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## **THE CONCEPT OF REAL-TIME BUSINESS INTELLIGENCE. REVIEW OF PRACTICAL APPLICATIONS**

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**Abstract:** The aim of the article is to presents the concept of Real-time Business Intelligence, focusing mainly on its practical applications. There was presented the notion and construction of Real-time Business Intelligence Systems with a general comparison to “traditional” BI, were indicated possibilities of its practical applications i.e. in supply chain management together with a presentation of a foreign case study in such enterprises as Continental Airlines and Atlantic Detroit Diesel-Allison.

**Key words:** Real-time Business Intelligence, decision making support, data mining, management information systems.

### **1. Introduction**

Enterprises, in order to obtain a huge market share in its business activity area have to undertake quick and efficient decisions. In order to support managerial decisions it is indispensable to apply proper IT solutions such as Business Intelligence systems. Real-time Business Intelligence can be applied in such areas of business activity where undertaking instant decisions is required. Speeding up the process of decision making may lead in such a case to the gain of a competitive advantage by a particular enterprise. Real-time Business Intelligence can be especially useful at operational level of management due to the fact that decisions undertaken at strategic and tactical level generally require data within the time scope of one month or one week compared to operational level where information needed for the purpose of decision taking should be up to date and nearest real-time as much as possible. Compared to “traditional” Business Intelligence systems, real-time BI implementation may sometimes be more costly as well. The popular applications of the mentioned solutions include real time marketing, fraud detection, optimization of supply chain in logistics etc. One of the most significant applications of such a solution similar to traditional BI can be the support of decision making processes – mainly its acceleration and efficacy improvement.

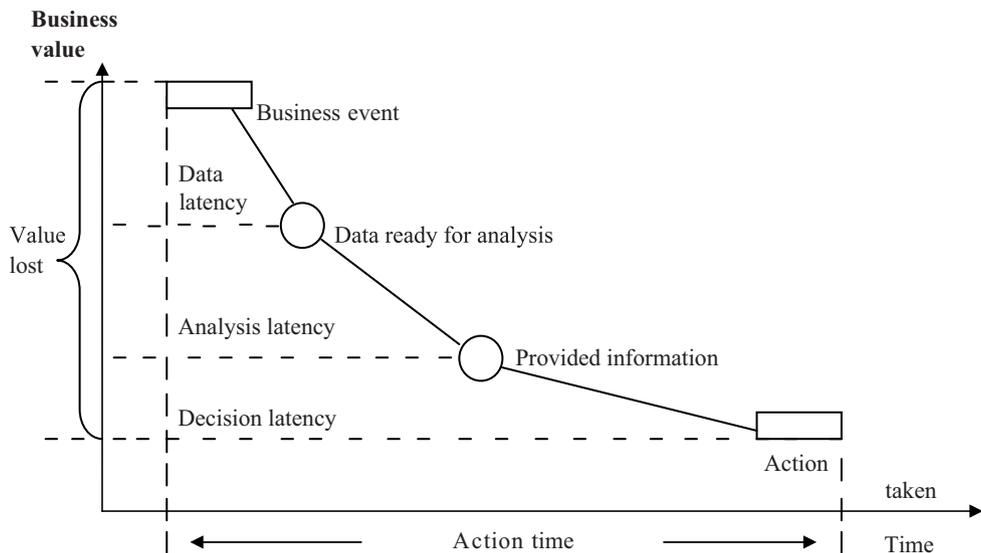
## 2. The concept and architecture of Real-time Business Intelligence

The definition of Business Intelligence was coined by Gartner Group as *concepts and methods to improve business decision making by using fact-based support systems* [Power 2007]. Gartner predicts that by 2012 *business units will control at least 40 per cent of the total budget for Business Intelligence and more than 35 per cent of the top 5,000 global companies will regularly fail to make insightful decisions about significant changes in their business and markets* [Petty, Stevens 2009]. J. Wang, X. Wu and Ch. Zhang claim that *the objective of Business Intelligence is to make well-informed business decisions by building both succinct and accurate models based on massive amounts of practical data which can be built for different practical problems, such as classifiers and regressors* [Wang, Wu, Zhang 2005, p. 5]. It allows for the gathering of appropriate information resources from the enterprise itself as well as from its environment which are used for the realization of decision processes [Olszak 2007, p. 10]. H. Dudycz distinguishes four basic approaches to the concept of Business Intelligence: the first one is a management concept of which the main aim is to ensure that the managers obtain information of appropriate quality and at the right time, the second is Information Technology solution meaning dedicated applications enabling advanced data analysis, the third is a system architecture and the last is a system solution resulting from close cooperation of Information Technology and business [Dudycz 2010, p. 10].

