Insights into the Consumer Loan Application process of a Dutch bank.

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Abstract. This paper presents an analysis of the loan application event log provided for the 2017 BPI Challenge. The analysis methods used include a combination of process mining techniques using the sponsors' tools, as well as traditional management consultancy analysis using standard spreadsheet and database software. The log data is analyzed through various lenses: firstly looking at throughput times of the key process steps; secondly assessing the relationship between bank and customer tasks while completing documentation; and thirdly the impact of performing multiple offer processes in parallel versus multiple offers made serially to an applicant. The results of the analysis lead to a number of observations which are discussed with recommendations for optimizing the process.

1 Executive Summary

This paper addresses three key questions for the bank in the areas of throughput times, the impact of incompleteness on the final outcome of the application and how the conversation compares between applicants receiving single or multiple loan offers. Details of the analysis supporting these summary findings are presented below this executive summary in the body of this paper.

1.1 Throughput Timings

The average throughput time for the process end to end is 22 days. However, it is important to consider the different types of application and how throughput times vary, specifically:

- Successful applications (**A_Pending**) take 18 days, declined loans (**A_Denied**) 17 days and cancelled loans 30 days on average
- Applications originated by the customer take on average 23 days, 4 days longer than applications originated by the bank (19 days).
- Limit raises take 17 days, 5 days less than new loans at 22 days respectively

- Loans flagged for Shortened Completion take longer than other loans. A successful shortened completion application takes on average 21 days compared to an average of 18 days for all successful loans
- Vehicle loans tend to be quicker than other types of loan, 20 days on average and 15 days for successful applications.

The high-level flow of a loan application from inception through to either a successful application, a declined application or a cancelled application is shown below. Note that this diagram is created by Celonis from the actual timestamps in the log file, which is slightly different than the logical flow provided by the challenge moderators. Specifically, the logical start events could be **A_Submitted** for customer initiated applications or **A_Create Application** for bank initiated applications.
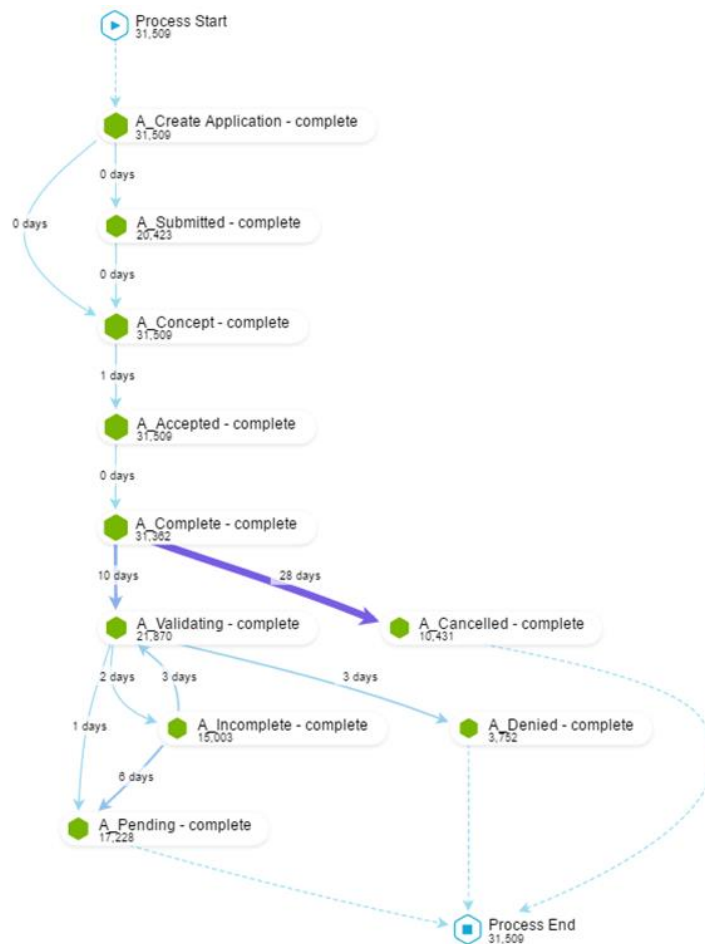

Figure 1.1: High level end to end process and timings generated in Celonis

As shown, the majority of the throughput time is concentrated in 3 sub-processes:

1. Sending offers to the customer and getting the required documentation back (10 days on average)
2. Validating the files returned by the customer and either successfully concluding the application (7 days on average) or declining it (5 days on average)
3. Cancelling an application (28 days on average)

Full details of all processes and timings are provided in section 3.

The first two of these scenarios are dependent on the customer returning the required information and the agent processing this information. These activities are tracked via workflow processes. The primary workflows relating to the above are:

1. **W_Call After Offers**: For chasing customers to return files after sending offers.
2. **W_Validate application**: For the agent to review the returned files.
3. **W_Call Incomplete Files**: For the agent to contact the customer and request information not originally provided

The time spent in these workflows is a combination of working time and waiting time. The working time relates to when an agent is performing an activity, for example attempting to contact a customer in the cases of **Call After Offers** or **Call Incomplete Files**. The table below summarises total amount of time consumed by these processes split by working time and waiting time.

Workflow	Working Time	Waiting Time
W_Call after offers	202.7 days (0.04%)	479,832.8 days (99.96%)
W_Validate application	390.3 days (0.6%)	64,227.8 days (99.4%)
W_Call incomplete files	164.4 days (0.2%)	91,673.1 days (99.8%)

Table 1.1: Workflow Working and Waiting Times

As shown in the table, the vast majority of time spent in these workflows is waiting time rather than working time. It is likely that the high proportion of waiting time relates to contacting a customer and then waiting for the customer to provide information, as described in section 3 where the cycles of activity within these workflow are explored. Further analysis is recommended to test the hypothesis that alternative ways of contacting the customer could reduce waiting time and significantly improve throughput.

