Optimization of the Business Processes Via Automatic Integration with the Document Management System

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***Abstract*— In today's global business environment, the importance of customer service, cost-competitiveness, and quality are key factors in determining an organization's success, or undesirable failure. Organizations try to optimize their processes to maximize their profits and make the very process faster. Users usually work with documents in the process. Working with documents makes the process more slowly, since the documents are important to be scanned and attached to the form. This work presents the optimization of such processes. It is achieved by automatic integration of Business Process Management and Electronic Document Management Systems. Improvements and results achieved by proposed integration are presented in this research. The model that is created enables monitoring of defined Key Performance Indicators in the identification process of the bottlenecks in the process. The process can be optimized by increasing the number of resources on the activities that are a bottleneck in the process. Such a solution has been tested in the process of opening a bank account.**

Keywords—business process management; business process optimization; document management; process automation; simulation

I. INTRODUCTION

Business Process Management (BPM) is a process-oriented management discipline [1]. Business Process Management is a top-down methodology designed to organize, manage, analyze, and reengineer the processes running in an organization. BPM is defined as a discipline "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" [2]. This means that BPM is linked with areas of Artificial Intelligence (AI) as Knowledge Management (KM), Knowledge Engineering (KE) and Business Intelligence (BI).

In the last few years, with the upcoming of the "third wave" of BPM [3], the BPM lifecycle has been increasingly supported by a set of software technologies, which have been bundled together to a so called BPM System (BPMS) and procedures, change business rules without impact on other applications

[4]. It means that processes involve collaboration individuals and/or groups. Companies which implemented Business Process Management are going to optimize their processes. Optimizing business processes results in: maximization of revenue and profitability, reduction of operational costs, customer service improvement, obsolescence and scrap reduction, risk management and compliance with policy and regulations.

Today's companies, moving from traditional work with documents and aiming to overcome technical, financial and operational barriers, gravitate towards implementation of Electronic Document Management System (EDMS). Benefits of EDMS are widely known: increased document security and control, more reliable backups, lower document management and archiving costs, better version control, better knowledge management and search possibilities [5].

Combining these two systems together enables a connection between content and processes at all levels of the enterprise. The right information, to the right people, at the right time, is critical in business process optimization [6]. In our work we combine BPM with EDMS system and this combination helps to make better and faster business decisions. Currently there are solutions that integrate BPM and EDMS together such as [7, 8]. Most of the solutions force users to the solutions document systems which are often restrictive. A General idea of integrating management systems and workflow-based electronic document management is presented in [9]. The mentioned general idea contains these two systems and benefits from their integration in terms of the organizational aspect. Solution (DocFlow) which combines these two systems is presented in [10] simple workflow, along with the workflow approval, which is also included. This work goes a step further and automate tasks in process where users use documents from EDMS. When scanned, documents are automatically attached to the process.

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Also, this work uses simulation to improve business process by identified bottlenecks and presents data warehouse model to analyze results of business process. The latter is done by using Business Intelligence (BI) before and after automation, while this research aditionally shows how can processes be improved using BPM-EDMS-BI systems.

This paper is structured as follows: BPM is discussed in general and an overview of BPM life cycle is given (see Sec. II). The idea of optimizing business processes with simulation, integration with EDMS system and automation of the steps where these two systems collaborate, and usage of data warehouse model to monitor process execution is presented in Section III. The idea is applied in financial service industry and the results are monitored using business intelligence. Evaluation is given by analyzing key performance indicators (KPI) before and after optimization (see Sec. IV). The paper ends with concluding remarks in Sec. V.

