Unification of business processes in a multi-site company

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Abstract: Companies operating as multi-site organizations usually operate disparate business processes across sites and IT systems written in various technologies. Therefore, unification of business processes as well as IT systems and technologies are becoming matters of high significance. The purpose of the paper is to present a method for unifying business processes of a multi-site company. The method addresses also the matter of IT support to selected activities within business processes. The method, proposed in the paper, examines the similarity of processes and is based on a comparison of pairs of nodes on the label and type. During unification, two version of the same process are compared. To the new, unified version, only the most time-efficient activities are selected. Corresponding, less effective activities are omitted. The method assumes refinement of business processes which stems from ability to execute business process in a different manner thanks to support of IT systems. An example of a business process unification in the medical sector with the participation of the Polish National Health Fund (NHF) was enclosed. In the paper are presented: AS-IS state, method of unification and TO-BE state of medical prescription lifecycle. In that example, selected similarity metrics of business processes are used. Furthermore, formulae are proposed for calculating savings that can be gained through unification of business processes in a multi-site company. A specific example of such calculations is presented. The reduction of time needed to carry out business process activities is realistic and can become a source of financial savings for a multi-site company. The medical example shows ability to reduce process execution time from hours to minutes. Such a significant time gain is possible not only owing to unification of the business process activities, but mainly through IT support and automation of most of the process activities.

Keywords: Business Processes Management, Business Process / IT Alignment, Enterprise Application Integration

1. Introduction

Companies operating as multi-site organizations are facing a whole range of various problems. The diversity of disparate business processes across sites is one of them. Also, problems may arise with various IT systems being operated separately in plants. Furthermore, if these systems are based on various technologies, the need to expand and maintain many technological platforms is becoming problematic. In addition to this, difficult interoperability between such systems impedes production of consolidated reports for the company. Lack of adequate support translates into extended duration of business processes. Moreover, incompatibility of business processes prevents adoption of standardized procedures throughout the company. Therefore, unification of business processes, information systems and technologies is becoming a matter of high significance. The subjects of enterprise de-
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scription and transformation are addressed by enterprise architecture which is defined as “a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise’s organizational structure, business processes, information systems, and infrastructure” [1].

The purpose of the paper is to present a method for unifying enterprise business processes, including the application of a standardized IT support to the unified business processes of the company. The important advantage of the approach proposed in the paper is the fact that it does not require re-writing the organization’s existing IT systems. Instead, application of a layer integrating the systems operated across the enterprise sites is proposed [2, 3]. Enterprise architecture is used as a solution to align business processes and IT systems of multi-site companies. The remainder of the paper is structured as follows. Section 2 contains an overview of publications dedicated to similar problems. Section 3 describes areas of support and benefits of implementing enterprise architecture in a multi-site company. Section 4 introduces business processes performance measures. In section 5, method for unifying business processes is presented together with a definition of business processes similarity metrics. Sections 6 and 7 gives a business case description and an example of selected business processes unification. Section 8 outlines benefits of business processes unification and integration of IT systems. Section 9 concludes the paper, summing up the subject and outlining directions for further work.

2. Related studies

An overview of the literature covers the following topics: business processes similarity, IT systems support for business processes. Similarity of business process models is discussed by Dijkman, Dumas et al. [4]. The article defines business process similarity metrics in such areas as: syntactic similarity, semantic similarity, similarity of attributes, similarity of types and contextual similarity. In the paper syntactic similarity measure is used. Furthermore, metrics for business process models are discussed by Mendling [5]. A comparative survey of business process similarity measures is presented by Becker and Laue [6]. In the paper the general method for comparing two process models is described, as well. Unification of business processes involves the problem of business process improvement. Lemets et al. [7] present factors that are critical to the improvement projects success seen from the perspective of supporting the organization’s business goals. Moreover, problem of refactoring of activity labels in business process models is still analysed in current works. The approach described by Leopold et al. [8] ensures recognition of activity labelling style and unification to one, desired labelling style. Business process model repositories tend to accumulate duplicate fragments over time. The approach which ensures fast detection of exact clones in business process model repositories is proposed by Dumas et al. [9]. Furthermore, Dijkman, Gfeller et al. [10] propose a technique for automatically detecting refactoring opportunities that can be applied to correct anti-patterns, such as overlap of process models, inconsistent labeling of activities and overly complex models. In area of process unification there are papers in the context of reference modelling. Reference models for a single company is under scrutiny and processes are modelled mainly with the use of extended Event-Driven Process Chain (eEPC) diagrams [11]. In the paper, BPMN [12, 13] and UML [14] are used. Furthermore, the paper deals with problem of business processes unification within enterprise consisted of multiple sites which realize similar functions. Plants in multisite companies often perform similar business processes. Therefore, an effective search in the repository can locate these processes and gives opportunity to unify them. Moreover, the literature addresses the subject of correctness of business process descriptions. Patig and
Stolz [15] present an approach for verifying business process descriptions that can be presented in any style. Whereas, Becker and Laue [6] focus on the BPMN business process models correctness. Also, the focus is increasing in the field of business process models quality, verification and improvement [16, 17]. The demand grows for guidelines that lead to consistent and integrated collections of process models. Dijkman et al. [18] provide an overview of the prevailing approaches to design a business process architecture and presents a framework for business process architecture design that can be used to develop a concrete architecture.