1.2   The impact of incompleteness

The bank's hypothesis here is that if applicants are confronted with more requests for completion, they are more likely to not accept the final offer. The scenario in which as customer does not accept the final offer relates to applications where:

- Offers have been sent to the customer and the customer has returned files (i.e. the application goes through the validating state)

- Despite a valid offer being sent and returned by the customer the application ultimately ends up being cancelled because the customer does not take it forward

The figure below shows the proportion of loans reaching a certain outcome by the number of times an application gets an incomplete status:
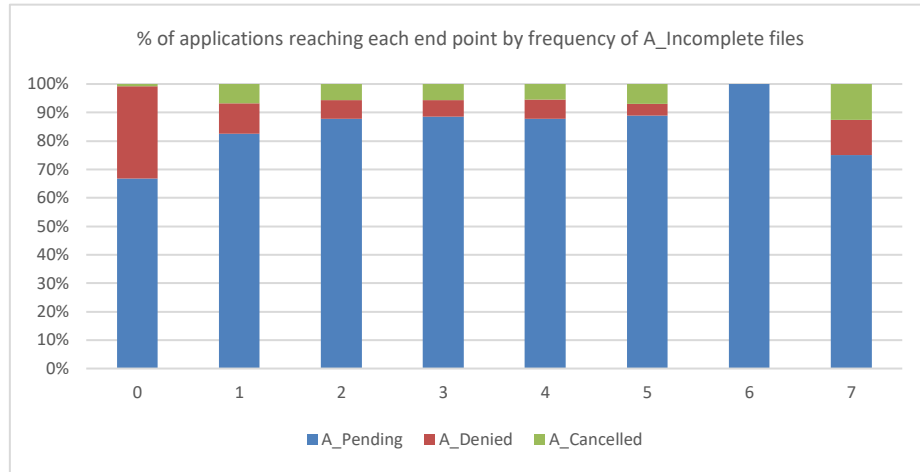

Figure 1.2: Application end points by number of incomplete states

From this figure it can be see that:

- There is an increase in the proportion of validated applications which are cancelled between zero instances of incompleteness and one instance. Implying that if the applicant does not send in a complete set of files first time then they are less likely to see the offer through to completion by subsequently sending the missing files.
- After 1 iteration of **A_Incomplete** 7% of cases were cancelled. This percentage then stays roughly consistent (between 5.4% and 7%) for 2-5 iterations. This would imply that if an applicant returns additional files at least once then these applications are not more likely to end up being cancelled as the frequency of incompleteness increases.
- The proportion of applications reaching the pending state rather than the declined state tends to increase with the number of iterations of incompleteness. This potentially indicates that where applications should be denied this tends to happen relatively early in the process, potentially accounting for the higher proportion of declined for zero iterations of incompleteness.

Another factor to consider is how frequently an applicant is confronted with a request for completion. The chart below shows the proportion of loan applications reaching the states **Pending**, **Denied** and **Cancelled** according to how many times the **W_Call incomplete** files workflow was started or resumed, i.e. how many times the Bank attempted to contact the applicant to request files.

As the figure below illustrates, there is a clear increase in the proportion of cancelled cases as the number of **W_Call incomplete files** activities increases. This may imply that an application is likely to end up being cancelled if the customer is confronted with many requests for completion. However, this could also be related to the age of the application as older loan applications are more likely to no longer be required by the customer.
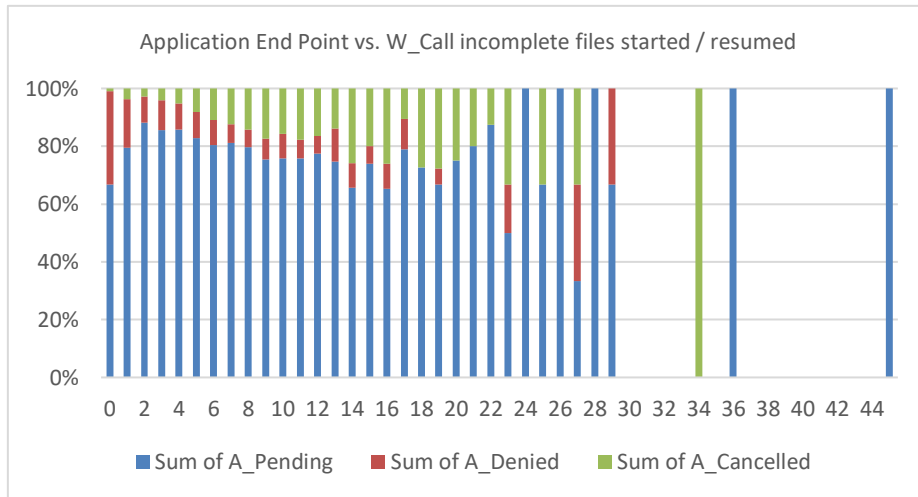

Figure 1.3: Application end states by number of calls relating to incomplete files

1.3   Single vs. Multiple Loan Offers

Offers can be made to the customer at several points in the process:

- As initial offers made once the application has been accepted by the bank; or
- During the **Call After Offers** workflow, potentially because when speaking to the customer it is determined that a variation in the original loan proposal would suit the customer's needs better; or
- During the validation process. Potentially due to reviewing the detailed customer files and finding that there is another loan variation more suitable to their needs or that they do not qualify for a particular type of loan.

Each of these scenarios represents a conversation with the customer, and in the case of the second and third scenarios these could represent multiple conversations.

Of the 31,509 applications 22,950 of these applicants request only one offer.

8559 applicants request more than one offer and 3664 of these request more than one offer in the initial offers stage of the process. 4895 customers ask for more than one offer in multiple conversations.

When multiple offers are made there can be up to six separate conversations. The figure below illustrates the relationship between the creation of offers and the workflows driving customer conversations.
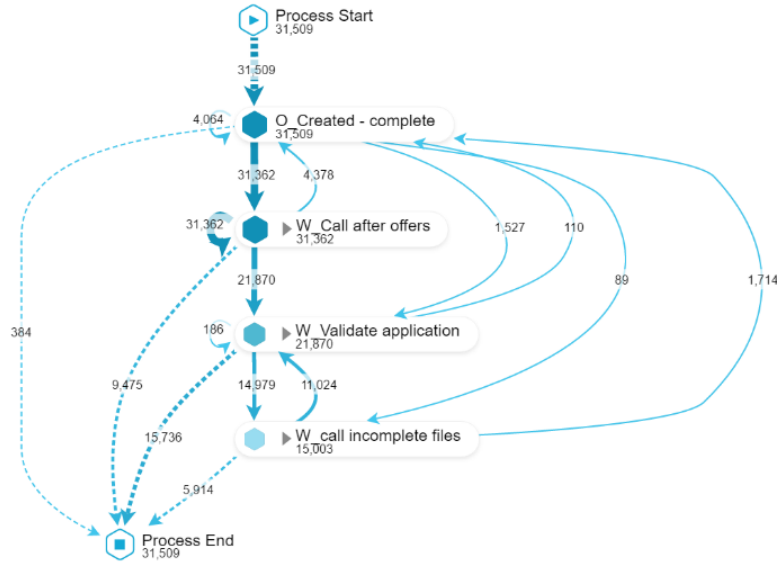

Figure 1.4: The relationship between offer creation and workflows involving conversations

From this figure it can be seen that:

- There are 4,378 cases where during the call after offers workflow the application results in new offers being created, it should be noted that this cycle can happen more than once per application.
- There are 1,714 cases where during the call incomplete files workflow new offers are created, where there can also be more than one cycle per application
- There are 110 instance of new offers being created after the validate application workflow.

