Operational Business Intelligence – A key to Just-in-Time Decision Making (JDM)

B.Saeed, M.Knahl, M.Frey-Luxemburger and P.S.Dowland

Centre for Security, Communications and Network Research,
Plymouth University, Plymouth, United Kingdom
Furtwangen Research Node, Faculty of Business Information Systems
Hochschule Furtwangen University, Germany
e-mail: baber.saeed@plymouth.ac.uk

Abstract

Everyone either business organization or individual wants to get the result, report or feedback on daily business operations as quickly as possible and no one want to wait for hours, days, weeks or months. This leads to agility and agility in Business Intelligence (BI) leads to operational BI. The main purpose of operational BI is to save time in the process of information delivery and to support business users to be able to influence what should happen next that's why management needs to know what is happening right now. The purpose of this paper is to introduce operational BI capabilities which are missing in traditional BI and to describe the latency problem which is the main hurdle in just-in-time decision making.

Keywords

Business Intelligence, Operational BI, Traditional BI, Real-time BI, Real-Time data analysis, just-in-time Decision Making.

1. Introduction

Large enterprises have entered the 21st century with vast amounts of data and the volume of data is increasing dramatically (Bradshaw *et al.* 2008) (IBM, 2005). At the same time, IT infrastructure (hardware and software) has been changed in a way that the processing and storage of such data volume is not a big issue any more. IT know-how at the top management has also changed the paradigm of information delivery in a way that now the top management wants to have robust systems and agility in every aspect of the business including time-to-information which is the basis for operational BI (Hatch, 2009), (Panian, 2007). Time-to-information is the gap between a business event occurring and information about that event available for analysis (Hatch, 2009).

Organization's success and failure is based on the ability of how quick it adapts or reacts upon the changing conditions which might come from customers, suppliers, competitors, partners, market situations, regulatory forces, natural disasters or world economic/political events (Panian, 2007) (Seufert and Schiefer, 2005). All these conditions or even an unlikely business event need immediate attention of a business user to make operational or just-in-time decisions. Unlike strategic and tactical decisions, operational decisions must be made in an agile way before a problem

escalates into a crisis or results in a missed opportunity. This means that enterprises need such a system which must be able to provide information to business users as soon as a specific business event occurs so that they can act just-in-time (Eckerson, 2007).

In order to act just-in-time for a business user, an operational Business Intelligence solution is needed. Operational BI is the process of delivering information about business operations with minimum latency i.e. in real time. In this context, real time means delivering information in a range from milliseconds to a few seconds after the occurrence of a business event (Dasgupta and Vankayala, 2007). While traditional Business Intelligence provides mostly historical information to business users for analysis. Operational BI compares current business events with historical patterns to detect problems or opportunities automatically. This automated analysis capability enables corrective actions to be initiated and/or business rules to be adjusted to optimize business processes (Dasgupta and Vankayala, 2007).

In today's business climate, the pace of business is very fast, operations are 24x7, physical borders have been erased and the flow of information is constant. Economic pressures weigh on every business. Competitiveness hinges on knowledge and on timeliness, on delivering the right information to the right people and systems at the right time. A decision advantage that is relevant, complete, and accurate and the ability to see and act on opportunities is essential. Traditional BI solutions fail to deliver this advantage. BI solutions that are designed for static, cleansed, historical data help to understand where the business has been and they don't provide for automated, real-time response to business opportunities and risks as they arise (Grimes, 2008).

Operational BI increases the value of BI by delivering information and insights on demand to all workers, from shipping clerk to CEO, so they can work smarter and faster to achieve critical business objectives. Operational BI is an approach to deliver the right information to the right people at the right time, so they can take actions accordingly. In its mature form, operational BI encapsulates business insights into rules and models that organizations can use to automate decisions and responses, eliminating the need for human intervention. Automating decisions not only streamlines processes and reduces costs, but also improves service and gives organizations a competitive advantage in the marketplace (Eckerson, 2007).