IT systems play an important role in companies. An overview of the literature addressing the problem of process models for service oriented applications provide Lane and Richardson [19]. The IT system support to business processes, seen in the context of dynamic and optimal selection of services needed for business process tasks, is subject of current research works [20, 21]. Most commonly, an organization operates a variety of IT systems. This implies the need to build integration solutions comprised of IT systems and a communication layer that enables cooperation between these systems [22, 23]. Integration of many various IT systems makes the integration project highly complex [24]. On the other hand, deployment of well designed integration solution among cooperating organizations can lead to substantial savings in terms of time [25]. Supporting dynamically reconfigured business processes [26] and addressing non-functional requirements [17, 27] are another vital problems concerning service oriented architecture.

The method, proposed in the paper, examines the similarity of processes and is based on a comparison of pairs of nodes on the label and type [9, 28]. An ambiguity of language arising from the formulation of the same things in different way often is the cause that individual labels activities may vary slightly. The author proposes to extend the comparing models method [4, 9] for the admission of discrepancies in the value of the label on the level of the acceptable threshold. The similarity of the two models of processes is defined as the percentage of the number of common nodes in relation to the total number of nodes. Furthermore, definitions of business process performance metrics are introduced. In the literature there are papers which deals with measuring the realization of benefits from Enterprise Architecture Management [29]. But authors concentrate mainly on EAM success factors derived from expert interviews. In the paper, author proposes formulae for calculating benefits of the business processes unification in a multi-site company.

3. Multi-site company support areas

The following areas of support to be provided by means of enterprise architecture to a multi-site company have been distinguished: business processes, information systems, technologies and technical infrastructure. In each of these layers, an organization can be supported in the context of a more efficient realization of its tasks. The maintenance cost of the infrastructure supporting the realization of tasks is also a matter of importance. The enterprise architecture implementation can result in the following benefits for the organization:

- unification of business processes – as a result, consistent processes and operating procedures are used throughout the company,
- unification of information systems – as a result, costs of IT support are minimized and business processes can be supported efficiently,
- automation of activities carried out within business processes – this includes a minimized time and resources required to perform the activities,
- unification of information technologies and tools – a minimized number of technologies, as well as strategic approach to decisions concerning the technologies
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...to be used [30]. This is particularly significant in the rapidly changing business environment.

The paper focuses on the aspect of supporting a multi-site enterprise in the area of unification of business processes and information technology systems.

4. Business process performance metrics

The basic criteria for evaluating the way how a business process is performed address the time taken to complete the process and the number of activities carried out within the process [31]. Business process performance metrics can be grouped into the following categories: effectiveness of tasks receiving, effectiveness of process’s activities realization, tasks service effectiveness.

In the category of effectiveness of tasks receiving, the following business performance evaluation metrics can be defined:

- \( z_t \) – the number of tasks received up to point of time \( t \),
- \( S_z = \frac{z_t}{t} \) – the mean number of tasks received in a time unit,

In the category of effectiveness of process’s activities realization, the following business performance evaluation metrics can be defined:

- the total time required to complete business process \( T_p \)
  \[
  T_p = \sum_{i=1}^{L_p} t_i
  \]
- the total cost of business process execution \( K_p \)
  \[
  K_p = \sum_{i=1}^{L_p} k_i
  \]

where:
- \( L_p \) – the number of steps (activities) in the business process,
- \( t_i \) – the time taken to complete the business process step (activity) \( i \), where \( i \in [1, L_p] \),
- \( k_i \) – the cost of the business process step (activity) \( i \) expressed in PLN, where \( i \in [1, L_p] \).

