Workflow optimization at financial institutions: survey and case study

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Abstract

This paper provides insights into the topic of workflow optimization and seeks to answer the question: what optimization techniques prove to be effective in optimizing workflows specific to financial institutions? This work includes an overview of the workflow concept and workflow types, describes the use of workflows at financial institutions and provides information about various workflow optimization methods. In order to gather and analyze quantitative data about the opinion of finance/IT industry professionals, a survey was conducted within two international financial institutions. To observe the efficiency of the described optimization methods, some of the methods were implemented practically and a case study was conducted to measure the impact of the optimization on the workflow execution time.

Keywords

Workflow, Optimization, Finance, Business process

1. Introduction

Workflows are used in various organizations, especially financial institutions, to ensure a controlled execution of various processes. The term “workflow” is closely tied to the term “business process”, however, the latter usually describes a more generalized procedure for reaching an organizational goal. According to the Workflow Management Coalition [1], the term “business process” describes a set of activities that collectively realize a business objective within the context of an organizational structure and the term “workflow” refers to a set of procedural rules for the automation of a business process, during which documents, information or tasks are passed from one participant to another for action. There are various definitions of the term “workflow”, however, the author has developed his own: a workflow is a mechanism, which allows one to describe in detail the steps necessary to ensure the execution of a business process (or a part of a business process). Within the scope of this paper, a workflow is perceived as an executable program, which is practically used for the day-to-day operations of a company.

Today, various organizations use workflows to control the execution of business processes and to ensure the quality of the process execution. The financial technology sector requires banks and other financial establishments to strictly comply with state institutions' requirements and swiftly adapt to the constantly evolving market demands. Defining and using workflows for day-to-day operations can bring various meaningful improvements to an organization, for example:

- Increase process transparency
- Quality assurance
- Automation
- Improve scalability
- Responsibility delegation

Businesses operating in a process-oriented fashion face the challenge of continuous business process improvement [2]. The improvement cycle includes activities of process design, modelling, implementation, monitoring and optimization [3]. Numerous methods and techniques

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for business process management and improvement have been elaborated [4]. The methods should support the various aspects of business process and workflow management such as procedure models, techniques, results, roles and information models. Business process improvement initiatives are instinctively intertwined with IT tools used to implement the processes [5]. Workflow redesign research considered such improvement methods as patterns, simulation, resource management, rule-based redesign and others [6]. This paper focuses on technology-enabled workflow optimization and considers prototyping as a method for the evaluation of improvement alternatives.

The objective of this paper is to give an overview of various control-oriented workflow optimization methods and to provide insight into the results of the conducted research about the effectiveness of workflow optimization methods. A survey of workflow management professionals is conducted to identify approaches used at financial institutions. The workflow improvement is performed at one bank by evaluating various improvement alternatives. The contribution of the paper is a combination of both structural and usability aspects to improve the workflows.

The rest of the paper is organized as follows. General aspects of workflow optimization are discussed in Section 2. The survey is reported in Section 3 and Section 4 discusses workflow improvement possibilities. Section 5 concludes.

2. Workflow typology, representation and application

2.1. Workflow classification

Generally, workflows can be classified into two categories: control-oriented and data-centric workflows [7]. Control-oriented workflows are mostly used to describe business processes and focus on activities and gateways, usually represented in BPMN or UML notation. Data-centric workflows are more often used for science and data analysis and concentrate on data processing activities and data transformation. A suitable graphical representation for data-centric workflows would be a directed acyclic graph. This work focuses more on optimization techniques for control-oriented workflows.

Another form of workflow categorization would be based on principles of operation, for example, the Microsoft Windows Workflow Foundation distinguishes two workflow types [8]:

- Sequential workflows, a linear execution model suited for more trivial processes, similar to a flow-chart. The activities in these workflows are not revisited.
- State-machine workflow, which depicts the transitions between various states. The main difference with sequential workflows lies in the ability to revisit previous states.

In practice, companies design their own workflows, suited to the given tasks and use elements of both - sequential and state-machine workflows, depending on the abilities of the chosen workflow management system or the developed in-house workflow software.

