is why it is necessary a short retrospection and analysis of their development to be made, before exploring the contemporary systems of such type.

Before 1965 it was too expensive to design a broad range information systems based on high class computers and that is why, the big companies have accepted more practical and effective (from cost point of view) approach to develop Management Information Systems (MIS). These systems centered on supporting managers by structured, periodical reports, gathering information mostly from accounting and transactional systems.

In the end of the 1960s there emerged in practice so called **model — oriented DSS** or Decision-Making Support System (DMSS), which have been used mainly for supporting investing managers in their administration of a clients' stock portfolio. Peter Keen and Charles Stabell are pioneers in the field of DSS.

From technological point of view, very important is DSS designed by J. Little in 1975, called Brandaid, by which he pointed out several criteria for designing models and decision support systems, which are valid until today when evaluating the contemporary DSS, e.g. robustness, ease of control, simplicity, and completeness of relevant details.

Except by Americans, DSS conception (in French — SIAD) is developed independently also in France by scientists, working on the SCARABEE project (1969-1974).

In 1979 John Rockart (Harvard Business School) published a key paper, which outlined the main ideas for designing and developing of so called Executive Information Systems (EIS) and Executive Support Systems (ESS). Later, some other authors created the theoretical range of the knowledge oriented DSS, showing how important for development of DSS Artificial Intelligence and Expert Systems are. The First International Conference on DSS was held in Atlanta in 1981.

Of course, in the area of DSS have been working many more researchers and designers whose achievements can not be given in this paper in details, but it is important the following remark to be done. Up to the end of 1970s are developed a variety of interactive information systems based

on data and models supporting the managers in analyzing of semi-structured problems but all of them were called with the common name **decision support systems**. In this early time there were considerations, that DSS could be designed to support decision makers at every organizational level; to support operations, financial management and strategic decision making using spatial data, structured multidimensional data and unstructured documents. In DSS were applied different models, including optimization and simulation ones and their establishment were founded predominantly on statistical program packages.

In the early 1980s, academic researches developed new category of software to support group decision-making — group DSS.

Gradually EIS evolved from single user model-oriented DSS toward data-oriented EIS and improved products for relational databases. More specifically, at the beginning of 1990s data warehousing and on-line analytical processing technologies started expanding the area of EIS and defined a broader category of **data-oriented decision support systems**. Bill Inmon (who first used the term “data warehouse” in literature) and Ralph Kimball are ones of the most active supporters of the idea for DSS, based on usage of relational database technology. Meanwhile, the term “business intelligence”¹ emerged describing a set of conceptions and methods for improvement business decisions making through facts supporting systems use. It could be said, that business intelligence systems (BIS) are data-driven DSS.

In the beginning of 1990s, a main technological revolutionary change happened — a shift from DSS working on mainframe platforms toward DSS, based on client/server technology. At this time, some desktop on-line analytical processing (OLAP) tools were introduced, too. DBMS producers realized the importance of OLAP technology and started implementing real OLAP capabilities into their databases. The two key technologies — EIS and data warehousing — overlapped. In 1995, when data warehousing and World Wide Web began to influence the work of practitioners and researchers working in the area of decision making support technologies the first Web-based DSS appeared.

Today, in decision making process support are used systems, operating on different management levels and the most important of which are Knowledge Work

¹ The term “business intelligence” (BI) was proposed by Howard Dresner from Gartner Group in 1989.

Systems/Knowledge Management Systems (KWS/KMS) and Office Automation Systems (OAS) at the level of knowledge management, Decision Support Systems (DSS) and Management Information Systems (MIS) at the management level, and Executive Support Systems (ESS) at the strategic level².

KWS/KMS help companies to find, organize and integrate new business knowledge. Working with knowledge are people, who possess university degrees and often are members of recognized professions — engineers, doctors, lawyers and scientists. In comparison the OAS support and manage documents and the document flow throughout the enterprise. Working with data people (secretaries, accountants, clerks, or managers) possess less formal modern scientific degrees and do not create information, but they process, use, manipulate and disseminate it.

