BPIC2020 process mining research report

Ruslan A. Filipov[1], Evgeniya A. Shtina[1], Alexander V. Balandin[1], Roman V. Krekhno[1], Anastasia A. Sviridenko[1]

[1] Ural bank PJSC Sberbank, Yekaterinburg, Russian Federation

filipov-ra2@sberbank.ru

Abstract. A study of Eindhoven University of Technology employee scientific trip travel and project activities money spending process was conducted using Process Mining methods for the sake of participation in the international online competition BPIC2020. A priori model was constructed using the description of the process obtained from the organizers of the competition and the owners of the process. Using Disco and Python, a model of a real process was obtained and characterized. After that, its conformance checking and performance mining were performed from the point of view of internal audit. Deviations from the priori model associated such as possible accounts receivable or violation of the order of spending money were found, recommendations were given to improve the process and eliminate problems. A monetary assessment of the deviations was given. Answers to questions of interest to process owners were formulated.

Keywords: Process mining, process discovery, conformance checking, process enhancement, BPIC2020.

1 Introduction

Theoretical representation of a process can be accurate, but can be very different from the reality. One of the advantages of studying a company's processes using Process Mining methods is the analysis of real-life data (as is) obtained from system logs. Based on the data obtained, models of the actual process can be built. At the same time, the constructed models reflect everything, even hidden processes, as well as all unnecessary coordination cycles, time delays and other shortcomings of the processes under study.

In the course of researching processes using the Process Mining methods, we used the following tools: a process model according to its description (The Process Flow https://icpmconference.org/2020/bpi-challenge/) was built with the Aris Express tool. Disco, Python, Graphviz, Excel, T-SQL were used for log analysis, construction of models of real processes and models for comparative analysis, as well as for answering the questions of the organizers and the process owners.

At the very beginning of our research, we set ourselves a **goal** to understand the real process using the Process Mining methods, to find the problems and to give recommendations for improving the process, which will provide benefits to process owner.
According to the goal, we set the following tasks:

1. Build a process model for comparative analysis according to the description.
2. Build a model of a real process, conduct a comparative analysis and identify deviations
3. Answer the questions proposed by the organizers and owners of the process.
4. Based on the identified deviations, give recommendations for improving the process.

1.1 Building a process model from description

Based on the description of the business process, a simplified process model was built for better understanding and use in comparative analysis.

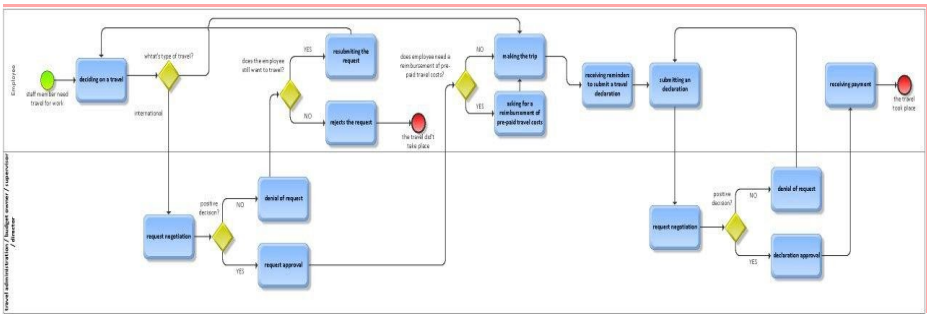

Fig. 1. Process by Description Model, obtained using Aris Express tool.

According to the model shown in the diagram, various declaration documents (national and international declarations, prepaid travel expenses and requests for payment) go through a similar process. After submission by the employee, the request is sent for approval to the travel administration. If approved, the request is sent to the budget owner and then to the manager. If the budget owner and the curator are the same person, then only one of these steps will be taken. In some cases, the director also has to approve the request.
In all cases, rejection has one of two results. Either the employee resubmits the request, or the employee also rejects the request.
If the approval process is successful, payment is requested and made.
The procedure for issuing travel permits is slightly different, as there is no charge. Instead, after all approval steps, a trip may take place with an estimated start and end date. These dates are not exact travel dates, but rather are assumed by the employee when applying for a permit. Actual travel dates are not recorded in the data, but in most cases, they should be close to the recorded dates.
After the end of the business trip, the employee receives several reminders about the filing of the travel declaration.

After approvement of travel permit, but prior to travel, staff may claim a reimbursement for prepaid travel expenses. Several requests can be submitted independently of each other. At the end of the trip, it is possible to submit an international declaration, although sometimes several declarations may be seen for specific cases.
It is important to understand that the process described above is from 2018. As for 2017, there are some differences, mostly in role names, as it was a pilot year and the process changed several times.

1.2 Building a model of a real process, comparative analysis and identification of deviations.

The following data were used to build a model of a real process in order to better understand and conduct a comparative analysis:

1. Payment requests (non-travel): 6,886 cases, 36,796 events: RequestForPayment.xes, columns for building graphs 'Rfp_id-trace', 'concept: name', 'time: timestamp'
2. Internal declarations: 10,500 cases, 56,437 events: DomesticDeclarations.xes, columns for building graphs 'id-trace', 'concept: name', 'time: timestamp'
3. Prepayment of travel costs: 2,099 cases, 18,246 events: PrepaidTravelCost.xes
4. International declarations: 6449 cases, 72151 events: InternationalDeclarations.xes, columns for building graphs 'id-trace', 'concept: name', 'time: timestamp'
5. Travel permits (including all related events of the respective prepaid travel value declarations and travel declarations): 7,065 cases, 86,581 events: PermitLog.xes

To analyze the process according to international declarations, the idea was to obtain a range of its most probable scenarios. For this, variants were selected containing more than 20 cases, as well as the best performance cases - 90% of cases completed within 150 days, rare activities were discarded, 80% of all activities were selected.

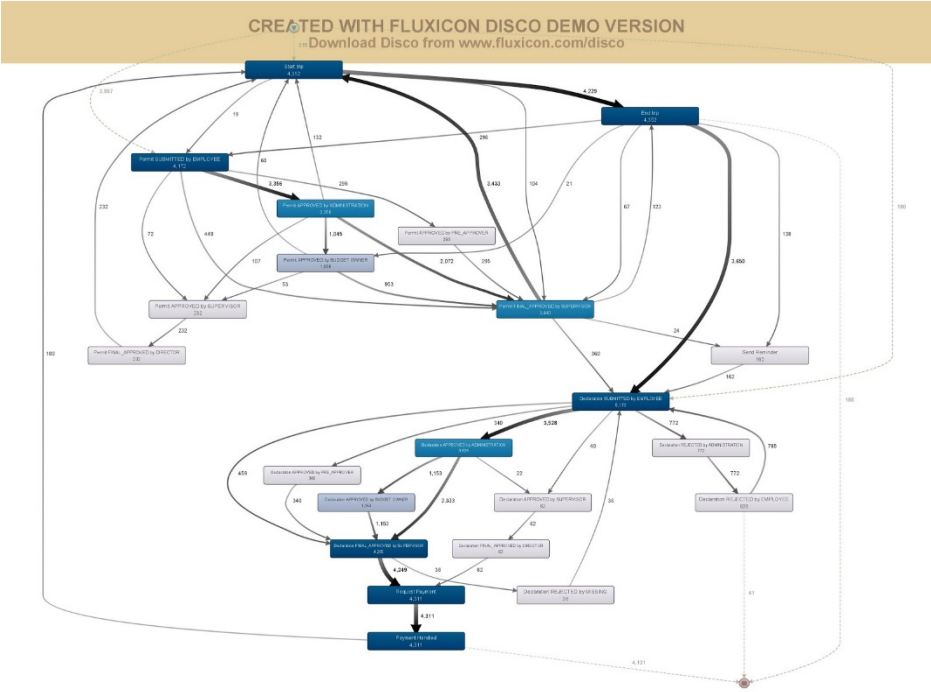

Fig. 2. Most frequent variants of the international declaration process (represented by frequency)

Figure 2 shows that the process consists of two parts: the approval of the travel permit and the filing of the declaration after the trip. It can be noted that in 7% of cases the trip takes place before the permit is submitted. In such cases, first a trip takes place, then a travel permit is submitted, then after the approval of the permit, a declaration is submitted, followed by payment. The current situation is inconsistent with the process description, which states that international travel requires a manager's permission and that travel authorization must be approved before any action is taken. Summing up the money given for these trips yields we can calculate a sum of~ 306 thousand euros. Recommendations are in section 3.