2.2. Workflow representation

Although workflows can be created without visual tools, graphical workflow representation is often used to help understand the activities, their sequence and the flow of data within a workflow. The key elements of a workflow diagram usually include start and termination points, activities, input/output data, gateways, direction arrows and swimlanes. Workflows can be represented in various notations, for example:

- ANSI flowchart
- UML activity diagram
- BPMN diagram
- DMN diagram
- Swimlane diagram
- SIPOC diagram

It is worth noting that popular workflow management software (Processmaker, Camunda, Pipefy et al.) use BPMN 2.0 notation, as it is a standardized notation system for business process representation, developed by the technology standards consortium Object Management Group in 2011 [9], and published as an ISO standard ISO/IEC 19510:2013 in 2013 [10]. BPMN notation is often used for workflow representation because it was developed specifically to represent business processes and contains elements that are helpful in workflow visualization. An example of a trivial workflow in BPMN 2.0 notation is displayed in Figure 1.

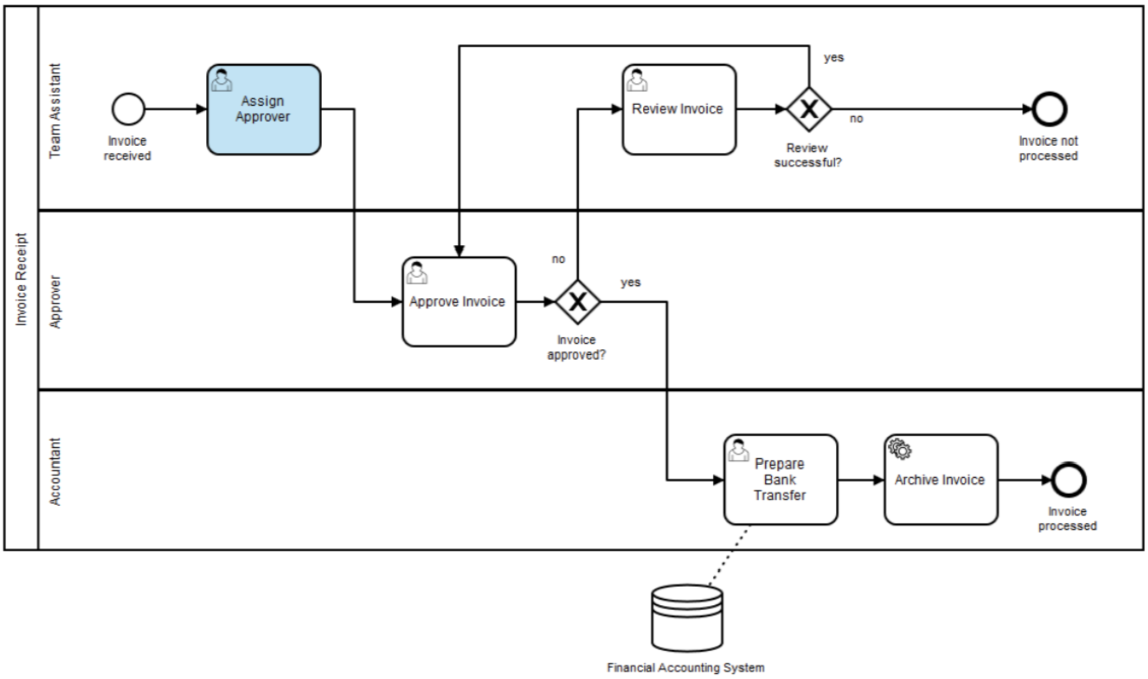

Figure 1: Invoice processing workflow diagram in BPMN 2.0 notation [11]

Depending on the organization, workflow diagrams can be used as a reference for the developers, to assist business analysts etc. Some companies adapt their own notation for workflow representation, using elements of various notations. Graphical workflow representation can help to better understand the logic of a business process, although some software tools also can generate the program code with the help of a graphical workflow editor, for example, Camunda offers a graphical workflow editor in BPMN notation, Oracle BPEL Process Manager allows its users to build workflows in BPEL notation and Microsoft Power Automate have their own graphical workflow editor which enables to build execution sequences for process automation.