With the business process performance metrics defined, it is possible to compare processes. The formulae presented above can be used for comparing business process variants operated by various company sites. On this basis, a standardized business process model can be developed for the entire company.

5. Method for unification of a multi-site company business processes

The following approach to unification of business processes is proposed by the author – complete unification of a business process.

The method involves analysing the business process variants operated throughout the company and using the pre-defined business process performance metrics as a basis for identifying the most efficient activities. Comparison addresses corresponding activities performed within the business process variants. Figure 1 is a graphic representation of a process executed at two different sites. Activities 1.1-1.3 are performed by site X, while activities 2.1-2.4 – by site Y. Activity 3.1 occurs on the company A level. Individual activi-
ties are compared in terms of efficiency. The most time-efficient activities are: 2.1, 1.2 and 2.4. Having merged the most efficient activities into a process, one obtains a new, unified process, which is more efficient than any of the previous variants executed by sites X and Y. Thereby, both sites’ process-related knowledge and experience are employed.

![Figure 1. Business process variants executed by various sites.](image)

Figure 1. Business process variants executed by various sites.

Figure 2 illustrates the unified process consisting of activities 2.1, 1.2, 2.4 and 3.1, which can be used at both sites – X and Y.

![Figure 2. A unified business process to be used by both sites, X and Y.](image)

Figure 2. A unified business process to be used by both sites, X and Y.

During unification, two versions of the same process are compared. To the new, unified version, only the most time-efficient activities are selected. Corresponding, less effective activities are omitted.

The similarity of the two models of processes is defined as the percentage of the number of common nodes in relation to the total number of nodes – process similarity coefficient $ps_{ij}$ [4]:

$$ps_{ij} = \frac{n_{sij}}{n_i} \times 100\%$$

(3)

where:

- $ps_{ij}$ – process similarity coefficient of model $i$ to model $j$,
- $n_{sij}$ – number of nodes from model $i$ which occur in model $j$,
- $n_i$ – number of nodes in model $i$.

It was assumed that process $i$ and process $j$ are considered as similar if the value coefficient $ps_{ij}$ is not less than 70%.
In order to be able to compare business process activities, it is necessary to know how to match similar activities from various variants of the process. As the analysis has addressed corresponding processes, the present paper focuses on syntactic similarities of the business process activities.

In the paper two metrics were used. Two elements of the process are considered equal if their type is the same and the label similarity coefficient is not less than 70%. The label similarity coefficient \( ls \) [4] is calculated as follows.

\[
ls = \frac{cl}{l} \times 100\%
\]  

(4)

where:
- \( cl \) – total length of the n-word substrings from the shorter label found in the longer label,
- \( l \) – length of the longer label.

For example: for an activity from a business process variants labelled “Verification of patient's rights in the system” and “Verifying the patient's rights in the system”, the value of \( ls \) is 0.77, since the \( cl \) equals 36 and the \( l \) equals 47.

These formulae (3) and (4) have been used for comparing all activities within the business process variants and for matching pairs of corresponding activities. More complex metrics of business processes similarities, comprising semantic similarity, similarity of attributes, contextual similarity, similarity of nodes, structural similarity and behavioural similarity are discussed by Dijkman, Dumas et al. [4].

The use of the label similarity coefficient expands potential opportunities for finding similar activities and processes. This approach can better select candidates for unification by excluding the inaccuracies due to human errors or a different nomenclature adopted by various sites.