J. Kisielnicki states that Business Intelligence is not only Information Technology and it links together relations between business and management [Kisielnicki 2008, p. 295]. Real-time Business Intelligence can support every phase of the decision process. BI systems has been implemented in many enterprises based on different models such as BPRS (*Business Pressure-Responses-Support*) presented by E. Turban, J. Aronson, T. Liang, R. Sharda [Turban et al. 2008]. M. Nycz puts emphasis on the utility of BI which results from its two features, mainly the fact that it uses data gathered in all information resources of the enterprise and it also embraces data collection, management, analysis and distribution [Smok (Ed.) 2010, p. 93]. Business Intelligence can be considered in a holistic approach as consisting of such functions as i.e. data extraction, transformation, integration, reporting, visualization, statistical analysis, data mining, predictive analytics, online analytical processing, benchmarking, corporate portal, managerial dashboard and business process management.

In order to determine Real-time Business Intelligence it is important to discuss factors constituting latency in the decision process. According to the concept of R. Hackathorn, latency occurs in the process of decision support between data collection, analysis and decision points. The three most important factors constituting latency in the decision process are presented in Figure 1 and include latency in data processing, latencies in analyses and in the decision process. Every latency in the decision process is connected with the loss of business value. Davis explains that

data latency is the time it takes to collect raw data, prepare it for analysis, and store it where it can be accessed and analyzed. Important functionality here includes data profiling, extraction, validation, cleansing, transformation, integration, transformation, delivery, and loading. Analysis latency is the time it takes to access the data, analyze it, turn the data into information, apply business/exception rules and generate alerts if appropriate and decision latency is the time it takes to receive an alert, review the analysis, decide what action is required based on knowledge of the business, and take action [Davis 2006].

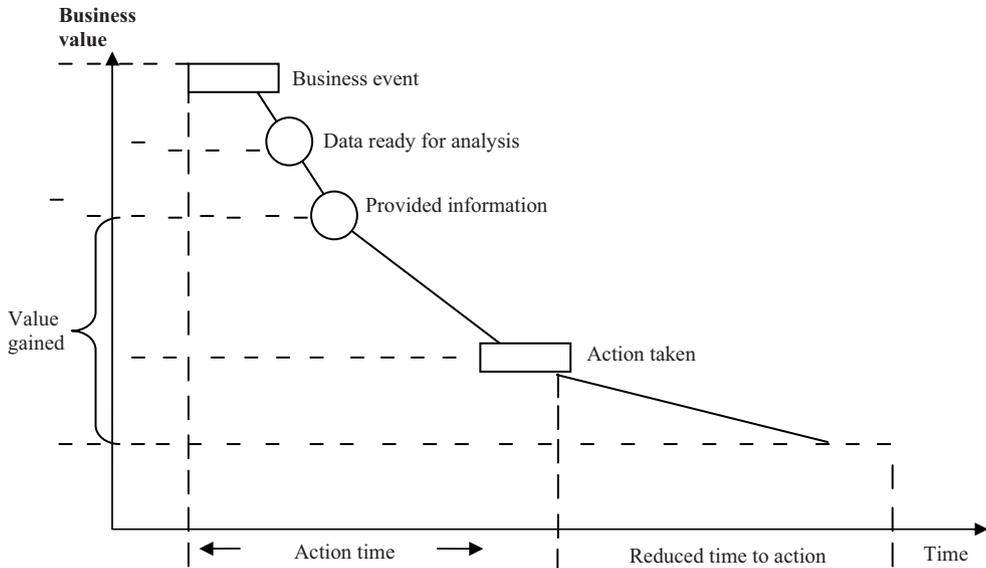


**Figure 1.** Basic components of latency

Source: R.D. Hackathorn [in:] [Davis 2006].