2.3. Use of workflows in financial institutions

As the author of this paper has professional experience working as an IT project manager in a bank, the research is focused on workflows specific to financial institutions. Key aspects of working with financial data are low error tolerance, the necessity to comply with various regulations set by the authorities and the obligation to store transaction data. Workflows are a useful tool to execute day-to-day operations in a controlled, streamlined manner. Most of the business processes, such as account opening, crediting and debiting funds usually involve workflows. Within the workflows, various activities are performed and control points are checked. As a result, the final actions are taken, such as crediting an account or submitting a withdrawal message to the SWIFT network.

There can be numerous different workflows within an organization, depending on the scale and variety of the offered services, however, the workflows commonly found in financial institutions can be classified into the following categories:

- Account opening
- Outgoing payments (wire withdrawals, card payments etc.)
- Incoming payments (wire deposits, deposit from card etc.)
- Loan-related (consumer loan, mortgage etc.)
- Insurance-related
- Account information updates
- Account closure

Workflow execution can be a slow process that can take several days or weeks, however, by leveraging the various optimization techniques companies can significantly improve the execution speed and other metrics, depending of the goal. Workflow optimization activities allow organizations to use their resources (such as time, financial assets, workforce etc.) more efficiently whilst, complying with the regulations and ensuring process transparency. Due to the significant positive impact on the company's performance indicators, workflow optimization tasks are often at the top of priorities of the development backlog.

Workflows in financial institutions usually perform activities with client and financial data. To better understand the nature of such workflows, the key characteristics of a workflow from the online bank are displayed in Table 1:

Table 1
Characteristics of workflow "Wire deposit"

Input data	Roles involved	Key activities	Expected result
Client ID, Transaction ID, Client account number, Amount, Currency, Sender (name, surname), Sender IBAN, Receiver (name, surname), Receiver IBAN, Intermediary bank IBAN, Reference	Accountant, Customer support, Compliance officer	Input data validation, Sender verification, Receiver limitation check	Receiver account credited or funds returned to the sender

3. Workflow optimization

There are numerous approaches for workflow optimization, however, most can be grouped into two categories: high-level optimization, which focuses on altering the execution logic and on the implementation of different techniques and low-level optimization, which focuses on finding specific technologies for optimization purposes. The research conducted by the author addresses mostly the high-level approach. Some of the described optimization methods were practically implemented and the implementation results can be viewed in section 4.

3.1. Workflow optimization methods

3.1.1. Input data optimization

The improvements can take place even before the workflow is executed. In this case, optimization involves preparing the input data in a way that would endure more efficient workflow execution. Workflows in financial institutions usually implement various data validation procedures and controls. In cases when the validation fails or additional actions are needed to continue the execution, the completion of the workflow gets delayed. Various input data optimization techniques can be used: data standardization and formatting, input data restriction activities (for example, using pre-defined choices for the user), data quality improvement and other techniques. The goal of input data optimization usually is to ensure a more effective, or, ideally, automatic workflow execution.

3.1.2. Execution step changes

According to the publication in the International Journal of Data Science and Analytics [7], this optimization method focuses on altering the sequence of workflow activities with the goal of minimizing the overall execution costs. A graphical example of execution step changes is displayed in Figure 2:

Figure 2: Changing execution steps in a workflow

The goal of minimizing the overall workflow execution (finding the minimal cost) costs can be expressed with the following formula:

$$min\ \Sigma\ c\ (a_i)$$

c expresses the function of cos (for example - expressed as time, money or other costs) t, *a* is a workflow activity and i = 1...n. There are various approaches for execution step changes that aim to minimize the overall execution costs:

- Dynamic programming. This approach involves changing execution steps in such a way that previously gathered information can be reused in the future activities of the workflow.
- Minimal data processing. In this case, the focus is on finding the order of execution steps that would result in fewer data processing activities for the transitions.
- Data/activity filtering. An approach that implicates prioritizing activities that would remove the unnecessary data processing activities in the following steps of the workflow.
- Ordering based on "weight". This approach prioritizes the "processing-heavy" activities to reduce the workload of the following steps.
- Asynchronous execution. This approach implicates executing multiple activities simultaneously to reduce execution costs
- Critical path method. Prioritizing the activities of the critical path of a workflow.

