

An Analysis and Comparison of the Domestic and International Travel Processes at Eindhoven University of Technology

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Abstract. This report analyzes domestic and international travel processes at TU/e during 2017 and 2018. The main objective was to analyze each process by checking multiple KPIs, their relationship with the roles involved and the date of the process, in order to compare both and determine which activities could be copied by each process to become more effective.

To achieve these objectives, process mining techniques were used through the Celonis platform. The happy path of each process was defined by using the data, and it was then compared to other paths that represented at least 1% of the cases, with special emphasis on the roles involved, and their impact on multiple KPIs.

According to the analysis by role of international travel process, it was found that the participation of ‘Director’ and ‘Budget Owner’ has a negative impact on most of the indicators, highlighting that these roles are not involved in the happy path. According to the results obtained in the comparison of KPIs over time, international trips perform better in most of the indicators. For the domestic travels regarding the difference in KPIs between variants, it seems that some variants and roles work better in certain KPIs, but these numbers are not conclusive.

Keywords: Travel analysis · Process mining · Eindhoven University of Technology

1 Introduction and Business Questions

The process to analyze is proposed by the BPI challenge. This challenge provides a real-life event log and challenges participants to analyze this data using process mining techniques.

For this analysis, two event logs from TU/e were used, these correspond to the payment request made by academics when they travel to conferences. The process is different whether the trip is made within the country or abroad. In the

first case, the process begins when the person returns from the trip, the expense statement is sent first, it must be approved by two different roles, when this occurs the payment request is sent and the process ends when the payment is delivered to the academic. In the second case, the academics must request permission before traveling, once the permission is approved by two different roles the trip is made. When the trip ends, the refund request starts, and it has the same steps as in the case of domestic trips.

The analysis of the two event logs is made separately, using process mining techniques. Process Mining is ‘*an analytical discipline for discovering, monitoring, and improving real processes by extracting knowledge from event logs readily available in today’s information systems.*’¹ In this way, three questions were asked to understand better these processes. The first one only focuses on international trips, and it is analyzed concerning the roles involved in the process. The second question focuses on domestic trips and was analyzed concerning time and existing variants. Then, a comparison was made between both processes, considering key performance indicators (KPIs) that they both have in common, in order to answer the third question. For each question, there is a section detailing the methodology used, the technical results obtained, and a conclusion on the most important data and associated recommendations.

The questions are the following:

- **Question 1:** *Are there roles associated with a worse performance of the process according to different KPIs in international travel?*

By defining and obtaining a list of KPIs per role, it can be observed how the participation of the different roles influences them. With this analysis, it will be possible to see if a poor performance in the variability, time, rejection rate, among other indicators, is associated with a specific role. With this information and according to the objectives of the university, it can be defined which specific roles should not be a part of the process.

- **Question 2:** *Are there different paths to the happy path that have better process performance according to different KPIs on domestic travel?*

By defining and obtaining a list of KPIs, it is possible to see that the most common case is not necessarily the one with the best performance. Analyzing the different paths concerning the KPIs, it is possible to define which are the best performing cases and thus define the desired activities according to different objectives.

- **Question 3:** *Based on common KPIs for domestic and international travel processes, are there practices that can be imitated to improve performance in both processes?*

By comparing the performance of different routes for each type of trip, according to different KPIs, specific steps that improve or worsen the process can be found. By knowing which steps work best for each KPI, it is possible to improve both processes according to the objectives set by the university.

¹ Obtained from Celonis ‘*Process Mining: What is it?*’

This analysis was made, mainly, through Celonis, a process mining software that allows the visualization and processing of different data logs. In particular, it was used to find different process paths, applying filters based on the data, and obtaining different values which were used as KPIs to measure some aspects of the process.

2 Question 1: Are there roles associated with a better performance of the international travel process?

2.1 Analysis Method

A first filter was used in Celonis to work with the variants that represent over 1% of the total cases; this was done to keep the focus on the variants that happen more frequently. One of the objectives was to understand the different variants, and how they relate to the happy path. In order to accomplish this, a ‘Variant Analysis’ was done, measuring multiple KPIs (such as total throughput time, number of cases in the variant or rework rate) across all variants, allowing an objective analysis and comparison of each of them.

Another important part of the analysis was the impact that each role had in the process; to do this, the variants (i.e., different paths the process takes) were classified according to which roles appeared in them. For example, the ‘*Budget Owner*’ doesn’t appear in all variants, and its presence has different impacts on each KPI. This meant that, in this part, variants with different activities but same roles were treated as the same ‘variant’.

2.2 Question-Driven Technical Analysis Results

Firstly, the analyzed cases correspond to the 13 most common variants, which represent the 59% of all the cases. These are described as follows:

On average, the variants that have more activities on their paths take longer to complete than those with fewer activities. For example, on average, variant 2 is 10 days longer than the happy path (see variants in Table 1). In addition to this, paths that include rejections also have a throughput time significantly greater than those that don’t, thus variants 4 and 7 are 13 days longer, on average, than the happy path.

Taking these 13 variants into account, 7 KPIs were calculated based on each role involved. These roles are: ‘*Administrator*’, ‘*Director*’, ‘*Budget Owner*’, ‘*Supervisor*’, ‘*Pre-approver*’ and ‘*System*’. Each KPI is explained as follows, including which role has the highest and lowest impact on them.

