TENTH INTERNATIONAL BUSINESS PROCESS INTELLIGENCE CHALLENGE

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Submission in The Non-Student Category
Aiming on completeness of analysis and usefulness
for the purpose of a real-life process mining setting.

Submitted by

Tatiana Zolotova
Konstantin Mikiev
Daria Zaplotnikova
Kseniia Khandogina

Contents

1. Abstract

For the ICPM Process Mining contest an anonymized dataset is available.

This dataset was provided by the Eindhoven University of technology (TU/e).The University specializes in teaching students in the field of science and technology. TU/e employees often attend conferences and other universities as part of project meetings or to exchange experience in their professional field. The task is to analyze the business process of organizing business trips. The data set is a real life event log that contains information about each stage of the process of sending employees on business trips.

The goal of this report is to help the company understand the process, point out errors and deviations in the business process, identify losses and optimize the process of registration travel requests and declarations. All these shortcomings remain unnoticed and lead to increased workload for employees and financial losses.

As part of the study, we considered the main points:

1   Throughput and bottlenecks of the main stages of process

2   Deviations from the standard process

**3**   Analysis of data for violations in the process

After the initial data processing was done, we decided to exclude the analytical data gathered up until the year 2018. The reasoning behind the decision was made due to the process of collecting data being not standardized and containing faulty logs.

2. Building graphs

The graph which depicts the process was built using "Disco". An analysis was done by using the collected data.

With the help of Disco, 2 graphs are generated for each of the types of trips:
- Domestic
- International.
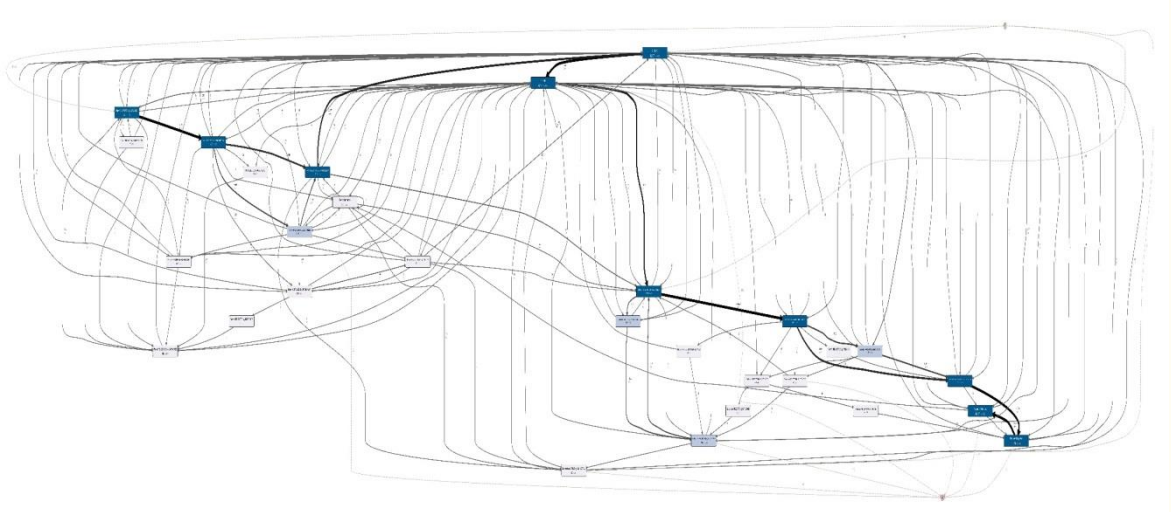
Picture 1. Graph of International trips.
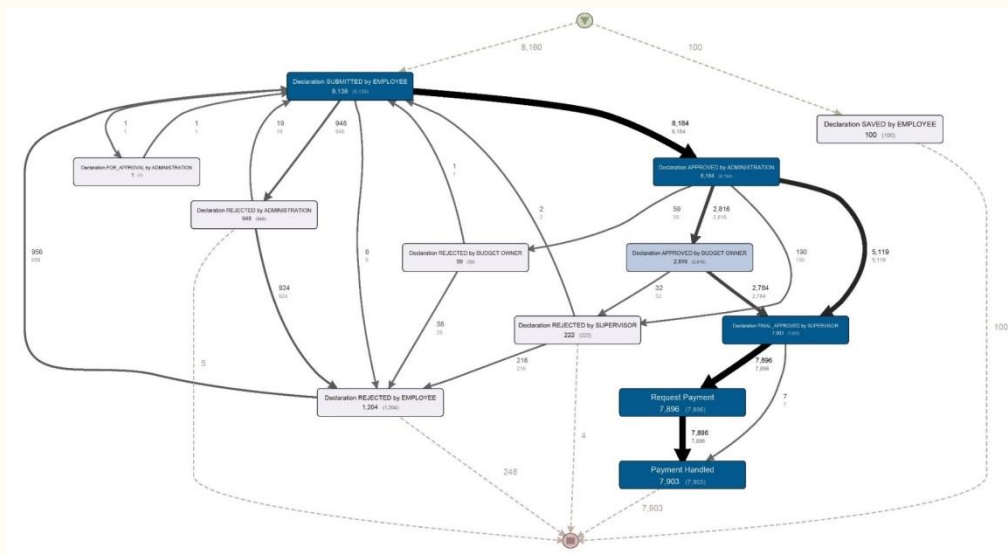
Picture 2. Graph of Domestic trips.

