Business Process Management Solutions Performance Tuning and Configuration

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Business Process Management (BPM) solutions provide full integration between business and IT requirements, ensuring that the business requirement adapt more easily to the environmental changes. Given that today's business environment is characterized by ever growing dynamism, the use of BPM solutions can provide additional consistency and opportunities for rapid alignment to change.
In this article we discus some of the standards and technologies for BPM solutions, we present several proposals for the lifecycle of a business process and also the main stages of our own proposal for a methodology for developing a BPM solution. Also we analyze one of the most popular BPM solutions on the market (Web Sphere Business Process Management suite) and present some key tuning and deployment guidelines.
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1 Introduction

Studying current professional literature related to economics and management, a new principle emerges that "mankind is moving quickly toward a new kind of economy and thus a new kinf of company and management"[1], this change being triggered specifically by developments in information technology and communications that led to profound transformations. These transformations mark the transition to a society based on information, communication and knowledge.
In the last decades, profound changes taking place globally reached all areas but mostly the business, so companies are forced to undertake a major reorganization of their management models and methods. The new competitive requirements of organizations require more attention given to customers, lower costs, quality and adaptability and technological developments continue to help organizations achieve these goals
Once organizations became aware of the need for change, they have begun to pay greater attention to key business processes with direct impact on customer profitability and growing importance. To be effective today, organizations must be able to define, analyze, implement, measure and control their processes, and this change is not possible without educating staff and implementing appropriate technologies. Business models continue to change as new technologies are introduced and each functional area of an organization is influenced by how well the information system transforms data into information or facts that help achieve business goals.
Mergers and acquisitions, changing business models, new business requirements and changes in customer expectations, all put multiple problems with processes in the organization. These problems can be solved by integrating Business Process Management (BPM) technologies, which enable organizations to manage changes in processes, changes that are required simultaneously in several areas of business.

Solutions in the Business Process Management category allow integration of very diverse systems that exist in an organization, providing additional advanced features for modeling and automation of business flows in the company. Business Process Management Solutions (BPMS) have visual tools that substantialy simplify how complex business processes, that involve access to various data sources and interoperability of many applications, are defined and integrated. Through BPM solutions business processes can be modeled directly by financial and economic analysts without haveing to requeste support from the IT departments.
BPM applications provide full integration between business and IT, business requirements beeing adapted to changes in current business environment in a simpler manner. Given that today's business environment is characterized by growing dynamism, the use of BPM solutions can provide an additional type of consistency and rapid alignment possibilities to the changes that occur.

2 Standards and technologies for Business Process Management Solutions

Integration of applications through BPM solutions is based on fundamental standards and technologies such as web services and XML. Web services represent a standardized way of distributing software, which uses the Internet and basic technology behind this network. Also, Web services enable interconnection of a wide array of applications available on different platforms and in various locations around the globe. In this way, we can say that new technology has opened the door to a new era of computing applications dominated by a high degree of intelligence, capable of making decisions and looking for information on the Internet as a support for most reasonable decisions.
EXtended Markup Language or XML is the basis of all elements which represent the foundation of Web services technology. Considering platform independency, XML is the engine that enables data transfer via the Internet, also constituting the foundation of Web services.
An important element to be mentioned in connection with BPM solutions and Web services is Service Oriented Architecture (SOA). SOA provides access to other applications. BPM uses SOA to include information on the best applications in the process. We can make an analogy saying that if SOA provides avenues for the flow of information then BPM is the machine that uses the infrastructure to obtaine something useful.
Sometimes BPM can be a catalyst for developing a SOA strategy. In a world where executives try to obtain a concrete value from the investments they made in the IT filed, SOA itself can be quite hard to sell because of the difficulty of explaining the added value it brings using concrete terms and quantifying this value. A strategy that can be used to counteract this shortcoming is to promote SOA as an element that supports business process management, because it has a concrete component and it’s much easier to quantify the added value achieved [2].
The most important developed BPM standards are:

- Business Process Modeling Notation (BPMN) which focuses on graphical modeling of business processes. BPMN it’s a standard for modeling business processes, proposed and developed by the Business Process Management Initiative and provides a graphical notation, easy to use and understand by all users involved in business processes [3].
- Business Process Execution Language (BPEL) is a standard based on XML and Web services that allows modeling and automation of business flows. Using this language, both the business flows and the business rules

can be defined in an intuitive manner, a high level of transparency in the conduct of these operations being assured. BPEL technology simplifies the integration of various applications and business processes

- Business Process Modeling Language (BPML) is an XML-based meta-language that describes business processes. It was originally intended to support business processes that can be executed by a BPMS [4]. The language was designed to handle processes with a long lifecycle, wich persistance is supported in a transparent manner. XML exchanges occur between different participants, each with an established role, and components belonging to their partners, like BPEL constructions. BPML also includes transactional support and exception-handling mechanisms.
- Business Process Query Language (BPQL) - focuses on administrative and monitoring aspects [5]. BPQL is a management interface to a business process management infrastructure that includes a process execution facility (process server) and a process deployment facility (process repository).

A notable aspect is that each of these standards, like many others not mentioned, focuses only on some aspects of the elements that are typically addressed by a BPM product. The challenge will arise when integrating these standards in a life cycle for continuous process improvement through BPM.

3 Business process lifecycle.

There are several approaches to the representation of a process' life cycle. Some illustrate the chronology of the life cycle phases of development while others focus only on the logical dependencies between different phases, considering that each of them can be resumed at different times.

According to [6] there are five stages through which a process passes throughout its life cycle, namely: modeling, implementation, execution, analysis and optimization, illustrated in Figure 1.

In the modeling stage new processes are designed or existing ones are modified according to the new requirements. Activities in this stage are carried out either by analysts or by the processes responsibles and result in advanced graphics representations of tasks to be executed.

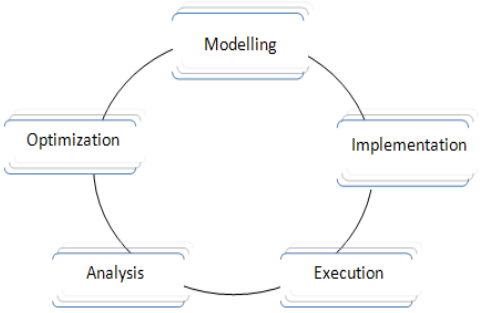

Figure 1. The life cycle of a business process. Adaptation from [6]

The purpose of the implementation phase is to obtain an executable model of the processes, based on existing abstract models. Basically, the theoretical model previously obtained must be adapted so that it can be used in the context of real business environment, taking into account the resources available and actors involved.

The next phase represents the actual implementation of the result of the previous stage (enabling the executable process model). This phase it's ideally concluded by obtaining added value for the company and the desired results by the client.

Running processes are subject to careful monitoring and analysis in the phase which bears the same name, in order to identify opportunities for optimization. Once the analysis is completed, the data obtained are used in the optimization and redesign phase in order to obtain a more efficient process

Another approach is the one proposed by [7], which identifies four stages of the business process lifecycle, organized in a cyclical structure illustrating logical dependencies but not the temporal sequence of their development. The four stages are analysis and design, configuration, execution and evaluation and they are represented in Figure 2.