As observed in the International Journal of Data Science and Analytics [7], other optimization activities that involve altering the workflow execution steps are:

- Introduction of new activities. Adding new activities that help reduce the execution costs (for example data standardization)
- Removal of redundant activities
- Workflow activities merging or decomposition

3.1.3. Manual processing reduction

On some occasions, manual processing activities may occur within workflows. In the scope of this paper, manual processing activities implicate human involvement in a workflow execution process. In financial organizations, manual processing is in some cases a mandatory activity, which aims to provide additional quality control or compliance with laws and regulations, however, there can be scenarios where manual processing is unnecessary and burdens the workflow execution process. The rather negative reasons for manual processing activities can be the lack of resources to perform optimization or the lack of motivation (if there is no business need to optimize the workflow).

Nevertheless, while conducting a survey among IT/Finance professionals (Section 3), 45% of the respondents admitted that manual processing reduction is the most important goal of workflow optimization, which indicates the importance of addressing this issue. There are numerous methods of manual processing reduction, some of them are mentioned below:

- Use of artificial intelligence. There are various AI tools that automate workflow activities which otherwise would require manual input. For example, document processing or fraud detection.
- Automated questionnaires. Solving the issue of manually gathering the necessary information from clients via chats, e-mails etc. Automated questionnaires can be triggered from a workflow and help to gather the required data.
- Integration with specialized services. Some activities in a workflow can be delegated to a specialized service provider, for example, by using an API (Application Programming Interface)
- Removal of redundant activities. By performing workflow audits or refactoring activities, redundant manual processing activities can be discovered and as a result - removed.

3.2. Measuring the optimization efficiency

An important aspect of workflow optimization is quantifying and measuring the optimization results. Just as the goals of the optimization can differ, for example - reducing the number of manual processing activities or reducing the execution time, so can differ the methods of measuring the optimization results. This section seeks to find an answer to the question - what data can be observed to measure workflow optimization efficiency?

According to the research on workflow optimization method implementation in IT companies in the Netherlands [14] and based on the author's professional experience, four categories for measuring optimization efficiency can be defined:

- Time. One of the most obvious measures for workflow optimizations is time. Reducing the workflow execution time is often a priority for workflow optimization processes, as it helps to speed up the business processes and, as a result, allows to process more workflows within a given time period. Various measures can be observed, for example, workflow execution time, processing time (time spent performing specific actions within a workflow) or idling time (the time when the workflow is paused, waiting for some activity to complete).
- Quality. Workflow quality can be measured by various parameters, for example, amount of errors during executions, output integrity with the same input data during multiple executions, number of successfully completed workflows.
- Elasticity. Elasticity can be defined as the ability of a workflow to adapt to changing requirements. It can be defined as a formula:

  $$e = c / t$$

  where c is the value of change complexity and t is the time required to implement the changes.

- Resources involved. If the workflow optimization goal is to reduce the number of resources used, for example, the employees involved, database requests made or memory used, then to measure the optimization efficiency, the amount of resources involved can be quantified and comparison can be done (before and after optimization).

4. Survey

To understand the opinion of IT/finance professionals about the workflow optimization topic, quantitative research in the form of a survey was conducted. A total of 60 respondents from two financial companies were surveyed - an internationally-operating online Swiss bank and a global money transfer service. The goals of the survey were to understand the importance of the workflow optimization subject and to find out the preferred optimization approaches. The Likert and semantic-differential scales were used to gather answers to the questions. Wilcoxon Signed-Rank Test was used to verify the statistical significance of the answers.