1.4   Other Findings

1. The log files appear to have some anomalies which may affect the accuracy of results slightly:
   a. Actual timestamps confuse the process model generated by process mining tools due to sub-second events possibly being out of sync
   b. There are what seems to be many "duplicate" events, particularly start (202 events) and suspend (2894 events) lifecycle transitions across all workflow events.

c. It looks like there are 98 cases where the application is still in progress, so some of the in-progress workflow events don't have an end state.

d. There a few cases where high numbers of workflow events in a short space of time indicate what could be on the job training / testing activity, for example Application_322077071, where **Handle Leads** started and resumed-suspended 22 times (44 events) on 30 Aug by 10 different users.

e. There are a handful of other unexpected events, in particular workflow events that indicate abnormal **start** transitions in between what looks like normal **resume** – **suspend** activities (815 events).

1.5   Recommendations and Next Steps

Based on the analysis a review of the tooling and processes supporting customer loan origination is proposed. There appear to be potential opportunities to improve data capture upfront, with a particular focus on the activities leading up to the Accepted state. Potential improvements in customer engagement should also be investigated, focusing on transparency of the process and more effective alerting of who is waiting for what.

Some key observations and next steps are summarized below:

- There appears to be an opportunity to reduce the time taken for customers to return offers as 25% of offer are returned in less than 6 days vs an average of 10. The same observation applies to the validating to pending stage and the incomplete to pending stage.
- Loan applications originated by customers take 4 days longer end to end than applications originated by the bank. The reasons for this should be investigated to determine if it is possible to realise efficiencies for customer originated applications.
- Applications relating to vehicles reach a pending state more quickly than other types of Loans. Opportunities to align other type of loan applications to the vehicle loan process should be explored.
- Applications flagged for shortened completion take 3 days longer than other loans. (There was not sufficient volume to indicate a huge issue, but terminology suggested these should be expedited faster. Further investigation should be performed, especially if these are high-value clients.)
- The longer an application take, the more likely it is to get cancelled. The bank should consider options to reduce throughput times to improve conversion rates including:
    - o Exploring alternative ways of contacting the customer to reduce the call after offers waiting times. I.e. the 4 day wait between suspend resume cycles
    - o Reviewing workflow processes to reduce the significant amount of time spent waiting compare to working.

Also, the bank may benefit by investigating potential user or system errors causing misleading events log anomalies.

2   Supporting Analysis

A Dutch bank has provided a detailed event log for its Consumer Loans Process. The event log covers all loans applications filed in 2016 and details of how these applications were handled up to February 2017.

The dataset covers 31,509 loan applications which resulted in 42,995 loan offers being made to customers. There were 1,202,267 process events performed in order to support these applications.

The bank in question is interested in answering some key questions to enable them to increase efficiency, improve customer conversion rates and enhance the customer experience, specifically:

1. What are the throughput times per part of the process, in particular the difference between the time spent in the company's systems waiting for processing by a user and the time spent waiting on input from the applicant as this is currently unclear.
2. What is the influence on the frequency of incompleteness to the final outcome. The hypothesis here is that if applicants are confronted with more requests for completion, they are more likely to not accept the final offer.
3. How many customers ask for more than one offer (where it matters if these offers are asked for in a single conversation or in multiple conversations)? How does the conversion compare between applicants for whom a single offer is made and applicants for whom multiple offers are made?
4. Any other interesting trends, dependencies etc.

We have used a combination of process mining tools and data analysis techniques to provide insights in these questions, focusing on making pragmatic recommendations that can be applied within the business.

3   Throughput times

Question: What are the throughput times per part of the process, in particular the difference between the time spent in the company's systems waiting for processing by a user and the time spent waiting on input from the applicant as this is currently unclear.

In order to answer this question, we first look at the throughput times per part of the process, starting at high level and then drill down into the areas which take the longest. Specific observations around how throughput times vary according to different parameters are then discussed.

Following this the analysis focusses on the second part of the question, namely the difference between time spent waiting for processing by a user and the time spent waiting for input from the applicant.

3.1   Definitions and Assumptions

When analyzing the throughput times certain assumptions have been made, based upon an analysis of the data. The key assumptions made are:

2. The overall process runs 24/7/365 as it involves the customer sending and receiving documentation. The customer will do this in evenings and weekend and physical documentation will also be in transit on a 24/7 basis
3. The Bank's agents work full time on Mondays to Fridays and half time on Saturdays (the data shows that the vast majority of agent activity takes place during these times).

3.2   The Overarching Process

In answering the first part of this question around throughput times per part of the process we have first looked at the Loans process at a high level to understand the overarching process. This was achieved using the Celonis tool focusing on the loan application state activities only (**A_**):
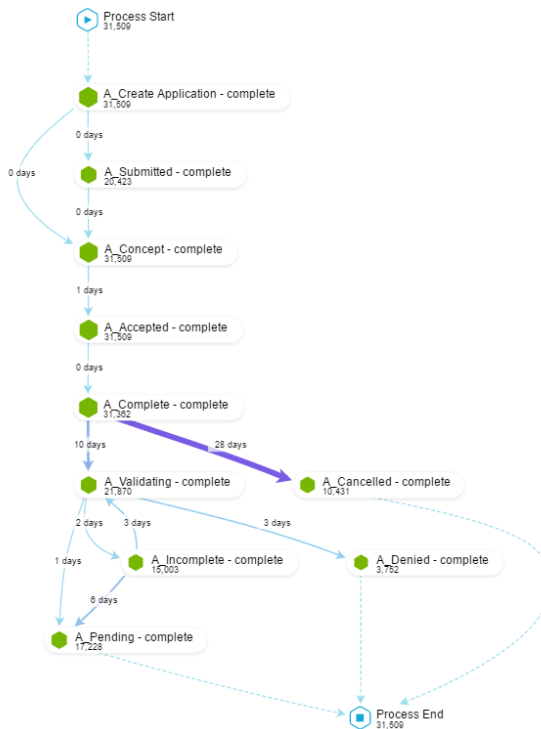

Figure 3.1: End to end flow focusing on A_ events. Produced using Celonis showing 100% of the A_ events and 99.4% of connections.