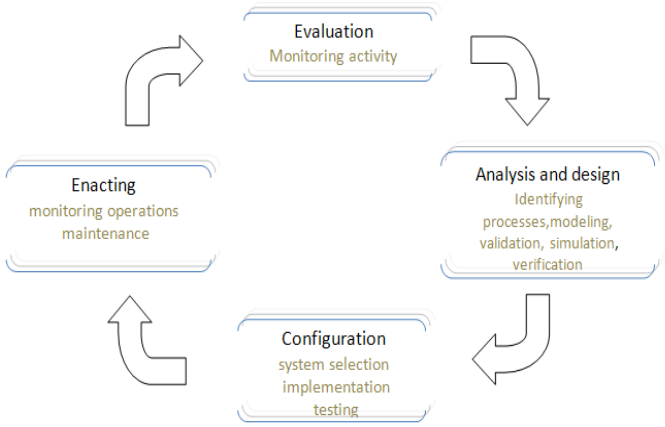

Figure 2. The life cycle of a business process. Adaptation from [7]

The life cycle of the process starts with an analysis and design phase. During this phase an assessment of the organization is made, in order to identify and understand the processes taking place within it and the organizational and technical environment in which they are carried out. Based on these evaluations, the processes are identified, reviewed, validated and represented using graphical tools resulting in business process models.

Once these models are built, the transition to the second stage takes place, namely to the configuration stage. Previously completed models must be implemented, and this can be achieved in two ways. Whether through the adoption of a set of policies and procedures that employees must comply with, in which case the process can be made without the assistance of a computer system, or by using a dedicated software.

In the latter case, the configuration phase involves the following activities: choosing a platform to implement, enriching the process model with technical information necessary for the enactment of the processes by the system and not least system configuration according to the organizational features of the enterprise environment.

The enacting phase of business processes includes the actual execution of the processes. The process management system actively controls the execution of process instantces according to the designed model. In this stage of the lifecycle, the process execution is monitorized and it's ensured that activities are conducted according to implementing restrictions specified in the model.

In the evaluation phase the available information is uesd to assess and improve business process models and their implementation. Execution logs are evaluated using activities monitoring techniques, which aim to identify the quality level of process models and the adequacy of the execution environment.

After studying the presented business process lifecycle as well as other materials regarding this issue, we propose a personal view on the topic.

Under this proposal the life cycle of a business process consists of six steps, represented according to the execution cycle and the logical dependencies between them.

These six stages are:

- Investigation

- Modelling
- Simulation and implementation
- Execution
- Monitoring
- Evaluation and optimization.

These proposal was developed after identifying all the steps in a BP lifecycle and it groups them according to logical

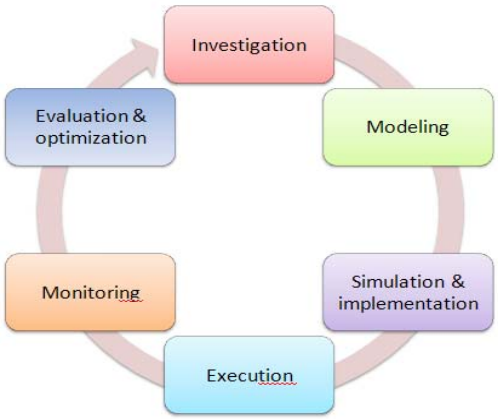

Figure 3. Proposed lifecycle of a business process

corelations. A graphical representation of the proposal is offerd in Figure 3.

The business lifeycle begins with the investigation stage. This is the moment when the strategic objectives of the company are corelated with the shorter term business objectives in order to identify and fully understand the scope of the business processes that are enacted within the company. This stage is necessary considering the direct link between the business processes and the strategic objectives of the firm.

After the processes have been identified, we move on to the second stage of the lifecycle which is modeling. Graphical tools are used to represent the processes thus creating the business process model.

One a process has been designed it moves on in the 3rd stage: simulation and implementation. The business model obtained in the previous stage is further developed by adding technical information regarding the enviroment in which the processes will run. Once the business model has been completed the process enters it's 4th lifecycle stage which is execution: enactement of the process in the production enviroment of the company.

Monitoring - running processes are monitored to measure key performance indicators and other relevant metrics. The results of monitoring are evaluated either according to predetermined criteria or by using simulation tools to obtain information on how to optimize processes using real data, this being the final stage of evaluation and optimization.

4. Methodology proposal for developing a BMP solution

Based on the described lifecycle, we propose an informal methodology that organizes the phases to be followed when developing a business process management solution.

