Bottleneck and Rework Analysis of the Budget Approval at University with Process Mining

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Abstract. Process mining is a new science that focuses on the transparency of an existing process. Especially in this world full of digitalization, of course, many companies, education, health are immediately competing in presenting the most efficient and effective processes to do. In this study, the authors used Request for Payment data owned by a university. These requests will later be checked by the travel administration, this budget approval can be done by supervisors, directors, or fund owners. The author uses Celonis tools and algorithms in Celonis to identify bottlenecks and rework in the process. We also attempted to analyze where new insights could be drawn from the resulting process model. The result of this research is to pay special attention to several activities, as well as to provide explanations of the criteria related to the application to be submitted.

Keywords: process mining, celonis, request for payment

1 Introduction

Process mining is a new science that focuses on the transparency of an existing process. Especially in this world full of digitalization, of course, many companies, education, health are immediately competing in presenting the most efficient and effective processes to be carried out. With this transparency, process mining can help agencies to understand more about the processes carried out, so that when there is a problem in the process, the agency understands where the error is and how to fix it. From here, process mining can also help us to execute processes with lower costs, shorter time and more efficient resources.

The data that the author uses is data regarding conference trips made by university staff to conduct conferences to other universities with the aim of conducting conferences or project meetings. This dataset consists of a total of 4 datasets but the author only chooses 1 dataset, namely RequestForPayment xes. The university also has several regulations regarding this trip, the trip is divided into two categories, namely domestic and international. For domestic trips, reimbursement can be done (travel first with personal money and then submit a disbursement that will be replaced by the university), but for international trips, reimbursement cannot be done, but must submit a budget first. These requests will be checked by the travel administration, and budget approval can be done by the supervisor, director, or fund
owner [1]. Here we will analyze the existing processes in the data to find out whether there is a need for an improved process and whether there are obstacles in the process. We also try to analyze if we find new insights that can be drawn from the process model that is generated later. Therefore, the aim of this research is to analyze the existing processes, identify potential obstacles, and propose necessary improvements. Process discovery in this study we do using Celonis tools.

Process mining serves as a link between the disciplines of process science and data science [2]. Process mining can be used to discover certain processes that exist in a customer fulfillment process that is not typically structured. In addition, process mining allows comparison between how the process actually runs and the way it is designed to operate [3]. In process mining, several mining algorithms are used specifically to analyze event log data with the aim of recognizing various patterns, graphs, and petrinet diagrams that exist in the events recorded in the information management system [4]. The findings generated from this paper contribute insights to the management of case companies and the further implementation of process mining in real cases [5]. The study shows that process mining can be implemented in real-life company cases, leading to the possibility that process mining will be effective when applied to this study.

There are 3 main types of mining processes used in the context of real cases [6]:

• Process Model Discovery (process model constructed from eventlog)
• Conformance Checking (model compared with eventlog and deviation discovery)
• Process Model Extension (the process model is extended or improved using information from the eventlog).

In this study, the authors used the Celonis tool. Celonis is a popular tool used for process mining research. A study comparing tools used in process mining research shows that Celonis ranks third in the most popular products commercially available in the market [7].

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Table 1. PM Tools Comparison

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<thead>
<tr>
<th>PM Tools</th>
<th>Number of Comparison</th>
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<tbody>
<tr>
<td>ProM</td>
<td>7</td>
</tr>
<tr>
<td>Disco</td>
<td>7</td>
</tr>
<tr>
<td>Celonis</td>
<td>4</td>
</tr>
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In this paper the authors describe process mining using algorithms and data (in the form of event logs) to create models that provide insight into an organization’s processes. This paper also explains the data quality problems that arise from experience using process mining analytics [8].

Proper utilization of large amounts of event data using process mining techniques enables the discovery, monitoring and improvement of business processes, allowing organizations to develop more efficient business intelligence systems. However, event data often contains personal information that is confidential, if not managed properly this can jeopardize people’s privacy when performing process mining analysis, therefore with the aim of protecting this provision in this paper there is a process mining method based on micro-privacy or can be called k-PPM, which aims to increase privacy in process mining through k-anonymity [9].

Rare earth elements (REEs) have evolved from common commodities to critical commodities. The exploration boom has uncovered vast resource contours
across all continents. However, given the constraints specific to the REE industry, this paper writes about mapping past bad practices and using them as guidelines to strengthen REE supply around the world, and not only that, this paper also focuses on the assessment that needs to be done to optimize process mining and improve market growth prospects [10]. This study did not involve the existing organizational structure at the university, but involved the relevant department, namely the travel department. Therefore, in this study the authors chose the process mining as the main method because it is easy to find transparency in a process, as well as detect bottlenecks and rework that occur in a process. Process mining was also chosen because the budget approval process at the university must have a long process log, from these logs process mining can detect problems and obstacles in the process. a process can become spaghetti and most organizations definitely don’t want that. When the process is in the form of spaghetti, the process will be difficult to analyze, predict and it is difficult to find obstacles in the process, therefore the author uses Celonis tools to generate an accurate process model that is not in the form of spaghetti.