- **Total case coverage rate:** percentage of cases in which a role is involved. In this KPI, it can be seen that the ‘*Supervisor*’ and ‘*System*’ are the roles with most appearance in the cases analyzed, both of them having a 59% total case coverage rate. On the other hand, the ‘*Director*’ is the role with least participation in the cases, being only in 1% of them.

Variant 1	This is the happy path. The travel permit is submitted and approved, then the trip happens, followed by the submission and approval of the travel declaration, ending with the payment being requested and handled.
Variant 2	Approval of the permit and declaration by the <i>'Administrator'</i> are followed by the <i>'Budget Owner's'</i> approval (of the permit and declaration).
Variant 3	<i>'Employee's'</i> submission of the permit and declaration go directly to the <i>'Supervisor's'</i> final approval.
Variant 4	Declaration submitted by the <i>'Employee'</i> is rejected by the <i>'Administrator'</i> , followed by the <i>'Employee's'</i> rejection, which results in the <i>'Employee'</i> submitting the declaration again.
Variant 5	Instead of the permit and declaration being approved by the <i>'Administrator'</i> , they are approved by the <i>'Pre-approver'</i> , going then to the <i>'Supervisor's'</i> final approval.
Variant 6	Combination of the variants 2 and 4.
Variant 7	Starts with the trip, then the permit and declaration are submitted and approved, and finally the payment is requested and handled.
Variant 8	There is no permit in this variant. The declaration and the payment happen before the trip. The process ends after the trip.
Variant 9	A reminder is sent after the trip.
Variant 10	Permit is not final approved by the <i>'Supervisor'</i> , but by the <i>'Director'</i> .
Variant 11	Like the variant 7, but the approval of the declaration goes through the <i>'Administrator'</i> before being final approved by the <i>'Supervisor'</i> .
Variant 12	Like variant 11, but after the approval of the declaration by the <i>'Administrator'</i> , the <i>'Budget Owner'</i> approves it too.
Variant 13	Trip starts before the permit is final approved by the <i>'Supervisor'</i> .

Table 1: Variants question 1.

- **Most common variant coverage rate:** ratio of coverage of the most common variant (the one with the highest amount of cases) from the total of cases where a specific role is present. In this case, 100% of the cases in which the *'Director'* and the *'Pre-approver'* appear belong to the most common variant; this means that there is only one variant when one of this roles appears. Whereas, the *'Supervisor'* and the *'System'* only cover the 36% of the cases in the most common variant, being the least recurring roles.
- **Rework rate:** percentage of cases where an activity is executed more than once. Here, the role that implies the highest rework rate is the *'Budget Owner'*, with 21% of its cases having an activity executed more than once. The *'Director'* and the *'Pre-approver'* don't have any reworked activities.
- **Total throughput time permit:** total time in hours from the permit being submitted to the permit being final approved. The highest throughput time occurs when the *'Budget Owner'* is part of the process approving the permit,

taking, on average, 132 hours. On the other hand, the lowest throughput time is given by the ‘Pre-approver’, making the process of the permit only 48 hours long.

- **Total throughput time declaration:** total time in hours from the declaration being submitted to the permit being final approved. Like the previous KPI, the highest throughput time occurs when the ‘Budget Owner’ is part of the process, taking, on average, 214 hours to complete. Also, the lowest throughput time is given by the ‘Pre-approver’, making the process of the declaration only 86 hours long.
- **Rejection rate permit:** percentage of cases having the permit rejected when a role is involved. In this KPI, none of the roles have cases in which the permit is rejected.
- **Rejection rate declaration:** percentage of cases having the declaration rejected when a role is involved. Here, 8% of the cases in which the ‘Administrator’ and the ‘Supervisor’ participate result in rejections of the declaration. This also happens in 3% of the cases in which the ‘Budget Owner’ appears. For all the other roles, the rejection rate is 0%.

In tables 2 and 3, the KPIs for each role are presented, and in table 4, the KPIs of the happy path can be seen.

KPIs/Role	Administrator	Director	Budget Owner
Total case coverage rate (%)	47	1	14
Most common variant coverage rate (%)	45	100	70
Rework rate (%)	16	0	21
Total permit throughput time (hours)	77	103	132
Total declaration throughput time (hours)	156	163	214
Rejection rate (permit) (%)	0	0	0
Rejection rate (declaration) (%)	8	0	3

Table 2: KPIs by role part I.

KPIs/Role	Supervisor	Pre Approver	Undefined
Total case coverage rate (%)	54	9	59
Most common variant coverage rate (%)	36	100	36
Rework rate (%)	13	0	13
Total permit throughput time (hours)	67	48	67
Total declaration throughput time (hours)	112	86	112
Rejection rate (permit) (%)	0	0	0
Rejection rate (declaration) (%)	8	0	0

Table 3: KPIs by role part II.

KPIs	Happy Path
Total case coverage rate (%)	21
Most common variant coverage rate (%)	100
Rework rate (%)	0
Permit total throughput time (hours)	52
Declaration total throughput time (hours)	118
Rejection rate (permit) (%)	0
Rejection rate (declaration) (%)	8

Table 4: Happy Path KPIs.