Before drilling down into the individual sub-processes we first look at some summary statistics and then consider some key variations in the end to end process.

3.3   Summary Statistics

The overall end to end process takes on average 22 days. The histogram below, generated by Celonis, illustrates the distribution of loan applications according to how long they take to complete. As shown in the figure a significant proportion of applications complete within 17 days.
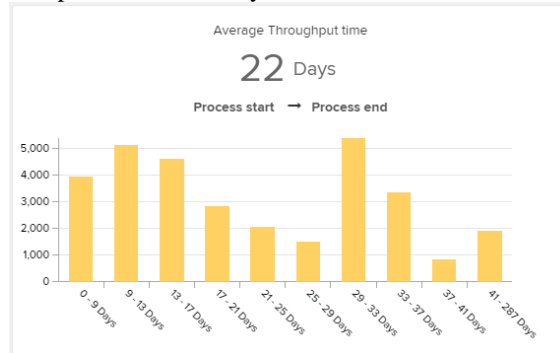
Figure 3.2: Histogram of throughput times from start to end of the process.

Approximately 30% of loan applications are cancelled and it appears that this may be the result of a process time out rule. Therefore, a more informative view of the average end to end lifecycle of the process can be provided by excluding cancelled applications as illustrated below:
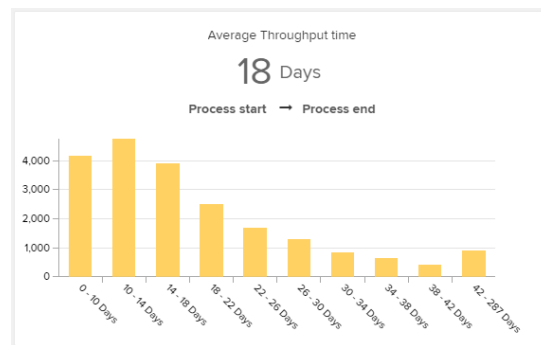
Figure 3.3: End to end throughput times excluding cancelled applications.

Here it can be seen that for loan applications which are not cancelled the average end to end process time is 18 days, with a significant number of applications processed in 18 days or less. It is worth noting that there are 2 applications of type "personal loan collection" which are extremely long lived.

The sections that follow now explore different varieties of loan to provide greater insight into the process before drilling down into sub-processes in detail.

3.3.1   Loan Origination

There are two business scenarios that result in a loan application which from a customer perspective are sufficiently different to warrant investigation. These are:

1. The Loan is originated by the customer (**A_Submitted** -> **A_Create Application**) which happens 65% of the time
2. The Loan is originated by the bank (the process starts directly at **A_Create Application**) which happens 35% of the time.

Given the differing nature of these two scenarios it is key to understand if this has an impact on the overall process. To do this we look at the relationships between the start point of the process and the end to end timings.

Loan Start Point	Average Overall Throughput time
All Start Points	22 Days
Customer	23 Days
Bank	19 Days

Table 3.1: Average Throughput Time by Loan Origination

The table above clearly shows that applications originated by the bank are completed on average 4 days faster than applications originated by a customer.

3.3.2   The End State of the Application

A loan application can also have 4 possible end points:

1. **A_Pending**: A loan is offered to the customer and accepted
2. **A_Denied**: A loan is offered to the customer but during the process is determined not to meet the Bank's acceptance criteria so is declined
3. **A_Cancelled**: The application is cancelled because the required information is not provide by the customer
4. N/A: There are 98 cases where it appears the application is still in progress and have not reached an endpoint

In order to understand the relevance of these different variations the table below summarises the end to end throughput times according to the start point and end point of the process:

Loan Start Point	Loan End Point	Average Overall Throughput time
All Start Points	All End Points	22 Days
	A_Pending	18 Days
	A_Denied	17 Days
	A_Cancelled	30 Days
Customer	All End Points	23 Days
	A_Pending	19 Days

	A_Denied	17 Days
	A_Cancelled	30 Days
Bank	All End Points	19 Days
	A_Pending	16 Days
	A_Denied	15 Days
	A_Cancelled	30 Days

Table 3.2: Average throughput times by process end point

The above table shows that the cancelled applications take a lot longer on average than pending or denied applications. It also re-enforces the observation that applications originated by the bank are processed more quickly (for those ending up either pending or denied) than applications originated by the customer, with those resulting in a pending state completing 3 days faster and those ending in denied completing 2 days faster.

3.3.3   Shortened Completion

Some loan applications can be flagged for Shortened Completion which means the customer has a certain profile that defines as a lower credit risk. These applications are investigated less thorough then higher risk applications. This only happens for 74 applications, and the table below presents details of the overall through put timing for these applications:

Loan Start Point	Loan End Point	Average Overall Throughput time
All Start Points	All End Points	27 Days
	A_Pending	21 Days
	A_Denied	22 Days
	A_Cancelled	39 Days
Customer	All End Points	28 Days
	A_Pending	21 Days
	A_Denied	22 Days
	A_Cancelled	39 Days
Bank	All End Points	15 Days (Only 3 cases)
	A_Pending	15 Days (Only 3 cases)
	A_Denied	N/A No cases
	A_Cancelled	N/A No cases

Table 3.3: Average Process Throughput Times for Shortened Completion

It would appear from this data that applications flagged for Shortened Completion take longer than other applications if originated by the customer and are no quicker that other applications if initiated by the bank.

3.3.4 Limit Raises vs. New Loans

The table below provides summary statistics by Loan Type. As shown, **New Loans** take on average 5 days longer to complete than Limit Raises. Applications reaching the **A_Pending** state take 5 days longer and those reaching the **A_Denied** state take 2 days longer.