Davis shows the benefits resulting from reducing latency claiming that *reducing latency at one or more points in the decision-making time continuum can dramatically increase the business value of the decision*. As presented in Figure 2 when the latency is reduced the decision is made quicker, the value of decision is gained and it gives the company potential benefits at e.g. the operational level of the enterprise's management. B. Azvine, Z. Cui, D. Nauck and B. Majeed claim that *the meaning of real-time business intelligence mainly depends on understanding what 'real-time' means for a business. It can mean: the requirement to obtain zero latency within a process, that a process has access to information whenever it is required, that a process provides information whenever it is required by management, the ability to derive key performance measures that relate to the situation at the current point in time*. According to this description they state that Real-time BI gives the same functionality as the traditional business intelligence, but operates on data that

is extracted from operational data sources with zero latency, and provides means to propagate action back into business processes in real time. It consists of real-time information delivery, real-time data modelling, real-time data analysis and real-time action based on insights [Azvine et al. 2006].



**Figure 2.** Benefits resulting from latency reduction

Source: R.D. Hackathorn [in:] [Davis 2006].

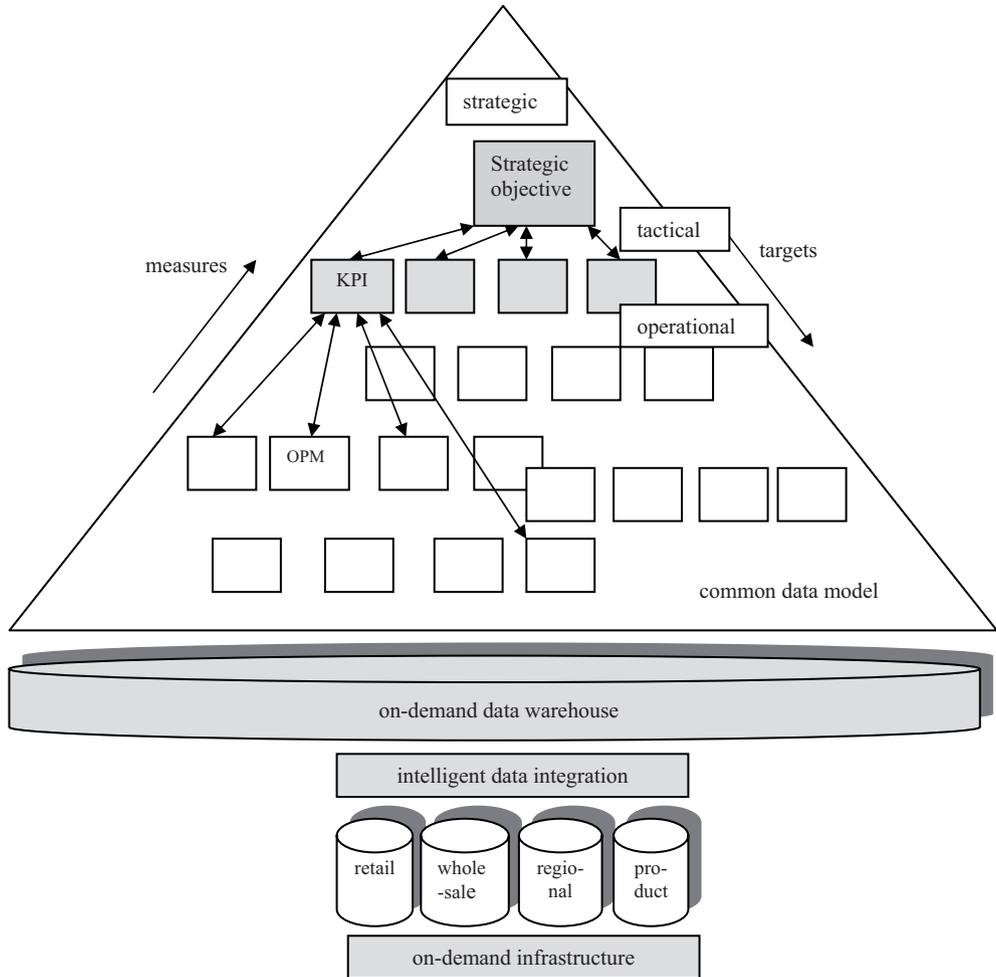
Botan et Al. provide Schneider's argumentation on critical requirements of real-time BI which include reducing latency and provision of rich contextual data that is directly actionable. They state that *the warehouses and database federation are good at providing reliable access to detailed, aggregated contextual data and stream processing, so custom systems are better for low latency* [Botan et al. 2009, p. 15].