6. Analysis of the case study business process AS-IS state

The case study presented below describes the medical prescription lifecycle. The company concerned is the Polish National Health Fund (NHF), while healthcare service providers issuing NHF-refunded prescriptions and pharmacies dispensing the NHF-refunded prescriptions, are its subsidiaries (sites). The cycle of prescription circulation consists of four main processes (Figure 3): assigning numbers to prescriptions, prescription issuing, prescription processing, prescription billing.
The first process begins upon the healthcare service provider’s request to the Fund to assign unique numbers to prescriptions. Most typically, these are collective requests, where administrative entities apply for allocation of numbers on behalf of all physicians working at the given provider’s facility. Each entity (physician) authorized to prescribe NHF-refunded medicines is allocated a pool of numbers ranging “from – to”. The numbers assigned in this way are usually printed on a pad of prescription forms; less typically they are entered to the HIS (Hospital Information System) class system, where a number is picked from the pre-prepared pool and assigned to a prescription being issued. A patient takes the filled prescription form to a pharmacy and hands the document over to a pharmacist. The pharmacist verifies the prescription, i.e. checks whether the prescription form used is valid, all the fields are filled as required and in a legible manner, the patient is eligible for refund and the medicine covered by the NHL refund plan. If any incorrectness is found, the prescription cannot be processed under the refund procedure. Consequently, the patient has two options to choose from – to buy the prescribed medicine at a full price or to revisit the doctor’s office to have the document corrected and come back to the pharmacy to have the medicine dispensed under the refund plan.

In the process of prescription billing, each pharmacy prepares a monthly report for the NHF, summarizing all the refunded prescriptions dispensed within the reporting period. The report is submitted to the Fund via a dedicated Internet portal. Following submission, a feedback message with report details and a proposed final summary is sent. The legislator has allowed 5 days for corrections or clarifications, when the proposal can be rejected once and correct data sent.

The analysis presented below covers business processes of healthcare providers and pharmacies who have a contract concluded with the National Health Fund. The units issuing prescriptions are Stermed and CMC. The pharmacies dispensing and billing the prescriptions are located in the towns of Końskie and Turek.
6.1. Assigning numbers to prescriptions at Stermed

Figure 4 outlines the process of assigning numbers to prescriptions at Stermed. The duration of this process has been computed by formula (1).

![Flowchart showing the process of assigning numbers to prescriptions at Stermed.]

Based on these component times, the total duration of the process has been computed to be 488 minutes, i.e. 8 hours and 8 minutes.
6.2. Assigning numbers to prescriptions at CMC

The second provider of healthcare services operates a HIS class system. In this case, prescription forms are not pre-ordered, but printed on request, when the prescription is being issued, therefore the number assigning process does not comprise any activities required to prepare the forms.

The total duration of the process is $T_p = 50.25$ minutes $= 50$ minutes 15 seconds. This has been computed based on the following assumptions:

- sending the physician’s message that the previous pool of prescription forms is running short – 0.25 minutes,
- receiving the physician’s message that the previous pool of prescription forms is running short – 2 minutes,
- preparing a request for a new pool of prescription numbers – 5 minutes,
- sending the request to the NHF’s portal – 10 minutes,
- request processing – 15 minutes,
- receiving a decision – 10 minutes,
- downloading an XML file from the NHF’s portal – 5 minutes,
- importing the file to the HIS system – 2 minutes,
- importing the pool of prescriptions – 1 minute.

6.3. Comparison of the “Assigning numbers to prescriptions” process flows

The “Assigning numbers to prescriptions” process flows of both service providers have been compared in the AS-IS process state. To this end, each of them has been mapped in the form of a business process graph [28].

![Business Process Graph for Stermed](image-url)
With a graph-based representation of business processes (BPG), graphs can be compared and process activities can be searched by labels. Owing to its structure, the business process graph can be generated automatically from popular notations used for business process mapping, such as the UML activity diagram or the BPMN process diagram. In the present paper, the UML activity diagram has been used, with the <<Business Process Graph>> stereotype. Activities with the <<Business Process Graph Node>> stereotype are graph nodes here. Activity names include \{x; y; z\} parameters of the node, where: x – node type, y – node label, z – node location (a partition of the activity diagram where it can be found). Figure 5 present business process graphs for Stermed. Next, both service providers’ Assigning numbers to prescriptions business process graphs have been compared (Figure 6).

Figure 6. Comparison of the Assigning numbers to prescriptions business process graphs
The comparison reveals that Stermed’s Assigning numbers to prescriptions business process flow is similar to the corresponding process of CMC in 60% – six out of ten process graph elements have been qualified as identical. The same outcome has been obtained when comparing the flows from the CMC’s side. Figure 7 summarizes the comparison of both service providers’ Assigning numbers to prescriptions process flows.