Rejections of declarations are present, but in most cases refusal declarations were successfully submitted again. In 6% of cases, the declaration was submitted before the trip, which again does not correspond to the description of the process, which asks for request for prior payment instead of filling the declaration. To discover this process in detail the “follower” filter was applied in Disco with a result on the next figure.

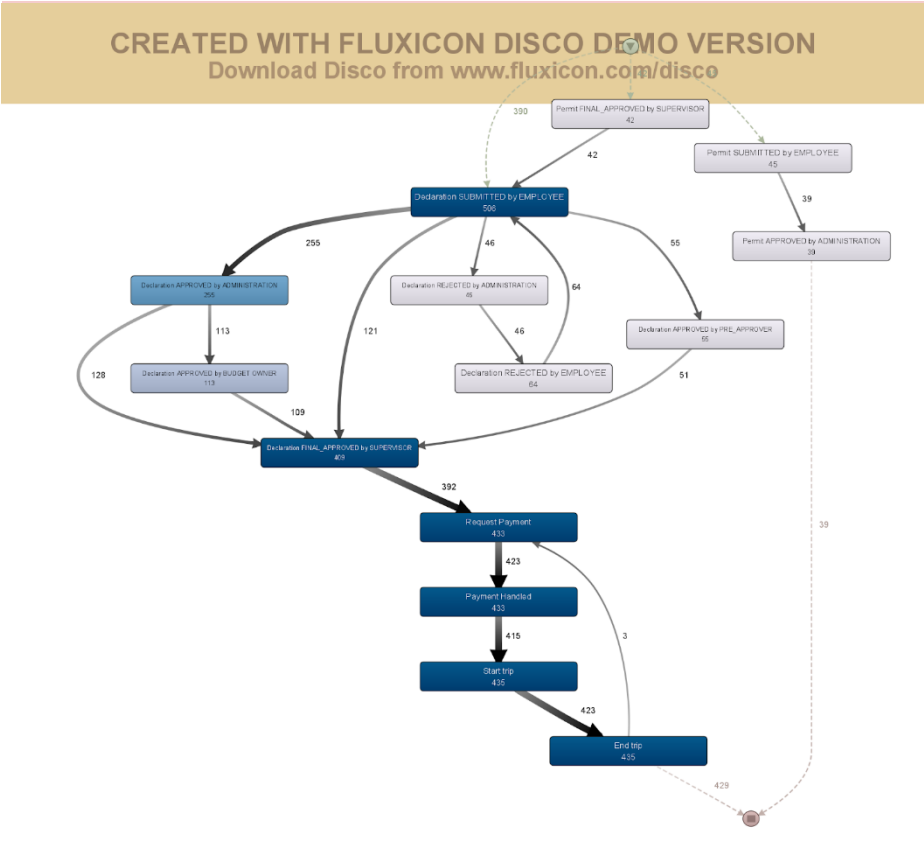

Fig. 3. Submission and payment of international declarations prior to travel (represented by frequency)

As shown on figure 3, 433 payments were done before the actual trip. Amount was ~380 thousand euros. According to median productivity, money is issued ~ 77 days before the trip, and employees are not accountable for it. As previously mentioned, recommendations are in the section 3.

Now, it is time to examine the process in terms of performance. Let's switch the statistics displayed on the graph from frequency to performance and choose the median representation.

In Figure 4, the Administrator and Pre_Approver roles are arguably automatic, as they process requests in mere minutes. After refusal, the declaration is submitted again on average in 2-3 hours. Most likely, the employee remakes the documents and resubmits the declaration. If the approval of the permit or declaration takes place without the participation of

BUDGET OWNER, then the final approval takes place on average within 28 Hr. The presence of BUDGET OWNER in the chain slows down the negotiation by an average of 3 times.

Recommendations related to this issue, as well as about the following ones, are in the section 3. Most declarations are filed within 5-6 days after the end of the trip and without reminders. The first reminder comes 30 days after the trip ends. In rare cases, the declaration is submitted after notification, which comes on average after 41 days. The amount for which they did not report before the remainder was ~290 thousand euros, and part of this money may be prepaid earlier and constitute the company's receivables.

Filtering cases by duration and selecting the previously discarded 10% of cases with more than 150-days duration reveals 392 such trips and each of them was successfully paid. Such a long duration was due to the fact that the travel permit was obtained long before the travel itself. Now let's filter cases once again, but now we will get variants with less than 20 cases in each.

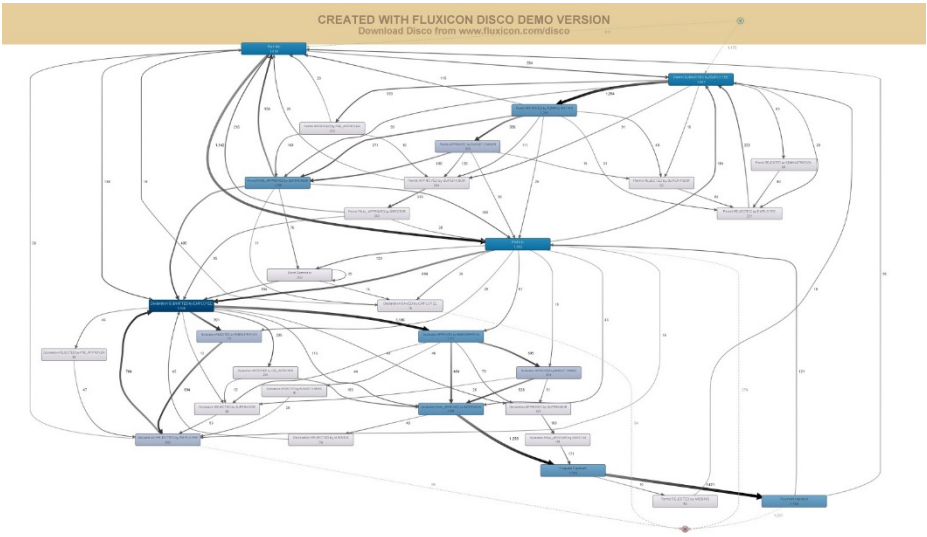

Fig. 4. Real process with scenarios with 20 or fewer cases (frequency representation)

Switching to show max repetitions mode, we will see that most of the deviating scripts are different ways to re-submit or re-declare after rejection, so such scripts still match the description.
In 130 cases, the chain is interrupted at the "Declaration REJECTED by EMPLOYEE" event, that is, the trip has occurred, but was not paid. The requested amount was approximately ~ 4900 euros.

To obtain the most likely implementation of the process for national declarations, we repeated the above actions by analogy with international declarations. To do this, we selected scenarios containing more than 20 cases, as well as the best cases in terms

of performance - 95% of cases completed within 30 days, and discarded rare activities, selecting 80% of all activities

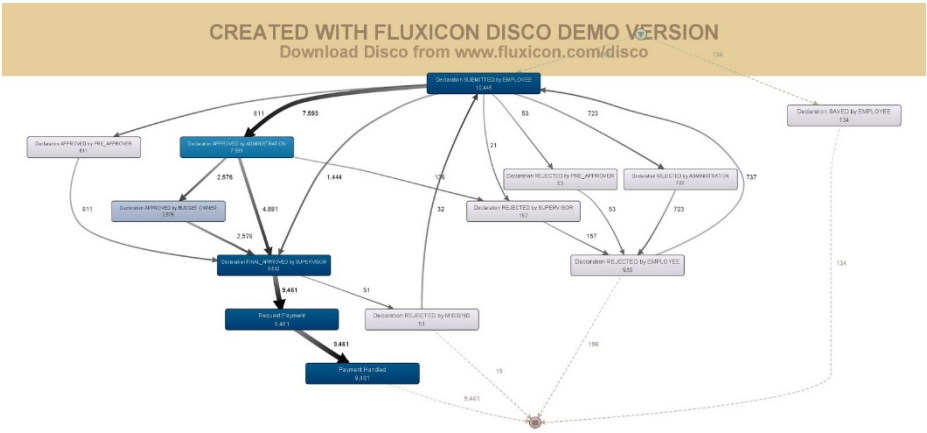

Fig. 5. Most likely implementation of the national declaration process (presentation by frequency)

The process for national declarations is much simpler, and in the most likely implementation it does not reveal any obvious deviations. But of course there are minor deviations in the process. For example, in 1 case (declaration 90815), there was a payment, in the state of declining the declaration even at the stage of agreement with the head.

