A Business Activity Monitoring System Supporting Real-Time Business Performance Management

Jin Gu Kang and Kwan Hee Han
Department of Industrial and System Engineering, Engineering Research Institute,
Gyeongsang National University,
900 Gazwa-Dong, Jinju, Gyeongnam 600-701, South Korea
kjg@autoeversystems.com and hankh@gsnu.ac.kr

Abstract

Recently, strong interests in the real-time performance management are increasing to gain competitive advantages in the rapidly changing business environment. For better business performance or continuous process improvement of an enterprise, real-time measurement and analysis of the performance of managerial activities is essential. Business Activity Monitoring (BAM) which provides real-time access to key performance indicators is one of core elements for the real-time performance management. A BAM system prototype is designed and implemented for a global automotive company in this paper. This paper presents the design procedure and implementation result of BAM system. This paper is expected to be a practical help to the practitioners who are planning and executing the BAM system implementation for the real-time performance management.

1. Introduction

Most enterprises are struggling to change their existing business processes into agile, product- and customer-oriented structures to survive in the competitive and global business environment. Many enterprises have recently been pursuing process innovation or improvement to gain competitive advantage. In such a today's dynamic business environment, maximizing and optimizing business performance is a critical requirement for maximizing business profitability and returning shareholder value.

For better business performance or continuous process improvement of an enterprise, effective measurement and analysis of the performance of managerial activities is essential. In other words, maintaining competitive advantage requires continuous real-time monitoring of business performance as well as scanning of business environment changes in what customers really want and what competitors are doing. For effective real-time performance management, enterprise must monitor their activities and respond to them in real-time basis. Business activity monitoring (BAM) system can be used for that purpose.

BAM was firstly defined by Gartner as the concept of providing real-time access to critical business performance indicators to improve the speed and effectiveness of business operations [1]. The goal of BAM is to provide real-time information about the status and results of various business operations, processes, and transactions [2]. Enterprise-wide task of BAM is to reduce or eliminate delays, bottlenecks and inefficient use of labor and materials, while providing real-time financial and performance data [5]. Representative feature of BAM is that it monitors many enterprise systems simultaneously and displays exceptional situation on the dashboard if symptoms of problem are identified by pre-defined rules.

Recently, many companies that are running Enterprise Resource Planning (ERP) system or introducing Business Process Management (BPM) system want to derive and monitor Key Performance Indicator (KPI) to assure the effectiveness of their innovation or improvement efforts. This requirement can be achieved by BAM system that collects and analyzes the related data in real-time and responds with appropriate reaction when a business event occurs. Therefore, BAM is the critical element for attaining the business goals aligned with business strategies.

In the previous research, authors (2007) proposed process-based performance measurement framework (PPMF) for continuous process improvement in which the relationship of business processes and enterprise performance is clearly defined and managed [3]. And authors (2007) also proposed two-stage business process analysis, which precedes BAM, for the new

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process design based on PPMF and business process simulation [4].

Goverka *et al.* (2002) emphasized that the potential problems with BAM are a shortage of the skilled workers, doubt over the ability of software vendors, union concerns, and so on [5]. Buytendijk *et al*. (2002) asserted that creating an effective BAM environment is not only about having the right technology and processes. They pointed out that enterprises should define the right set of metrics for BAM [6].

White (2003) proposed a BAM framework through the comparison with Business Intelligence (BI) framework. He emphasized the followings to prepare the BAM system: First, it is important to gain a good understanding of BAM technology and its business benefits. Second, BAM must be integrated with existing BI and enterprise integration (EI) solutions. Third, it is important to realize that although there are already a number of successful BAM implementations, this is immature technology that will undergo rapid evolution over the next few years. Last, it is crucial to recognize that BAM is not just a technology alone [7]. Broda *et al*. (2006) proposed key steps and critical success factors to BAM system implementation. The key steps are as follows: define a vision, establish the data model, build real-time data streams, and roll out operational dashboards. The critical success factors are performance, heterogeneous data access, and usability [8].

The objective of this paper is to propose BAM design framework for the real-time business performance management and implement a BAM system prototype to show the applicability of proposed framework. This system is based on the real case of a global automotive company pursuing the real-time performance management.

The rest of this paper is organized as follows. Section 2 describes the design framework of BAM system. Section 3 presents the result of BAM system implementation. Finally, the last section summarizes the results and suggests directions for further research.