![Figure 7. Similarity of the Assigning numbers to prescriptions process flows for both service providers](image)

The remaining processes have been described and compared in a similar manner.

### 6.4. The process of issuing prescriptions

At Stermed, the whole process is performed manually, without the IT system aid. Under such circumstances, a mistake can be easily made and the patient will be forced to return for a new prescription. The total duration of the process is 9 minutes. This time has been computed based on the following component activities duration:

- checking patient’s eligibility – 2 minutes,
- filling in the prescription form – 3 minutes,
- verifying the refund plan options – 3 minutes,
- handing the prescription over to the patient – 1 minute.

At CMC, prescriptions are issued using the IT system. The total duration of the process is 8 minutes. Process analysis has revealed the following component activities:

- filling in the prescription form (including all adjustments resulting from validation errors) – 5 minutes,
- validating the prescription (with all the inputs resulting from correction of any earlier mistakes) – 0.5 minute,
- saving the prescription – 0.5 minute,
- printing the prescription – 1 minute,
- handing the prescription over to the patient – 1 minute.

The comparison shows that Stermed’s Prescription issuing process flow is similar to CMC’s process flow in 85.71%. A distinctly lower similarity (54.55%) has been obtained when comparing the flows from the CMC side. The reasons is that in case of Stermed, the process is much shorter.
Figure 8 presents a summary of the *Prescription issuing* process comparison for both service providers.

![Figure 8. Similarity of the Prescription issuing process flows for both service providers](image)

### 6.5. The process of prescription processing at Końskie pharmacy

The next two sub-processes take place at private pharmacies in the towns of Końskie and Turek. The process looks the same in both cases. Each pharmacy operates an IT system. The difference in process duration follows from the fact that the pharmacies are using systems of two different providers.

One and the same process flow is presented for both pharmacies, but the measure – process duration – has been computed separately for each of them.

Durations of the component activities are as follows:

- receiving the prescription from the patient – 0.5 minutes,
- checking the prescription for correctness – 0.5 minute,
- entering the prescription items in the system – 2 minutes,
- finding the items prescribed – 1 minute,
- dispensing the items prescribed – 3 minutes,
- archiving the prescription form – 1 minute.

Based on these values, the total duration of the process has been computed at 8 minutes.

### 6.6. The process of prescription processing at Turek pharmacy

In Turek – with a different system being operated – durations of the component activities are as follows:

- receiving the prescription from the patient – 0.5 minute,
- checking the prescription for correctness – 0.5 minutes,
- entering the prescription items in the system – 3 minutes,
- finding the items prescribed – 2 minutes,
- dispensing the items prescribed – 5 minutes,
- archiving the prescription form – 0.5 minute.
- receiving the prescription from the patient – 11.5 minutes.
6.7. The process of prescription billing at Końskie pharmacy

In both cases studied here, the process of prescription billing takes place after each month closing, according to the clearing cycle of the National Health Fund. Both processes follow the same pattern in some areas, as required by the procedures imposed by the NHF. The dissimilarities are due to the fact that different methods are used for preparing data and for generating reports.

The first pharmacy uses a system without the option of generating reports for the NHF, therefore a special staff member is employed to prepare data in a separate computer program.

Durations of the component activities of the process are as follows:

- opening a sales report in the pharmacy system; this operation is performed five times a month and takes 1 minute each time, therefore the total time of this activity equals 5 minutes;
- generating the sales report; the functionality is activated by the preceding activity; a single operation lasts 30 seconds; with five operations the total time is 2.5 minutes;
- entering data in the NHL’s billing system – this operation is also performed five times in a month; a single operation lasts about 60 minutes, giving the total of 300 minutes;
- compiling a report for the NHF – 60 minutes;
- generating a report for the NHF – 1 minute;
- saving the report to the NHF’s portal – 5 minutes;
- report processing – 1440 minutes; such a long time of this operation results from the report analysis method used by the NHF;
- report acceptance – 60 minutes;
- report approval – 60 minutes.

Hence, the total time of the basic process is 1933.5 minutes, i.e. 32 hours 15 minutes.