This methodology is based on the life cycle stages of business processes summarized above, and uses a series of informal notations, its purpose being to provide a guide for those who are responsible for planning and implementing the project management business processes.

The methodology is organized in seven stages:

- Strategic Objectives
- Investigation
- Modelling
- Identification
- Simulation and implementation
- Execution and Monitoring
- Evaluation and optimization.

The first step (or stage) is to identify strategic and operational objectives of the company, which is necessary due to the direct link between the organization's strategy and business processes.
Business processes must work towards achieving the strategic objectives of the organization and as such they must be clearly identified and formulated. Processes contribute to realizing business goals which in turn contribute to meeting the strategies.
Once the organizational objectives have been identified it is necessary to study existing processes and ito identify processes that should be implemented (to-be processes). The overall objective of this phase is collecting and organizing information on all aspects of business process management, to ensure that we have a complete overview. This phase was called Investigation.
The third phase is the phase of modeling, in which the theoretical processes model is designed. Information obtained in the previous phase are structured, analyzed and represented as the processes model.
Once we have obtained the processes model, we must realize a selection of the platform on which the model will be implemented. Selected platform can be technical or non-technical. In the first case a variety of platforms might be suitable for the implementation of business processes, including automated platforms, such as enterprise application integration software or workflow management systems that support human interaction flows. In the second case, the busines processes model is realized through various business policies and procedures.
This selection phase is called Identification and it supposes passing through a decision node after the phase was completed. If the results of the stage indicates the need for using a non-technical platform, then we jump on to the execution and monitoring stage, and if technological platform is needed then we first go through the simulation and implementation phase.
Simulation and implementation of business processes involves completing the business processes model with all the technical information necessary to adapt the model to selected technology and also the development of prototypes to verify the accuracy and efficiency of the model obtained, under production conditions.
Once this phase is completed we proceed to execution and monitoring, a phase which comprises the enacting of the modeled processes. Simultaneously with the process/processes execution a monitoring component of the system vizualisez the state of process instances and collects information on them. Data is usually stored in log files and it represents the foundation for the next phase: evaluation and optimization.

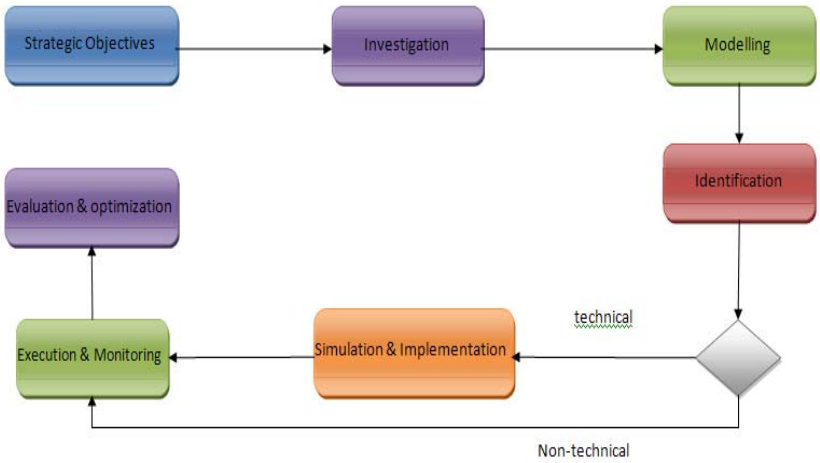

Figure 4. Proposed methodoloy for developing a BPM solution

5 Web Sphere Business Process Management (BPM) solution

It is approximated that currently there are over 160 BPM solutions on the market, and it is estimated that the market will grow by about 20% annually over the next two years. Opportunities on the BPM solutions market are very high. In 2000, most estimates showed that the BPM market was worth tens or hundreds of millions of dollars. Following analysis concluded that in 2011 the same market would reach a value between 4 and 6 billion dollars.