As previously, performance graph is moved to a figure 29 in the appendix. If the approval of the declaration takes place without the participation of BUDGET OWNER, then the final approval takes place on average within 21 Hr. The presence of BUDGET OWNER in the chain slows down the negotiation by an average of 3 times.

We can also repeat the above steps for non-travel project activities, representing on the figure 6 below and in appendix:

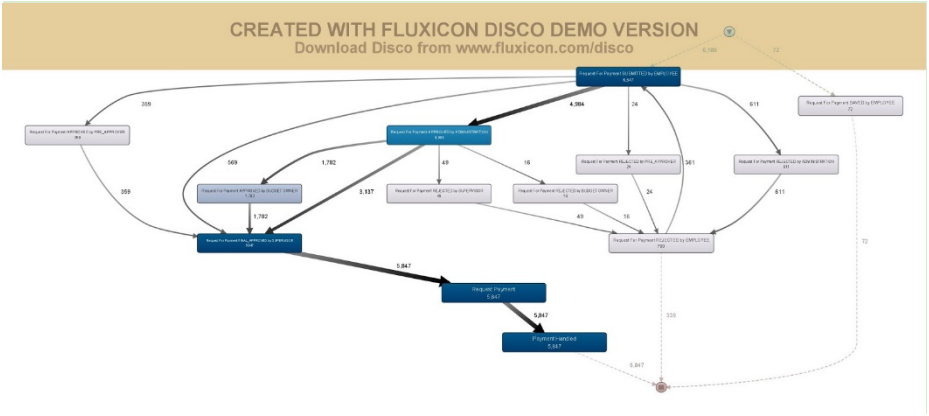

Fig. 4. The most likely implementation of the process for requests for payment for project activities (representation by frequency)

If the approval of the payment request takes place without the participation of BUDGET OWNER, then the final approval takes place on average within 26 Hr. Just as with other files, the presence of BUDGET OWNER in the chain also slows down the negotiation by an average of 3 times.

The important part here is there are no events on the graphs related to reports on spending by projects. They may not be logged. Logging of such events would expand the possibilities of analyzing the expenditure of funds for projects. When analyzing the process of spending money on project activities, an unreasonably frequent formation of requests for payment for projects was found. The cases were filtered by the presence of Payment Handled, and here are the top 3 by the money issued and the number of requests.

Project	RequestedAmount, Euro	count
project 503	320386	982
project 147546	172610	1036
project 147556	155695	922

Fig. 5. Table of top 3 most active projects.

Figure shows that the most frequent projects have more than 900 requests in the observation period, up to 3 times a day. It might be an inconvenience for administration.

Finally, to conclude the discovery part of the paper, we will repeat the above steps for prepayment negotiation process.

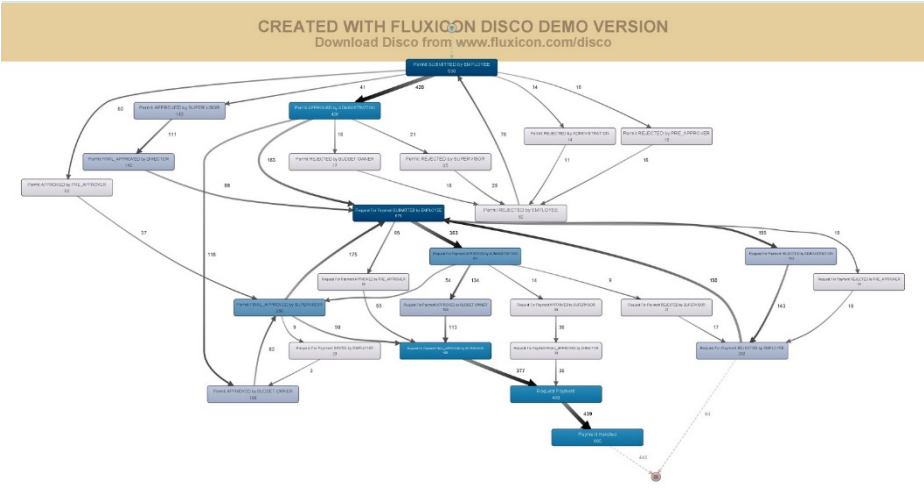

Fig. 6. Most likely implementation of the process for prepayment requests (representation by frequency)

As usual, performance graph is in the appendix.

In a small number of cases (only 6), payment is made upon request for a prepayment prior to agreeing on a travel permit. It was considered as noise.

In general, national and international declarations, travel prepayments and requests for payment, as stated in the description, go through a similar process. Let's try to identify any deviations in the real process in the course of answering general and detailed questions from the organizers of the competition and the owners of the process.

2 Answers to questions

2.1 General questions

1. What is the throughput of a travel declaration from submission (or closing) to paying?

The events “Declaration SUBMITTED by EMPLOYEE” and “Payment Handled” were selected to answer this question.

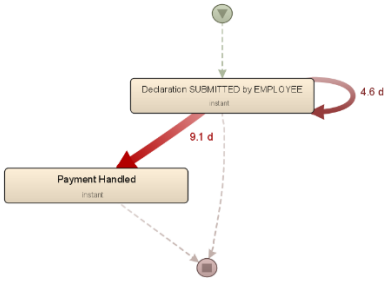

Fig. 7. Median productivity of the process according to international declarations.

The duration of the process for international declarations from the moment of submission to payment was on average ~ 9 days in case of successful submission or ~ 14 days in case of refusal of approval, taking resubmission into account.

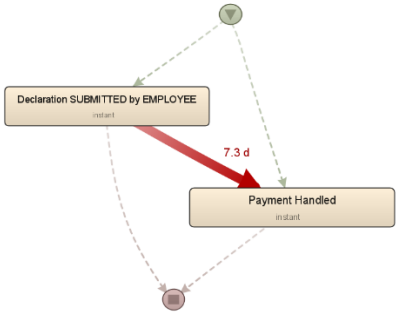

Fig. 8. Median productivity of the national declaration process.

According to national declarations, the duration of the process was ~ 7 days.

2. Is there any difference in throughput between national and international trips?

Based on the obtained performance figures from the first question, we conclude that the process for internal declarations in general takes less time, is executed faster, while international declarations process is slower. Although the processes for domestic and international declarations are similar, but since the levels of responsibility are different, there is some slowdown.

3. Is there any differences between clusters of declarations, for example between cost centers/departments/projects etc.?

With the help of Disco, let's look at the statistics on attributes in the logs for national and international declarations.

National declarations are not grouped because they do not have attributes such as BudgetNumber, Permit OrganizationEntity, Permit ProjectNumber, so domestic declarations file is not applicable for this task. On the other hand, BudgetNumber and Permit BudgetNumber on international declarations do not have distinct groups. The only parameter we can cluster declarations is Ogranization Entity.

Permit Organization Entity is clustered into large groups by organizational unit 65458, 65455, 65456 and 65454, containing 21.6%, 15.7%, 14.9% and 13.2% of cases, respectively. Let's filter the file InternationaDeclarations.xes by these cases and compare their numerical characteristics.

The most numerous declarations from the organization 65458 are slightly more likely to be agreed upon (17% of refusals against 22% on average), while they do not have advantages in the speed of approval. Declarations from organization 65455 are much more likely to be approved (10% of rejections versus 22% on average) and have record processing times, up to 2 times faster. The performance log of the process filtered by this organization is presented in a figure 11 below.