4.1. Respondent profile

The breakdown of respondents by companies was equal - 30 respondents from the online bank and 30 respondents from the money transfer service. The majority of the respondents fell into the age group of 24-41 years (Figure 3) and the largest group was working in the IT/Programming field (Figure 4). The largest group, 43% of the respondents have professional experience of 10 or more years (Figure 5).

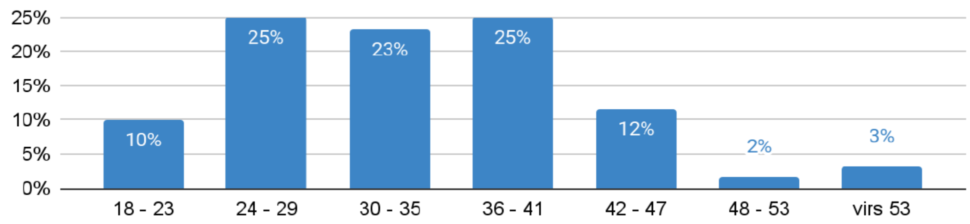

Figure 3: Age of the respondents

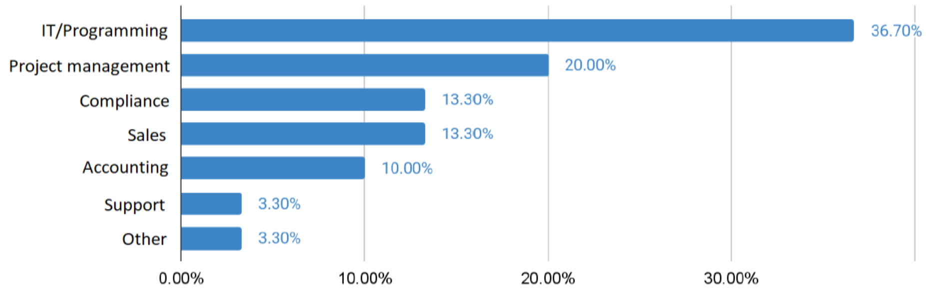

Figure 4: Occupation of the respondents

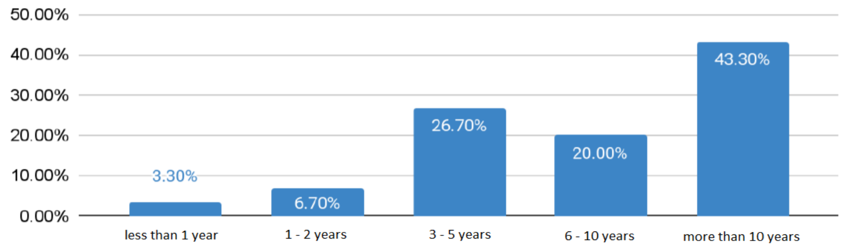

Figure 5: Work experience of the respondents

4.2. Survey results

The survey successfully gathered answers from 60 respondents. Below are listed the key results from the survey questions.

How important is the workflow optimization topic? The majority (83%) of the respondents stated that the workflow optimization topic is important or very important. No significant correlation was detected between the topic of importance and other parameters (role, age, experience).

Which workflow optimization goals are the most important? By calculating the sum of assigned scores, the following results were gathered (top 3 goals):

- Automation and manual input reduction (4.4 / 5)
- Improved decision-making and data analysis (4.1 / 5)
- Quality improvements (4.1 / 5)

Which optimization method is the most effective? By calculating the sum of assigned scores (1 - 5), the following results were gathered (top 3 methods):

- Manual processing reduction (4.2 / 5)
- Input data optimization (3.6 / 5)
- Execution step and logic changes (3.6 / 5)

What roles in the company are the most responsible for workflow optimization process? By calculating the sum of assigned scores, the following results were gathered (top 3 responsible roles):

- Project management (4.5 / 5)
- IT / Programmers (4.1 / 5)
- Compliance (4.0 / 5)

5. Case study

The case study is carried out according to the general case study research guidelines [15]. To conduct the case study, three workflow optimization methods were chosen:

1. Manual processing reduction (automated questionnaire implementation)
2. Execution step changes (data/activity filtering approach)
3. Input data optimization (applying pre-defined inputs)

5.1. Case study context

To conduct the research, the above-mentioned workflow optimization methods were applied to the workflows at the online bank, which services about 300’000 client accounts and provides internet-banking services such as online personal and business account opening, wire payments, card operations, currency exchange, investments etc. Workflows are used in the bank in order to implement the necessary controls to the basic banking operations and to streamline the business processes.