2.3 Business Owner Conclusions

The total permit time from ‘*Submit*’ to ‘*Final approved*’ on the happy path is 52 hours on average. This time is improved when the ‘*Pre-approver*’ role is involved, resulting in a 7.7% time reduction. Conversely, **the time increases considerably when the ‘*Director*’ and ‘*Budget Owner*’ roles are involved in the process**, with the process lasting 98% and 153% more time, respectively. In the case of the total time of the declaration, the time in the happy path is 118 hours on average, and when the ‘*Pre-approver*’ role is involved, a 37.2% decrease in time is observed. On the other hand, the ‘*Director*’, ‘*Administrator*’ and ‘*Budget Owner*’ roles increase time in 38%, 32% and 81% respectively. As a conclusion, if the objective is to reduce the time of this process, it is advisable to establish rules that prevent the participation of ‘*Director*’ and ‘*Budget Owner*’.

Analyzing the variability in the different paths, **the case with the least variability would be when the ‘*Budget Owner*’ is involved**, where the most typical path represents 70% of the total cases. On the other hand, **the greatest variability occurs when the ‘*Administrator*’ appears in the process**, where the most typical path represents only 48% of the total cases. Regarding the rework rate, it is interesting to note that the ‘*Budget Owner*’ has a notably higher rate than the ‘*Administrator*’ and the ‘*Supervisor*’, although it could be partly explained by the fact that it is present in a lower percentage of total cases.

Analyzing this process, **only 53% of the cases follow the happy path**, considering both 2017 and 2018. On the other hand, if only the year 2018 is considered, 66% of the cases follow the happy path. Finally, the ‘performance time’ of the happy path is 68.3 days, while the average time for non-happy path cases is 87.75 days. Therefore, **a slower process can be associated with the appearance of roles that do not participate in the happy path**. If the objective is to reduce time, it is recommended that measures should be taken to assure that the roles involved in the process are only those present on the happy path. On the other hand, **if the goal is to decrease variability, the**

inclusion of the *'Budget Owner'* is recommended, although this role is associated with the higher rework rate.

3 Question 2: Are there variants that have better performance than the happy path on the domestic travel process?

3.1 Analysis Method

To fulfill this objective, three approaches were taken. First, different KPIs were evaluated through time in order to identify peaks and valleys and find their causes. Second, non-ideal paths (i.e., not the most common variant) of the domestic travel process were explored to detect its shortcomings. Third, KPIs were analyzed for each role and activity, in order to establish a comparison point with the international travel process.

For the first part of this analysis, **the data was preprocessed**. Every event had a role associated in the name, with that in mind the log was transformed so that every event was independent of who was executing it, in a way that **similar tasks performed by different agents were aggregated on a common task**. Then, the variants of the process with at least 1% of representativity were taken into account; by doing so, only the 6 most common paths were considered. With this, the happy path was established from the data, and the different roles that take place in every event were identified. Finally, **the following KPIs were evaluated for each variant: throughput time, rejection rate, roles per case, and coverage rate**.

The analysis mentioned above was done monthly through the years 2017 and 2018. Coincidences were found between years according to their peaks and valleys, which will be explained in greater depth afterwards. Secondly, **non-ideals variants, the ones that do not follow the description of the process given by the challenge**, were analyzed. From them, **shortcomings** of the process were detected **identifying their causes**. In third place, it proceeded to obtain different **KPIs corresponding to each role**, similar to how it was done with the international travel process. It is important to mention that in the domestic data the travel permit event does not exist.

3.2 Question-Driven Technical Analysis Results

KPIs through time

As a first point, the analyzed cases correspond to the six most common variants, which covers 94% of cases. These are described in Table 5.

Out of the above, and evaluating the data of each variant, it can be established that variant 1 has a 11% higher median throughput time than variant 3, this can be explained because variant 1 has an extra activity. Between variants

Variant 1	Corresponds to the happy path of the whole process of 2018. The happy path is the following: the travel declaration is submitted by the <i>'Employee'</i> , then accepted by the <i>'Administrator'</i> , followed by the final approval by the <i>'Supervisor'</i> , and finally the payment is requested and handled.
Variant 2	Incorporates a loop on the <i>'Declaration Approved'</i> activity from variant 1.
Variant 3	Second most common path, corresponds to the happy path of the 2017. Has one activity less than variant 1 (skips one activity).
Variant 4	This variant shows the path of a request that is rejected then re-requested to be finally accepted. Is the variant that has the longest throughput time given its complexity.
Variant 5	The request is rejected and then terminated.
Variant 6	Similar to 4 but with a loop on the activity <i>'Declaration Approved'</i> .

Table 5: Variants question 2.

1 and 2 there is only a loop that differentiates them, something similar happens with variants 4 and 6. From this analysis, a couple of observations can be derived:

- **Loop in 'Declaration REJECTED':** 93% of cases that contain the activity go through this loop. This could mean that it is part of the process of 'confirming' the rejection of the declaration.
- **Loop in 'Declaration ACCEPTED':** 32% of cases that contain the activity go through this loop. It is also interesting that the median time it takes for cases that go through this loop is greater in 3.1 days.

As to the stability of the process through the year, it is possible to notice that for both years there are certain recurring patterns. In particular, it can be noted that there exists a considerable drop in case amounts on August, and the highest peaks are on June and December, as stated in tables 6 and 7. Also, the amount of cases increments from the 2017 to the 2018, alongside with that there is an increment on the rejection rate and a decrease on the coverage rate of the most common variant.

