Bank Loan Processes Modelling Using BPMN

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Abstract

The development of products and IT services in bank sector, including the number and the complexity of processes required to operate efficiently, have had important improvements. The work that is presented in this paper is focused on the modelling of business processes that a banking organization follows, during the procedures of a loan request. These activities are modeled with the aim to trace time-consuming processes, which cause delays to the total procedure. The methodology that is used for the Bank loan processes is the Business Process Modelling Notation (BPMN). Objectives of this work are: reduction in the duration of implementation of enterprising process, reduction of implementation time, reduction of cost, improvement of quality. Through the application of BPM and the use of process-oriented IT systems (BPM systems using BPEL code) bank performance of loan processes could be increased substantially. The proposed system will help in the synchronized selection and effective correlation of all information, so as to result in the creation of a centralized knowledge base, through the dynamic depiction of important KPI networks. Furthermore, for modelling and assessment of loan process effectiveness purposes and in order to model in the best way the analyzed simulation results, some specific KPIs are proposed in order to measure and assess BPMN-based processes.

Key Words: Business Process Modelling, Business Process Modelling Notation, Key Performance Indicators, Decision Support System, Bank Loan Processes.

1. Introduction

There has been much activity in the past three years in developing Web-Service based bank application systems [1, 2, 3, 4]. Our work focuses on the optimization of the approval process a bank conducts during the application process of small business loans. When a customer requests a loan from the internal departments of a bank, its application has the capability to slide from stage to stage after its initial submission, until the loan's final decision is made. The proposed information system objectives are the quantitative and qualitative follow-up of the process in question, through the creation and management of Key Performance Indicators (KPIs) in each status. An important attribute of successful process improvement efforts is the close relationship to the organization's business goals.

Once the business goals are defined, the organization has to accomplish the following tasks:

- Select a framework that will enable the realization of the goals and objectives.
- Select a process improvement approach.
- Develop and document a process improvement plan.
- Execute the plan with all of the management attributes that accompany any project.

There is a strong belief, as stated by Oberweis [5], that the most effective and efficient way to satisfy more than one standard is to implement them simultaneously rather than sequentially. Such an approach enables process developers to capitalize on the commonalties between those standards and use the strengths of one standard to offset the weaknesses in the other.

Process improvement is a major undertaking for any organization established [6]. It requires these tasks:

- Analysis of existing processes
- Changing existing processes
- Developing new processes
- Deploying new and modified processes through the organization
- Training staff to use new or modified processes
- Sometimes abandoning comfortable, yet inefficient old processes

Most organizations select an approach that will enable them to implement the selected standard(s) and then

measure the effectiveness of the new processes. The most fundamental approach is based on Plan–Do–Check–Act (PDCA) cycle [7]. In the PDCA cycle, the existing process is compared to the selected (or required) standard or model. Based on the detected "gaps", the organization develops a plan for process improvement, updates or changes processes, measures the improvement, standardizes the new processes, and finally implements them across the organization. The cycle repeats until all goals are achieved. With this definition, we move away from the rigid implementation of each clause found in a standard. The methodology that will be used will be applied to the Bank Loan Application Process. Focus is placed on the following four axes:

1. Reduction in the duration of implementation of enterprising process
2. Reduction of implementation time
3. Reduction of cost
4. Improvement of quality

2. Problem formulation

Business Process Management (BPM) is a concept tightly engaged with Information Technology (IT) and Management, for many years, under various names and labels [8, 9, 10]. Based on a process definition a BPM tool can route work between process participants, no matter if they were human actors or computer machines. As automatic management of business processes is considered as one of the cornerstones of advanced Enterprise Application Integration (EAI) solutions, leading EAI vendors started putting BPM engines on top of their EAI suites. Today's advanced EA concepts revolve around the idea of Service-Oriented Architecture (SOA) [11, 12]. Not surprisingly, BPM again is seen as an important building block of SOA. Since SOA focuses on standards, the industry has witnessed a "BPM standards war" with Business Process Execution Language (BPEL) emerging as a clear winner [13, 14, 15].