Loan Type	Loan End Point	Average Overall Throughput time
Limit Raise	All	17 Days
	A_Pending	14 Days
	A_Denied	15 Days
	A_Cancelled	29 Days
New Loan	All	22 Days
	A_Pending	19 Days
	A_Denied	17 Days
	A_Cancelled	30 Days

Table 3.4: Average Process Throughput Times for Limit Raises vs. New Loans

3.3.5 Loan Goal

This section looks at any patterns between the goal of the Loan and the throughput time.
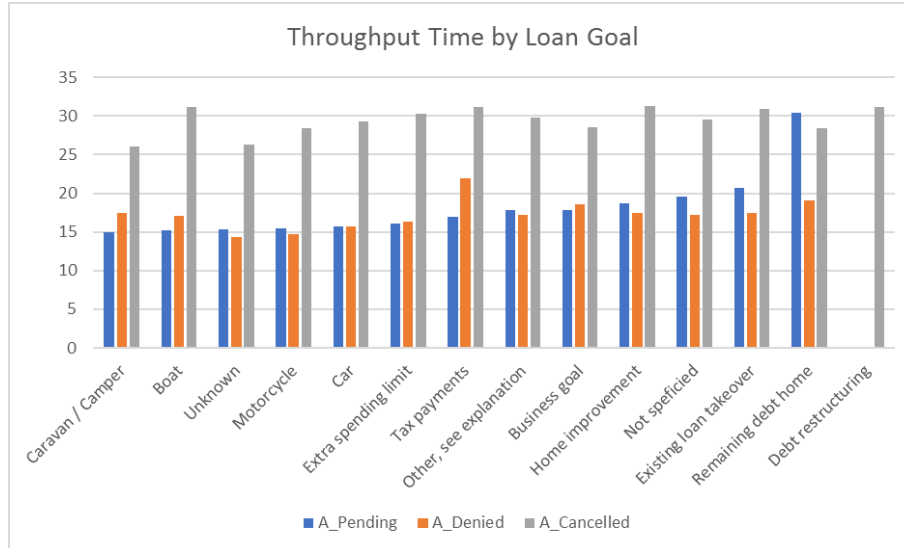
Figure 3.4: Throughput Timings by Loan Goal

The graph above shows that loans relating to vehicles reach a pending state more quickly than other types of Loans. Loans for **Remaining Debt Home** seem to be

outliers, taking a long time to approve perhaps due to additional documentation being required if these loans are secured against a house.

3.4   Drilling into the Sub-Processes

Having explored the overarching process, this section now drills down into the underlying sub-processes, focusing on those which contribute the most to the throughput times.

Figure 3.1, repeated below, shows the average times between each of the main loan application stages.
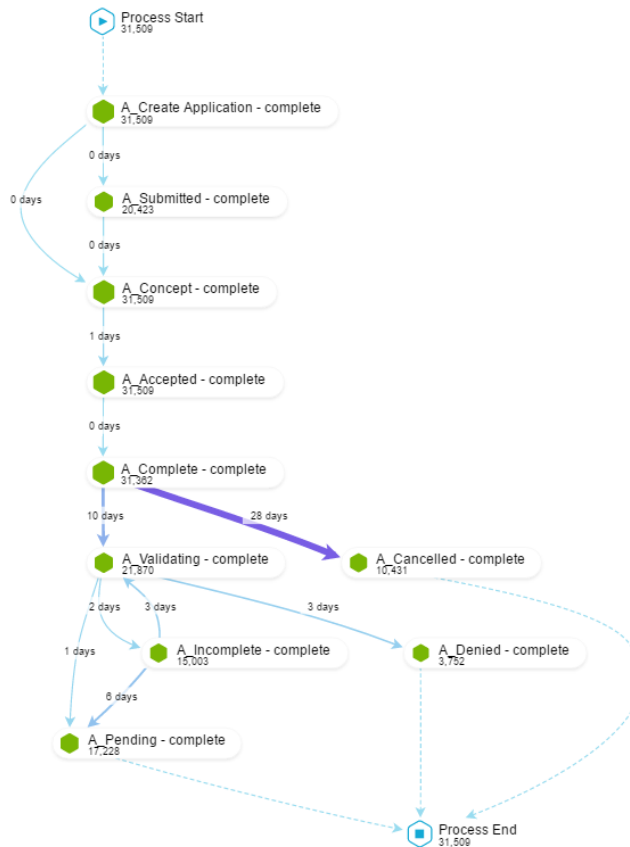
Figure 3.5: The high-level end to end process showing all **A_** statuses and 99.4% of connections.

From the diagram, it is clear that the process leading up to the creation of a loan offer (**A_Complete**) operates fairly quickly, taking on average 1 day to reach this stage. The majority of the time is spent after the Loan offers have been created and sent to the customer (after the **A_Complete** event).

Full details of timings between each stage of the loan application process illustrated above are provided in table 3.5 below:

Activity	Min	Q1	Median	Q3	Max	Average	Count
A_Create Application to A_Submitted	0.00	0.00	0.00	0.00	0.00	0.00	20423
A_Submitted to A_Concept	0.00	0.00	0.00	0.00	5.02	0.05	20423
A_Concept to A_Accepted	0.00	0.01	0.86	1.83	30.90	1.42	31509
A_Accepted to A_Complete	0.00	0.00	0.00	0.01	30.06	0.13	31362
A_Complete to A_Cancelled	0.00	30.54	30.70	30.85	79.70	28.36	9307
A_Complete to A_Validating	0.00	5.90	7.78	12.02	80.01	9.83	21870
A_Validating to A_Pending	0.00	0.10	0.72	2.04	23.84	1.44	12291
A_Create Application to A_Concept	0.00	0.00	0.00	0.00	0.00	0.00	11086
A_Validating to A_Incomplete	0.00	0.06	0.86	2.82	27.98	1.66	23052
A_Incomplete to A_Validating	0.00	0.25	1.01	3.08	117.93	2.86	16939
A_Validating to A_Denied	0.00	0.77	2.02	4.21	92.05	2.80	3373
A_Incomplete to A_Pending	0.00	0.77	3.74	9.87	51.78	5.88	4937
A_Incomplete to A_Cancelled	0.00	0.88	7.36	27.75	140.10	15.16	924
A_Accepted to A_Cancelled	0.00	0.01	0.01	3.58	31.91	5.77	110
A_Validating to A_Cancelled	0.00	0.14	1.27	4.07	11.88	2.40	90
A_Incomplete to A_Denied	0.00	0.10	0.21	1.14	34.00	2.14	210
A_Complete to A_Denied	0.00	0.13	2.99	7.95	37.11	6.24	132
A_Accepted to A_Denied	0.00	0.01	0.01	0.06	5.10	0.27	37
A_Denied to A_Denied	0.00	0.00	0.00	0.00	0.00	0.00	1
A_Validating to A_Validating	0.00	0.00	0.00	0.00	0.01	0.00	7
A_Incomplete to A_Incomplete	0.00	0.00	0.00	0.00	0.00	0.00	3