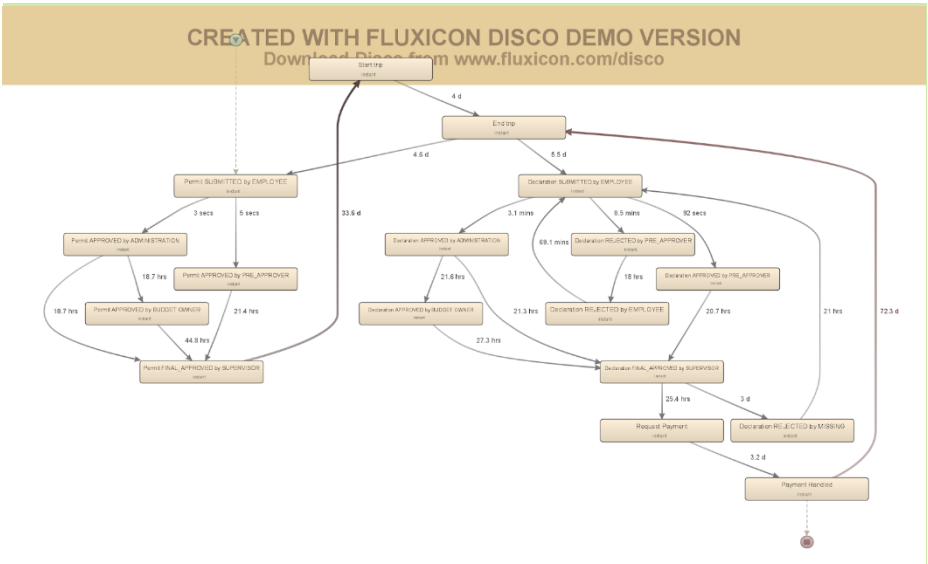

Fig. 9. Median process performance by international declarations, filtered by organizational unit 65455.

Organization 65456, as well as 65454, does not stand out, compared to the whole file. It can be concluded that one of the organizations, namely 65455, has a significant advantage over the others, being either clearly the most important, or implicitly having connections that facilitate coordination.

Permit ProjectNumber has just one distinct group, project 426, representing only 5% of cases. The declarations included in this project are on average one and a half to two times longer to be agreed upon by BUDGET OWNER and SUPERVISOR, while the number of refusals for them is lower than the average (17% versus 22%). Considering the not too noticeable difference with declarations not tied to projects, and the absence of other clearly distinguished projects by case amount, it can be assumed that grouping by projects is also not effective, as well as grouping by budgets. At the same time, the grouping by organization is important and representative.

4. What is the throughput in each of the process steps, i.e. the submission, judgement by various responsible roles and payment?

Consider the International declarations file. Analysis of the scenarios (as mentioned, "variants" in Disco) according to which events took place in it shows that there are 753 variants in total. Nevertheless, only the two most frequent scenarios cover 21% and 10% of cases, respectively. Let's plot a performance histogram for each of these two options. Since these diagrams are very similar, we can place them in one picture below.

International Declarations.xes	Throughput time, days	
Activity name	main variant	secondary variant
Permit SUBMITTED by EMPLOYEE	0	0
Permit APPROVED by ADMINISTRATION	1	0,9
Permit APPROVED by BUDGET OWNER	2,1	
Permit FINAL_APPROVED by SUPERVISOR	28,5	26,6
Start trip	4	4
End trip	4,8	5,4
Declaration SUBMITTED by EMPLOYEE	0	0
Declaration APPROVED by ADMINISTRATION	1,9	1,6
Declaration APPROVED by BUDGET OWNER	2	
Declaration FINAL_APPROVED by SUPERVISOR	1,1	1
Request Payment	3,2	3,2
Payment Handled	0	0

Fig. 10. Median internal declarations throughput time in days in the most frequent and second most frequent case scenario.

Figure 12 shows a histogram of median performance, in which the value of the table corresponds to the number of days after the event, the name of which is in the first

column, for example, Payment Handled occurred on average 3.2 days after Request Payment.
It can be seen that the two main scenarios are similar, differing only in the presence of the BUDGET OWNER role in the first option and the absence in the second. The longest stage is waiting for the trip - on average, a month passes between the final travel authorization and the trip. The first option is longer than the second because of the agreement with BUDGET OWNER both in the case of a travel permit and in the case of a declaration.

Let's build a histogram for domestic trips using the same principle. The first two scenarios cover 44% and 23% respectively. The values are given in hours, since there is no such long stage as waiting for a trip in the logs.

Domestic Declarations.xes	Throughput time, hours	
Activity name	main variant	secondary variant
Declaration SUBMITTED by EMPLOYEE	0	0
Declaration APPROVED by ADMINISTRATION	21	21
Declaration APPROVED by BUDGET OWNER		46
Declaration FINAL_APPROVED by SUPERVISOR	25	27
Request Payment	77	77
Payment Handled	0	0

Fig. 11. Median domestic declarations throughput time in days in the first two most frequent case scenarios.

It can be seen that the scenarios, as in the case of international travel, differ in the presence of the BUDGET OWNER role and the associated slowdown in the process. The longest time is to receive payment after a request for payment, which is 3.2 days or 77 hours.

Similarly, histograms are built for the process of requests for payment for project activities.

Request for payment.xes	Throughput time, hours	
Activity name	main variant	secondary variant
Request For Payment SUBMITTED by EMPLOYEE	0	0
Request For Payment APPROVED by ADMINISTRATION	28	26
Request For Payment APPROVED by BUDGET OWNER	0	52
Request For Payment FINAL_APPROVED by SUPERVISOR	26	31
Request Payment	77	77
Payment Handled	0	0

Fig. 12. Median request for payment throughput time in days in the first two most frequent case scenarios.

5. Where are the bottlenecks in the process of a travel declaration?

To find bottlenecks in the process of international travel, we will simplify the graph by reducing the number of activities to 8 - 10%. It can be seen that the greatest delays are at the stages of approval of the declaration by the head (~ 2 days), after the declaration has been agreed by the owner of the budget and the execution of the payment (~ 3 days).

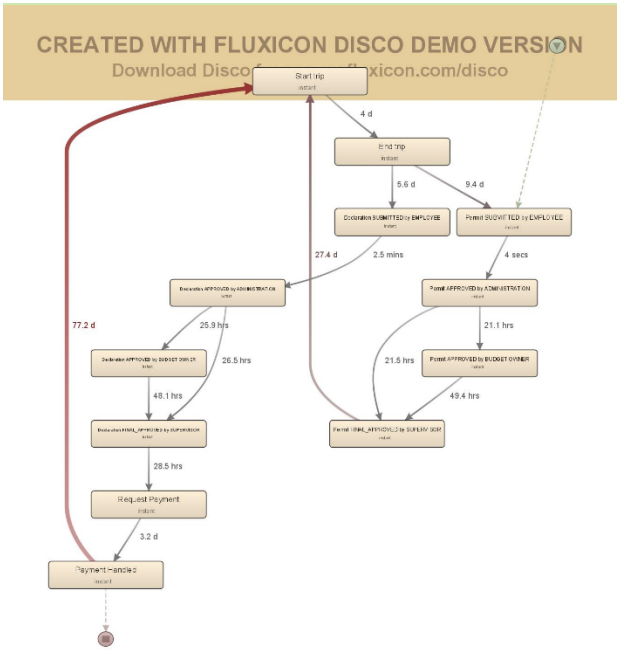

Fig. 13. Median process productivity according to international declarations with the number of activities ~ 8-10%.

A similar situation can be observed on the process graph with internal trips (figure number 16 below). The approval of the declaration by the manager after the owner's agreement on the budget and the execution of the payment are also bottlenecks in the process.

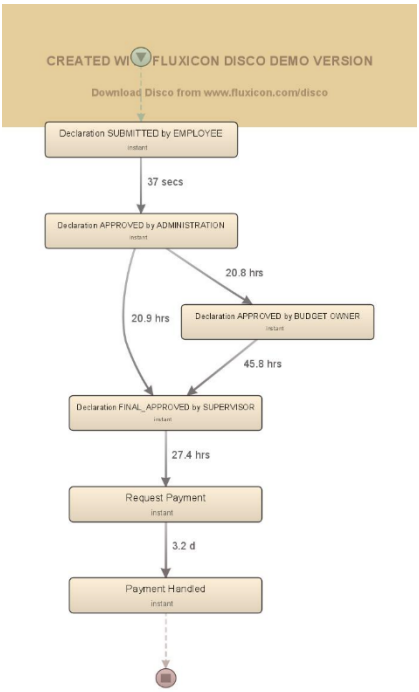

Fig. 14. Median productivity of the process according to national declarations with the number of activities ~ 8-10%.