The Business Process Modelling Notation (BPMN) is the new standard able to model business process flows and Web-Services. Its definition has evolved over the years with its beginning being described as a way to manage processes on an ongoing basis and offsets it from BPR's one-off radical changes [16]. Van der Aalst [17] comprehensively defines of BPM as "supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information", further connecting BPM from modelers to organizations, their administration, and of course their highly valuable asset, their customers. As illustrated in the Fig. 1.1, these stages complete a Business Process Management life cycle.

The use of BPMN as the formalization language for contract-business processes is based on many features that make it prevail compared to other similar languages such as UML, activity diagrams, and format colored Petri nets. BPMN offers flexibility because it uses two levels of information representation, the graphical notation, that makes it simple to understand and the use of BPMN constructs to define a set of attributes that allow it to be specific.

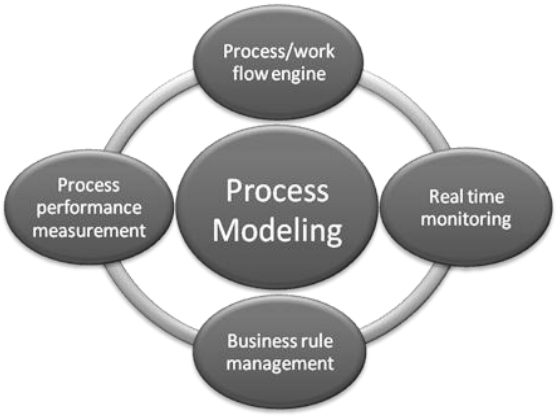

Fig. 1.1. Process Modelling Mix.

The ability to define attributes, user-specific activities and procedures makes BPMN the preferred option. The language's graphical nature makes it easily comprehensible by both modelers and users. Maintaining this easily understandable format, BPMN's non-graphical attributes allow modelers the ability to map to Business Process execution languages.

3. Loan Process Flow

The BPMN diagram, illustrated in Fig. 1.2, comprises of three separate pools. A pool object represents a participant in a process. A participant can be a specific business entity (e.g., a company) or a more general business role (e.g., a buyer, seller, or manufacturer). Graphically, a pool is a container for partitioning a process from other pools, when modelling business-to-business situations, although a pool need not have any internal details (i.e., it can be a "black box").

The first pool models the bank's client and implements the process of various loan applications. The second pool, the Bank System pool, contains the loan application processing operations and approval procedure. The orchestration pool acts as a central management entity of all other pools, administered by those that are responsible for the overall organization and communication. In the third pool, the employee pool, the bank employee operations, who is responsible for the approval phase are modeled.

The client, from the client pool, completes an application form on the internet. Thus, a request for a loan product from the bank is initialized. The bank system pool, after receiving the application request, communicates through xforms with the employee pool in order to check the client's application. The "check" sub-process examines the credibility status of each client and automatically designates the status of each application. This state verdict is an approval or denial of the particular client's application.

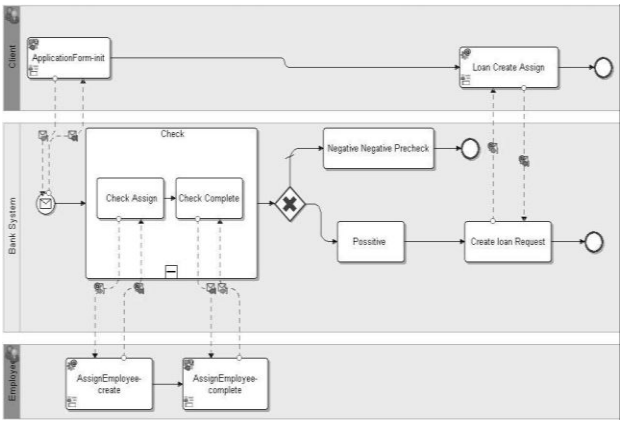

Fig. 1.2. BPMN model for bank loan initiation.