2017	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MCVCR (%)	0,84	0,78	0,57	0,67	0,65	0,61	0,69	0,85	0,80	0,55	0,70	0,59
DRR (%)	0,03	0,05	0,03	0,03	0,06	0,03	0,05	0	0,02	0,06	0,03	0,09
AD (d)	9	10	7	8	10	10	9	11	7	7	7	9
#C	93	161	181	160	181	211	138	66	209	192	234	228
CxU	26	40	45	40	45	42	35	17	52	48	47	38
UxC	3	3	3	3	3	3	3	3	3	3	3	3
DAU	2	3	3	3	3	2	2	2	2	3	2	2

Table 6: KPIs 2017. MCVCR: Most common variant coverage rate, DRR: Declaration rejection rate, AD: Average duration (days), #C: Number of Cases, CxU: Cases per user, UxC: Users per case. DAU: Daily active users.

2018	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MCVCR (%)	0,58	0,59	0,61	0,59	0,60	0,59	0,59	0,62	0,61	0,64	0,57	0,55
DRR (%)	0,07	0,07	0,06	0,06	0,1	0,11	0,16	0,14	0,09	0,08	0,09	0,1
AD (d)	8	9	8	8	9	9	10	10	9	9	9	12
#C	525	620	647	719	598	859	642	280	604	758	813	721
CxU	105	124	129	144	120	172	128	56	121	152	163	144
UxC	4	4	4	4	4	4	4	4	4	4	4	4
DAU	3	3	3	3	3	3	3	3	3	3	3	3

Table 7: KPIs 2018. MCVCR: Most common variant coverage rate, DRR: Declaration rejection rate, AD: Average duration (days), #C: Number of Cases, CxU: Cases per user, UxC: Users per case. DAU: Daily active users.

Explore non-ideal paths

As a second point, from the analysis of the non-ideal variants of the process that had at least 1% of case coverage, the following four cases were found:

- **Declaration APPROVED is followed by Declaration REJECTED:** This variant exist mainly on cases of the 2018 (only 11 of 282 cases are from 2017). It raises the total throughput time in 9 days. The identified cause is that in 61 cases it happens when the requested budget is zero, and the role who executes the rejection is *UNKNOWN*.
- **Incomplete case:** This variant exists mainly on cases in 2018 (only 16 of 227 cases are from 2017). It increases the total throughput time in two days, and does not end with finish activity. The identified cause is that, for the all cases that it occurs, it happens when the requested budget is zero.
- **Declaration SAVED:** This variant is present in both years, with 135 cases. The average time is less than a day, making it the shortest among the vari-

ants. The identified cause is that, for all the cases it happens, it's when the requested budget is zero.

- **Declaration FINAL_APPROVED is followed by Declaration REJECTED:** This variant exists in 2017 and January 2018, there are 82 cases. The average time is increased in 16 days, making it the worst variant amongst the 6 according to this KPI. The identified causes are that the role that executes the rejection activity is *MISSING* and in 23 cases the requested budget was zero.

From the variants analyzed, an error can be found, in which the requested amount is not submitted; despite this, the request is processed. In 2017, 7.6% of the cases had this problem, while in 2018 6.9% of the cases had it. This shows that is a common problem not submitting the requested amount on the request.

Finally, a conclusion that can be drawn from this analysis is that variants can have very different KPIs, and that each can be said to have strengths and weaknesses. Going beyond this, some variants should be analyzed in other ways: for example, the variant with Declaration *SAVED* is the shortest in time, but it seems to be related with an error in which the requested amount is 0.

KPIs per role/activity

As a third point, we proceed to obtain the defined KPIs per role just like in the international travel process, the obtained values are detailed in tables 8 and 9. From the extracted data it can be shown that when the '*Budget Owner*' takes action in the process, it takes 40% more time to complete than the happy path. Although, when the '*Budget Owner*' intervenes, the process is rejected only in 2% of cases, in contrast with the average 7% rejection rate of cases that go through the administration. This means that the variants with the '*Budget Owner*' tend to be either amongst the best or the worst, depending on the KPI used to measure the variant. Also, the rework rate is very similar for every role, always close to 7%. This extra rework seems to not affect the total time of the process, as it remains quite similar to the total time of the happy path.

KPI/Role	Administrator	Budget Owner	Supervisor
Total case coverage rate (%)	76	25	91
Most common variant coverage rate (%)	59	93	48
Rework rate (%)	7	7	6
Total declaration throughput time (hours)	178	247	176
Rejection rate (declaration) (%)	7	2	5

Table 8: KPIs by role part I.

KPI/Role	Pre Approver	Undefined	Happy Path
Total case coverage rate (%)	5	91	72
Most common variant coverage rate (%)	100	48	68
Rework rate (%)	0	6	0
Total declaration throughput time (hours)	175	176	176
Rejection rate (declaration) (%)	0	5	0

Table 9: KPIs per role part II.