In the context of this case study, the influence of the chosen optimization method on the average workflow execution time was recorded for 2 different workflows used within the organization daily. The observations were made for workflows executed during the period of 8 months, from March 24, 2022, to November 25, 2022. The following workflows were observed:

- workflow “Wire deposit”, optimization method applied: manual processing reduction (overall 11’236 executions observed)

- workflow “Wire withdrawal”, optimization methods applied: execution step changes and input data optimization (overall 16’407 executions observed)

5.2. Data collection and analysis

As a criterion to measure the effectiveness of the optimization method, data about the average workflow execution time was gathered:

- 28 days before optimization method application
- 28 days after optimization method application

The optimization methods were implemented consecutively, allowing to observe the influence of each optimization method separately. The gathered workflow execution time data for each optimization method were grouped into four 7-day intervals, to provide a better understanding of the impact of the chosen optimization method. To test the significance of the observed results, a two-sample T-test was applied, proposing the following hypotheses (with $p = 0.05$):

- H_0 ... the average workflow execution time before and after optimization does not differ significantly
- H_1 ... the average workflow execution time before and after optimization differs significantly

5.3. Case study results

The influence of the optimization methods on the average execution time of various workflows within the online bank is displayed in the figures below (Figures 6, 7 and 8):

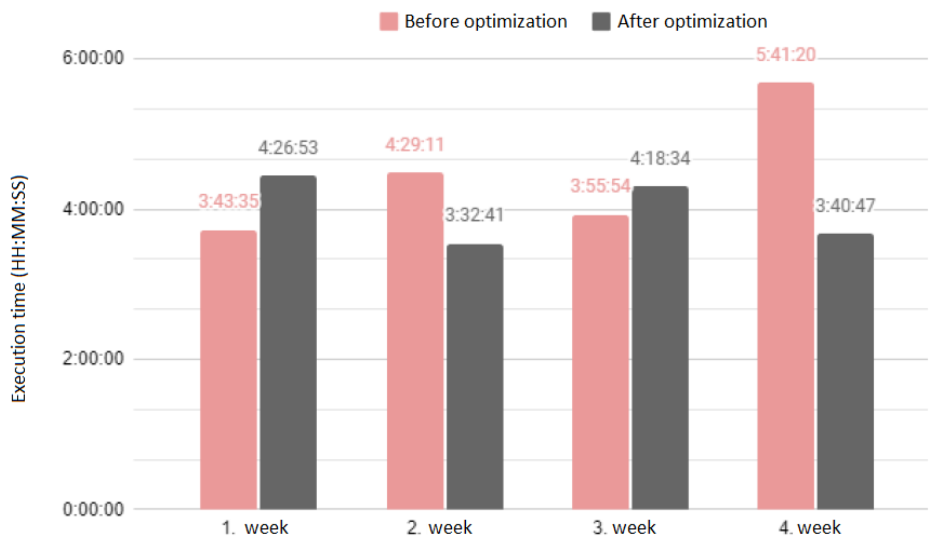

Figure 6: Average execution time of workflow “Wire deposit” before and after applying optimization method - manual processing reduction (automated questionnaire implementation)