J. Patel lists the important benefits of Real-time BI such as [Patel 2005]:

- Ability to provide analytical information with superior performance while refreshing the data marts real-time,
- Justification of cost versus benefits for real-time business intelligence,
- Impact on performance of one or more source applications,
- Ability to perform all of the transformations in the ETL (Extraction, Transformation and Load) process in real-time.

C. White claims that *most real-time BI requirements can be placed into one of four main categories: right-time data integration, right-time data reporting, right-time performance management and right-time automated actions*. He explains that *right-time data reporting provides business users with on-demand access to business transactions and master data; right-time performance management enables business*

users to monitor and optimize the business performance of intraday business operations; right-time automated actions improve the speed of business decision making and increase business productivity by automating the decision-making process [White 2004].



**Figure 3.** The concept of Real-time Business Intelligence

Source: [Azvine et al. 2006].

B. Azvine et al. state that Real-time BI will have a key role in aligning strategic objectives with business operations, and provide cross organization alignments to reduce friction between operational units. They presented the vision for Real-time Business Intelligence depicted in Figure 3. The authors claim that the challenge is to use intelligent technologies to model the manual intervention present in current

*systems and automate both the flow of information from operational to tactical to strategic layer, representing data to the information stage of Real-time BI and the actions necessary to translate strategic objectives back to operational drivers to effect strategic decisions in real time [Azvine et al. 2006]. In many cases real-time data updates and access are critical for an organization's success and with the advent of real-time data warehousing, a shift began toward using these technologies for operational decisions. Operational and tactical personnel who generally deal with the short term aspects of running an organization can use tools and up-to-the-minute results to make decisions [Turban et al. 2008, p. 114]. Real-time BI systems, sometimes perceived as a new generation of BI systems, are aimed at operational employees who have to systematically analyze data flowing in real time from i.e. transactional systems and on such a basis undertake proper decisions [Januszewski 2008, p. 141]. The vision of Real-time BI is also convergent with the concept of Real Time Enterprise or Zero Latency Enterprise. Such an enterprise can be briefly characterized as one which has removed latency from its business operations.*

### **3. Review of Real-time Business Intelligence practical applications**

Real-time Business Intelligence is applied in many business domains. Its basic applications include – similarly to “traditional” BI systems – Business Performance Analysis, Profitability Analysis, Campaign Analysis, Customer Profiling, Loyalty Analysis, Sales and Purchase Analysis, Customer Care Analysis, Cost Analysis. In finance and accountability there are worth mentioning Risk Modelling, Balance Sheet Reporting and Analysis, Accounts Receivable and Payable Reporting and Analysis, Profit and Loss/Income Statement Analysis, Financial Budgeting and Forecasting, Cash Flow Analysis, Risk Management. Wang, Wu and Zhang mention classifiers which are able to predict unseen data. In the example concerning telecommunication companies, *the classifiers are expected not only to describe behaviours of current customers, but also, more importantly, to predict behaviours of new customers. The response speed of classifiers is expected to be high when applied into real-time BI systems, e.g., in stock market surveillance and network intrusion detection [Wang, Wu, Zhang 2005, p. 5].*

In the field of Logistics they are applied in the area of Supply Chain Analysis. Sahay and Ranjan indicate that *when applying the concepts of BI to data from SCM systems, supply chain analytics seek to provide strategic information to decision makers in organizations. Real time BI in SCM requires the ability to analyze products, processes, components, and materials. This demands a data integrated infrastructure which extracts, transforms and loads the data from multiple sources like ERP, SCM, CRM systems, customer data, supplier data, product data, manufacturing data, quality management data, shop floor manufacturing data, legacy system data, online web-based SCM data, demographic market places-based data and marketing data from third party data suppliers. Real time BI in SCM requires tighter integration of manufacturing into analytics [Sahay, Ranjan 2008, pp. 28–48].*