The graph shows fuzzy models of the process, that is a result of the presence of events with errors (omissions, incorrect event time, the same events in different requests go in different order with a difference of several milliseconds).

From the following graphs, we can conclude that processes do not have a certain directed movement and have a lot of cyclical events - for example, when requests are rejected at different stages of approval.

Due to the complexity of perception, it was decided to transform and simplify the scheme for more detailed analysis. With the help of clearing logs from noises, we get the following graphs of processes (Picture 4, 5).
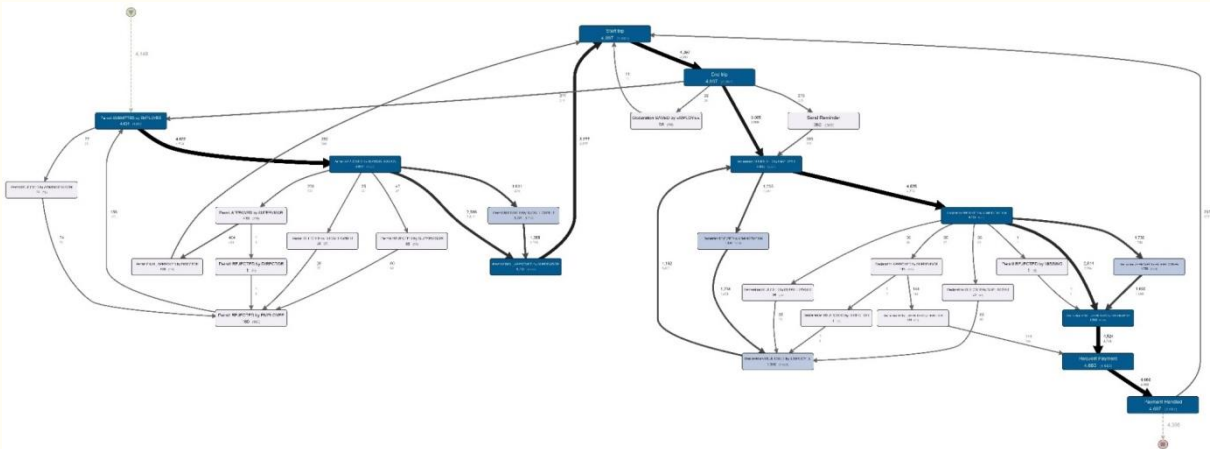
Picture 3. Graph of International trips after clearing.
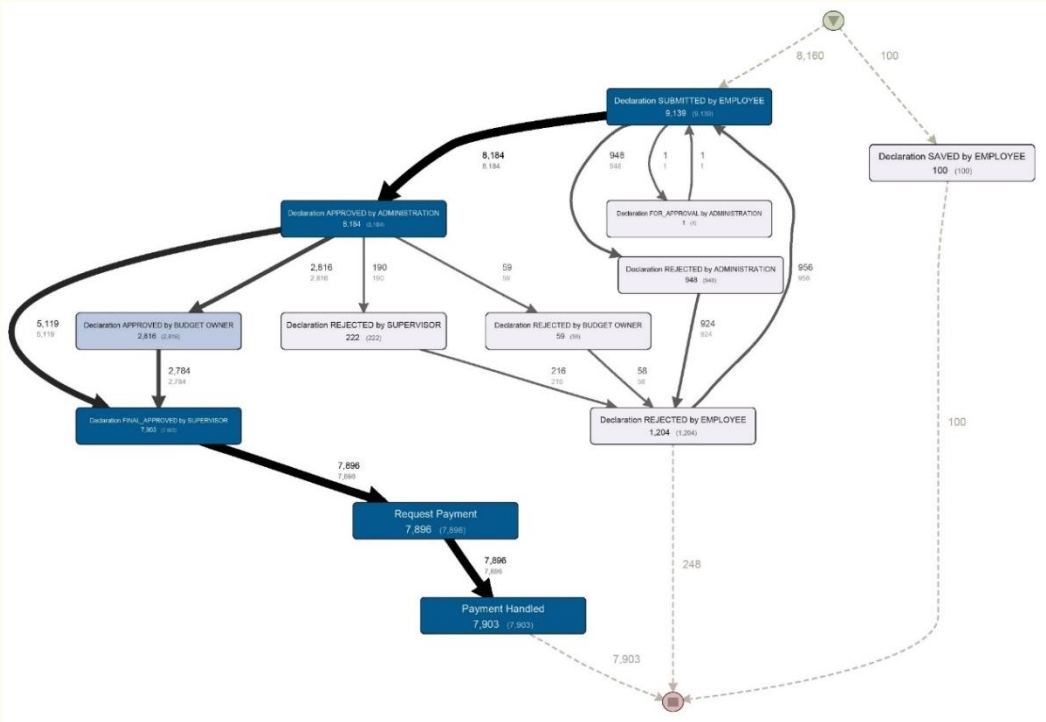
Picture 4. Graph of Domestic trips after clearing.

3. Ideal process

Initial data: 13 157 trips registered by employees for the period from 01.01.2018 with **103 640** events on them.