II. Business Process Management

A Business Process is the complete and dynamically coordinated set of collaborative and transactional activities that deliver value to customers [3]. BPM system is a suite of software applications that enable the modeling, execution, technical and operational monitoring, and user representation of business processes and rules, based on integration existing and new information systems functionality that is orchestrated and integrated via services [11]. BPM can be viewed as continuous cycle comprising the following phases [12]:

- *Process identification*. This the first phase where processes relevant to the problem are addressed. Sometimes this is done parallel with performance measure identification.
- *Process discovery*. This phase is also called as-is process modeling and here are current processes documented.
- *Process analysis.* In this phase issues related to as-is process are identified, documented and quantified whenever it is possible. Simulation is often used to identify bottlenecks, resources needed in process and process cost [13].
- *Process redesign.* The goal of this phase is to identify changes to the process that would help to address the issues from the previous phase and allow organization to meet its performance objective.
- *Process implementation.* After analysis and redesign comes implementation where process developers perform tasks: data mapping and transformation, system fault handling, designing and implementing user interface, designing business rules, creating dashboards.
- *Process monitoring and controlling.* Once the process is running, relevant data are collected and analyzed to determine how well is the process performing to the defined KPIs. New issues may then arise, and the cycle needs to be repeated on the continuous basis.

The BPM Life Cycle helps to understand the role of technology in BPM. Technology in general, and especially in Information Technology (IT), is a key instrument to improve business process. However, to achieve maximum efficacy, system engineers need to be aware that technology is just one element for managing and executing processes. System engineers need to work together with process analysts in order to understand what main issues affecting a process, and how to best address these issues, be it by means of automation or by other means.

III. Automatic Integration of Bpm and Edms Systems

As mention above, before and after the implementation there is a way to improve process by using simulation. Simulation is widely applied technique in BPM because of its flexibility. Simulation is used for what-if analysis or the correctness of a new design is verified using model checking. The first step in the simulation is the estimation of the parameters of the simulation. Parameters are estimated by recording of the real process and they depend on the tools simulation is done in. These are the types of the parameters for the BPM Suite [14].

- *The resource parameters:* resource cost per hour, availability, efficiency and number of resources.
- *Parameters of the initial activity:* instances of the process are being generated and defined. There are following distributions: constant, uniform, exponential, normal and real.
- *The activity parameters:* there are two types of such parameters. The first type relates to the activities in the process involving the user: the distribution tasks are carried out in the process with the mean value and standard deviation, resources that can be shared, meaning, to be shared among numerous activities or fixed ones (in this case, it is important that the number of fixed resources is specified) and activity price - which may only be the price of the resource performing the activity or to include the additional cost (workplace cost). The second type refers to automatic activities where the number of threads is being specified which demonstrates the speed of finalizing the activity.
- *Parameters of the gateway elements:* it is important to specify the probability of the instance of the process that will be continued with each branch.

The more precise simulation parameters, the better results will be. More precise results are achieved by methods such as: interviewing users involved in the process or by analysis of the files which contain information about already completed processes. Performances can be analyzed in three KPIs: time, price and the number of instances. For each of these KPIs, there is the cost analysis of resources and the activities in the process (Fig. 1.), and has two components: Resource busy cost and Resource total cost.

In most business scenarios, there will be information exchange between users. Documents are often used to store necessary

information and they are often mandatory in process. In most cases, documents must be reviewed by a number of individuals before they can be approved and forwarded further. This can extend duration of business process and directly affects the cost of process, quality of service etc. Let's assume the documents are manually submitted from one to the other participant in the process. Usually, the users are not close to each other physically, they can be in different offices, different buildings or different states. Users are also usually involved in different processes, deciding to treat some tasks with greater priority. This results in forgetting to manage the tasks of a lesser priority and loosing these very documents in the process. Additionally, the duration of the process is being increased, while at the same time, the efficiency of the process becomes insignificant. It would be convenient if all the documents were gathered in one place and users, depending on their assigned rights and obligations, could perform their activities on these documents. This would result in avoiding the abovementioned problem of losing the documents in the process, reduction of the duration of the process and increased efficiency. This brings the idea of working with documents in electronic formats where the documents would be stored in the folder alike structures - introducing the Electronic Document Management. Folders are organized in order to reduce operating costs and shorten the time of searching through documents searching of documents [15]. One of the main advantages of the BPM and EDMS integration is that users during the filling of the electronic forms, where they are supposed to attach documents, do not attach the very documents, but the links to the documents located on a specific site in the organisation. This helps us to avoid the duplicaton od the documents in the system and the process is faster, because the time of the uploading of the documents is reduced. Users exchange links among themselves, but have the impression of exchanging the documents.