2. BAM System Design Framework

2.1. Functional Requirements

The reference company of this research is a global automotive company in Korea and it has many overseas plants and sale offices on a global basis. The real-time monitoring for the business performance of all plants and sales offices was needed because of the rapid globalization and business environment changes. Until recently, it had difficulties for monitoring and analyzing business events in integrated and comprehensive manner because of wide spread site locations and varieties of source information systems for performance measures. BAM system was proposed as a most promising solution to cope with this need, and pilot project for BAM system was conducted.

2.2. Structure of Enterprise Information System

Before designing a BAM system, it is necessary to investigate the structure of current enterprise information system (EIS). Generally, enterprise information system can be classified into two categories: a transaction processing system and an analytical processing system. A transaction processing system contains a group of enterprise systems that process large amount of transactions for the daily operation of enterprise. Transactions are generally processed in real-time and continuous basis and are related to many applications and databases. ERP system is the representative application of the transaction processing system. An analytical processing system includes a group of systems that collect and analyze data for the decision support. In general, databases in one system are operated independently from the other system because of system performance problem. In other words, the analytical processing system is separately managed from the transaction processing system to protect the predefined performance of transaction processing system from the effect of the analytical processing system which requires many resources. Data warehouse (DW) and On-line Analytical Processing (OLAP) are representative applications of the analytical processing system. BAM system is classified into the analytical processing system.

Figure 1 shows the structure of enterprise information system of the reference company. The transaction processing system of this company includes BPM system, ERP system and other legacy systems. The analytical processing system includes BAM system that contains a separated database and dashboard.

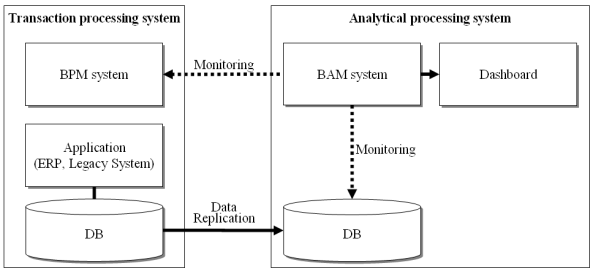

Figure 1. Structure of enterprise information system

2.3. BAM System Design Procedure

In this paper, BAM system design is conducted according to the following general procedure as depicted in Figure 2.

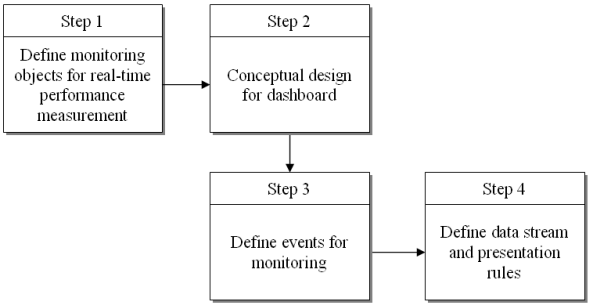

Figure 2. BAM system design procedure

2.3.1. Define monitoring objects for real-time performance measurement. Monitoring objects of which performance should be measured in real-time are selected in this step. Alternatives for real-time performance measurement in an enterprise are categorized into two groups.

One group is such KPIs that can add significant values to an enterprise through the real-time performance measurement. In case of the reference company, the 'Monthly of Supply (MOS)' KPI showing the level of the current sales inventory is important because this KPI indicates the daily operational efficiency of sales and the properness of sales inventory. In the past, it was calculated and presented in daily base. In the BAM system, MOS is selected as a KPI for real-time performance measurement because it is much more useful to decision making if it is presented in real-time basis.

The other group is such business processes that are controlled and coordinated by the BPM system. In case of the reference company, the equipment problem management process is executed based on the BPM system which has a cycle from 'Equipment Problem Registration' to 'Results Verification'. Managers and engineers want to know that the current state of each equipment problem and whether this process is going well or not in real-time basis. Therefore, the equipment problem management process is selected as the business process for real-time performance measurement.

2.3.2. Conceptual design for dashboard. In this step, the structure and display format of dashboard are designed schematically to properly present the status and trend of selected KPIs or business processes. Generally, bar chart, line chart, pie chart, gauge, and list are used. In case of the reference company, the dashboard to present the status of MOS by region is sketched schematically in Figure 3. Gauges on the world map present regional MOS status. And vertical bar charts are used for indicating status of MOS and inventory level. The dashboard to present the status of equipment problem management process is organized as depicted in Figure 4. Pie chart is used for displaying number of occurred problems by function. Vertical bar charts are used for the number of equipment problems by plant. Delay activities or alert processes are displayed by list format.