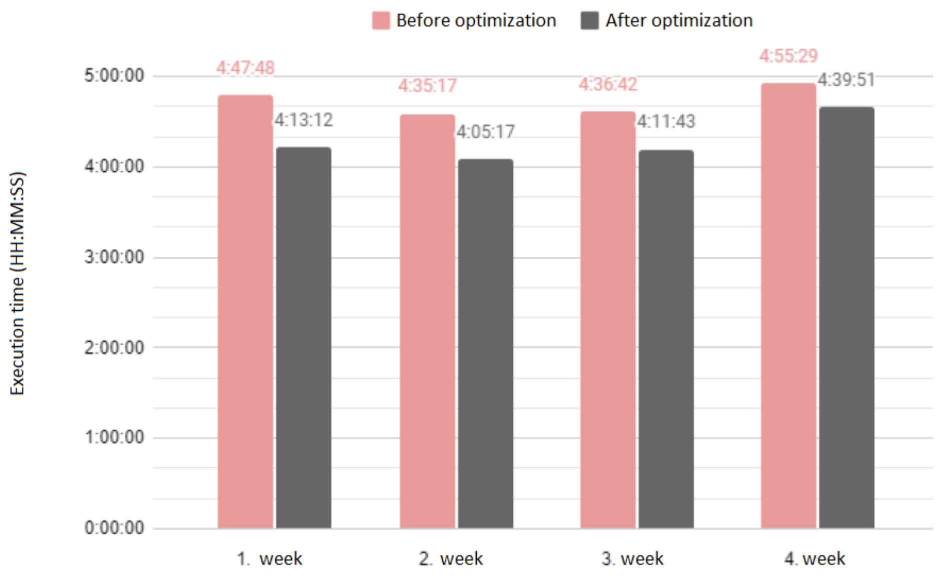

Figure 7: Average execution time of workflow "Wire withdrawal" before and after applying optimization method - execution step changes (data/activity filtering approach)

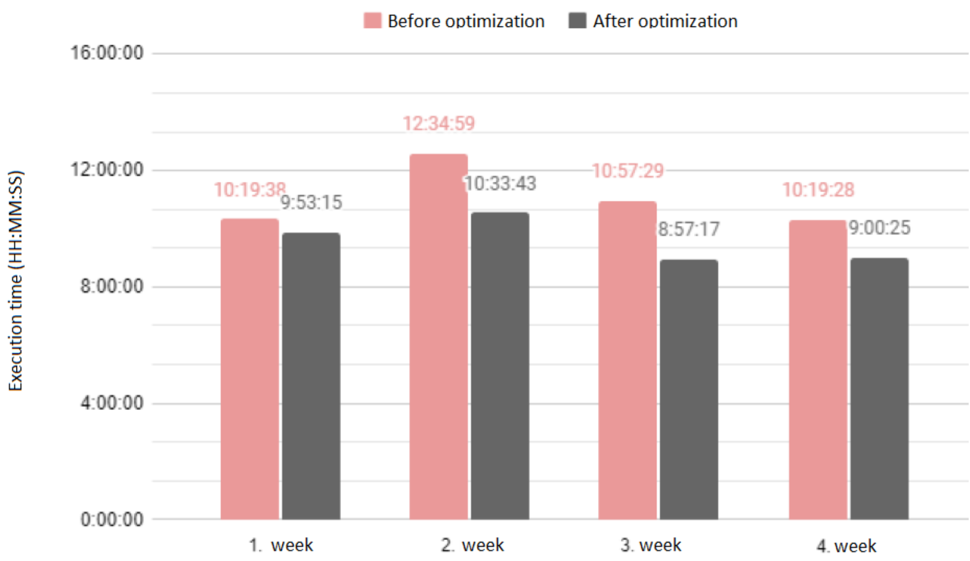

Figure 8: Average execution time of workflow "Wire withdrawal" before and after applying optimization method - input data optimization (applying pre-defined inputs).

The observations allow for answering the following questions about the influence of the implemented workflow optimization method.

Does the chosen optimization allow to reduce the workflow execution time? The analysis of the gathered data suggests that the chosen optimization methods allow for a reduction in the average workflow execution time:

- Input data optimization (applying pre-defined inputs), by 13,08%
- Manual processing reduction (automated questionnaire implementation), by 10,38%
- Execution step changes (data/activity filtering approach), by 1,16%

What workflow optimization method proves to be the most effective? The analysis of the gathered data suggests that the most significant reduction (13,08%) was the result of applying input data optimization (applying pre-defined inputs).

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