From the large pallete of BPM solutions a few of them stand out and take a high percentage of the market. One of these is the Business Process Management solutions suite from IBM WebSphere® portfolio, which is dedicated to ensuring the growth and productivity of a company and represent key elements of IBM Business Process Management Platform. They enable advanced integration by modeling, monitoring and effective management of current or planned processes within the company or partner network. Furthermore, increases the visibility of these processes within the company and how to quantify and audit them.

New software applications can be exploited quicker and the market transactions can be performed more efficiently than the competition. Control of these processes moves from IT people to business people which means extensive possibilities to adapt companies to economic changes.

The Business Process Management suite comprises the following products: WebSphere Process Server, WebSphere Enterprise Service Bus (WebSphere ESB), WebSphere Integration Developer, WebSphere Business Monitor, WebSphere Business Modeler.

WebSphere Process Server is a comprehensive Service Oriented Architecture integration platform that allows the deployment of standards-based business integration. It is it is based on the robust J2EE 1.4 infrastructure and platform services and includes, but is not limited to capabilities such as business process automation.

WebSphere ESB is a flexible connectivity infrastructure for integrating applications and services. It manages the flow of messages between service requesters and service providers and offers some mediation modules thathandle mismatches between requesters and providers, including protocol or interaction-style, interface and quality of service mismatches

WebSphere Integration Developer (WID) is an integrated development environment for building applications based on service-oriented architecture and it's based on industry standards, most notably WSDL, XSD, BPEL, Java, and UML. WID uses a set of visual construction tools and higher level concepts, which lets one focus on the business problems insted of code issues.

WebSphere Business Monitor is a Web application that is deployed and run under WebSphere Process Server 6 and that provides the ability to monitor different aspects of business performance in real-time. Among the features it provides we mention: monitor and manage business performance indicators, visualize performance data such as KPIs and metrics, view business-critical information graphically and others.

WebSphere Business Modeler is IBM's premier business process modeling and analysis tool for business users. It offers process modeling, simulation, and analysis capabilities to help business users understand, document, and deploy business processes for continuous improvement.

6 WebSphere Business Process Management solutions performance tuning and configuration

IBM engineers suggest the following key tuning and deployment guidelines as relevant in virtually all performance-sensitive customer engagements [8]:

- Use a high-performance disk subsystem. In virtually any realistic topology, a server-class disk

subsystem (for example, RAID adapter with multiple physical disks) will be required on the tiers that host the message and data stores to achieve acceptable performance.

- Set an appropriate Java heap size to deliver optimal throughput and response time. JVM™ verbosegc output will greatly help in determining the optimal settings.
- Where possible, utilize non-interruptible processes (microflows) instead of interruptible processes (macroflows). Macroflows are required for many processes (for example, if human tasks are employed or state must be persisted). However, there is significant performance overhead associated with macroflows.
- Use DB2 instead of the default Derby database management system (DBMS). DB2 is a high-performing, industrial strength database designed to handle high levels of throughput and concurrency. It scales well and delivers excellent response time.
- Tune the database for optimal performance. Proper tuning and deployment choices for databases can greatly increase overall system throughput.
- Disable tracing. Tracing is clearly important when debugging, but the overhead of tracing severely impacts performance.
- ConFigure thread and connection pools for sufficient concurrency. This is especially important for high-volume, highly concurrent workloads, since the thread pool settings directly influence how much work can be concurrently processed by the server.
- Use composite query tables for task and process list queries. Query tables are designed to produce excellent response times for high-volume task and process list queries.
- Use work-manager-based navigation to improve throughput for long-running processes. This optimization reduces the number of objects allocated, the number of objects retrieved from the database, and the number of messages sent for Business Process Choreographer messaging.
- Avoid unnecessary usage of asynchronous invocations. Asynchronous invocation is often needed on the edges of modules, but not within a module. Utilize synchronous preferred interaction styles.
- Avoid too granular of transaction boundaries in Service Component Architecture (SCA) and Business Process Execution Language (BPEL). Every transaction commit results in expensive database or messaging operations. Design your transactions with care.