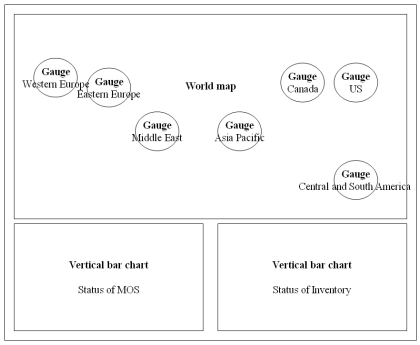

Figure 3. Dashboard design for MOS by region

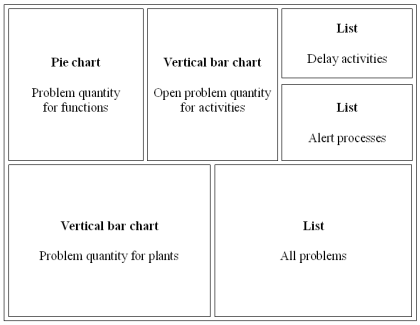

Figure 4. Dashboard design for equipment problem management process

2.3.3. Define events for monitoring. In this step, the events that should be monitored to follow up the status and trend of the selected KPIs or business processes on the dashboard are defined. Event is defined as "a record of specific activity in a system" [9] and events are categorized as a business event or a technical event. If the business process is executed based on the BPM system, the start or the completion of each activity within the specific process is defined as a business event. If the business process is conducted without BPM system and the KPI is calculated by data manipulation in the database (i.e. addition, deletion, and update of data records), this manipulation is defined as a technical event.

In case of the reference company, the start and completion of each activity of the process are defined as the business event to be monitored for the equipment problem management process. And the addition of record to the table for sales status by region is defined as the technical event to be monitored for the status of MOS by region.

2.3.4. Define data stream and presentation rules. In this step, the flow from the event extraction among various data source to the presentation of them on the dashboard are specified. After that, presentation rules are defined.

In case of the reference company, Figure 5 shows the data stream and the presentation rules for the status of MOS by region. The data source for MOS is DB table for sales status by region in the overseas sales information system within the transaction processing system. And the data of this table is transferred to the independent DB table within the analytical processing system once per one minute by means of enterprise application integration (EAI) tool. The EAI methods are classified as follows: information-oriented approach, business process-oriented approach, service-oriented approach, and portal-oriented approach. Information-oriented approach is further classified into data replication, data federation, and interface processing method [10]. The data replication method is used in order to transfer sales inventory data from the transaction processing system to the analytical processing system.

BAM system monitors its own DB table within the analytical processing system and calculates the value of MOS according to the predefined formula and presents the MOS value on the dashboard according to the presentation rules. MOS is the ratio of the present sales inventory with the average sales by month as follows: MOS = Present Sales Inventory / Average Sales by Month

In order to intuitively show the status of MOS, MOS level is displayed by one of three categories (normal-boundary-abnormal). If the MOS value is less than 3.5, then the indicator is presented in green. Else if the value is more than 3.5 and less than 4.0, then the indicator is presented in yellow. And if the value is more than 4.0, then the indicator is presented in red.

Figure 6 shows the data stream and the presentation rules for the status of equipment problem management process which is conducted through the BPM system. The equipment problem management process consists of the five activities. The start and the completion events of each activity are monitored and presented on the dashboard. An uncompleted activity within 48 hours after the start time is categorized as a delay activity. And a process that is not completed until the planed finished date is classified to an alert process.

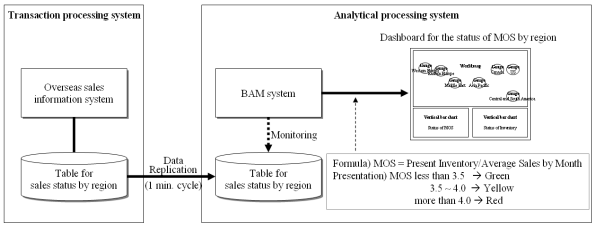

Figure 5. Data stream and presentation rules for MOS

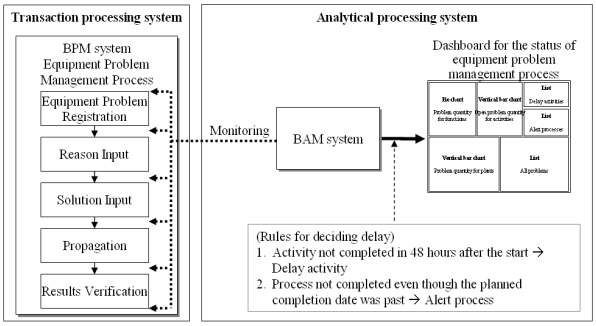

Figure 6. Data stream and presentation rules for equipment problem management process

3. Implementation of BAM system prototype

3.1 Commercial solutions for BAM system prototype

Based on the design procedure described in Section 2, a BAM system prototype is developed in this research. Because of time constraints in the pilot project, several commercial solutions are used actively instead of in-house solutions during the implementation phase.