6.8. The process of prescription billing at Turek pharmacy

The billing system operated by the pharmacy in Turek is integrated with the pharmacy’s internal computer system, therefore there is no need for the manual entering of data. Durations of the process component activities are as follows:

- opening a report for the NHF in the pharmacy system – 2 minutes,
- generating a report for the NHF – 2 minutes,
- saving the report to the NHF’s portal – 5 minutes,
- report processing – 1440 minutes (similarly as in Końskie, such a long time is a result of procedures adopted by the NHF),
- report acceptance – 60 minutes,
- report approval – 60 minutes.

The total time of the basic process is 1569 minutes, i.e. 26 hours.

7. Unification of prescriptions circulation in the TO-BE state

Understanding the AS-IS process flows and process requirements was the basis for commencing the unification. Since one of the project goals was to adjust the processes to electronic processing of prescriptions, a method of complete unification in combination with improvement has been selected. The changes are intended to result in a situation where the
repository of prescriptions and the access to the process layer is provided by the NHF. The presentation layers required for entering data are prepared in individual systems. The access to process elements follows the SOA design. The National Health Fund provides all necessary services.

Following unification, the four processes of the prescription lifecycle have been reduced to two processes (Figure 9). This was possible owing to a much more advanced use of IT systems. In addition, with the central repository of documents, and the business logic standardized and concentrated in one location, some of the tasks can be automated and they are now performed as individual activities within processes, instead of constituting separate processes.

![Figure 9. The TO-BE state of business processes.](image)

### 7.1. The unified process of prescription issuing

Table 1 describes how the original processes have been redesigned into component activities of the unified process of prescription issuing in the TO-BE model.

<table>
<thead>
<tr>
<th>AS-IS model activity</th>
<th>TO-BE model activity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill in the prescription form</td>
<td>Fill in the prescription form</td>
<td>From the AS-IS model in the second pharmacy</td>
</tr>
<tr>
<td>–</td>
<td>Forward the prescription for validation and save</td>
<td>New activity resulting from the requirements imposed by ePrescription</td>
</tr>
<tr>
<td>Check patient’s eligibility</td>
<td>Validate patient’s eligibility</td>
<td>From the AS-IS model in the first pharmacy</td>
</tr>
<tr>
<td>Validate prescription</td>
<td>Validate prescription correctness</td>
<td>From the AS-IS model in the second pharmacy</td>
</tr>
<tr>
<td>–</td>
<td>Assign prescription number</td>
<td>New activity resulting from improvements to the process of assigning prescription numbers</td>
</tr>
<tr>
<td>–</td>
<td>Send prescription back</td>
<td>New activity resulting from the requirements imposed by ePrescription</td>
</tr>
<tr>
<td>Verify refund plans</td>
<td>Assign the refund plan</td>
<td>From the AS-IS model in the first pharmacy</td>
</tr>
<tr>
<td>Save prescription</td>
<td>Save prescription</td>
<td>From the AS-IS model in the second pharmacy</td>
</tr>
</tbody>
</table>
7.2. The unified process of prescription processing

Table 2 describes how the processes have been redesigned into component activities of the unified process of prescription processing in the TO-BE model.

<table>
<thead>
<tr>
<th>AS-IS model activity</th>
<th>TO-BE model activity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receive receipt from patient</td>
<td>Search patient’s prescriptions</td>
<td>Activity reengineered in order to meet the ePrescription requirements</td>
</tr>
<tr>
<td>Receive receipt from patient</td>
<td>Get patient’s prescriptions</td>
<td>Activity reengineered in order to meet the ePrescription requirements</td>
</tr>
<tr>
<td>Enter prescription item in the system and find items entered</td>
<td>Select items for dispensing</td>
<td>Activities combined and adjusted to ePrescription requirements</td>
</tr>
<tr>
<td>Dispense prescription items</td>
<td>Dispense prescription items</td>
<td>From the AS-IS model in the first pharmacy</td>
</tr>
<tr>
<td>Archive prescription form</td>
<td>Save dispensing</td>
<td>Activity reengineered in order to meet the ePrescription requirements</td>
</tr>
</tbody>
</table>

8. Benefits of the business processes unification

The main criteria used for evaluation of the business process flow are based on duration of tasks. With the business process performance measures given in section 4, processes can be compared. Formulae (1) and (2) can be used for comparing variants of a business process used by various sites and for designing a unified business process model suitable for all company sites. The paper presents the unification of processes constituting the medical prescription life cycle. Owing to new technologies, it is possible to reduce the number of subprocesses in the cycle from four to two and thereby cut the entire cycle duration down (Table 3).