7 Performance tuning methodology and checklist

For system performance tuning to be performed efficiently and succesfully, serious and vast training and experience are required. Therefore we do not try to describe the activity in detail but only highlight key aspects that are particularly important.

A system-wide approach to performance tuning of a WebSphere BPM environment is recommended.

When tuning a system it is important to remember that the activity includes and regards all the elements of the deployment topology and in the case of the WebSphere BPM suite this includes :

- Physical hardware topology choices
- Operating system parameters tuning
- WebSphere Process Server, WebSphere Application Server, and ME tuning.

The tuning methodology proposed consists of 4 iterative steps that will be executed in a loop.

1. Selection of the initial parameters and run the system.
2. Monitorization of the system to obtain metrics that indicate system health and to asses the need for further tuning.
3. Use of data obtained in the previous stage in order to guide further tuning changes. In general, this phase requires the analyst to examine the collected monitoring data, detect performance bottlenecks, and do further tuning.
4. Repeat until done.

In order to make sure all the important steps in tuning a WebSphere BPM solution are met, [8] suggests a checlist of activities to be used as a guide, by those performing the tuning. The list is organized in several categories, according to the tool used:

1. Common tuning actions:
   - Disable tracing and monitoring when possible.
   - Move databases from the default Derby to a high-performance DBMS such as DB2.
   - If security is required use application security instead of Java2 security.
   - Use appropriate hardware configuration for performance measurement
   - If hardware virtualization is used, ensure that adequate processor, memory, and I/O
   - resources are allocated to each virtual machine. Avoid over-committing resources.
   - Do not run the production server in development mode or with a development profile.
   - Do not use the Unit Test Environment (UTE) for performance measurement.
   - Tune external service providers and external interfaces to ensure that they are not the system bottleneck.
   - ConFigure MDB Activation Specs.
   - ConFigure for clustering (where applicable).
   - ConFigure thread pool sizes.
   - ConFigure data sources
   - Consider using non-XA data sources for CEI data when that data is non-critical.
2. Business Process Choreographer actions
   - Use work-manager-based navigation for long-running processes.
   - Optimize Business Flow Manager resources.
   - If work-manager-based navigation is used, also optimize message pool size and intertransaction cache size.
   - Optimize the database configuration for the Business Process Choreographer database (BPEDB).
   - Optimize indexes for SQL statements that result from task and process list queries using database tools like the DB2 design advisor.
   - Turn off state observers that are not needed (for example, turn off audit logging).
3. Messaging and message bindings actions
   - Optimize activation specification (JMS).
   - Optimize queue connection factory (JMS, MQJMS, MQ).
   - ConFigure connection pool size (JMS, MQJMS, MQ).
   - Optimize listener port configuration (MQJMS, MQ).
   - ConFigure SIBus data buffer sizes.
4. Database actions
   - Place database tablespaces and logs on a fast disk subsystem.
   - Place logs on separate device from tablespace containers.
   - Maintain current indexes on tables.
   - Update database statistics.
   - Set log file sizes correctly.
   - Optimize buffer pool size (DB2) or buffer cache size (Oracle®).

5. Java
   - Set the heap/nursery sizes to manage memory efficiently.
   - Choose the appropriate garbage collection policy.
6. Monitor
   - ConFigure CEI.
   - Set message consumption batch size.

8. Conclusions

Business Process Management Solution provide increased performance, productivity and reduce processing time by automating and optimizing complex processes by managing the workflow throughout the organization. Based on flexible customized standards, and with a large applicability area, BPM solutions can be implemented quickly and easily according to the needs of beneficiaries, by creating an infrastructure that connects users and applications.

One activity of utmost important in ensuring that the implemented BPM solution provides optimum results is tuning. The art of system performance tuning, requires training and experience and therefore it is difficult to synthesize it in just a few indications, so the intention of the present paper was only to provide a few key points of special importance.

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