Tracking data from activity checkpoints of unit transactions within an organization's business processes is an important data resource for business analysis and decision-makers to provide essential strategic and tactical business information. It's very important to know how processes are executed in real time. To analyze processes in real time we use Business Activity Monitoring. This technique allows us to measure various aspects such as time, cost, performance and many others [16]. To be able to monitor activities occurred in business process in detail and provide a good visibility for process monitoring there should be a good data warehouse model [17]. We created an activity warehouse model. This model contains an activity table and set of dimension tables as shown in Fig. 2. Activity table is structured as follow:

```
Activity (ID, ProcessID, ActivityLabelID,
RoleID, StatusID, OrganizationID.
```

Dimension tables consist of dimensions like process, user, role and time.

```
ActivityLabel (ActivityLabelID, Name,
ActivityCost)
Role (RoleID, Name, RoleCost, Description)
Organization (OrganizationID,
Name,Description)
Status (StatusID, Name, Category)
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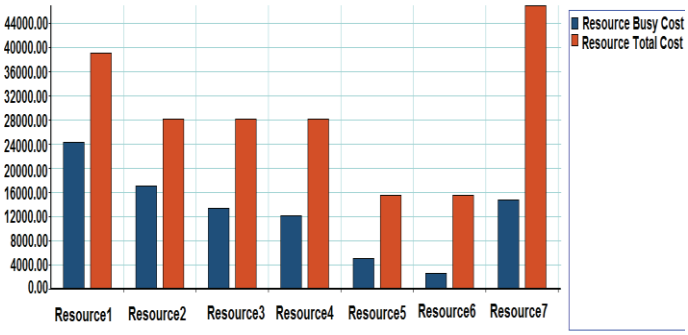

Fig. 1. Resource Cost analysis in BPM

We use this model to monitor real time execution of business process with business intelligence and business activity monitoring.

All the optimization ideas of the business processes through the simulation, integration of the BPM and EDMS systems and real time monitoring are presented in the following chapter on the specific process from one of the banks in Bosnia and Herzegovina.

IV. Case Study

The idea of optimizing the business processes through the simulation and automatic integration with EDMS system is represented in the process of opening an account in a bank in Bosnia and Herzegovina, whose name is omitted for anonymity.

A. Problem description

This process is chosen because it represents the process in which users work with documents: they scan, submit and control the documents, and it is a good example of the process that can be optimized as mentioned above. Fig. 3. shows the process of opening an account to legal entities. BPMN 2.0 (Business Process Management Notation) standard was used for the presentation of the process and it is the world standard for business process modeling. The process begins when a client comes to the bank to open an account. The client submits an appropriate request for opening an account. After that, a loan officer collects the necessary documentation for opening an account. Another loan officer checks the completeness of the collected documentation. Then, they check if the client has already had an opened account status in the registry, and his account is registered. It is necessary to record if the contract is generated and sent to signing. When the client signs, the recording of the executed signing is made, as well as the account activation. In the end, it is necessary to record again if the original documents of the client have been received.

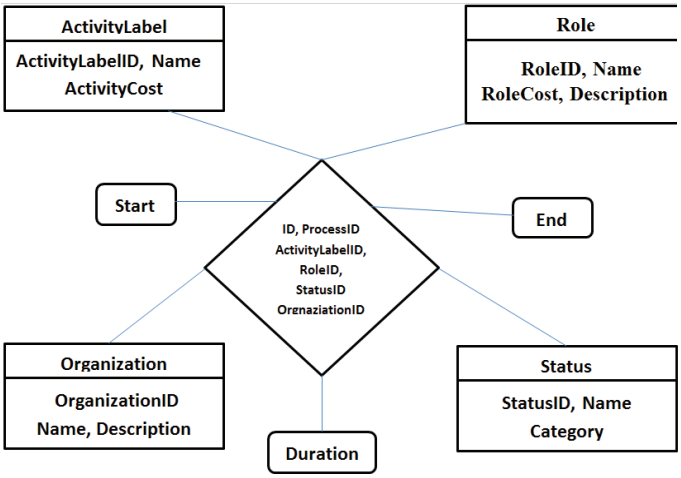

Fig. 2. Data warehouse activity model

B. Problem definition