MIS aggregate and create weekly, monthly and annual reports about the essential operations in the company and are oriented almost exclusively to internal (not external) events. They serve functions of planning, controlling and decision making at the middle management level, work with structured questions and use routine procedures. They are not flexible and have weak analytical capabilities. At the same level work DSS, but they however support semi-structured, unique and fast changing decision making utilizing internal and external sources. DSS have significantly more analytical power, allow users' direct work through their user-friendly interface and are interactive.

ESS serve the top strategic firm management. These systems deal with non-structured decisions, they are designed to be able to collect data from external events but simultaneously they aggregate the information from internal MIS and DSS. They filter, compress and track critical business data using the most contemporary graphic software, and less analytical models.

Throughout the years there have been designed decision making support systems in various functional areas, earmarked for execution of strategic, tactical and operative business goals at a given moment, according to the overall economic development and market traditions³. Recently however, under conditions of the global competition and fast changing market environment the management puts forward new requirements about this kind of systems in order to let the organization remain competitive and flourishing:

—> *Faster information synthesis and a more intelligent analysis* — the business environment is much more competitive today, because organizations became decentralized, products life cycle shortened, too. In order to function in such environment, organizations need more

intelligent analyses and technologies to connect their operational performance with the strategic goals;

—> *More and more increasing needs for exact, essential and timely data* — today, when the information volume increases all the time and the changes in business environment are highly dynamic, corporative decision making will get worse if basic data are defective, inaccessible or obsolete. Therefore, companies want to have well timed access to various, but reliable information sources to make adequate decisions⁴;

—> *A requirement for making better decisions faster* — as the main assumption for decision making is the information, which is fast changing by nature, it is too difficult for the business to cover and evaluate these changes. Better decision making process demands the envelopment and evaluation to be improved, in order to receive less wrong and much better decisions, which support the corporative goals. Because of the competition the opportunities for business are extremely time sensitive and that is why, there is a need to make not only better, but faster decisions using quicker access to relevant information;

—> *Real time working* — in contemporary conditions it becomes very necessary to establish enterprises which could work with so called zero latency. This means that the goods manufactured by a respective producer have to be realized fast without using warehouses. This could happen only by using real time systems;

—> *Competitive power improvement* — since e-commerce has changed competition parameters in all industries oriented toward production or services, companies repeatedly seek for new technologies and new ways for their usage in order to take possession and make use of their sources effectively and on this basis — to remedy their competitive situation on the market;

—> *Management and staff productivity improvement* — recently the focus is shifting more toward the management productivity in contradiction of production effectiveness improvement only. While managers make decisions, not goods, their productivity is measured by quality and timeliness of these decisions. Companies consider that managers' decisions are more important for organizational productivity than operative activities automation and therefore, they look for methods for its short-term and long-term improvement;

—> *Using comprehensible models and transformations for insight* — business users want to analyze and acquire thorough insight of their data using more comprehensible models. They do not desire complex statistical conceptions — they want to employ tools for direct visualization and to obtain immediate respond to their tasks results;

² Laudon, K. C., Laudon, J. P., Management Information Systems: Organization and Technology in the Networked Enterprises, 6th Edition, Prentice-Hall, ISBN 0-13-011732-3, 2000.

³ For more details about the purpose of the DSS types see: Power D. J. A Brief History of Decision Support Systems, DSSResources.COM, version 4.1. <http://DSSResources.COM/history/dsshistory.html> Cited 23.09.2010.

⁴ Business Intelligence — THE MISSING LINK, July 2000, <http://www.cherrytreeco.com>.

—> *The analytics as a part of a larger system* — consumers want the analytical capabilities to be built within the systems instead of realized through additional tools subsequently. Such improvements could be sought mostly in the areas of data collection, generation of unique identifiers, integration with multiple data sources, etc.⁵

From all said above, one can realize, that the decisions support systems based on information technologies are not as new as an idea, but they have gone a “long way” of development and improving in order to reach the contemporary business intelligence tools and systems.