Table 3.5: Timings between **A_** activities in days

From both the diagram and the table above it is clear that the majority of the throughput time relates to when:

1. The application is cancelled, taking on average 28 days from **A_Complete**. This happens for approximately 30% of applications**.**
2. One or more loan offers are sent to the customer, who then returns the documents to the bank for validatation. The application is then:
   a. Confirmed (**A_Pending**), taking on average 7 days from **A_Validating** (via one or more cases on A_Incomplete)
   b. Denied, taking on average 5 days from **A_Validating** (via one or more cases on **A_Incomplete**)

There is a cycle of activity associated with the validation process where the files sent in by the customer are incomplete and further information is required. Therefore, the total throughput time is dependent on how many cycles a given application goes through.

3.4.1   The most long lived sub-processes

As mentioned in section 3.3 the majority of the throughput time is focused in several key areas of activity, namely:

1. Sending offers to the customer and getting the required documentation back
2. Validating documents sent in and either finalising or declining the loan
3. Cancelling an application

The table below provides summary statistics for these sub-processes:

Sub-Process	Average Duration	Customer Originated	Bank Originated
A_Complete -> A_Validating	10 Days	10 Days	9 Days
A_Validating -> A_Pending	7 Days	7 Days	7 Days
A_Validating -> A_Denied	5 Days	5 Days	5.5 Days
A_Complete -> A_Cancelled	28 Days	29 Days	28 Days

Table 3.6: Summary timings for the most long lived sub-processes

One key observation from the above is that the reduction in time of 3 days seen for the end to end process between applications originated by the bank and application originated by the customer does not seem to be fully reflected in these sub-processes. Even though these sub-processes cover the majority of the throughput time only.

Looking at the data, the reason for this relates to the process of creating a concept loan (**A_Concept** -> **A_Accepted**). The 3 day difference is down to the following:

1. **A_Concept** -> **A_Accepted** takes on average 1.7 days longer for customer originated loans
2. **A_Complete** -> **A_Validating** takes 1.1 days longer
3. **A_Validating** to **A_Pending** takes 0.5 days longer

Another key observation from section 3.2.4 was that New Loans take on average 5 days longer to complete than limit raises. The table below shows that these key processes account for 4.5 of the 5 days difference.

Sub-Process	Average Duration	Limit Raise	New Loan
A_Complete -> A_Validating	10 Days	8.5 Days	10 Days
A_Validating -> A_Pending	7 Days	4 Days	7 Days
A_Validating -> A_Denied	5 Days	5 Days	5 Days
A_Complete -> A_Cancelled	28 Days	27 Days	28 Days

Table 3.7: Timing for long lived sub-processes

3.5   Sending Offers to the Customer and Receiving Documents

As mentioned in section 3.3.1, the first long lived process to consider is where offers are sent to a customer and the customer then returns documents to the bank to support

the request for a loan. This part of the process is between **A_Complete** and **A_Validating** and takes on average 10 days.

To provide further detail on this the figure below illustrates the distribution of time taken for an application to go from **A_Complete** to **A_Validating** as well as summary statistics:
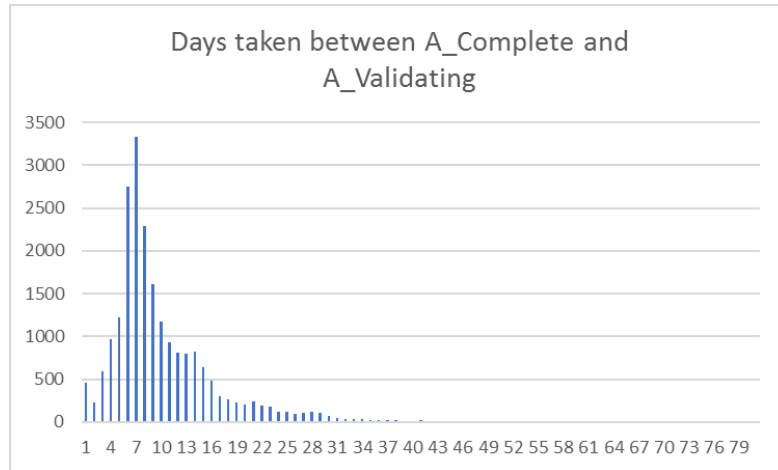
Figure 3.7: Distribution of timings for **A_Complete** to **A_Validating**

Sub Process Timings from A_Complete to A_Validating					
Mean	Median	Min	Max	Q1	Q3
10	8	0	80	6	12

Table 3.8: Summary timing statistics for **A_Complete** to **A_Validating**

Given that in 25% of cases this sub process completes in 6 days or less it appears that there may an opportunity to reduce the time taken by better understanding the drivers of this process. Therefore, we now explore the detailed steps within this sub-process.

3.5.1 The W_Call after offers Workflow

The **A_Complete** to **A_Validating** sub-process covers the period from having sent offers to the customer to having received documents back.

Once the offer has been sent this then starts a workflow process **W_Call after offers**. This creates a work item where the customer is reminded about the offer, to ask if he received everything, still has any questions, is planning to accept the offer etc.