2. Background

Computer based decision support continuous to evolve from its early structured reporting roots. Command line interfaces and green bar reports are relics of the past, replaced by graphical interfaces that allow users to "slice and dice" and view data in the multi-dimensional form (Watson, 2009). Organizations have been using reporting systems so called BI solutions for many years to monitor, report, analyse and to improve the performance of their business operations (White, 2006).

The term "Business Intelligence" was first introduced by (Luhn, 1958) in his research paper "A Business Intelligence System". (Luhn, 1958) envisioned a BI

system as an automatic system to disseminate information to various sections of any industrial, scientific or government organization (Agrawal, 2008). The figure 1 depicts the overall history of Business Information Systems (BIS) (Zhang, 2009).

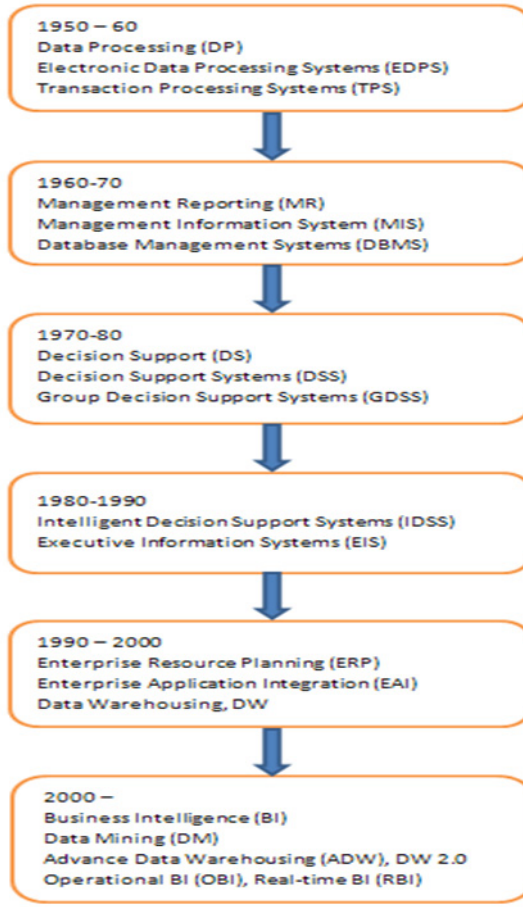

Figure 1: Evolution of Business Information System

As far as, a data warehouse is concerned, the first article describing data warehouse architecture was published in 1988 in the IBM Systems Journal (Devlin and Murphy, 1988) based on work in IBM Europe (Devlin, 2010). The structure and main components of the 1st data warehouse architecture are shown in Figure 2.

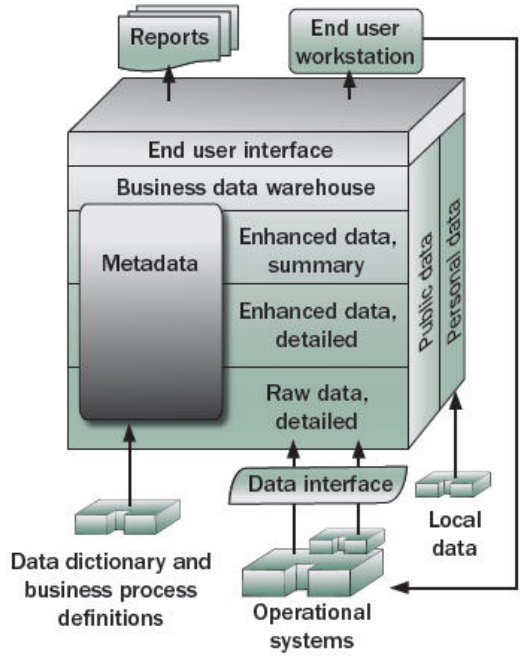

Figure 2: Data warehouse architecture (Devlin, 1988)

In 1990, Bill Inmon earned the title "Father of the data warehousing" (Breslin, 2004) by defining the term "Data Warehouse and publishing his book "Building the Data Warehouse". He defined data warehouse in the following words: *"A warehouse is a subject-oriented, integrated, time-variant and non-volatile collection of data in support of management's decision making process"* (Inmon, 1991). He described some properties of a data warehouse (Inmon *et al.* 2000) (Lawyer and Chowdhury, 2004):

- Subject Oriented
- Integrated and time variant
- Non-Volatile
- Top-Down approach
- Enterprise's "Single Source of the truth"
- Normalized structure.

