Performance-Centric Business Activity Monitoring Framework for Continuous Process Improvement

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Abstract: - 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 or business processes is one of core elements for successful BPM system. Since performance measurement cannot be managed independently of business processes, BAM system needs to monitor performance metrics in terms of business process.

This paper proposes BAM framework based on the process-based performance measurement model, in which monitored KPIs are closely related with business processes. To show the applicability of proposed framework, BAM system prototype was also developed using a real case.

This paper is expected to be a practical help to the practitioners who are planning and executing the BAM system implementation for the continuous process improvement.

Key-Words: - Business Activity Monitoring (BAM), Business Process Management (BPM), Business Performance, Key Performance Indicator (KPI)

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. In today’s dynamic business environment, the ability to improve business performance is a critical requirement for any organization. So many enterprises have recently been pursuing process innovation or improvement to attain their performance goal. A business process is a sequence of activities that carries out a complete business goal. To comprehensively support business process execution, the concept of business process management (BPM) has been recently proposed.

The BPM cycle is composed of diagnosis, process design, and process execution phase. In the diagnosis phase, the operational processes are analyzed to identify problems and find areas for improvement. In the process design phase, to-be processes are newly designed and their performance evaluation is conducted. In the execution phase, business activities are monitored, coordinated and controlled continuously for better performance.

Business activity monitoring (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 [8]. BAM is usually conducted during the execution phase of BPM. The goal of BAM is to provide real-time information about the status and results of various business operations, processes, and transactions [11]. 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 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.

Since performance metrics show how well the
business is doing relative to a defined strategy, they help managers to derive better business decisions. Because enterprise performance is achieved through the execution of business processes, business process and enterprise performance measurement are closely interrelated. In other words, performance measurement cannot be managed independently of business processes in order to attain the goal of an enterprise. As a result, BAM system needs to monitor performance metrics in terms of business process.

However, current measurement practices have not clearly defined and managed the relationships between business processes and KPI. Therefore, it is necessary to establish a process-based performance measurement model.

The objective of this paper is to propose BAM framework based on the process-based performance measurement model, in which monitored KPIs are closely related with business processes and are composed by combining the other lower-level KPIs. To show the applicability of proposed framework, BAM system prototype was also developed using a real case.

The rest of this paper is organized as follows. Section 2 describes related works. Section 3 presents process-based performance measurement model (PPMM), which is an underlying scheme of performance-centric BAM. Section 4 shows proposed BAM framework and its prototype implementation. Finally, the last section summarizes the results and suggests directions for further research.

2. Related Works
Of the research related to the performance measurement of an enterprise, Chan and Qi decomposed the business process hierarchically into sub-processes, and then proposed a method of calculating the performance measure by summing up the measures of the lowest level activities [4]. It is a top-down approach that defined the business processes level-by-level, and mapped the performance measure to each business process. Nevertheless, they suggested that the business process has a simple one-to-one relationship with a performance measure. Bititci conducted a case study that applied the information systems modeling techniques to the modeling of a performance measurement system and implied that KPIs are interrelated with multiple and weighted relationships [1]. Munehira et al. suggested that it is necessary to specify which processes should be improved or created to achieve the business performance goals described in BSC [9]. For this purpose, they defined the relations between BSC structure and business model elements. Yet they did not implement their proposed method to a real business case. In the previous research, authors of this paper proposed two-stage business process analysis, which precedes execution phase of BPM, for the new process design based on PPMM and business process simulation [7].

In the area of BAM, Goverka et al. 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]. Buijtenjijk et al. asserted that creating an effective BAM environment is not only about having the right technology and processes [3]. They pointed out that enterprises should define the right set of metrics for BAM. White proposed a BAM framework through the comparison with business intelligence (BI) framework [10]. 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. Broda et al. proposed key steps and critical success factors to BAM implementation [2]. The key steps are as follows: define a vision, establish the data model, build real-time data streams, and roll out operational dashboards. They suggested that the critical success factors are performance, heterogeneous data access, and usability.

3. Process-Based Performance Measurement Model
The need for systematic performance measurement based on business processes has been steadily increasing. However, the proper correlation scheme between business processes and KPIs is not clearly established in the current measurement practices. As a result, in the diagnosis phase of BPM, it is difficult to decide which process should be improved to achieve a specific performance goal or which performance index is influenced when a specific business process is executed successfully. In the execution phase, it is also difficult to decide which KPIs or business processes
are monitored and to define the relationships between monitored KPI and other KPIs. Consequently, a performance measurement model that is closely correlated to business processes should be established to achieve the goal of an enterprise.

The proposed PPMM consists of three sub-models, as shown in Figure 1: KPI model, process model, and K-P model. Firstly, KPIs are hierarchically classified into three levels in the KPI model according to the following management decision level: strategic level KPI (SLK), tactical level KPI (TLK), and operational level KPI (OLK). The contribution index having a 3-point scale, which is a measure of the contribution of a specific KPI to other same level or higher level KPI, is determined in the KPI model. Figure 2 shows 12 SLKs of Case Company S in terms of balanced scorecard (BSC) perspectives. Figure 3 shows an example of KPI model, in which the contribution index of ‘output quantity’ TLK to the ‘productivity’ SLK is marked as 3.

Secondly, business processes are classified into three levels in the process model in accordance with the size of the process span as follows: enterprise level, process level, and sub-process level. Each sub-process has a network composed of unit activities as shown in Figure 4. The definition of process, sub-process and activity in this paper is compliant with the definition of workflow management coalition (WfMC). Process model of Case Company S consists of 14 main processes as follows: understand market and customers, develop vision and strategy, research and development, engineering, marketing and sales, purchasing, production, customer satisfaction, manage information, manage human resources, finance, execute environmental management program, manage external relationships, and manage changes.