II.

Throughout the years the term Business Intelligence significantly expanded its scope and turned to an important aspect of the management information support. In order to clarify this term⁶ many books, papers, etc. have been written and research performed, but the most important thing is that the development of the realizing intelligent technologies and tools has led to the emerging of new type of decision support information systems — Business Intelligence Systems (BIS).

An important advantage of BIS is that with their assistance the decision makers can understand not only what has happened (the main task of the MIS in the past), but also *why* and *what could be done*. Discovering answers of the questions why and what could be done, BIS helps managers to drill down to the roots of the emerged problems for preventing the appearance of such similar matters in the future.

First BIS use too many of so called data marts⁷, data warehouses (described later) and operative databases. But meanwhile however, business intelligence activities expand in order to include other type of data, information and knowledge, oriented toward the future. BIS is centered mostly on the management of external and internal information, knowledge and the resulting intelligence to be able to create competitive advantage related to the achievable and measurable goals of the company. On the other hand BIS could be viewed as a set of tools and applications, which help the decision makers to collect, organize, analyze, distribute and act on critical business issues aiming to support the companies to make faster, better and more informed business decisions.

Therefore, BIS could be defined as **business**

information systems, which transform selected data, information and knowledge into specific intelligence in order to let the decision makers to gain business profit⁸. The type of BIS and the software, which is used, depend on the situation. BIS use various analytical, interactive and linked tools and the infrastructure of the available databases in network environment.

We could say that BIS provide the decision makers with the opportunity to understand (e.g. intelligence for achieving a deep insight) of relations within the represented facts in the form of data, information and knowledge in order to conduct activities toward a desired and achievable goal. They provide the decision makers with relevant data, information and knowledge for finding problems and their solutions.

BIS could be represented by the scheme on the fig. 1:

The **source data** could be internal (related to production, consumers, suppliers and the partners) and external (data from third parties). The database sources are mostly relational, but there are also some text files or electronic spreadsheets. The data from heterogeneous sources are transformed, aggregated and copied into the data warehouse by usage of **extracting, transforming and loading tools** (ETL). Very often the data is transformed and validated “on the way”, and their transfer to the data warehouse is done in the format of packets, which are automatically scheduled. An example of such an ETL tool is the Microsoft’s Data Transformation Services (DTS), a part of SQL Server 2000.

The **data warehouse** contains read only data, illustrating the status of the organizational information in some specific periods of time — weekly, daily, hourly. Important parameters of data warehouses are the quality of data and the speed of queries sending and processing. The data warehouse, however (when it is implemented as a relational database) does not respond fast enough to some complicated queries. That is why lately in order to fill this gap, more and more often multidimensional cubes are used (MD Cube). The **MD Cube** is a complicated, effective and specific data structure, which includes data, aggregated data and information about security. Cubes operate much quicker⁹, when replying to complicated queries. The data in them are compressed in such a way, that they contain ten of millions of records. The Cube

⁵ Emerging Trends in Business Analytics, Communications of the ACM, Volume 45, Number 8, Aug 2002, pages 45-48.

⁶ BI is not only a single product, a technology or a methodology — BI combines products, technologies, and methods to organize key that management needs to improve profit and performance. Williams S., Williams N. The Profit Impact of Business Intelligence. Morgan Kaufmann Publishers, San Francisco, 2007. p. 2. ISBN-13: 978-0-12-372499-1.

⁷ These are special repositories for data, containing information of a specific functional area, which serve separate organizational units in the enterprise.

⁸ Thierauf R. J., Effective Business Intelligence Systems, Quorum Books, Westport, Connecticut, London, ISBN 1-56720-370-1, page 23, 2001.