<table>
<thead>
<tr>
<th>Process before the unification</th>
<th>Process duration before unification</th>
<th>Process after the unification</th>
<th>Process duration after unification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigning prescription numbers</td>
<td>50,25 minutes</td>
<td>Issuing a prescription</td>
<td>2,5 minutes</td>
</tr>
<tr>
<td>Issuing a prescription</td>
<td>8 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescription processing</td>
<td>8 minutes</td>
<td>Prescription processing</td>
<td>6,5 minutes</td>
</tr>
<tr>
<td>Prescription billing</td>
<td>1569 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total time before unification</td>
<td>1635,25 minutes</td>
<td>Total time after unification</td>
<td>9 minutes</td>
</tr>
</tbody>
</table>

The automation of processes yields a significant reduction of time in case of two processes – assigning numbers to prescriptions and prescription billing. They have been separated as individual activities performed within the two remaining processes. In addition to the prescription lifecycle reduction, the resources needed for the entire procedure – and consequently, its costs – have been cut down. The possibility of standardizing the system architecture across all enterprise sites is another benefit of the unification. It facilitates the
monitoring of process performance and responding to any deviations from the standard operation.

Time savings result in financial benefits. One should remember that the savings presented above have been calculated for a single execution instance. Moreover, savings can also be sought in other business processes of the company. Therefore, a formula can be given for calculating the savings to be gained from unification of business processes and providing IT support at the site level of enterprise $O_j$.

$$O_j = \sum_{i=1}^{N} (f_i * m_i)$$

(5)

where:

- $f_i$ – financial savings from a single instance of the $i$-th process,
- $m_i$ – the annual number of the $i$-th process instances,
- $N$ – the number of all processes throughout the enterprise.

Additionally, processes are executed at many sites of the company. The savings for the entire company can be given by the following formula $O$:

$$O = \sum_{j=1}^{Z} O_j$$

(6)

where: $Z$ – the number of all company sites.

For example, assuming the following values: $f_i = \text{PLN } 500$, $m_i = 10000$, $N = 30$, the savings for a single site would amount to $O_j = \text{PLN } 150\,000\,000$. With a similar level of savings for each site and $Z = 100$, the annual savings of the entire company would reach $O = \text{PLN } 15\,000\,000\,000$. It has been assumed in the calculations, that the number of sites is 100 and the total annual number of appointments equals 30 000 000. Taking data from Central Statistical Office [32] as a basis, there were 16252 outpatient healthcare facilities in Poland in 2009. The number of medical advice services provided within the outpatient healthcare system amounted to 291 415 400. In the light of these data, the estimations presented in the paper can be considered as safe.

With such high potential savings, it is worth investing resources and work in solutions of this type.

9. Conclusion and further work

What is important, the reduction of time needed to carry out business process activities is realistic and can become a source of financial savings for a multi-site company. Due to integration of information systems, it is possible to fully automate the flow of electronic documents between hospitals and the NHF. The medical example shows time savings exceeding 27 hours to be gained. Such a significant time gain is possible not only owing to unification of the business process activities, but mainly through IT support and automation of most of the process activities. In essence, some of the activities within the unified process are preformed differently than in both process flows prior to unification. Automation of activities offers new opportunities as regards the way how the process is executed.

The focus of further studies will be on automation of the business process comparison. As the analysis presented in the paper has been limited, by definition, to one and the same process, therefore the syntactic similarity metrics is sufficient here. Yet, when analysing a repository of process models, it is better to use a much broader range of business process
similarity measures and it is recommended to build a tool for automation of the business process comparisons. It would be interesting to see further work towards analysing business process models quality, verification and improvement. The key emphasis of further studies will be on the last unification method. That approach will engage all layers of enterprise architecture. It will be shown method of unification of business processes with their refinement. Further studies will mainly concentrate on designing and development of integration solutions intended to support refined business processes in enterprises and calculating benefits from such kind of unification in layer of IT systems.

References