Finally, the K-P model represents the relation between KPI and business process. Enterprise, process, and sub-process levels in the process model correspond to SLK, TLK, and OLK in the KPI model, respectively. The influence index having a 3-point scale, which is a measure of the influence of a business process on a specific KPI, is determined in the K-P model.
model. Figure 5 shows the integrated view of PPMM of the Case Company S. In the left side of Figure 5, influence index of ‘production’ process upon the ‘output quantity’ TLK is marked as 3.

During the execution phase of business process, the impact of each unit task’s performance on the enterprise-level performance can be monitored and measured in real-time, and the analysis result of monitoring activities can be reflected to the business process operations by integrating this PPMM and the BAM system. The detailed procedure to develop a PPMM in an organization was previously addressed by authors of this paper in [6].

Figure 5. Integrated view of PPMM (simplified)

4. Performance-Centric Business Activity Monitoring Framework

Proposed BAM framework consists of general BAM design procedure, methods and tools. The general BAM system design procedure based on PPMM is as follows: 1) define monitoring objects based on PPMM, 2) conceptual design for dashboard, 3) define presentations rules.

4.1. Define monitoring objects based on PPMM

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

One group is such KPIs that are significant to attain an enterprise goal through the real-time performance measurement. Target KPIs for monitoring can be selected based on KPI model of PPMM at any KPI level. For example, in the case company S, ‘efficiency of cooperation with venders’ of customer perspective in the Figure 2 is selected as a target SLK.

Since SLK is enterprise level, it is too broad in scope and difficult to calculate and monitor comprehensively. Therefore, most contributing TLK to selected SLK is the candidate KPI for monitoring. Based on the PPMM, we identify that the most contributing TLK to this SLK is ‘material supply cooperation with vendor’ in the KPI model (number 1 and 2 arrow in Figure 5). The contributing OLKs for this TLK can be found in the KPI model (number 3 arrow). These are on-time collaborative design (OTCD), on-time supply (OTS) and emergency material order rate (EMO). As a result, ‘material supply cooperation’ is selected as a monitoring object, and is calculated by weighed average of 3 contributing OLKs as mentioned above.

The other group is such business processes that are controlled and executed by the BPM system. Proposed PPMM is used for determining which processes should be executed successfully to achieve a target SLK. For example, in the Case Company S, the problem is to select process and sub-process we have to improve for enhancing the ‘productivity’ SLK of internal process perspective. By using the proposed PPMM, we identify that the major contributing TLK to the ‘productivity’ SLK is ‘output quantity’ in the KPI model (number 1 arrow), as shown in Figure 6. Then we determine that the major influencing process on ‘output quantity’ TLK is ‘production’ process in
the K-P model (number 2 arrow). To find the major influencing sub-process, we see that the major contributing OLK to the ‘output quantity’ TLK is ‘Mean time to repair (MTTR) in the KPI model (number 3 arrow). This result indicates that the major influencing sub-process on ‘MTTR’ OLK is ‘equipment maintenance’ subprocess in the K-P model. Finally, we find that ‘equipment maintenance’ is the sub-process of ‘Production’ process in the process model (number 4 arrow).

4.2 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. After that, data sources for monitoring objects are identified, and it is investigated that the source data is directly used or it needs to be transformed.

4.3 Define presentation rules
In this step, presentation rules for KPI or business process are defined.

As an example for the KPI monitoring, in case of Case Company S, monthly material supply cooperation with vendor (MSC) TLK index is calculated as a monthly weighed average of contributing OLKs (i.e., OTCD, OTS and EMO). Its formula is as follows: MSC = 3/7*OTCD + 3/7*OTS + 1/7*(100-EMO) where OTCD = (monthly # of on-time collaborative design completion)/(monthly completed total # of collaborative design) * 100. OTS = (monthly # of on-time supply/ monthly total # of supply) *100. EMO = (monthly # of issued emergency order)/ (monthly total # of purchase order)*100.

Figure 7 shows dashboard for the monitoring of ‘material supply cooperation with vendor’ TLK trend. The left part shows the status of certain month as a bar chart: The upper bar represent current status of ‘material supply cooperation’ index by weighted average of other three indexes as formulated above. Lower three bar describes the current status of three OLKs contributing to ‘material supply cooperation’ SLK. The right part of Figure 7 show monthly trend of MSC index as a graph of broken line.

As an example of process monitoring, in case of Case Company S, ‘equipment maintenance’ subprocess consists of the five activities as follows: registration, input of failure cause, input of treatment result, verification of treatment. In order to reduce or eliminate delays, an uncompleted activity within 48 hours after the start time is categorized as a treatment delay activity. A process that is not completed until the planned finished date is classified to an alert process. Monitoring display consists of 5 parts as depicted in Figure 8. Among them, the treatment delay activities are presented by the warning list, and the alert processes are presented by the alert list on the right upper part.

5. Conclusions and Further Research
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 framework based on the PPMM for continuous process improvement, and an implementation of BAM system prototype to show the applicability of proposed
Proposed BAM system design procedure is as follows: 1) define monitoring objects for real-time performance measurement. 2) conceptual design for dashboard. 3) define 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.

As well as the importance of business process to an enterprise performance, knowledge is also treated as a critical driving force for attaining enterprise performance goals because knowledge facilitates the better business decision makings in a timely fashion. Therefore, enterprise-level perspective on the relationships among enterprise performance, business processes and knowledge should be established. Therefore, as a further research, development of process-centered enterprise structure integrating process, performance and knowledge in a value chain context is needed.

References


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