3.3 Business Owner Conclusions

As a summary of the analysis of this objective, it can be asserted that, amongst the 6 variants that represent at least 1% of the total cases **the 6 variants with most cases represent 94% of the total cases**, which indicates that process is fairly consistent. **The most common variant is the happy path**, and it only appears on the year 2018, in which the whole process had some changes compared to the 2017 version. Despite this, both 2017 and 2018 share a pattern throughout the year: **the number of cases is lower during August, and it reaches a peak during July and December. The third most common variant is the 2017 happy path**, and it is similar to the 2018 version, the only difference being that it skips one of the 2018 activities, making it last 11% than the 2018 version. Finally, **2018 has more cases than 2017, a higher overall rejection rate, and the happy path represents a lower percentage of the total cases**, which indicates that the process is less consistent during this year.

The most common loop happens when a declaration isn't approved, and that part of the process has to be repeated once, until it is finally approved. This loop makes those variants last 3.1 days longer than the variants that don't have the loop.

There are non-ideal variants where the requested amount is 0, and this leads to certain situations: a) the declaration is rejected, b) the case is complete (it doesn't have a closing activity) or c) the declaration is saved. The reason for this requested amount seems to be an error during the input of this amount.

When the 'Budget Owner's appears in the process, it takes 40% longer than the happy path, even though the rejection rate goes from 7% to 2%.

Regarding the difference in KPIs between the variants, it seems that **some variants and roles perform better in certain KPIs**, but these numbers may not tell the whole story; Further analysis should be done to determine which roles and variants can be compared through each KPI.

4 Question 3: Based on KPIs that are common to both the domestic and international travel processes, are there practices that one can adapt from the other in order to improve the process performance?

4.1 Analysis Method

This third objective is based on the results obtained from both the international and domestic process analysis. The idea is to compare both processes, as they share similarities, with the objective of discovering if one of them has better performance given the specific KPIs analyzed. The data from the previous questions was used and the analysis carried out on domestic trips was replicated on international trips. By doing so, an objective comparison can be made between both processes, in spite of their differences.

On a first step, the focus was the different KPIs per role for each process, so conclusions about their performances could be sketched. On a second step, the changes in KPIs through time were studied, analyzing trends that both process may share.

Just as in the previous objectives, variants that have less than 1% of the case coverage were left out, in order to focus on the main flow of each process.

4.2 Question-Driven Technical Analysis Results

First, both processes were compared through their KPIs per role. It is important to notice that the role of the *'Director'* is not present in any of the cases of the domestic process, thus it will not be included in the analysis.

- **Total case coverage rate:** the *'Supervisor'* and the *'System'* have the same percentage of appearance in the total of cases, in both processes. In addition to this, for every role, the coverage rate is higher in the domestic process, observing big gaps in the rate for some of the roles. For example, in the international process, the *'Administrator'* is part of the only 47% of the cases, while in the domestic process, it appears in 74% of them. In general, the order of the roles, from highest to lowest coverage rate is the following: *'Supervisor'*, *'System'*, *'Administrator'*, *'Budget Owner'* and *'Pre-Approver'*. This order is the same for both processes.

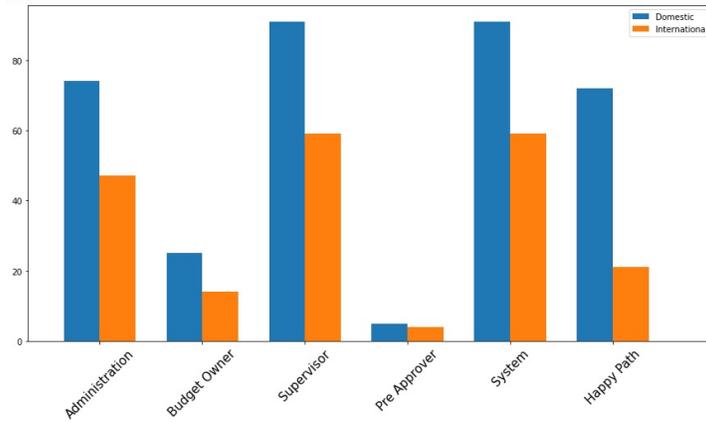


Fig. 1: Total case coverage rates per role.

- **Most common variant coverage rate:** like the previous KPI, for all roles, the most common variant coverage rate is lower in the international process than the rate in the domestic process. Also, both processes have the same order of roles according to this rate, which is (from the highest role to the lowest): ‘*Pre-Approver*’ with 100% coverage for international and domestic, ‘*Budget Owner*’, ‘*Administrator*’, ‘*Supervisor*’ and ‘*System*’.

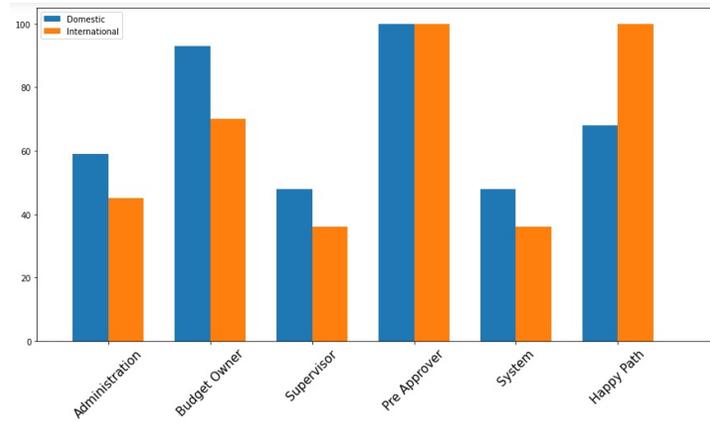


Fig. 2: Most common variant coverage rate per role.