After creating the ideal process, we identified:

✓ all process includes 4 main stages:
  ➢ Permit
  ➢ Prepaid
  ➢ Declaration
  ➢ Payment

✓ each one of these stages goes through identical phases of agreement:
  ➢ SUBMITTED by EMPLOYEE
  ➢ APPROVED by ADMINISTRATION
  ➢ APPROVED by BUDGET OWNER
  ➢ APPROVED by SUPERVISOR

There are two stages for domestic trips : Providing a declaration and payment for the trip
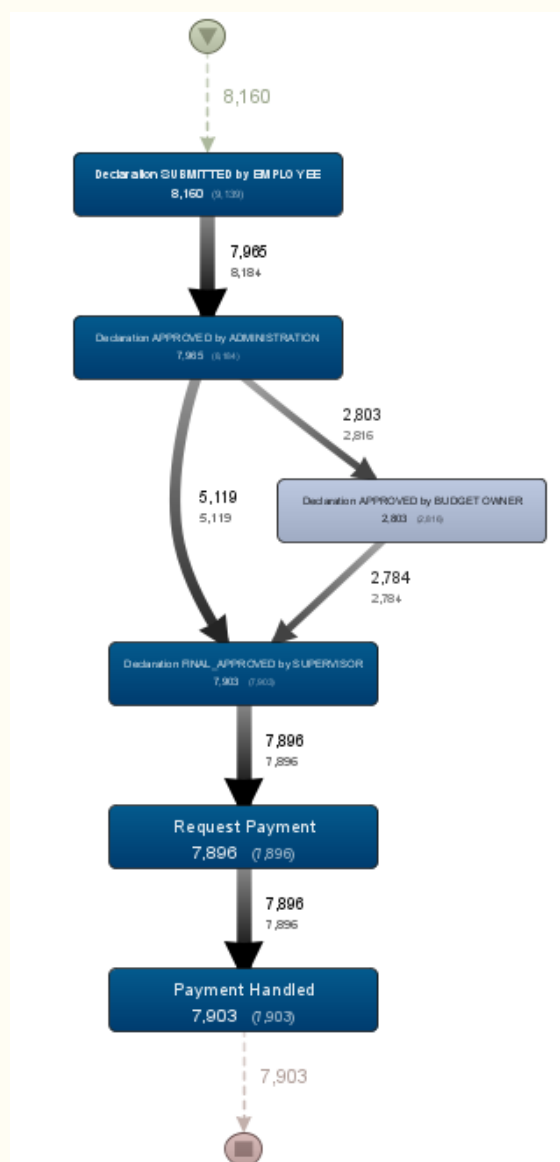
Picture 5. Ideal process of Domestic declarations log-file

There are four stages for international trips : Permit, prepaid, submission of a declaration and payment of a trip

The scheme of ideal process is shown in the following picture 6

Permit

- SUBMITTED by EMPLOYEE
- APPROVED by ADMINISTRATION
- APPROVED by BUDGET OWNER
- APPROVED by SUPERVISOR

Prepaid

- SUBMITTED by EMPLOYEE
- APPROVED by ADMINISTRATION
- APPROVED by BUDGET OWNER
- APPROVED by SUPERVISOR

START TRIP

END TRIP

Declaration

- SUBMITTED by EMPLOYEE
- APPROVED by ADMINISTRATION
- APPROVED by BUDGET OWNER
- APPROVED by SUPERVISOR

Payment

- SUBMITTED by EMPLOYEE
- APPROVED by ADMINISTRATION
- APPROVED by BUDGET OWNER
- APPROVED by SUPERVISOR

PAYMENT HANDLED

Domestic Trip

International Trip

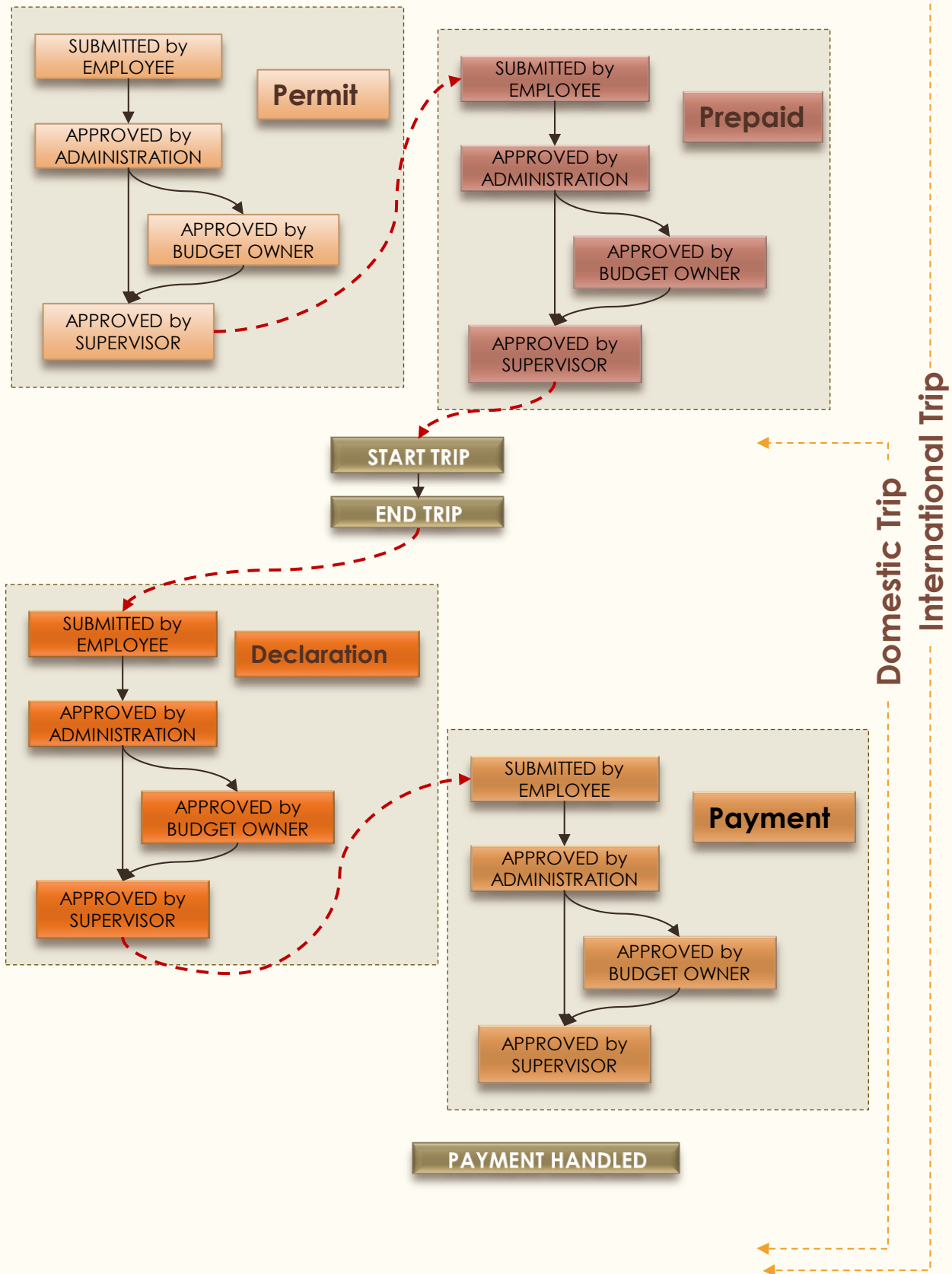**Picture 6. Scheme of the Ideal process**