The performance of the process will be observed with two KPIs: process time execution and the total cost of the process. The execution time of the process for a single instance can be calculated as the sum of the time execution of all the activities in the process. This is also applied for the cost of the process. If there are *n* activities in the process, the time execution *t* and the cost *c* can be calculated in these relations (1) and (2):

$$t = \sum_{i=1}^{n} t_i \tag{1}$$

$$c = \sum_{i=1}^{n} c_i \tag{2}$$

Where t_i is the duration of the execution of *i* activity in the process, and c_i the cost of the execution of *i* activity in the process. It is important to emphasize that the durations t_i are mutually dependent. The duration of the execution of the current activity in the process depends on the duration of the execution of activities that come before analyzed activity, which can be presented through (3):

$$t_i = f(t_1, t_2, \dots, t_{i-2}, t_{i-1}) \tag{3}$$

For example, if we observe the activity Completeness check in the process in Fig. 3., this activity obviously depends on activity Collection of documents. Users can not perform their task in the process, until documentation is collected. They can also get documents for review when they are not at work, for example during the break or meeting. The duration of their performance of the activity will not be the same as in the case when they are available to review the documentation promptly. In the process shown in Fig. 3. it is important to pay attention to Collection of documents activity. In this activity starts a connection with the EDMS system. In this part of the process, the users scan the documents, required for opening an Scanned documents are saved in the system and users attach

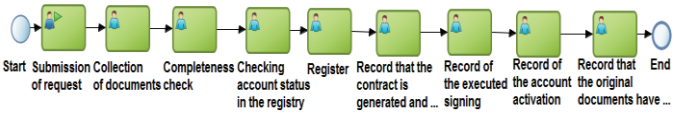

Fig. 3. Process of opening an account to legal entities

these documents in electronic format to the process. The time this activity takes for execution, has 3 components (4):

$$t_2 = t_s + t_a + t_d \tag{4}$$

Where the t_s time is necessary for scanning the documentation, t_a time necessary for attaching the documents to the process, t_d time necessary for completing the task in the process (filling the appropriate fields in the form, etc.). Integration is achieved as described in the previous section. Documents are kept at a unique place in the system, and users in the process only submit links to the documents. This results in not occupying the additional space on disks and the process of the attachment of the documents is faster.

C. Data

Presented BPM and EDMS systems integration is realized at the application level via links (Fig. 4.). BPM and EDMS use separate databases. BPM database stores the information about the process, users etc. and EDMS database stores documents and information about the metadata documents. Data are obtained from the database which registers and stores all occurrences of the process. Occurrences contain information about: unique instance number of the process, event (activity), type of event (started or completed), time of event and about the user who is involved in the process. This kind of integration is implemented in the process shown in Fig. 3. In order to monitor performances