6. Where are the bottlenecks in the process of a travel permit (note that there can be multiple requests for payment and declarations per permit)?

Permits are only obtained for international travel. Therefore, in order to find bottlenecks in the process of obtaining permits, we need a log with international travel. We will use the figures 15 and 16 from the previous question. The bottleneck for permits is in the same place where the bottleneck for declarations is the approval of the permit by the head (~ 2 days), after the declaration has been approved by the budget owner.

7. How many travel declarations get rejected in the various processing steps and how many are never approved?

To answer the question on international declarations, we group the events according to the similarity of their names and select the events related to the rejection and approval of declarations. As disco in its free version doesn't provide us with this

functionality, we use a home-made python solution using graphviz as a graph drawing engine.

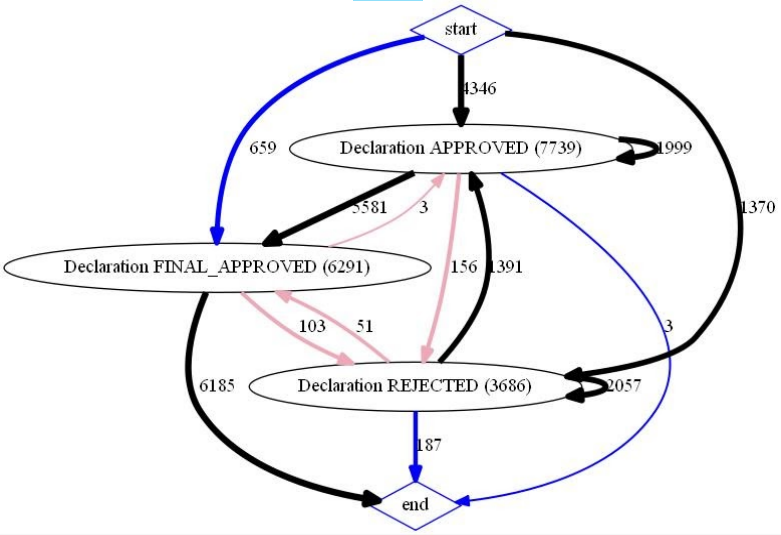

Fig. 15. Process graph for international declarations with grouping of events by similarity of name.

As shown on the figure 17, 3686 international declarations were rejected at various stages of processing (including 2057 resubmitted). Now let's filter only "Declaration REJECTED" cases.

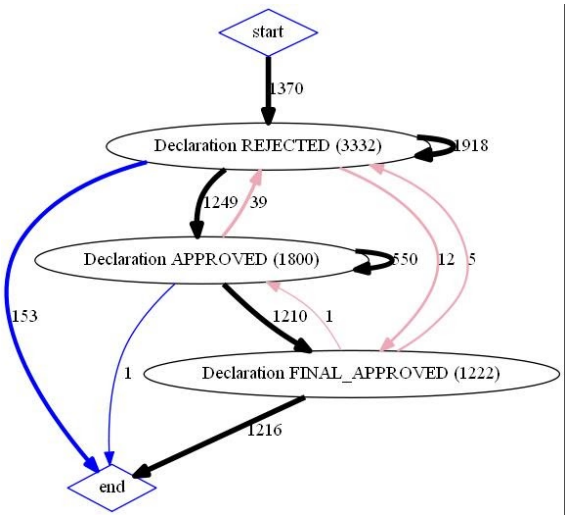

Fig. 16. Process graph for international declarations filtered by "Declaration REJECTED" cases

It is visible from the picture as a blue line with numbers 153 (“Declaration REJECTED” → end) out of 1370 international declarations have not been approved. We can look at them in a detailed way.

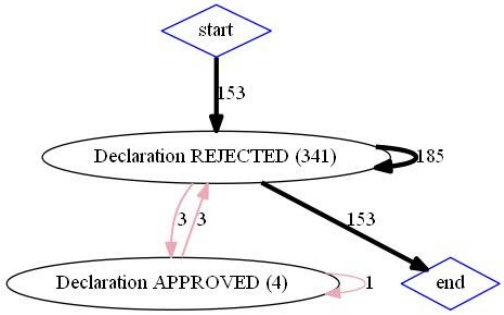

Fig. 17. Process graph for international declarations filtered by the path “Declaration REJECTED” → end.

3 out of those 153 declarations were approved (not final). Thus, 150 were never approved.

To answer the question on national declarations, we will also group events by similarity of name and select events related to the rejection and approval of declarations, repeating the previous process.

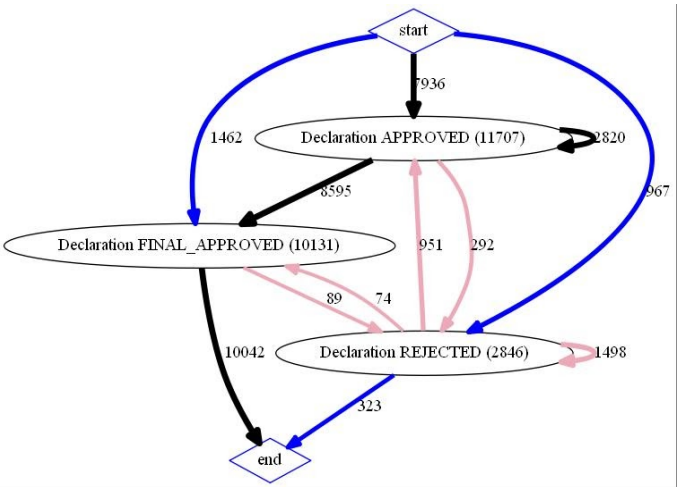

Fig. 18. Process graph for national declarations with grouping of events by similarity of name.

2846 national declarations were rejected at various stages of processing (including 1498 resubmits). Let's filter by them.

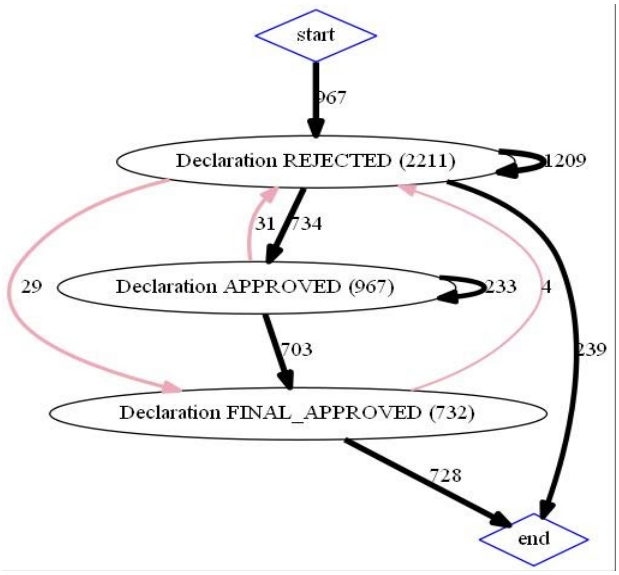

Fig. 19. Process graph for national declarations filtered by "Declaration REJECTED".

Once again, 239 "Declaration REJECTED" out of this 967 national declarations have not been approved. Going deeper.

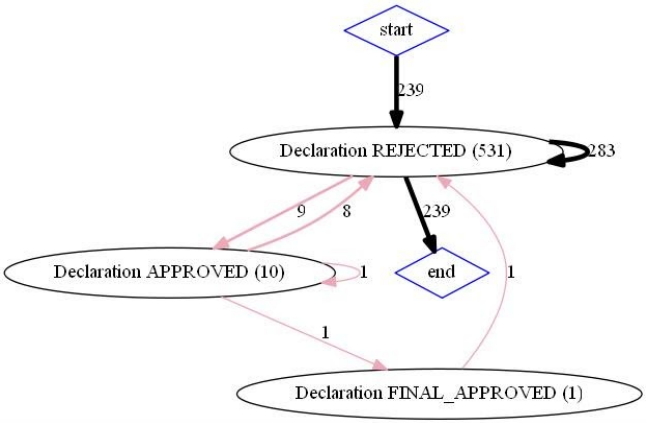

Fig. 20. Process graph for national declarations filtered by the path "Declaration REJECTED" → end.