4. Deviations in the process

We have identified the main deviations in the process:

- A large number of applications are rejected at different stages of approval The most number of rejections are at the first stage of approval.

- Identified applications processed within a period of more than 14 and 28 days. The longest phase at the approval stage is approval/rejection of the application by Supervisor.

Domestic trips			International trips		
	>14 days	>28 days		>14 days	>28 days
Declaration submitted by employee– Declaration approved/rejected by administration	232 2,8%	135 1,63%	Permit submitted by employee– Permit approved/rejected by administration	43 0,88%	-
			Declaration submitted by employee– Declaration approved/rejected by administration	208 4,25%	103 2,04%

- The existing stages follow the exact same approval path.

- Submitting a request for a business trip permission, after the start of the trip, or absence of a permission at all or submitting a declaration without a trip.

- A reminder of the need to submit a Declaration is made long after the end of the trip (in the median of 43 days).

5. Suggestions for improving the process

- Probably the application template is difficult for understanding and has ambiguous concepts. We offer to modify the template of sending declarations, make an intuitive interface and modify or add hints in parts where errors are most often made when filling out the application form

- Develop a tool or guide for searching for applications that have been in processing for a long time.

- Define regulatory deadlines for each stage of approval

- Consider the possibility of partially automating the process of verification and confirmation of applications.

- It is necessary to consider possibility of combining stages into one, for example foresee the possibility of filling out an application for payments as a part of declaration, so that both stages could be approved simultaneously, which will significantly reduce the time spent from filling a declaration to receiving the payment.

- Approve a strict procedure for making business trips, finalize templates to avoid deviations.

- Reduce the time for sending a reminder to 5 days after the end of the trip, and provide a second reminder to 20 days after the end of the trip

6. Results of analysis

6.1. Main parameters of the duration of the stages

Duration of main stages:

	Domestic	International	
From Submitting a Declaration to Payment	Min: 25,6 hrs	Min: 24,9 hrs	
	Max: 41,6 wks	Max: 14,1 mths	
	Mean: 10,4 d	Mean: 12,4 d	
	Median: 7,3 d	Median: 9,3 d	
		DIRECTOR	SUPERVISOR
From Approve to Payment	Min: 23,6 hrs	Min: 25,0 hrs	Min: 39,6 mins
	Max: 40,6 wks	Max: 30,1 d	Max: 39,0 wks
	Mean: 6,4 d	Mean: 5,6 d	Mean: 6,4 d
	Median: 5,2 d	Median: 4,8 d	Median: 5,3 d

A large number of applications are rejected at different stages of approval (12% of declarations for internal business trips are rejected, and the maximum number of corrections reaches 7 times, 30,9 % of declarations for international business trips are rejected, and the maximum number of corrections reaches 5 times).

REJECTED BY	Domestic	International
ADMINISTRATION	842	1258
BUDGET OWNER	58	36
DIRECTOR	-	1
SUPERVISOR	217	90

The most number of rejections are at the first stage of approval (Rejections in every log-file):

Request for Payment	Prepaid Travel Cost		Domestic Declarations	International Declarations		Permit
Request for Payment Rejected by Administrator	Request for Payment Rejected by Administrator	Declaration Rejected by Administrator	Declaration Rejected by Administrator	Declaration Rejected by Administrator	Permit Rejected by Administrator	Permit Rejected by Administrator
6324/834	1943/228	1618/15	9139/948	6334/1512	4803/79	5763/126
13,19%	11.73%	0,93%	10,37%	19.18%	1,65%	2,18%

There are Declarations which have never been Approved:

	Total Declarations	Never Approved
International Declarations	4840	153
Domestic Declarations	8160	257

Since 2018, a total of 4 840 declarations have been submitted for projects, of which 4 687 have been paid for in the amount of 3 821 273,48 c.u.