To understand this in more detail we then look at the **W_Call After Offers** workflow events that occur between an offer being made and the offer moving to validating as illustrated in figure 2 below.
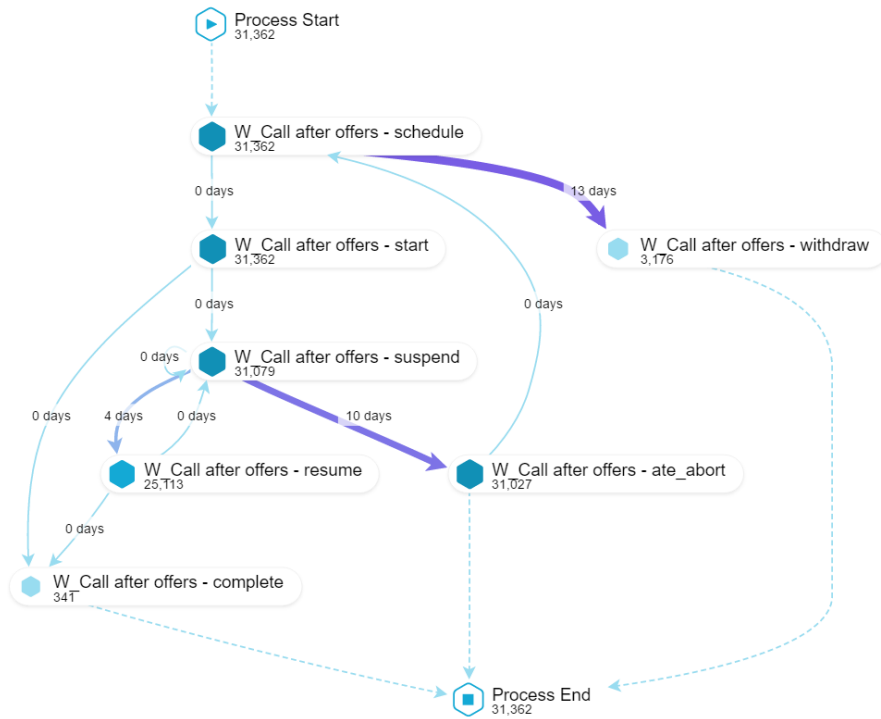
Figure 3.8: The W_Call after offers workflow process showing 99.9% of connections.

In analyzing this process, it can be seen that there are 2 categories of activities here:

Long Lived Activities (Abort -> Withdraw; Suspend -> ate_abort; Suspend -> Resume)

Having examined the data (detailed in Appendix A), it appears that the long lived activities may be driven by factors external to this workflow, for example.

1. Withdraw appears to be triggered as a result of the customer returning files to the Bank for validation, meaning that the **W_Call after offers** workflow is no longer required.
2. **Ate_abort** may be triggered as a result of
   a. The application being cancelled
   b. The documents being returned and the validation process starting.
3. Resume activities are unlikely to take place in short order after a suspend as certain activities may need to take place, for example if the applicant was contacted then time would be allowed for the applicant to send in any files before being called again.

It appears from that data that a period of approximately 4 days is allowed between suspend and resume as both the first quartile and third quartile values are approximately 4 days.

Short Lived Activities (Schedule -> Start; Start -> Suspend; Start -> Complete; Resume -> Suspend)

It appears from the data (detailed in Appendix A) that the short-lived activities are likely to relate to activities undertaken by a user to reach out to the customer to follow up on the offers which have been sent. As shown in the table, none of these activities take longer than 1 day and looking at some of the individual timings it appears that many of these manual workflow items may be automatically closed by a system and the end of business to then be re-assigned.

The Suspend /Resume Cycle

As mentioned above once the **W_Call after offers** workflow has been scheduled a work item is created for a user to contact the customer. This workflow can be suspended and resumed several times, presumably depending on whether or not the user was able to contact the customer.

The scatter plot below illustrates how the end to end **W_Call after offers** workflow time varies by the number of Suspend / Resume cycles. Clearly the time taken to complete the **A_Complete** to **A_Validating** sub-process is driven by the number of cycles within the **W_Call after offers** workflow.
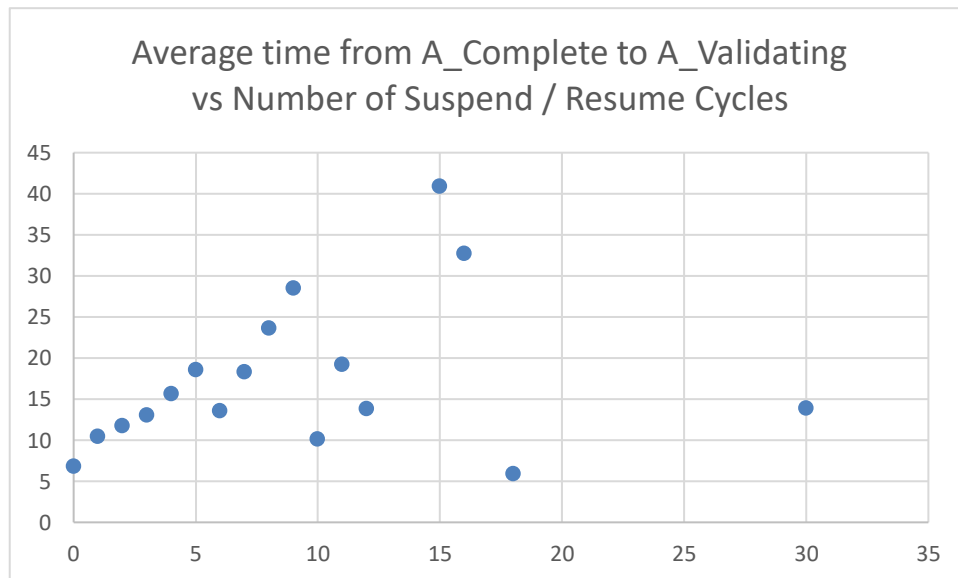

Figure 3.9: Average time from **A_Complete** to **A_Validating** vs # Suspend Resume Cycles

3.6   Reviewing Returned Documents and Deciding Whether a Loan is Made or Declined

For clarity, the area of the process that we are now focusing on is illustrated below.

Figure 3.10: Application Validation

As illustrated above once a customer has sent in their documents they are then validated by the Bank. Once validated a loan is either then finalised (set to pending) or denied.

There are two outcomes to consider here:

1. Making a Loan (**A_Validating** -> **A_Pending**), taking 7 days on average
2. Declining a Loan (**A_Validating** -> **A_Denied**), taking 5 days on average

There is also a cycle to and from an incomplete status which is a key factor in the overall time taken to reach with a Pending or Denied state.