Finally, 9 out of 239 national declarations were approved at least once. Thus, **230** were never approved.

To conclude, 230 domestic declarations and 150 international declarations were never approved.

2.2 Detailed questions

1. How many travel declarations are booked on projects?

The following SQL code was used to collect the target amount:

```
SELECT
   COUNT (DISTINCT [case_DeclarationNumber])
FROM [work_base].[dbo].[International Declarations] ID
WHERE 1 = 1
AND ID.case_Permit_ProjectNumber LIKE '%project%'
```

To answer this question, we counted the number of declarations that have the word "project" in the "ID.case_Permit_ProjectNumber" field. The number of international declarations that have been booked for projects is 3959. There are no declarations of payment for domestic travel booked for projects.

2. How many corrections have been made for declarations?

To answer this question on declarations of payment for international travel, we grouped and selected events related to the rejection, filing, editing, saving and approval of declarations.

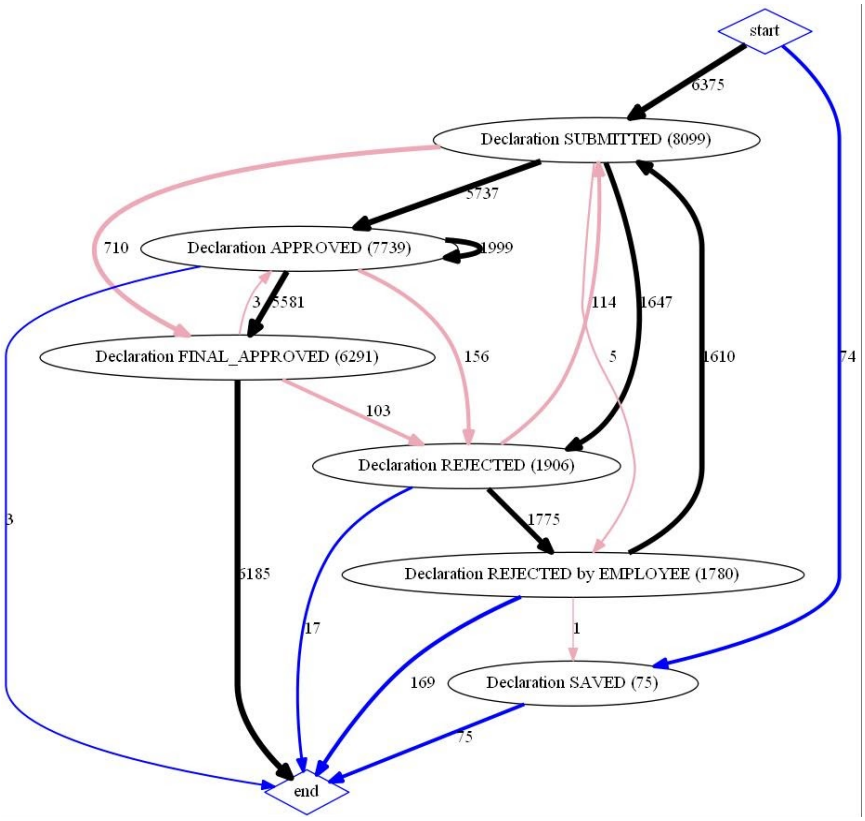

Fig. 21. Process graph for international travel payment declarations with events grouped by similarity of name.

After rejection, 1610 (rejected by the employee) and 114 (other stages of rejection) international travel payment declarations are returned to the submission.

To answer the question on domestic travel declarations, we grouped events by similarity of name and selected events related to rejection, submission, editing, saving and approval of declarations.

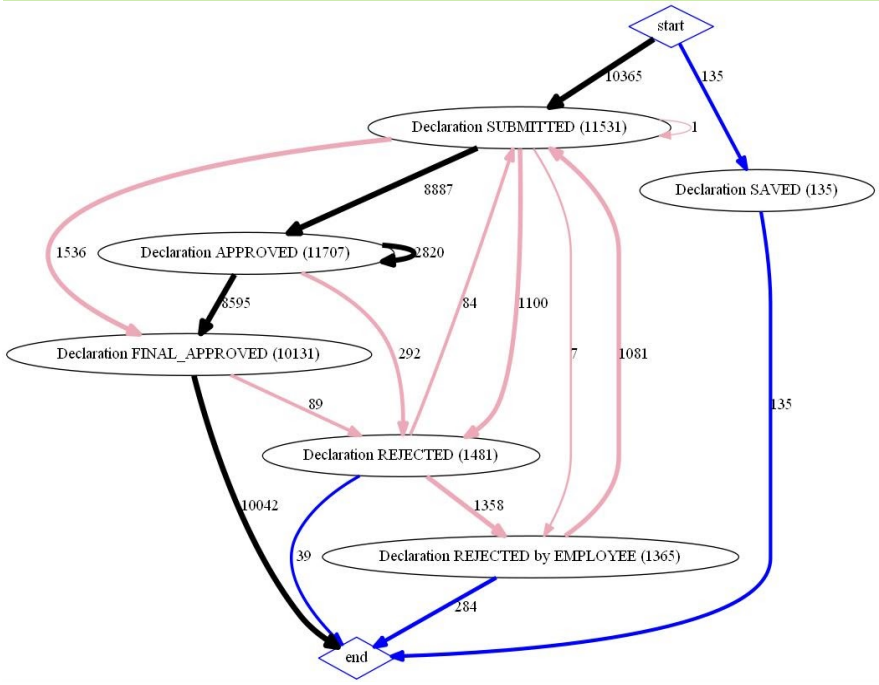

Fig. 22. Process graph for declarations of payment for domestic travel with events grouped by similarity of name.

After rejection, 1081 (rejected by the employee) and 85 (other rejection stages) returns for internal travel payment returns are re-submitted.

So, we can say that 1724 (1610 + 114) declarations for payment of international travel and 1166 (1081 + 85) declarations for payment of domestic travel were resent for approval. It is very likely that some of these declarations have been corrected. However, we cannot say that all these declarations were corrected, since such events as opening a declaration for editing and saving changes to the declaration are not recorded in the logs.

3. Are there any double payments?

To answer this question, we created a graph filter with the starting and ending points "Payment handled" via a Disco program,. There are no such cases in the "InternationalDeclaration", "DomesticDeclaration" and "PrepaidTravelCost" files. There are such cases in the Permitlog file, but these are situations in which, according to one permission, several declarations pass. We believe that the information provided is not sufficient to find double payments. To solve this problem, we need information about

the purpose of the payment, details, payment amounts, etc. Information on debts is also needed.

4. Are there any declarations that were not preceded properly by an approved travel permit? Or are there even declarations for which no permit exists?

To answer the question on international travel declarations, we have grouped events by similarity of name and selected events related to approval of permits and approval of declarations.

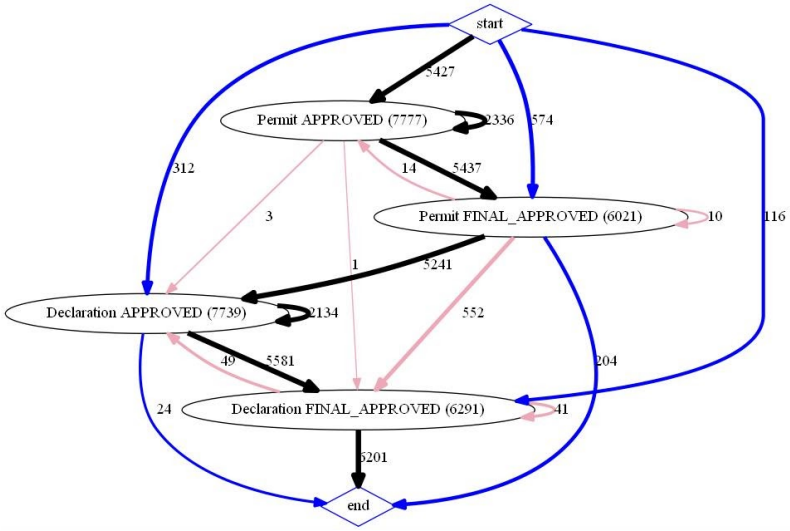

Fig. 23. Process graph for international travel payment declarations with a grouping of events related to the approval of permits and the approval of declarations.