2 Method

In this study, the author started by importing the existing eventlog data into the Celonis application, from there the author conducted an analysis with the Celonis tool.
The author identifies several aspects such as process modeling aspects, bottleneck aspects, and rework aspects. Then the last is to evaluate the model that has been analyzed.

In this research, the reason why the writer does bottleneck and rework analysis is to analyze the problems that might occur in the current process. These problems can be in the form of a lack of resources, large costs incurred by the organization, and other problems.

3 Results and Discussion

In this chapter, the author will explain the results of the analysis process that the author did earlier. This chapter will provide an explanation of the process model, bottlenecks, rework, and evaluation.

3.1 Process Model

![Process Model at default](image)

Fig. 2. Process Model at default

The following is the process model generated by the Celonis tool (Fig 2) using the Celonis algorithm. Cases that have activities like this occur in 86.6% of all existing cases, while cases that have connections like this occur in 78.9% of existing cases. Overall the activities in this process are; Start, Request For Payment SUBMITTED by EMPLOYEE, Request For Payment APPROVED by ADMINISTRATION, Request For Payment FINAL APPROVED by SUPERVISOR, Request Payment, Payment Handled, End.
If we do the setting with the entire process that occurs in all cases, the activities and connections that appear will be very complex and form like spaghetti (Fig 3). Due to the limitations of the author’s tools, the author cannot do a good eventlog data preparation (into a lasagna model).

From Fig. 4 it can be seen that case that occur per day can reach 10 cases, with a total of 54 events that occur per day, with an average case completion time of 10 days. From the figure it can also be seen that cases that occur mostly appear towards the end of the year, maybe this is because the university carries out more outbound service assignments and conferences at the end of the year.
In Fig 5, it can be seen that the most executed activity in all-time is payment handled, with 29 events per day, followed by request for payment approved by administration with 15 events per day. From this we can conclude that, per day there can be 29 funds spent by the company to finance the trip.

3.2 Bottleneck

![Throughput Time](image1)

<table>
<thead>
<tr>
<th>Median throughput time</th>
<th>Slowest Case</th>
<th>Fastest Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00 days</td>
<td>406.00 days</td>
<td>0.00 days</td>
</tr>
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</table>

![Filtering Throughput Time](image2)

To identify bottlenecks, the first step the author takes is to find out the average case that is resolved, as can be seen in Fig. 6 by using the Throughput Times (details) feature in Celonis, the author finds that the average completion time of each case is 12 days.

![Throughput time selection](image3)

![Throughput time selection](image4)

After knowing the average required to complete a case, the author uses the filtering feature in this Celonis tool (Fig 7). Filtering is used to select which cases the author thinks need to be analyzed. Therefore, the author filtered the cases that were completed in more than 13 days. It can be seen that there are 29% of cases selected, namely 2,005 cases.
After that the author simulates the process with Celonis tools, it can be seen in Fig. 8 that the bottleneck occurs in the Request For Payment SUBMITTED by EMPLOYEE to Request For Payment APPROVED by ADMINISTRATION, Request For Payment FINAL APPROVED by SUPERVISOR to Request Payment, and Request Payment to Payment Handled activities. There are still other bottlenecks, but the author can only see bottlenecks from the simulation and produce these three bottlenecks.

By using the Process Overview feature in Celonis, the author can get more bottleneck analysis. 3 of the bottlenecks that the author previously analyzed are listed in Fig. 9, where the three bottlenecks are the dominant bottlenecks among other bottlenecks. With Request For Payment SUBMITTED by EMPLOYEE to Request For Payment APPROVED by ADMINISTRATION (78%), Request For Payment FINAL APPROVED by SUPERVISOR to Request Payment (91%), and Request Payment to Payment Handled (91%).

3.2 Rework

To analyze rework, the author used the Rework Rate feature in Celonis. As can be seen from Figure 10 above, the rework that occurs in this process occurs around 9%
of the existing cases. Which means 9% of cases in this process have events that are executed more than once. The most rework occurred in Request For Payment SUBMITTED by EMPLOYEE and Request For Payment APPROVED by ADMINISTRATION.

This can happen because many employees or university academics are wrong or do not meet the existing criteria for administrative approval, so this causes the academic community to submit a new application again to the administration.

4 Conclusion

Based on the results obtained, it can be concluded that there is potential to improve the efficiency in the approval process of conference travel budgets at the university. Bottlenecks and rework become the main focal points for evaluation. The evaluation and suggestion that the author can give to the Request for Payment process is, in the bottleneck aspect, activities that experience bottlenecks, it is better if the university can pay more attention so that the process can run smoothly and well. It is also good for the university to manage the number of resources on the administration so that it can be faster in processing the payment request, but of course adding resources means that it will increase the existing costs, so the university can consider automating the approval process on the administration and also the payment request payment process. And in the aspect of rework, the author suggests that the university can provide direction and SOP (explanation of what criteria are needed so that the submission can be approved) for the academic community who want to make a submission, so that less rework can occur. By evaluating these processes, it is hoped that the time to complete cases will be reduced, and overall efficiency will be improved.

Of course, this solution can also be applied to other organizations. It should also be noted that every organization certainly have different problems and obstacles, but most likely every organization in this topic has the same problems and obstacles. Back again to each of these organizations, these organizations can adapt this solution to the characteristics of each of themselves.

Reference