Information about projects is contained in the following logs : PermitLog, PreparedTravelCost, RequestForPayment, InternationalDeclaration. However, logs PreparedTravelCost, RequestForPayment do not contain information about the Declaration within which the payment was made. Thus, to calculate the number of declarations for Domestic business trips (Domestic Declaration) is not enough data in the project context, as log PermitLog contains information only on International declarations (International Declaration).

The top 20 project data is shown in the table.

The largest number of declarations and funds spent were on business trips that were not related to a specific project activity (UNKNOWN).

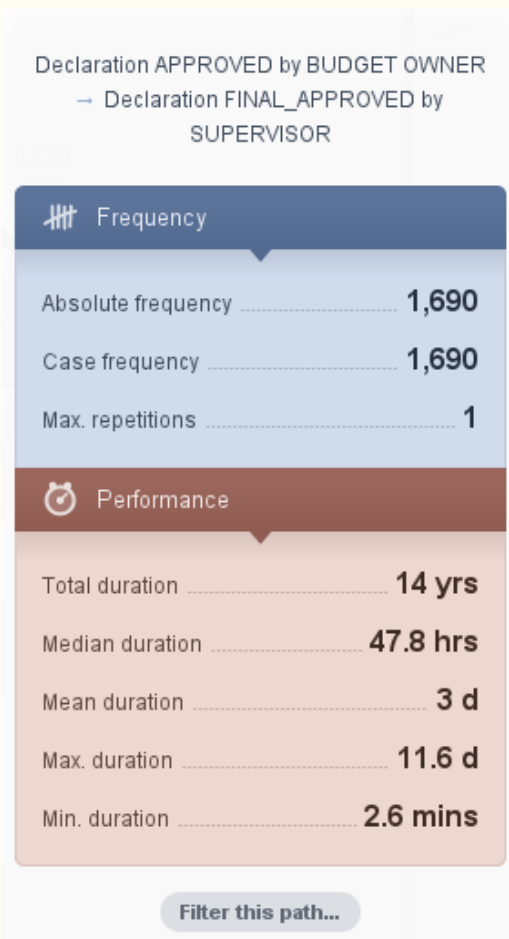| Project	Number of Declarations	Sum of Declarations	Number of paid Declarations	Sum of paid Declarations
UNKNOWN	1898	1353010,72	1810	1353010,72
project 426	282	263550,67	266	263550,67
project 1623	27	6603,28	26	6603,28
project 1115	26	39301,54	26	39301,54
project 1185	26	21350,14	26	21350,14
project 3442	24	17758,51	24	17758,51
project 1400	22	19470,6	22	19470,6
project 981	22	27706,05	22	27706,05
project 6406	19	25324,87	19	25324,87
project 3318	19	13950,4	19	13950,4
project 3352	18	11471,67	18	11471,67
project 647	18	6653,96	18	6653,96
project 723	18	15973,74	15	15973,74
project 12435	17	14655,24	17	14655,24
project 1078	17	7673,69	16	7673,69
project 830	16	9363,9	16	9363,9
project 636	16	17181,81	16	17181,81
project 6649	16	15894,07	14	15894,07
project 6210	15	9223,78	15	9223,78
project 8761	14	11015,92	14	11015,92

In the data provided, information about project trips is reflected only in the logs of international trips.

From the data provided, we can conclude that different departments implement a different number of projects in which trips are carried out. However, the cost also differs significantly. Thus, the amount spent on 1 project varies from 178.83 USD to 11,911. 25 USD, the number of projects per Department varies from 1 to 180, and the total number of declarations - from 1 to 883.

Project	Number of Declarations	Sum of Declarations	Number of paid Declarations	Sum of paid Declarations
organizational unit 65456	883	703059,15	180	3905,88
organizational unit 65454	775	643207,56	54	11911,25
organizational unit 65458	742	551120,93	91	6056,27
organizational unit 65455	523	321377,63	99	3246,24
organizational unit 65459	469	416644,42	108	3857,82
organizational unit 65460	458	416638,6	94	4432,33
organizational unit 65464	303	202917,53	42	4831,37
organizational unit 65457	299	203465,22	48	4238,86
organizational unit 65466	213	185098,99	28	6610,68
organizational unit 65461	77	31569,71	11	2869,97
organizational unit 65469	50	50521,14	6	8420,19
organizational unit 65470	40	13193,16	2	6596,58
organizational unit 65472	19	16068,16	3	5356,05
organizational unit 65467	18	9071,34	1	9071,34
organizational unit 65475	16	11687,67	1	11687,67
organizational unit 65468	13	8631,25	2	4315,63
organizational unit 65473	12	3452,61	2	1726,3
organizational unit 65480	9	10837,18	2	5418,59
organizational unit 65465	7	6401,18	1	6401,18
organizational unit 65471	7	5716,25	1	5716,25
organizational unit 65482	7	5164,2	1	5164,2
organizational unit 65477	4	1976,35	1	1976,35
organizational unit 65484	3	2041,09	1	2041,09
organizational unit 65486	2	641,24	1	641,24
organizational unit 65488	1	1529,71	1	1529,71
organizational unit 65478	1	492,74	1	492,74
organizational unit 65462	1	178,83	1	178,83

6.2. Bottlenecks of process

There are no pronounced bottlenecks in all sections of the application process. The only bottleneck is the passage of the application from the accountant to confirmation by the Supervisor in all the company logs, which may be caused by a special feature of the business process. This section is worth paying attention to in order to optimize the process, or partially automate the process of checking and confirming applications.