of the process, data warehouse model is defined (Fig. 2.). Using the model with the help of dimensions `ActivityLabelID` i `Duration` we can get the information on the duration of each activity in the process. Also using the dimensions `ActivityLabelID`, `ActivityCost` and `RoleCost` we can get the information about the cost of the each performed activity in the process. As mentioned in Section 3., the cost of performing the activity includes the cost of the workplace and the cost of the person performing this task. These documents are sufficient for the analysis of the process by two different KPIs: duration of execution of the process and the total cost of the process. After defining the data warehouse model, we can continue with the analysis of the process execution. Results are shown in Fig. 5. The analysis was conducted in the period of 15 days. Fig. 5. shows the total execution time for each activity in the process. Fig. 5. also shows that Collection of the documents activity has the longest execution time of more than one day. This means, the instances of the process are most retained during the collection of the documents and this is where is the bottleneck in the process. Retaining the process instances in this activity directly influences the retaining in other activities following this one according to relation (3). After this activity, the process retains the most in the activities Completeness check and Checking account status in the registry. The activity Collection of documents, which is a bottleneck in the process is

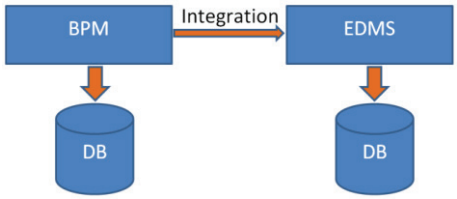

Fig. 4. BPM and EDMS system integration

at the same time the place where the integration with EDMS have been realized. The execution time of this activity has 3 components according to relation (4). In order to optimize the process, it is necessary to reduce the execution time of that activity. The only component of the time that can be affected is t_a. The component t_s is the scanning time and cannot be eliminated, because it is necessary to scan the documents in order for them to be available in electronic form, as well as the time t_d, because the user has to examine filled fields in the form, and possibly fill some of them. The execution time of the collection of documents t_2 will be reduced by minimizing the component t_a. The measured results of proposed solution of the optimization is shown in Fig. 6. Instead of existing integration at the application level, integration at the database level was presented. The system now uses one database instead of two. User is no longer obligated to scan the document and submit it again in the form. Now the system works in a instances of the process as one of metadata. This data is sufficient for the system to recognize the instance at the level following manner: after the documents are scanned, those documents (more precisely: links to the documents) are automatically attached to the corresponding instance of the process. The automatic integration is achieved when the user, during the scanning of the documents inserts the number of instances of database, and to join links to the instance (links that lead to the newly scanned documents). Thus, the users do not have to attach documents at $t_a = 0$.