⁹ From an architectural point of view the multidimensional cube is also a type of database with multidimensional architecture (in the references it is also known as OLAP database) and it is a type of fast working memory. On fig. 1 the corporate data warehouse is illustrated as a combination of two types of architectures — a relational database and OLAP database. But from a conceptual point of view it can be implemented as a relational database, OLAP database or as a combination of both. For more details see, for example: Vitt E., Luckevich M., Misner S., Business Intelligence: Making Better Decisions Faster, Microsoft Press, ISBN 0-7356-1627-2, page 62, 2002.

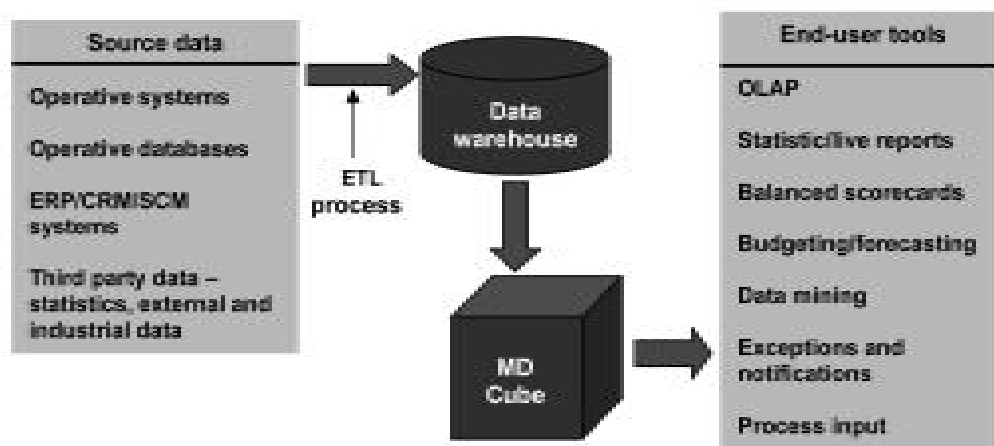


Fig. 1. A conceptual scheme of a business intelligence system.

updating very often is done during the night as a part of the ETL package work.

There is quite a large variety of standard applications in the end-user tools, but there could be created some specific ones when needed. The customers' applications operate in several areas:

1. **OLAP** — in the on-line analytical processing the end-user has direct/on-line access to the cube through analytical software, installed on his PC. The free browsing in information allows spontaneous actions, which make easy tracking the trends and relations;

2. **Statistic/live reports** — the statistical reports represent an information insight, arranged preliminary in a specific way — for example, the sales during a month in regions. The live reports allow the end-users interactively to manipulate the information and to reach greater details;

3. **Balanced scorecards** — they emphasize on the frequent and timely measurement the individual or team performance to key financial and non-financial aims;

4. **Budgeting/forecasting** — BI budgeting offers advantages as: better forecasting, faster aggregation and possibility to analyze up till a minute aggregations, by using the reach capabilities of the OLAP tools;

5. **Data mining** — the aim of these tools is pattern recognition in data and relations which are not obvious for the simpler analytical methods;

6. **Exceptions and notifications** — the modern systems for exceptions and notifications allow the end-users or managers to connect the events (when there is a registered event beyond the limits of some key performance measurements) with some appropriate notifications;

7. **Process input** — in the past the people have transferred the information from a process to another process. Today an automated system for purchasing can receive information directly from BIS, in order to create the basis of a made analysis the necessary quantity, to determine what is on the production floor of purchases, etc.

Recently the development and implementation of

BIS includes use of combination of techniques and technologies. These processes must be correctly planned and conducted, in order to be really effective in appropriate data information and knowledge and their resulting intelligence acquisition as well as making managerial decisions on their basis.