Presumably for 3 (“Permit APPROVED” → “Declaration APPROVED”) and 1 (“Permit APPROVED” → “Declaration FINAL_APPROVED”) cases there was no final approval of the permission. But after drawing these cases on separate graphs, it becomes clear that the time of the final approval of the permission coincided with the time of approval of the permission for these cases.

For cases 312 (start → “Declaration APPROVED”) and 116 (start → “Declaration FINAL_APPROVED”) cases, there was no approval or final approval of permission at all, which is also confirmed after drawing these cases on separate graphs.

To answer the question whether there are declarations of payment for international travel without permits at all, we grouped the events again and selected the events related to the creation of permits, approval of permits and approval of declarations.

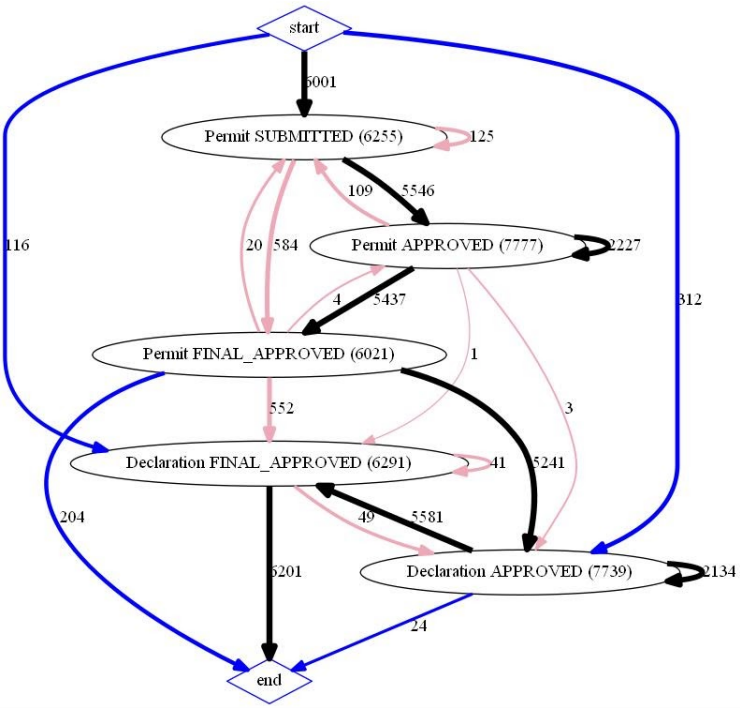

Fig. 24. Process graph for international travel payment declarations with a grouping of events related to the creation of permits, approval of permits and approval of declarations.

For 312 (start → "Declaration APPROVED") and 116 (start → "Declaration FINAL_APPROVED") cases there was no permission at all.

6. How many travel declarations are first rejected because they are submitted more than 2 months after the end of a trip and are then re-submitted?

We applied two filters to the graph of the payment process for international trips, with the condition that the declaration must be rejected at least once and 60 days have passed between the end of the trip and the submission of the declaration.

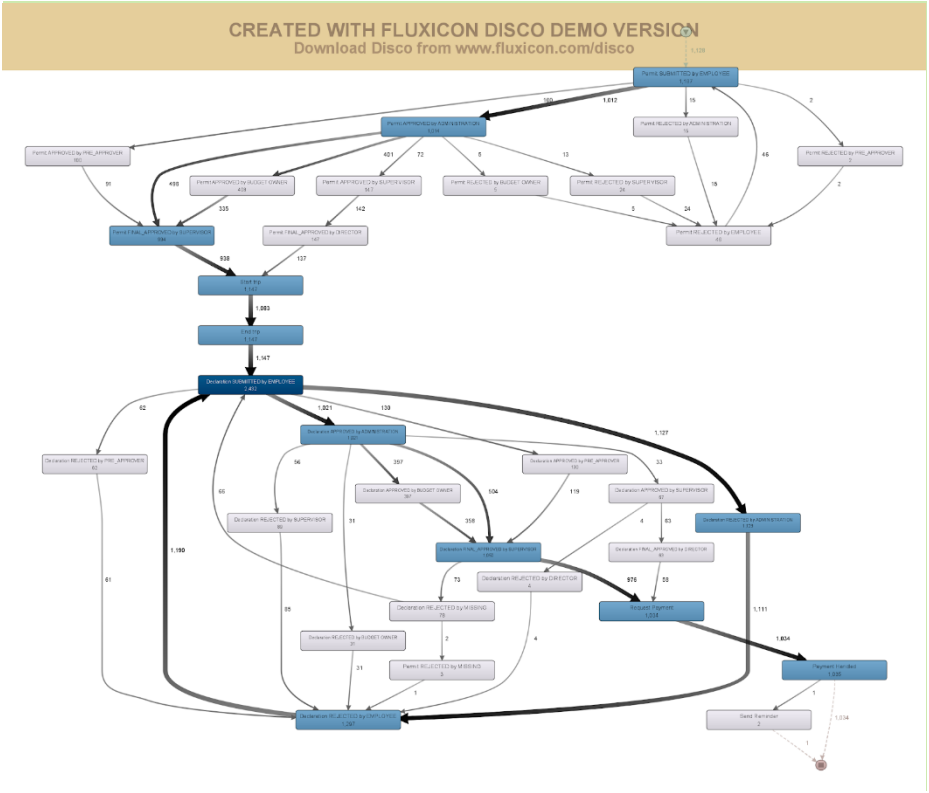

Fig. 25. Process graph for international declarations

In total, there are 2432 such international declarations, 1190 have been re-submitted, and 1034 of which ended in the issuance of money after re-submission.

7. How many travel declarations are not approved by budget holders in time (7 days) and are then automatically rerouted to supervisors?

Just one filter is enough to answer this question. If more than 7 days have passed between "Declaration SUBMITTED by EMPLOYEE" and "Declaration FINAL_APPROVED by SUPERVISOR", then "Declaration APPROVED by BUDGET OWNER" will not even appear there. There are 319 such cases for international travel and 193 for national ones.

8. Next to travel declarations, there are also requests for payments. These are specific for non-TU/e employees. Are there any TU/e employees that submitted a request for payment instead of a travel declaration?

There are only 8 of such cases. In one of them however, request for payment was rejected and employee submitted an actual travel declaration afterwards.

Now after the questions are answered we are to provide process owner and competition host with a set of recommendations, derived from an issue list that we uncovered previously.

3 Recommendations

The payment processes for international declarations and project activities turned out to be the most interesting in terms of analysis, it was them that the main deviations were identified and recommendations were given on.

Since in 7% of cases the trip takes place before the permit is submitted and the current situation does not correspond to the process description, which states that the permission of the manager is required for international travel and this travel permit must be approved before taking any measures, it is logical to recommend prohibiting payment for declarations for which permits were requested after the trip, or reflect the established procedure for agreeing permits in the description of the process, and it would be logical in such cases to skip the permit application process.

In 4% of cases, the declaration is submitted before the trip - this also does not correspond to the process description, which involves only a prepayment request in this case. We recommend not to accept declarations and do not pay for them until the end of the trip, because the trip may not take place, and the employee can potentially make a refund of tickets after payment on the declaration. In such cases, only prepayment requests should be accepted for payment.

In the course of the research, we realized that in the case the owner of the budget participates in the approval chain the approval process slowed down by an average of 3 times. This is a common problem for all the studied processes. To find out the reasons for the decrease in productivity at this point, it is necessary to analyze the work of the employee performing the approval directly at his workplace. You can also automate reconciliation for pre-planned costs to speed up the process.

We also found out that most declarations are filed within 5-6 days after the end of the trip, without reminders. Although, in rare cases, the declaration is submitted after notification, which takes on average 41 days. We consider that it is necessary to limit the time for filing the declaration after the trip, to exclude accounts receivable in cases with prepayment, and we also suggest reducing the period of time for the first reminder to 7 days. Currently this period of time is 30 days.