Modelling of the whole of the activities is performed using Intalio designer. Intalio|Designer is built on top of the popular Eclipse platform. It is a collection of Eclipse plug-ins, and runs on any of the many operating systems supported by the Eclipse workbench, including Linux, Mac OS X, and Microsoft Windows. Intalio|Designer is based on a modular architecture, with core modules being part of Intalio|BPP Community Edition. Intalio|Designer provides an environment where deployed processes are just one click away, literally. Once a BPMN process has been modeled, bound to external systems and linked to workflow tasks all artifacts are deployed onto Intalio|Server. Intalio|Server is a native BPEL 2.0 process server based on the J2EE architecture and certified for a wide range of hardware platforms, operating systems, application servers, and database servers.

The proposed system will help in the synchronized selection and effective correlation of all information, so as to result in the creation of a centralized knowledge base, through the dynamic depiction of important KPI networks. The key, for the successful system application for web-KPI monitoring, is the equitable choice of measurement indicators of record and their corresponding statistical significance, in order to reflect the strategy and the objectives of a bank, via the central loan methodology. The system will provide information and knowledge so much for time indicators of lending flows (named as "Timestamps KPIs") as for, quantitative indicators (named as "Volume KPIs") and qualitative indicators (named as "Quality KPIs") respectively. The correlation of the three categories that will be achieved via the proposed system could produce a dynamic system of decision making where the user will be able to make decisions based on the connected KPIs.

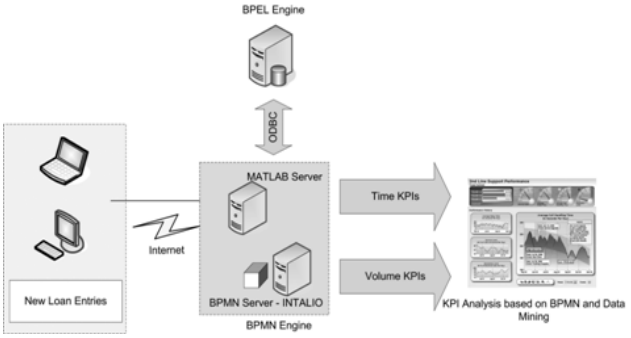

Fig. 1.3. Bank Loan Business Flow Technical Topology.

All the available information, as well as the access in all the sub-systems of the new web-KPI system of a bank, will be achieved by a specific web portal which will be accessible via the bank's intranet by all users, according to the rights of use and access that the bank has designated. The breadth of information is explicitly sufficient stemming from the fact that it does not emanate only from one system, but is found to be collected from various external sources and relevant databases.

More specifically, according to the actualized architectural structure (Fig. 1.3) of the information systems of the bank, the information that is used for catering of currently-used web-KPI system is found mainly in external DB systems of the bank, from where a credibility status of the application is generated automatically, according to the bank's internal data warehouse system. The core of the system is the central business logic server, implemented on Matlab along with the BPMN Intalio Server Engine. As soon as a loan request is made, the BPMN model generates some BPEL outputs that are analyzed by the business logic middleware (Matlab) according to some specific Key Performance Indicators that are explained below. The KPI analysis creates a dashboard of results and various graphs in order to assess the KPI performance and make a decision, based on the k-means clustering algorithm [18].

4. Dynamic Monitoring and Metrics (KPIs)

For modelling and assessment of the loan process effectiveness and in order to efficiently model the analyzed simulation results, some specific KPIs are derived. The KPIs are divided into three distinct sections. Section A comprises of Timestamps-relevant KPIs,

Section B includes Volume-related KPIs and Section C is a combination of the two above to create some Quality KPIs. The calculations are based on the BPMN model which has been already presented (Fig. 1.2) and was generated and simulated on the BPMN workflow engine, using the BPEL language and a back-end database system.