Declaration APPROVED by BUDGET OWNER
→ Declaration FINAL_APPROVED by
SUPERVISOR

Frequency

Absolute frequency	1,690
Case frequency	1,690
Max. repetitions	1

Performance

Total duration	14 yrs
Median duration	47.8 hrs
Mean duration	3 d
Max. duration	11.6 d
Min. duration	2.6 mins

Filter this path...

**Picture 7. Example of the stage of Approval
by Supervisor**

6.3. Corrections

In total, there were 2 473 corrections in the submitted declarations for international and domestic trips.

We accept all repeated submissions of declarations by an employee (Declaration SUBMITTED by EMPLOYEE) as corrections. A total of 6 334 declarations were sent for international trips, of which 4 840 were unique. Domestic Declarations were sent 9 139 of them unique 8 160. Thus, the number of repeated applications can be easily calculated, which we did by calculating the difference between unique declarations and the sum of all submitted declarations.

This is a key point we also took into consideration and brought to the main deviations of the process, because this is additional work for employees checking incoming applications and employees returned from a business trip.
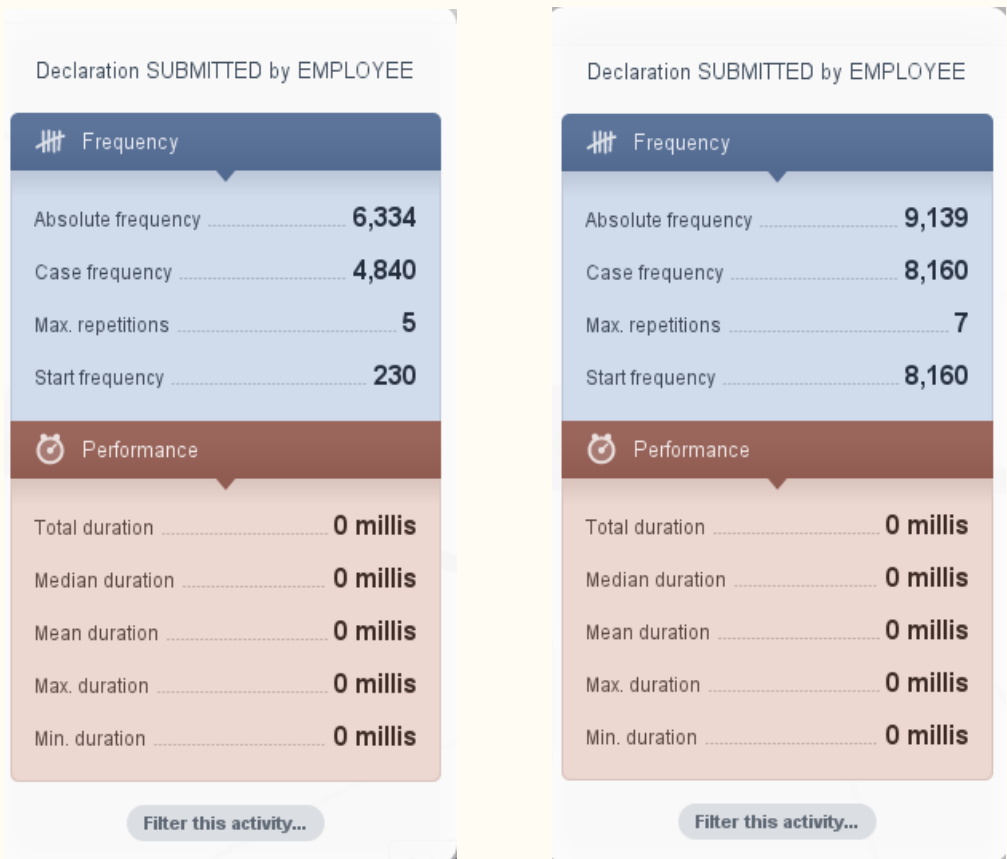

Picture 8. Corrections in Declarations

6.4. Deviations from the standard process

858 or 17,73% of cases when the request for a trip passed the final confirmation by the Manager after the start of the trip, including 493 cases or 10,18% when requests for approval of the trip were submitted after the start of the trip itself.