The development and implementation of BIS contain the following **four basic components**:

- *Usage of the working recent information systems as a foundation for upgrading them with new BI modules* — the recent IS, which could be upgraded in this way and developed to BIS are DSS, EIS, OLAP and KMS. These systems provide an opportunity to the decision makers for a data, information and knowledge access in ways, which were not possible in the past, in order to let them better understand the company's operations, which necessary for answering the global competition today and in the future;

- *Usage of methods for finding of the knowledge (data mining) and BI methods and software for better understanding of all operations of the company, now and in the future* — appropriate software is used, in order to collect data, information and knowledge and to develop the necessary intelligence and share the results with other people. Today there exists a large number of software packages, which meet the needs of the decision makers for operative BI and only the concrete circumstances determine which package should be selected and used;

- *Establishment of effective data warehouses and computer systems working in real time, where the focus is on many factors, related to Internet, Intranet and Extranet* — this component includes establishment of an appropriate infrastructure for the data, information and knowledge, which is related with data marts, data warehouses and operative databases. Normally, before BIS to start working effectively using some selected software, a large quantity of aged and/or real time data, information and knowledge must be available in order to be resolved/explored current or future problems/opportunities;

- *Usage in highest degree a computer network*

processing, related to e-commerce as a way of doing business with company's customers and suppliers — the fourth component has the capability to change the way in which the companies work with their customers, suppliers and employees. If it is applied correctly, the intelligent network processing could help companies to simplify significantly their operations, because it allows companies' information systems to "talk" to each other. And e-commerce provides an opportunity to businesses to optimize their daily operations.

In conclusion there could be said, that the establishment of BI environment and implementation of BIS usually costs millions of dollars for organizations beginning such initiative. This step requires new technologies to be considered, some additional tasks to be performed, roles and responsibilities to be exchanged, and applications for analysis and decision support with acceptable quality to be provided.¹⁰ But the properly developed and implemented BIS ensures a number of advantages — material (increasing the volume of sales, increasing the profit, etc.) and non-material (for example, improvement of the organization reputation and image, etc.), which are hardly measurable in monetary value.

In spite of the advantages, however, if BIS initiatives could not be linked to specific problems and strategic goals of the organization, they would not be approved by top management. But as we know, the main aim for BIS development and BI tools usage is to provide new intelligent ways for decision making and effective management in order to keep the organization competitive in today's fast changing market environment.

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Marinova N. Decision Support Systems Development and Benefits of Business Intelligence Systems Usage

The developers and technologists of information systems design and explore decision support systems over 35 years. They emerged at the beginning of the distributed computer processing, but their history is not so straightforward and linear. That is why it is necessary a short retrospection and analysis of their development to be made, before exploring the contemporary systems of such type.

Key words: decision, system, development, business, benefit.

Маринова Н. Розвиток систем забезпечення ухвалення рішень і вигоди від використання систем штучного інтелекту в бізнесі

Розробники і технологи інформаційних систем проектують та досліджують системи забезпечення ухвалення рішень понад 35 років. Вони з'явилися на початку розподіленої обробки даних, але їх історія не так проста і лінійна. Тому необхідно коротко проаналізувати сучасний розвиток, що й здійснено в цій статті.

Ключові слова: рішення, система, розвиток, бізнес, вигода.

Маринова Н. Развитие систем обеспечения принятия решений и выгоды от использования систем искусственного интеллекта в бизнесе

Разработчики и технологи информационных систем проектируют и исследуют системы обеспечения принятия решений свыше 35 лет. Они появились в начале распределенной обработки данных, но их история не так проста и линейна. Поэтому необходимо короткое размышление о прошлом и анализ их развития, которое сделано в настоящей статье, перед исследованием перспектив современных систем такого типа.

Ключевые слова: решение, система, развитие, бизнес, выгода.

Received by the editors: 26.09.2010
and final form in 01.12.2010

¹⁰ 60% of BI projects end up with abandon or failure, due to the non-adequate planning, missed tasks, not met deadlines, bad management and so on — source: Larissa T. Moss, Shaku Atre, Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications, Addison Wesley, ISBN: 0-201-78420-3, 2003.