In addition, we have identified cases in which travel permits were approved well in advance of travel. We propose to set reasonable deadlines for submitting permits for approval and exclude approval of permits more than a year before travel.

Many declarations are rejected and then re-submitted, and this situation is described by the organizers of the competition as part of the process. However, it can be assumed that employees are not well informed about the rules for filling out and the deadlines for submitting declarations. Perhaps it makes sense to better inform employees about the payment procedure for each type of expense. This can significantly reduce the number of refusals at the stages of approval of declarations and will save time for all participants in the process.

To understand how many corrections are made to the declaration, we recommend logging the events of submitting declarations, editing of deckarations, and the events of saving the changes in declarations after editing.
In a small number of cases, payment is made upon request for a prepayment prior to agreeing on a travel permit. We propose to improve the software in order to close the possibility of prepayment in the lack of an approved travel permit.

There are no events associated with project spending reports on the process graphs. Most likely they are not logged. Logging of such events would expand the possibilities of analyzing the spending of funds on projects.

Analysis of the process of spending money on project activities showed an unreasonably frequent submission of requests for payment for projects. Sometimes there are several requests per day for payment for the same project. We suggest grouping payment requests by projects and by tasks within a project. Thus, we will get a decrease in the number of submitted requests for projects and will simplify the accounting of these costs.

Conclusion

Using Process Mining methods and the provided data provided, we tried to understand the real process of spending money on paying for trips to TU/e. We found some issues and bottlenecks, and suggested some recommendations to improve this process.

Appendix

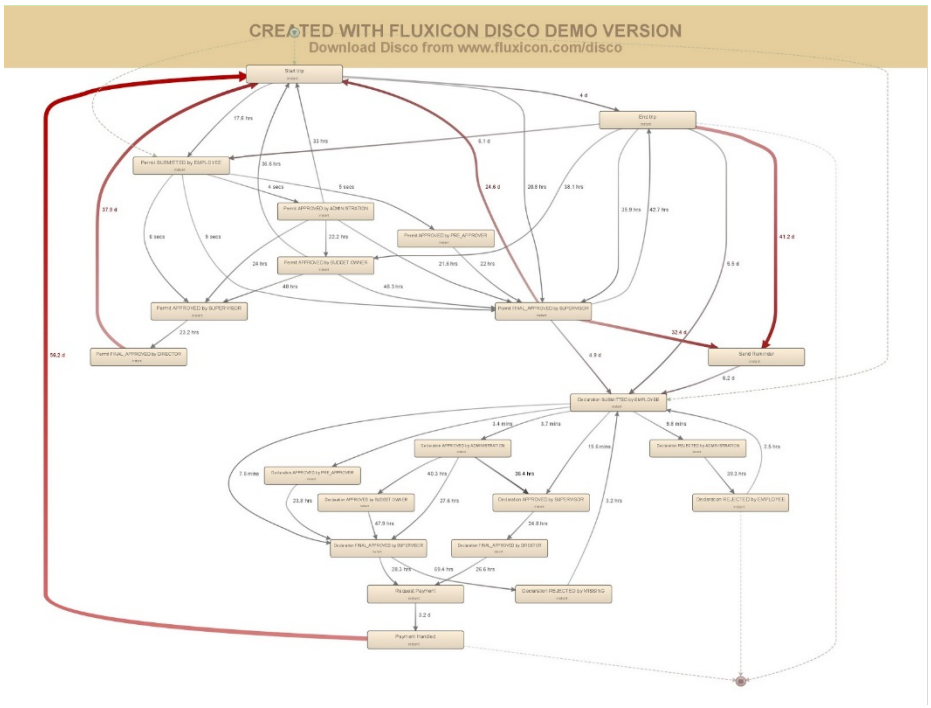

Fig. 26. Most frequent variants of the international declaration process (represented by performance)

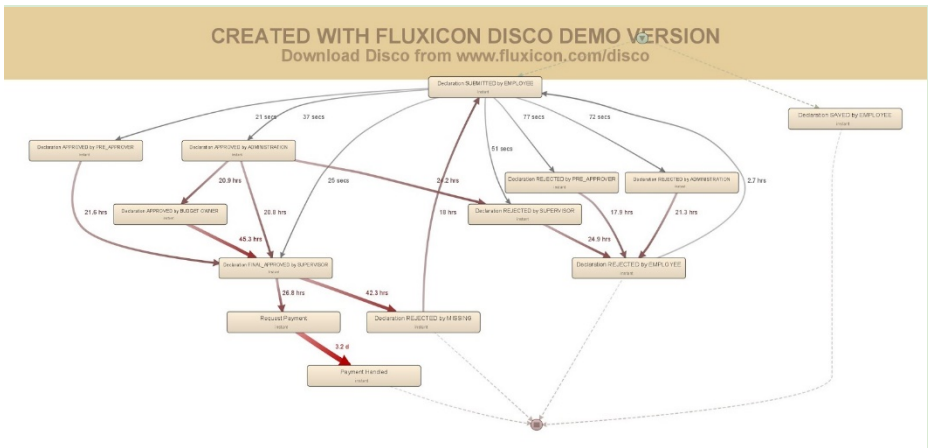

Fig. 27. Most likely implementation of the national declaration process (representation by median productivity)

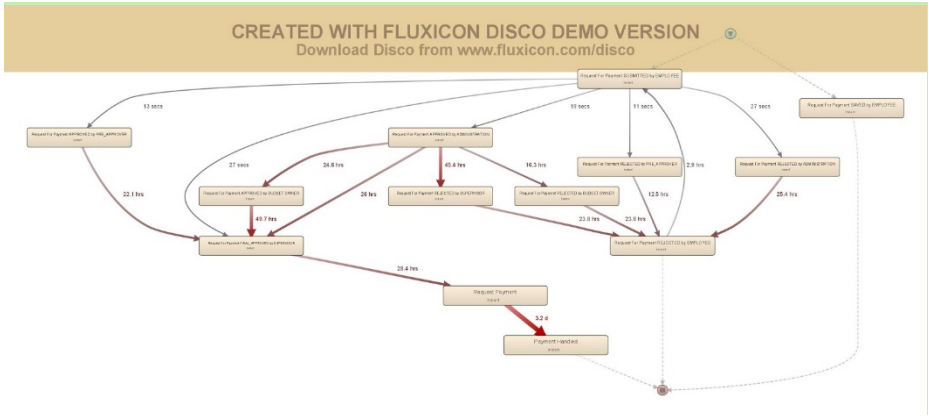

Fig. 28. The most likely implementation of the process for requests for payment for project activities (representation by median productivity)

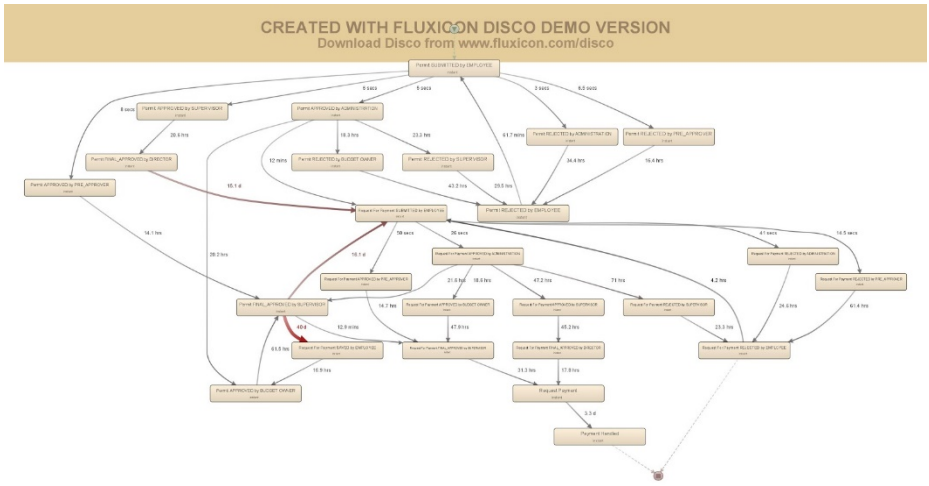

Fig. 29. The most likely implementation of the prepayment request process (representation by median performance)