- **Rework rate:** for this KPI, in general, the rework rate is higher in the international process than in the domestic process. In the international process, the ‘*Budget Owner*’ implies the highest rework rate, whereas in the domestic it does not stand out from the other roles. In fact, in the domestic process,

there is no role that has a particularly high rework rate. One similarity between both processes is that when the *‘Pre-Approver’* is involved, there is no activity which is executed more than once.

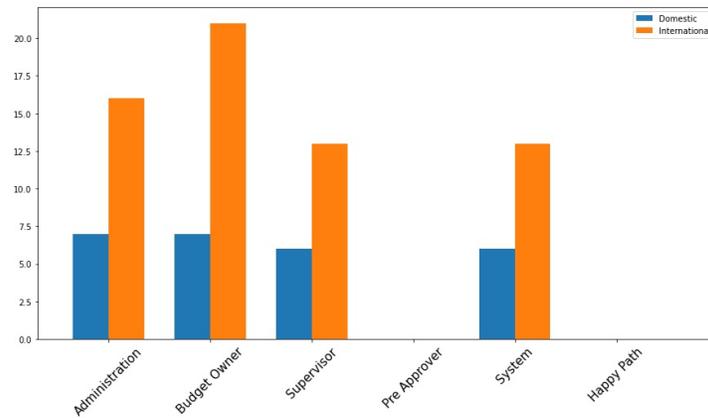


Fig. 3: Rework rate per role.

- **Total throughput time declaration:** in general, for every role, the time it takes to finish the declaration process is higher in the domestic trips. It can also be noted that, for both processes, the *‘Budget Owner’* increases the throughput time by an amount significantly higher than the other roles. On the other hand, there is a difference in how the presence of the *‘Pre-Approver’* affects the total throughput time, as in the international process it means a drop in the total time, with a 36% of decrease on the average per role, while in the domestic process it only implies a 7.9% decrease.

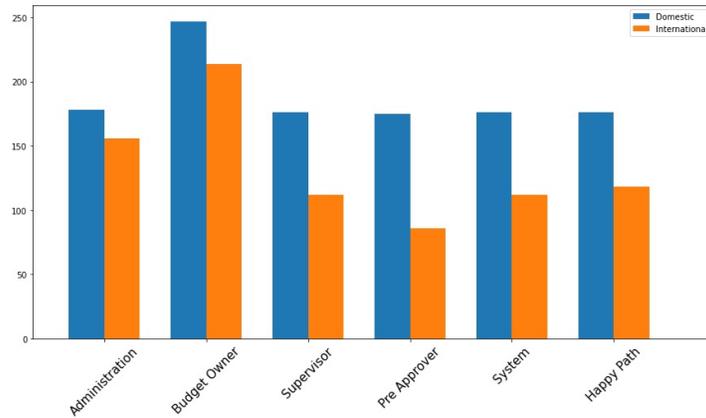


Fig. 4: Total throughput time declaration per role.

- **Declaration rejection rate:** both processes have very similar rejection rate for every role, differing in only a couple of percentage points, except for the ‘*System*’, where its presence in the domestic process implies a 5% rejection rate, while in the international process it implies 0%.

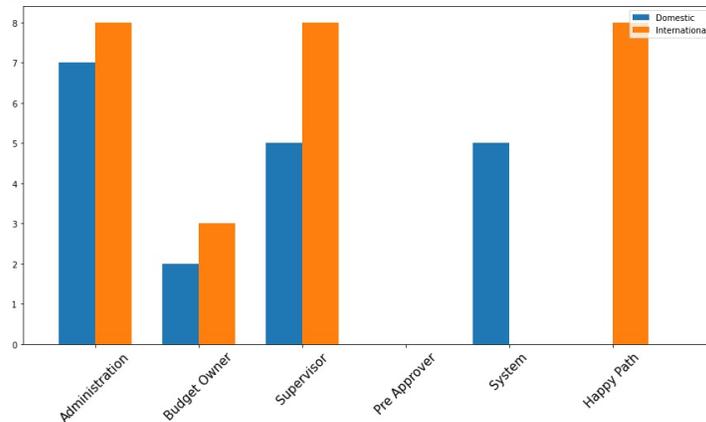


Fig. 5: Rejection rate declaration per role.

Secondly, a KPI analysis is performed according to the month/year:

- **Most common variant coverage rate:** It is possible to observe that for the two years the coverage percentage is higher for the domestic travel process, with an average of 69% and 59% for the years 2017 and 2018 respectively. While in international travel the coverage is 49% and 50% respectively.

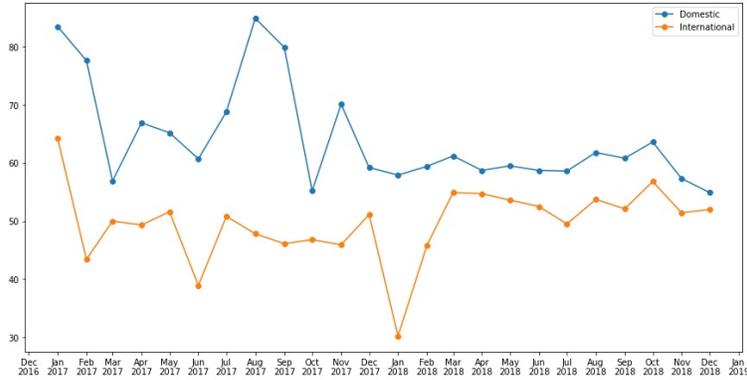


Fig. 6: Most common variant coverage rate over time.