Table 1 shows the solutions used for the BAM system prototype such as BAM, DB, EAI and programming language.

Table 1. Commercial solutions for the BAM system prototype

Type	Solution
BAM	Oracle BAM
DB	Oracle Database 11g
EAI	WebMethods
Programming language for UI	Java

3.2 Implementation results

3.2.1 KPI status – The dashboard for the status of MOS by region. The dashboard for the status of MOS by region consists of three parts as shown in Figure 7. The minute-by-minute MOS value update of each region is presented by the gauge on the upper world map. On the left lower part, the MOS value of each region is presented by the vertical bar chart for the comparison. In this chart, horizontal red line is displayed at the MOS 4.0 level for the warning of abnormal state. On the right lower part, the current inventories of each region are presented by vertical bar chart.

The dashboard is refreshed with one minute cycle because the data replication cycle from the data source of the transaction processing system to the data target of the analytical processing system is one minute. One minute update cycle is considered as real-time information providing in light of the characteristics of automotive sales. Executives and managers can monitor the MOS of each region in real-time by using this dashboard.

Figure 7. Dashboard for MOS by region

3.2.2 Business process status – The dashboard for the status of equipment problem management process. The dashboard for the status of equipment problem management process consists of six parts as shown in Figure 8.

On the left upper part, the numbers of equipment problems by department such as press, body, paint, assembly, and engine shop are displayed by the pie chart. On the middle upper part, the numbers of the in-process problems of each activity are presented by the vertical bar chart. The equipment problem management process consists of the five activities as follows: 1) Equipment Problem Registration, 2) Reason Input, 3) Solution Input, 4) Propagation, 5) Results Verification.

On the right upper part, the delay activities are presented by the list and the alert processes are presented by the list. On the left below part, the numbers of equipment problems by plant are presented by the vertical bar chart. Lastly, on the right below part, all equipment problems executed on the BPM system are displayed by the list. If one problem is clicked in this list, a screen showing the detail contents of the problem appears in a drill-down way.

By using this dashboard, the number of delayed activities can be smaller, and the total time for execution of this process can be reduced.

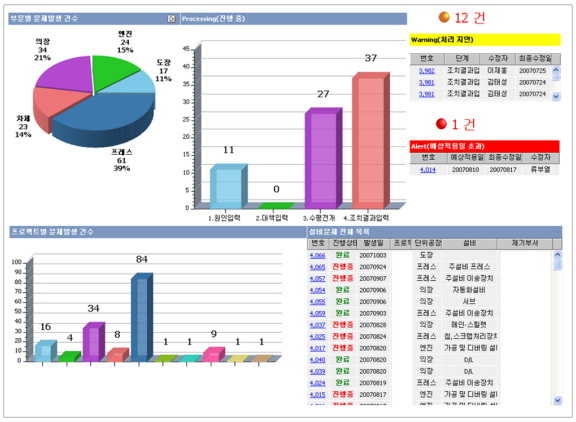

Figure 8. Dashboard for equipment problem management process

4. Conclusions

Today's enterprise faces a daunting world of ruthless, global competition, overcapacity, depressed economies, and increased product commoditization. Whether the enterprise focuses on profitability, earning per share or market share growth, hitting such goals is becoming ever more challenging. To cope with these challenges, companies must monitor and manage their performance to assure that they properly execute their strategies.

BAM is the key element for the real-time performance management aligned with business strategies. Proposed in this paper are a BAM design framework for the real-time business performance management and an implementation of BAM system prototype to show the applicability of proposed framework.

Proposed BAM system design procedure is as follows: 1) Define monitoring objects for real-time performance measurement. 2) Conceptual design for dashboard. 3) Define events for monitoring and 4) Define data stream and presentation rules. The result of this research is expected to be a practical help to the practitioners who are planning and executing the BAM

system implementation for the real-time performance management.

Since enterprise performance is achieved through the execution of business processes, it is essential to establish a process-centered enterprise structure in a value chain context based on BPM system. Therefore, as a further research, development of performance-centered BPM system framework is needed in which analysis, design, execution, monitoring and business intelligence phases of business processes are all closely related with business performance.

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