In the third edition of his book (Inmon, 2002), Inmon mentioned a logical architecture that extracts detailed, time-stamped data from disparate operational databases. The data is then transformed and stored in a single data warehouse (normalized form). Smaller, departmental, aggregated data marts (dimensional form) are then created based on this atomic data warehouse (Breslin, 2004) (Inmon, 2002).

In contrast to this approach, another data warehouse expert, Ralf Kimball, sketched a data warehouse which competes with Inmon's model. In 1996, Kimball described his model in his book "The Data Warehouse Toolkit" (Kimball, 1996). He published a 2nd addition of his book in 2002 (Kimball, 2002). He recommends an architecture of multiple databases, called data marts, organized by business processes, and the data warehouse is the union of all the data marts (Breslin, 2004). According the Kimball, a data warehouse has the following properties (Kimball, 1996):

- Business-Process-Oriented
- Bottom-Up approach
- Dimensional Model, not relational
- Integration Achieved via Conformed Dimensions

From the structural point of view, the main difference between two models is that Inmon focuses on the data warehouse in normalized form and then data marts based on the data warehouse which are in dimensional format whereas Kimball says that a data warehouse is a collection of all data marts and these data marts are in dimensional format (Breslin, 2004).

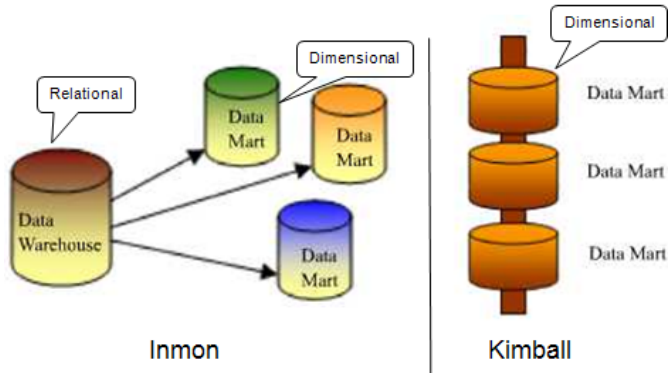

Figure 3: Inmon vs. Kimball's model

In modelling a data warehouse, Inmon's approach is strategic and subject oriented (Inmon, 1991) whereas Kimball's approach is tactical and business process oriented (Kimball, 2002).

Both schools of thoughts of data warehousing have their popularity in industry. However, over the last few years, the Kimball approach of dimensional data warehouse design gained more importance in industry (Agrawal, 2008). However the revised architecture of data warehouse by Bill Inmon in his book "DW 2.0: The Architecture for the Next Generation of Data Warehousing" seems to get advantage over Kimball's model of data warehouse in the near future. In his book he described in detail the different types of data warehouses and their drawbacks and suggested a new architecture which facilitates not only structured and unstructured data but also

describes the real-time data access from Online Transaction Processing Systems (OLTP) (Inmon *et al.* 2008).

3. Real-Time Business

Business transactions happen in real time. All of them generate data i.e. customer data, product data, sales data and sometimes even meta-data. People's as well as businesses' expectations lie in the real world. They are impatient and expect everything to be 'always on' and always up-to-date. It would be unacceptable now for any of these transaction or services to be delivered in batch. Nobody wants current account that shows yesterday's balance and enterprises can't afford to run their businesses based on out of date information (Panian, 2007).