- **Declaration rejection rate:** The rejection rate is lower on international trips for all the periods observed. With an average of 0.4% and 1.7% for the years 2017 and 2018 respectively. In the case of domestic travel, it is 4% and 9.4% respectively.

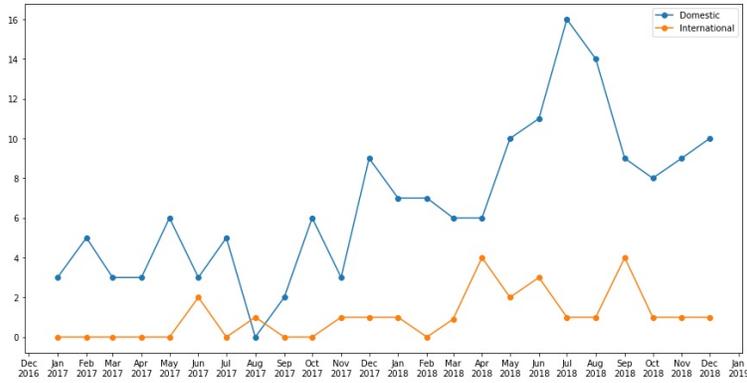


Fig. 7: Declaration rejection rate over time.

- **Average time in days:** The average time in days is less on domestic trips than on international trips. On domestic trips, the average is 9 days for both years while on international trips the average is 68 and 15 days for the years 2017 and 2018 respectively. It is possible to observe that for international trips the first two months of 2017 have values much higher than the rest of the year, this generates an increase in the average value, if the first three months are not considered, the average time for the first year is 19 days. For this process, in both years the month with the longest time is January.

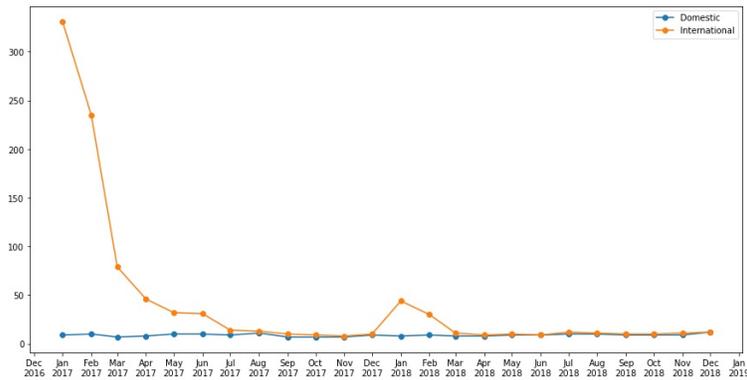


Fig. 8: Average time over 2017-2018.

- **Number of cases:** For both processes, the number of cases increases considerably in the second year. In both periods the number of cases is higher in domestic trips.

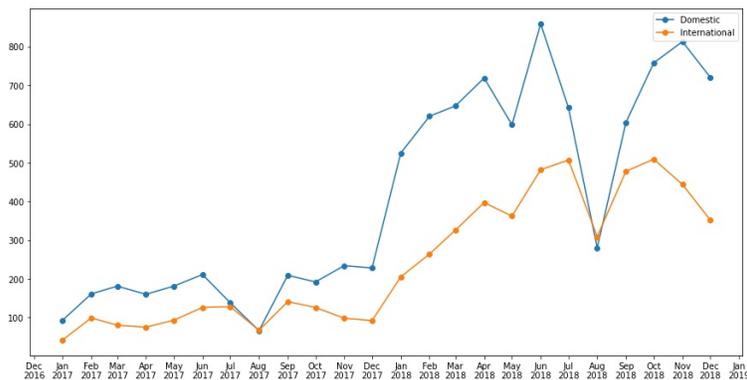


Fig. 9: Number of cases over time.

- **Cases per user:** Due to the behavior of the number of cases and the active users per day, it is possible to observe that for the domestic travel process the number of cases is considerably higher than for the international travel process. For domestic trips, the average during the two years is 85 cases and for international trips, it is 42 cases. For both processes, the indicator rises during the second period.

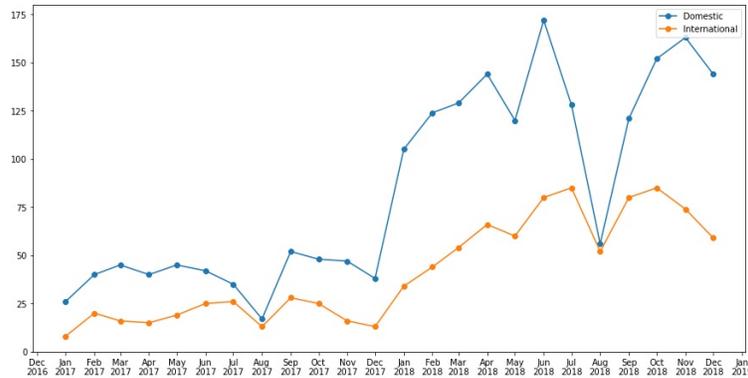


Fig. 10: Cases per user over time.