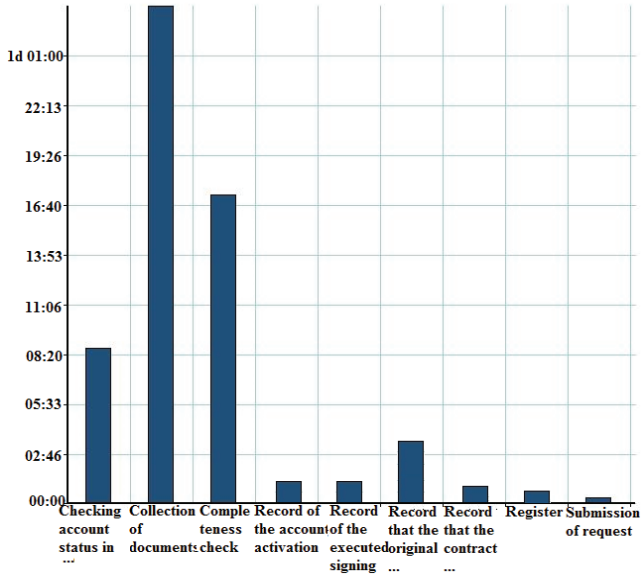

Fig. 5. The total time of activities duration in process

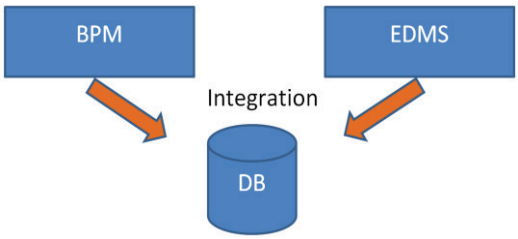

Fig. 6. Automatic integration of BPM and EDMS systems

D. Result

Fig. 7. shows the time analysis of the automated process in the same period of 15 days. The process acceleration is even faster, considering the fact that Collection of documents activity is performed by 14 users. It is obvious that the proposed solution is improved, in other words, the time execution of the Collection of the documents activity is reduced. This also causes the reduction of the execution time as well as other activities in the process following after the Collection of the documents activity. The total cost of the process is reduced too, because the cost of the process depends on execution time of activities in process.

Fig. 7. shows that the bottleneck is in the process on the Completeness check activity. For the further optimization of the process the implementers suggest to increase the number of the users performing the activity in the Completeness check. Currently, the number of users performing this activity is 2. Increasing the number of the users can result in increasing the cost of the resources in that activity, because workers cost more. On the other hand, the execution time of the very process will be reduced as well as the total cost of the process. It is profitable to increase the number of users if the reduction in prices of the process will be higher than the increase of prices by adding new participants to the process. Simulation shows that the cost of the process decrease by 8%, with over 10000 to 9200 unit prices (Fig. 8.). The total cost of the process takes

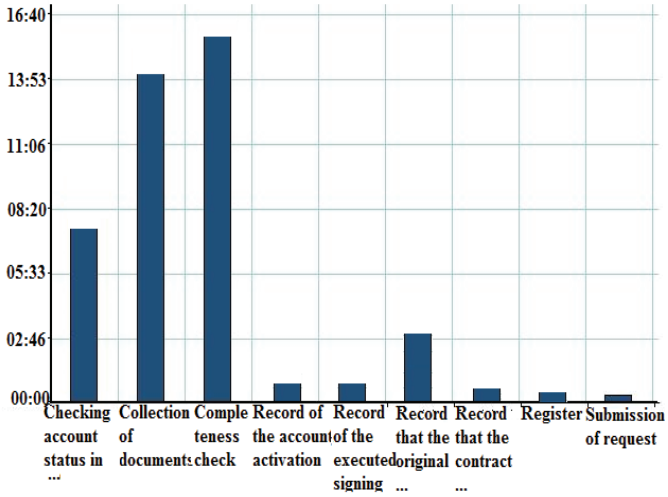

Fig. 7. The entire time execution of the activity in the process after the automatic integration BPM and EDMS systems

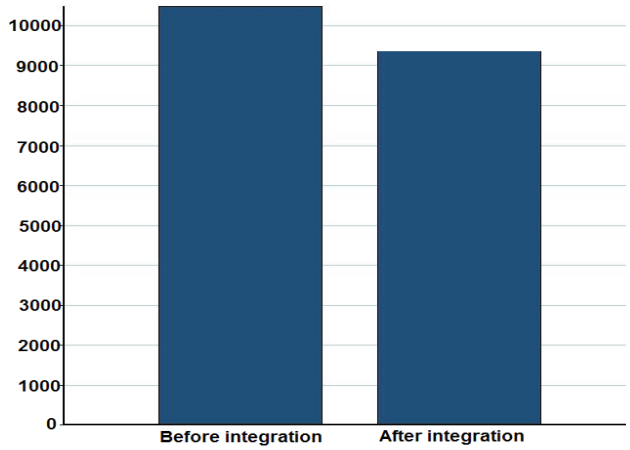

Fig. 8. The entire time execution in the process are minimized after the automatic integration BPM and EDMS systems

into account the cost of resources and the cost of jobs, and depends on the execution time of the process. Increasing the number of resources regardless of the simultaneous increase of the cost of resources, decreases the total time of the execution of the process on every activity and will cause decreasing of the cost of the entire process. The results of the simulation are presented to the bank which will further decide on the proposal of the optimization.

V. CONCLUSION

This paper shows the processes that can be optimized in which users work with the documents. The presented idea of optimization includes the automatic integration of BPM and EDMS systems. During the scanning, the documents are automatically being attached to the appropriate instance of the process, which helps users to avoid manual attaching of the documents in the form. In this way, time of the process implementation and price of process, too, were reduced. Larger number of places for integration BPM and EDMS systems in process, mean greater improvement of process. This approach is comprehensive, and can be used in any process. Solving the problem of bottleneck in the process on one activity is reflected on all other activities in the process. It has also been demonstrated by simulation that the increasing of the number of the resources on the bottleneck in the process results in reduction of the cost of the overall process, no matter of the resource price increase. This improvement has been achieved because the total duration of the process is effectively reduced.