4.1. Timestamp KPIs

Four Time-related KPIs are used, in order to measure the time delays in between several statuses in the overall BPMN model. The time measurements will be executed on the workflow engine, using BPEL coding and a MySQL database in order to store and analyze the timestamps. TA represents the overall approval time for a specific application (i) in a specific branch of a bank (j). Summation series are used to measure the overall delay from the initial loan request up to the final contract status for a loan request. TR represents the overall rejection time for a loan application that due to several reasons is rejected by the bank employee. TD represents the application queue delay metric that represents the fractional delay factor between two important process flows. The process of creating a loan request after the application is being approved over the two signatures processes. This fractional time indicator will measure and compare at the same time the two most important and time consuming processes in the loan request procedure.

Finally, the TC metric will measure the final contracting time for every application. The combination of the contracting time with the overall delay and the delay metric, will reveal the cause of any specific delay in the overall process and indicate the employee that should speed up its individual performance.

4.1. Volume KPIs

Regarding the volume metrics, three Volume-related KPIs (Table 1) are used, in order to measure the volume delays between several statuses in the overall BPMN model. The basic metric unit is the application of a loan.

Table 1. Volume Key Performance Indicators

Description	Volume KPI
Total Applications Processes (F_A) per Bank (j)	$\sum_{j \in N} [F_A]_j$
% of Rejection (F_R) per Bank (j)	$\sum_{j \in N} \left([\frac{F_{2R}}{F_1}]_j \right)$
% of applications actually processed by contracting (F_C) per Bank (j)	$\sum_{j \in N} \left([\frac{F_4}{F_{2A}}]_j \right)$

According to the assessment procedures, the application may be rejected, or even blocked in a later stage of the overall process. Volume KPIs were constructed to measure and count the overall numbers of applications. FA represents the initial application pool of a specific branch (j). FR is the percentage of the rejected applications and FC denotes the final loan contracts that were processed by some successful applications. Volume KPIs will be combined with the time metrics in order to produce good quality KPIs to assess the quality of the loan procedures and by definition the quality of the employees taking part in the processes in various statuses and parts of the BPMN model.

4.3. Overall Quality KPIs

Quality KPIs evaluate the combination of the delay metric and the volume metric. Three quality metrics were produced, that will take part in the decision process according to some clustering algorithms. Metric Q1 represents the % ratio of accepted applications over the acceptance time. It denotes the quality of the loan acceptance "speed" and should be higher than the rejection quality metric, in order for the branch to have a positive ROI. Metric Q2 represents the % ratio of rejected applications over rejection time. A small value of Q2 denotes problematic employee performance (low number of loan application requiring big time intervals to be rejected) whereas high number also must be examined since the rejection status would be very "quick" to be analytic. Finally, Q3 denotes the overall quality metric of the loan process, by a product of the basic time delay metric (TD) and the number of final contracts from the successful applications.

5. Conclusions and Further Work

In this paper, BPMN approach was used, in order to model and measure a process performance. Through the application of BPM and the use of process-oriented IT systems (BPM systems using BPEL code) quality and bank performance of loan processes loan processes could be increased substantially. The most important effects of the procedure presented in this paper, are the following:

1. Cycle time could be reduced. This is mainly due to the fact that waiting time may be completely eliminated. As soon as a certain process step is finished the case is automatically moved forward by the BPM system using BPEL code.
2. Output per employee could be increased. All process steps that can be performed by a BPEL machine (without loosing quality) will be executed by the IT

system. For instance, prior to automation, employees were required to use long checklists for certain processes to ensure the process was carried out correctly.

In general, the importance of using simple models to describe, simulate and assess business processes is increasing in the field of financial institutions. However, the various systems available do not always offer cost-efficient integration mechanisms for BPM systems. Almost every BPM system available has its own reporting and performance measurement concept. Some of them are rather rudimentary whereas other systems are provided with broad and user-friendly analysis functions.

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