There are 261 requests for Declaration confirmation for which there is no trip permission at all. For 249 of them, a payment was made in the amount of 249 766,68 and only 11 declarations were rejected by the ADMINISTRATION/ SUPERVISOR and 1 case of an approved Declaration in the amount of 0 (declaration 147263).
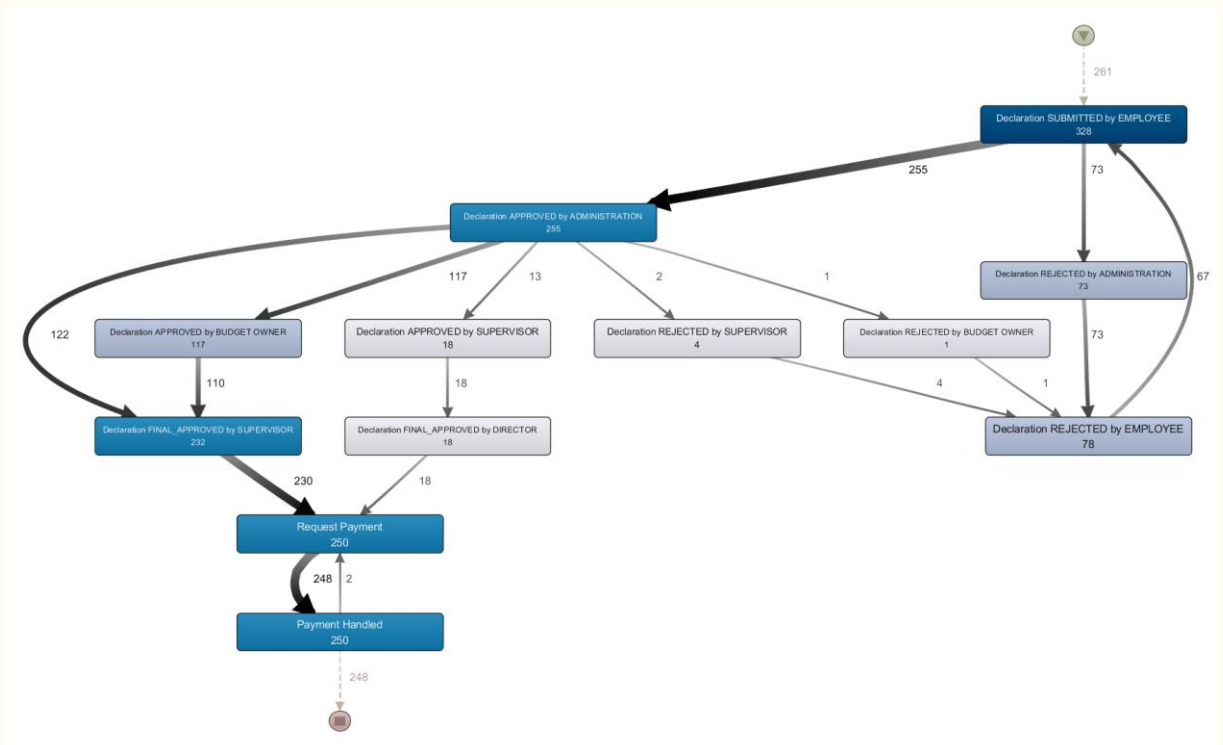
Picture 9. Graph of process where declarations were not preceded by a duly approved travel permit

There was only one violation of the process sequence, and it can be assumed that this was caused by a technical error. Log International Declarations.xes, declaration 6199 (Picture 10).

These cases are a serious violation of the progress of all stages of the employee's business trip. The travel permit must be confirmed by all participants in the approval. It is necessary to minimize situations in which the approval of the application does not have time to go all the way, but the business trip is mandatory and important.

It is necessary to find out where the submitted declarations without a finished trip come from, and Refine the system that will allow you to submit a Declaration if you have an approved permit, i.e. the Declaration must be linked to a specific travel permit, without excluding the possibility of adding multiple declarations for a single trip.
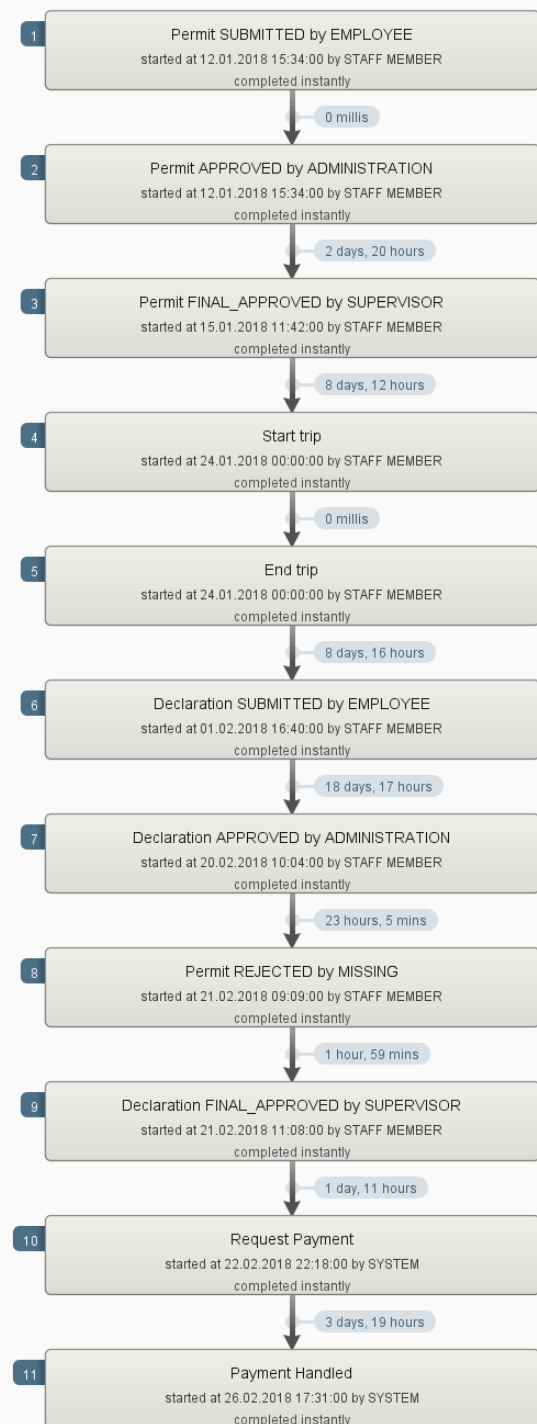
Additionally, our team checked for the presence of double payments for a single Declaration.