REFERENCES

[1] R.K.L. Ko, "A computer scientist's introductory guide to business process management (BPM)," ACM Crossroads, vol. 15, no. 4, pp. 11–18, Summer 2009.

[2] W.M.P. van der Aalst, A.H.M. ter Hofstede, and M. Weske, "Business process management: A survey," in Proc. Business Process Management: International Conference, BPM 2003, Eindhoven, the Netherlands, ser. LNCS. Springer, June 26-27, 2003, pp. 1–12.

[3] H. Smith and P. Fingar, Business Process Management. The Third Wave. Meghan-Kiffer, US, 2003.

[4] S. Cleveland. (2016, January, 14). BPM from a Business Point of View, business process management, Greatest Benefit from BPM. [Online]. Available: http://www.ebizq.net/blogs/bpm_business .

[5] P. Fenton. (2016, January, 20) 10 Benefits of Moving to Electronic Document Management System (EDMS). [Online]. Available: http://blog.montrium.com/blog/10-benefits-of-moving-to-electronic-document-management-for-life-science-companies

[6] G. Paradapakis, Business Process Management with Document and Content Management. IBM United Kingdom, 2010.

[7] Xerox Document Management. (2016, February, 3). [Online]. Available: http://www.realbusiness.com/#/documentmanagement/service-offerings-dm

[8] HP. (2016, February, 3). JetAdvantage solutions for workflow management. [Online]. Available: http://www8.hp.com/us/en/solutions/business-solutions/printingsolutions/workflow.html.

[9] H.T. Pho and T. Tambo, "Integrated management systems and workflow-based electronic document management: An empirical study," Journal of Industrial Engineering and Management (JIEM), pp. 194-217, 2014.

[10] B. Yimwadsana, C. Chaihirunkarn, A. Jaichoom, and A. Thawornchak, "DocFlow: An Integrated Document Workflow for Business Process Management," Interntaional Journal of Digital Information and Wireless Communications (IJDIWC), pp. 219-229, 2011.

[11] P. Ravesteyn, R. Betenburg, and B.D. Waal. "In Search of Competencies Needed in BPM Projects," Communications of the IIM, vol 8(2), pp. 23-30, 2008.

[12] M. Dumas, M.L. Rosa, J. Mendling, and H.A. Reijers, Fundamentals of Business Process Management. Springer. New York, U.S., 2013.

[13] G. Hook, "Business process modeling and simulation," in Proceedings of the 2011 Winter Simulation Conference, Winter 2011.

[14] Oracle Corporation, Modeling and Implementation Guide for Oracle Business Process Management. U.S., 2013.

[15] K. Neal. "Driving better business performance with document management processes," The Information Management Journal vol. 42, no. 6, pp. 48-49, Winter 2008.

[16] Oracle Corporation, Monitoring Business Activity with Oracle BAM. U.S., 2015.

[17] O. Mangisengi, M. Pichler, D. Auer, and D. Draheim. "Activity warehouse: Data management for business activity monitoring". in Proceedings of the Ninth International Conference on Enterprise Information Systems, vol. DISI, June 2007