- **Users by case:** For the domestic travel process, the value is 3 users during the first period and 4 users during the second. For the international travel process, it varies between 4 and 3 users during the first period and remains as 4 during the second.
- **Active users per day:** Both processes behave similarly, during the first year the indicator varies between 2 and 3. In the second year, both have a value of 3 except in the month of October, where it takes a value of 4 for international travel

4.3 Business Owner Conclusions

Based on the reviewed results about the total case coverage rate, it can be noticed that the high prevalence of the ‘*Supervisor*’ and the ‘*System*’ may be given by their relevance on the process, as it is expected some ‘*System*’ to take automatic actions on common situations. As stated by the challenge, the ‘*Supervisor*’ is a key part of the process and takes part in many cases. Something interesting is the low case coverage of the ‘*Budget Owner*’, which may be explained because he only appears when he is not the ‘*Supervisor*’. From this, it can be asserted that it is quite common that the ‘*Supervisor*’ is in charge of the budget.

Something good that can be extracted from the most common variant is that it is the case where the travel is pre-approved, which shows us that an ideal case

that it is faster happens quite often on both processes.

About the *'Budget Owner'*, it only appears on few cases, but has negative effects on the process, increasing the rework rate and the throughput time for both process. The increase on time it is explainable because of an extra task that has to be done, but the increase in the rework rate is a concern as its presence implies a low rejection rate. This specific cases would be interesting to analyze in the future.

It would also seem that the *'System'* can reject requests only on the domestic process, or at least it does not reject any case in the international process. This means that the *'System'* is doing some automatic step that can lead to a rejection on the domestic process, such step may not be present on the international process and as the processes are very similar it may be interesting to study such cases and such step.

Considering the analysis over time, it can be seen that the domestic travel process has greater coverage in its most common variant, this means that most cases follow the same path. On the other hand, throughout the two periods, the rejection rate of the international process is considerably higher than domestic travel. This difference is exacerbated in July 2018 where the domestic process has a peak in this indicator.

An interesting point is that the average time is lower on domestic trips. In the happy path, this process for both types of trips begins once the trip is over and has the same activities, so it is curious that it does not have a similar average time. On the other hand, there is a peak at the beginning of the year 2017 for international trips, these values are higher than the rest of the year and may be due to a cut in the log information, or to requests that had not been closed from previous periods. As the behavior is different, if the first three months are not considered, the average time for the first year is 19 days.

Answering the question, the domestic process has worse performance in the rework and rejection rate, it would be advisable to review how under these circumstances these activities occur and compare them with how they occur for international travel since in both cases this process is better. On the other hand, domestic trips have a greater number of cases per user, this is because despite having a greater number of cases than international trips, both have the same number of active users per day. The international travel process has a lower coverage rate, that is, there are many more cases that do not follow the happy path. If this is the path desired by the university, it should review which is the reason why so many variants arise, since the percentage of coverage of domestic trips is higher, although the activities included in the happy path of both processes are the same.

5 Conclusions

After analyzing both the domestic and the international travel processes, there are a couple of conclusions that can be drawn regarding the roles and dates involved in each process.

From the international travels, it can be concluded that the overall process is affected by the roles involved in it; more specifically, the *'Budget Owner'* raises the total process time and rework rate, while also decreasing its variability. Meanwhile, the *'Director'* raises the total time, and the *'Administrator'* raises the variability.

In the case of domestic travels, the main conclusions were that a small number of variants include almost all the cases, with the most common variant being the happy path. Regarding the dates, it's easy to see that there are big changes in the internal process from 2017 to 2018: they have different most common paths and rejection rates, but they both follow a pattern where July and December have the highest amount of cases, while August has the lowest.

The conclusions obtained from the comparison of both processes are the following: the low appearance rate of the *'Budget Owner'* shows that the *'Supervisor'* is usually in charge of the budget, which is probably good because the *'Budget Owner'* increases the throughput time and the rework rate. When there are pre-approved activities in one of the processes, which happens quite often, the total time decreases. The *'System'* can only reject on domestic travels, so it a special case that should be investigated further in the future. The rejection rate of the international process is considerably higher than the domestic travel process.

According to the results obtained in the comparison of KPIs over time, international trips perform better in most of the indicators. Analyzing how the activities are carried out in this process, it would be possible to improve the domestic travel.

Something can also be said about the use benefits of using process mining in this and other cases. The amount of data provided made its analysis and visualization a difficult process for both computers and humans, so the ability to determine and compare the different variants of the process, while simultaneously applying filters on the data and changing the ways of visualizing it allowed a much deeper understanding of the process that could not have been done without process mining methods. This greater understanding of the process is of utmost importance to support decision making.

Another important aspect of this analysis was that it didn't stop at simply understanding the process, but it also allowed the discovery of multiple insights that would allow to change the process and make it more efficient, according to the different KPIs that were defined for it. For example, the analysis showed

that some months have higher or lower amounts of cases, which in turn generates problems in the process. This information can be used to create a more efficient allocation of the relevant resources, while also allowing the future analysis of the results this changes have in the most relevant KPIs.

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