The business users are frustrated by the fact that the information is arrived just too late to be really useful. At a first sight one can understand that it is a timing problem and it is clear that real-time business generates real time information that must be acted upon in real time in order to get benefit from this information. Business people universally agree that they don't need more reports. What's lacking is real insight (Panian, 2007).

The solution of these problems is to have instant access to the data related to a particular business event. Only the access of the data is not enough until the business users take the corrective actions accordingly and instantly. This leads to Event-Insight-Action cycle (Panian, 2007).

Figure 4: Event-insight-action cycle

4. Latency Problem

Operational business intelligence is the process of delivering information about business operations with minimum latency (Dasgupta and Vankayala, 2007). If the information is not available in time, actions can't be taken accordingly and this leads to latency problem. Latency is the time taken from something happening or changing to the moment when one can do something about it. The study of "The BI Watch" (Hackathorn, 2004) shows that there are three types of latency:

- Data latency
- Analysis latency
- Decision latency

The data latency is the time required to feed (ETL, cleansing and storing) the data warehouse with the transactional data. Analysis latency is the time taken for the analysis and delivery of information to the concerned persons. The decision latency

is the time required for a person to understand the situation, decide on a course of action and initiate it (Hackathorn, 2004) (Seufert and Schiefer, 2005).

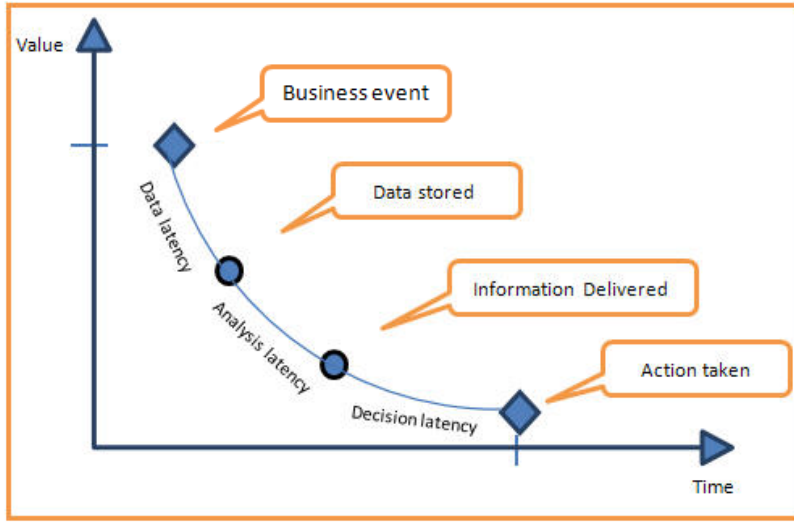

Figure 5: Types of latencies (Hackathorn, 2004)

Once the business event occurs, its value starts to drop immediately. The event is saved in an OLTP system and then the data is transferred from OLTP to data warehouse that requires extensive data cleansing, data consolidation and data quality management (data latency). There are some techniques to overcome this problem e.g. the use of operational data store (ODS) (Inmon *et al.* 2000), Enterprise Application Integration (EAI) or event-driven approach (Seufert and Schiefer, 2005) (Schiefer and Bruckner, 2003), log-based Capture Data Change (CDC) (Oracle, 2010) or Rules Engine (Agrawal, 2008).

Once the data is in data warehouse it is available for the analysis and until the analysis is done and the information is propagated to the concerned persons (analysis latency) action can't be taken. The effect of analysis latency can be reduced by using data mining techniques (Seufert and Schiefer, 2005).

When the concerned persons receive the information, they initiate the process to take action (action latency). Least IT support has been identified in action latency because it depends on the personal abilities of business user and decision makers. New techniques especially in the area of Business Activity Monitoring (BAM) try to improve this situation by automating certain decision processes with the help of rule based decision engines. Based on real-time analysis of the data, the decision engine checks for predefined business rules and notifies responsible person, or triggers other tools for conducting other actions (Seufert and Schiefer, 2005).