The example of Real-time Business Intelligence application was presented by Anderson-Lehman, Watson, Wixom and Hoffer in the case study of Continental Airlines founded in 1934 with its headquarters in Houston, Texas. It carries approximately 50 million passengers a year to five continents such as North and South America, Europe, Asia, and Australia, with over 2,300 daily departures to more than 227 destinations. The fundamental application of Real-time BI in Continental Airlines include: fare design, recovering lost airline reservations, customer value analysis, marketing insight, flight management dashboard, fraud investigations. The authors of the study state that in the case of fare design *Continental moved real-time data ranking from to-the-minute to hourly, about customers, reservations, check-ins, operations, and flights from its main operational systems to the data warehouse (...)* *Continental uses real-time data to optimize airfares using mathematical programming models. Once a change is made in price, revenue management immediately begins tracking the impact of that price on future bookings. Knowing immediately how a fare is selling allows the group to adjust the number of seats which should be sold at a given price. Last-minute customized discounts can be offered to the most profitable customers to bring in new revenue, as well as to increase customer satisfaction* [Anderson-Lehman et al. 2004]. Customer value analysis is performed in Continental every month *using data in the data warehouse, and the value is fed to Continental's customer-facing systems so that employees across the airline can recognize their best customers when interacting with them.* In the case of marketing insight e.g. gate agents are able to *pull up customer information on their screen and drill into flight history to see which high-value customers have had flight disruptions.* The Flight Management Dashboard is a *set of interactive graphical displays, which help the operations staff quickly identify issues in the Continental flight network and then manage flights in ways to improve customer satisfaction and airline profitability.* Real-time Business Intelligence in Continental Airlines helped to support so called aggressive business plan, leading to the transformation of its industry position, increasing revenues and saving costs.

The other application of Real-time BI solution was mentioned by Ortiz, who is IT Director of Atlantic Detroit Diesel-Allison, which is a leading Eastern U.S. distributor and service provider of engines, automatic transmissions, and parts. He says that the goal of the company was to *put a corporate initiative in place to empower its service department to process more orders, drive more revenue, and increase customer satisfaction (...)* *In order to achieve these objectives, Atlantic DDA had to make real-time information available to service representatives so they could improve efficiency and relay the most up-to-date information to customers. The access to real-time information enables up-to-date operational reporting and supports current information in Web applications (...)* *Atlantic DDA selected Attunity's Operational Data Replication (ODR) solution.* The real-time information made available by the ODR solution provided fast and real benefits, so Atlantic DDA was able to realize significant savings in cost and time. The author of the study specifies the final

benefits resulting from the application of the mentioned solution as [Ortiz 2010]: *enabling the service department to double its order processing capabilities, doubling the revenue associated with increased repair orders, improvement of reporting and business intelligence for optimal operational efficiencies and increased customer satisfaction through improved responsiveness.*

## 4. Conclusions

Nowadays more and more enterprises are eager to apply modern IT solutions like the mentioned real-time BI systems in order to become competitive on the global market. Real-time Business Intelligence is being applied by many differentiated enterprises and such systems are not only the domain of big enterprises. Its main task is to support decisions at operational level of management by the possibility of up to date information usage on every stage of the decision making process. The mentioned solutions allow for the performance of intraday analyses and the acceleration of the final decision which may be connected with gaining the business value of such a decision. Such solutions comprise many elements and hold many advanced functions which act together in order to help to achieve the best business results in a given field or business domain.

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## KONCEPCJA BUSINESS INTELLIGENCE CZASU RZECZYWISTEGO. PRZEGLĄD WYBRANYCH ZASTOSOWAŃ

**Streszczenie:** Celem artykułu jest przedstawienie koncepcji Business Intelligence czasu rzeczywistego, a przede wszystkim zastosowań praktycznych takiego rozwiązania. W artykule zaprezentowano istotę i konstrukcję systemów Business Intelligence czasu rzeczywistego, ogólnie porównano takie rozwiązania z „tradycyjnymi” systemami BI, wskazano możliwości praktycznych zastosowań „Real-time BI” w zarządzaniu łańcuchem dostaw oraz dokonano przeglądu zagranicznych studiów przypadku w przedsiębiorstwach Continental Airlines oraz Atlantic Detroit Diesel-Allison.

**Słowa kluczowe:** systemy Business Intelligence czasu rzeczywistego, wspomaganie procesu podejmowania decyzji, eksploracja danych, systemy informacyjne zarządzania.