According to the available data, there are no cases when the same amount was paid out in Prepaid and Request for payment for the same project.

Picture 10. Violation of the process sequence

By DomesticDeclarationslogs.xes and InternationalDeclarations.xes there are no facts of double payment within the same Declaration.

Conclusion: There were no double payment made

However, within the framework of a single travel permit, this is quite possible when several declarations are submitted.

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During the analysis of logs for errors, 2 cases were found in which sending a reminder about filing a Declaration occurred after receiving payments. Payment Handled –> Send Reminder.
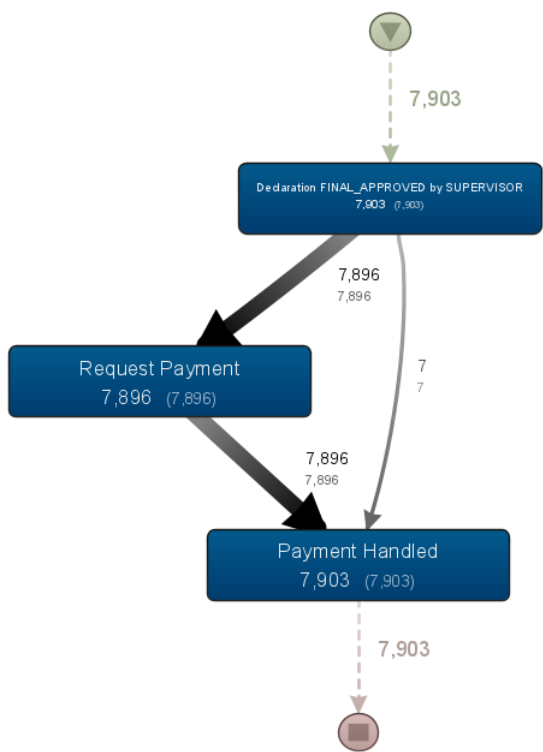
There are 7 cases in which the payment was made without a request for payment.

Decaration   115669
Decaration   124535
Decaration   136996
Decaration   138147
Decaration   138710
Decaration   141310
Decaration   142992
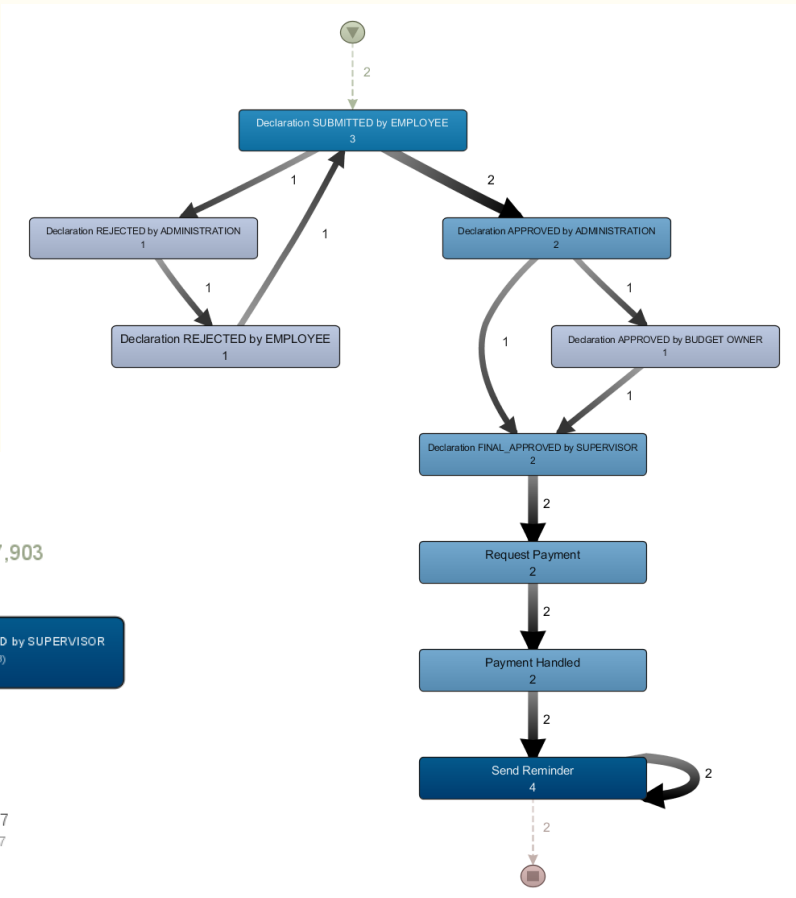
Picture 11. A reminder about filing a Declaration occurred after receiving payments

Picture 12. payment was made without a request for payment.

Moreover 168 International Declarations were submitted 2 months after the trip, 113 of them were paid for the first time, 55 were rejected at various stages, and after that 45 were re-sent and paid. 17 declarations were rejected after sending the Declaration after 2 months, 11 of them were eventually paid.

Thanks for reading!

Tatiana Zolotova

zts91@yandex.ru

Daria Zaplotnikova

zapldaria@gmail.com

Konstantin Mikiev

mickeyk@yandex.ru

Kseniia Khandogina

Kshandogina@gmail.com