So the latency problem is a key issue in a traditional BI environment where business users can only analyse the historical data and access to the current data is not

possible. If we are able to overcome latency problem issues, we'd be able to analyses the business data in real-time and can make business decision just-in-time.

5. Operational vs. Traditional BI

Operational BI satisfies the requirement of business users especially Line of Business (LOB) managers by serving them actual and accurate data to facilitate just-in-time decision making process and to update a specific business process when it is needed. In contrast, traditional or conventional BI provides the reports on historical data, which is fruitful in making a company's long term strategy (Linthicum, 2011). It is a resource for a small group of analysts and decision makers engaged in strategic planning that affects time horizons of months or years. Today, more and more companies maximize the value and competitive advantage of their data warehouse by using it in an operational role, adding mission-critical decision support to their workload (Oracle, 2010).

The difference between operational and traditional BI can be examined in the Table 1 (Linthicum, 2011) (Imhoff, 2007).

	Traditional BI	**Operational BI**
Business Focus	Long-term business goals	Manage and optimize daily business operations
Primary users	Executives & business analysts	Analysts, LOB managers, business user
Time Frame	Weeks, Months, Years	Intra-day
Data	Historical Data	Real-time, low-latency and historical data
Analytics	Complex	Simple
Cost	High	Low
Integration	Complex	Simple

Table 1: Comparison of traditional and operational BI

6. Just-in-Time Decision Making (JDM)

Making decisions is required by almost every system or process in a real-world. But the question is how a good decision should be made which has its value or the value is justifiable. In a business world, a good decision optimizes one or more Key Performance Indicators (KPIs) such as cost, revenue, lead time or profit (Dalal *et al.* 2003). The value (good or bad) of a business decision can be measured in future i.e. strategic decisions. But if we talk about the just-in-time or real-time then decision making continuously involves making decision within current time. It is an analytic process that allows organizations to automate 'next best actions' based upon their goals and objectives. It embeds real-time analytic capabilities into business processes (Panian, 2007). It is the process of analysing the events as they happen and to act accordingly without wasting time. Just-in-time decision making process addresses individual business transactions. In addition, they likely represent the highest number

of decisions made on routine and day-to-day basis. (Panian, 2007) describes six steps to achieve just-in-time decision making.

- define performance goals
- get data in real-time without latency
- monitor process in real-time
- learn about customers and processes automatically
- evaluate the impact of potential actions on all performance goals
- drive the best action and refine the business action

The key component in just-in-time decision making is the availability of relevant data about a specific business event, just in-time as it occurs which is the basic point in operational BI.

7. Conclusion

The operational BI technology is still evolving. Many researchers are trying to model the operational BI framework. Even Inmon and Kimball are now introducing real-time data access through real-time data warehouse in their data warehouse models (Inmon *et al.* 2008) (Kimball, 2010). Therefore it is important to stress the importance of operational BI in today's business world. It is a relevant problem domain not only among the researchers and business community but also the software providers. Almost every BI software vendor is trying to create BI software for operational BI (Oracle, 2010) (Watson, 2009).

The adaptability of operational BI in the industry on a considerable high rate (Agrawal, 2008) is a crucial aspect as there are no standards or established frameworks to build operational BI environments. Every vendor has its own framework. As we have mentioned in "Latency Problem" section there are many different techniques to achieve operational BI, but all these techniques are based on the structured data and we cannot ignore unstructured data. So the new Inmon's model (Inmon *et al.* 2008) seems to be a more realistic approach. Even, if we ignore unstructured data and only concentrate on operational BI based on structured data, some questions remain open e.g.

- How will data be accessed in real-time operational BI either ETL, EAI, Rule Engines, log-based CDC or anything else?
- How can data harmonizing and data cleansing be done in this approach?
- How can data quality be assured in real time BI?

The further developments and future work related to operational BI can be based on these questions that would help researchers to develop a common base and a framework for operational BI.

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