3.6.1   The cycle to and from an incomplete status

The **A_Validating** to **A_Incomplete** events create a cycle in the end to end flow. This cycle results from the W_Validate application workflow where the user assesses the files returned by the applicant. If the files are incomplete then the application enters the **A_Incomplete** state and the **W_Call incomplete** files workflow is triggered.

W_Validate application

Compared to the **W_Call After Offers** workflow all of the intra workflow timings are relatively short lived. The suspend to resume and suspend to abort activities consume the most time and appear to represent the time when the workflow item is allocated to a Bank agent to undertake validation work. It is not clear that the agent is

working on the application for all of this time. The timings for this workflow are detailed in Appendix A.

W_Call incomplete files

The **W_Call incomplete** files workflow relates to when a customer has returned documents to support a loan offer but having gone through the validation process, it has been determined that these documents are incomplete. The timings for this workflow are detailed in Appendix A.

All of the intra workflow timings are relatively short lived. The suspend to resume and suspend to abort activities consume the most time and appear to represent the time when the workflow item is allocated to a Bank agent. It is not clear that the agent is working on the application for all of this time.

3.7   Exploring Cancelled Loan Applications

As mentioned above approximately 30% of loan application are cancelled after offers have been sent to the customer. On average it takes 28 days to cancel a loan application. It appears that there is a timed business rule that drives a large proportion of the cancellations as 44% of applications which are cancelled are cancelled between 30 and 35 days as illustrated in the chart below:
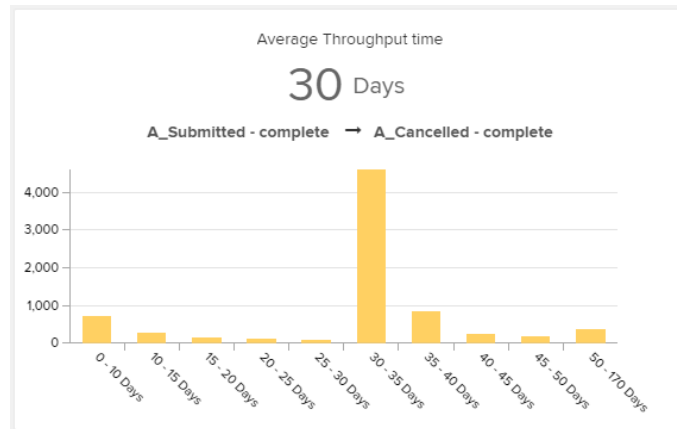
Figure 3.11: Cancelled Application Timings

3.8   Time Spent Waiting on Users

As well as understanding the throughput times end to end, the Bank is also interested in understanding the time spent waiting on users.

In order to understand this in more detail the timings for the workflow tasks undertaken by users need to be understood. Each workflow task follows the same flow as shown below:

Figure 3.8: Workflow lifecycle transition event flow

In this workflow process the user is undertaking activity between:

1. Start to Complete
2. Start to Suspend
3. Resume and Complete
4. Resume and Suspend

The table below shows the time spent on these activities for each of the workflow types:

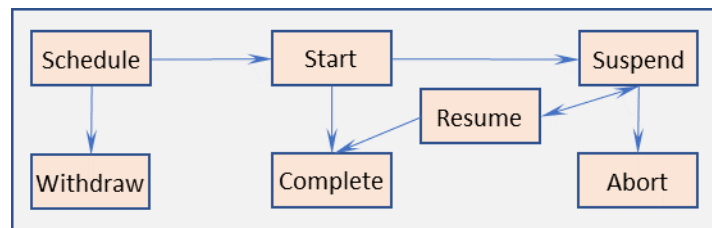| Workflow	activity	Average	Median	Min	Max	Q1	Q3	Count
Handle Leads	start to suspend	6.31	0.73	0.04	598.06	0.20	1.93	906
	start to complete	1.67	1.17	0.02	45.02	0.71	2.02	2738
	resume to comlplete	1.77	1.30	0.03	27.24	0.59	2.11	755
	resume to suspend	6.61	0.81	0.04	924.37	0.23	2.32	492
Call After offers	start to suspend	8.32	2.36	0.03	1147.35	1.30	4.40	31144
	start to complete	3.06	0.46	0.03	180.42	0.12	2.91	286
	resume to comlplete	2.62	1.56	0.18	17.70	0.58	3.05	56
	resume to suspend	1.10	0.49	0.01	815.10	0.38	0.68	29074
Validate Application	start to suspend	5.00	2.23	0.02	1026.17	0.83	4.68	34736
	start to complete	3.03	1.59	0.02	125.08	0.07	4.08	4276
	resume to comlplete	16.57	13.10	0.08	349.14	5.08	22.98	11572
	resume to suspend	8.21	0.44	0.02	962.00	0.12	4.20	22348
Call incomplete files	start to suspend	2.83	0.52	0.02	811.65	0.17	1.62	22760
	start to complete	1.79	0.44	0.02	33.12	0.08	1.84	295
	resume to comlplete	5.59	3.54	0.01	388.45	1.82	6.65	2498
	resume to suspend	4.30	2.05	0.03	925.48	0.78	4.30	36703
Complete Application	start to suspend	3.42	1.26	0.02	812.43	0.27	2.63	16994
	start to complete	10.89	9.61	0.13	158.41	6.48	13.86	12675
	resume to comlplete	12.27	11.17	0.02	63.13	7.77	15.51	6429
	resume to suspend	3.15	1.29	0.03	884.07	0.36	2.56	16223
Assess Potential Fraud	start to suspend	9.63	0.57	0.04	482.13	0.15	3.02	302
	start to complete	12.33	0.62	0.14	181.77	0.39	2.43	22
	resume to comlplete	9.34	0.63	0.09	294.74	0.30	3.28	260
	resume to suspend	54.86	1.01	0.04	906.05	0.31	16.07	736
Personal Loan Collection	start to suspend	0.32	0.32	0.17	0.47	0.24	0.39	2
	start to complete	0.00	0.00	0.00	0.00	0.00	0.00	0
	resume to comlplete	0.00	0.00	0.00	0.00	0.00	0.00	0
	resume to suspend	0.64	0.42	0.12	2.31	0.20	0.61	7
Shortened completion	start to suspend	3.47	0.71	0.03	27.35	0.08	4.30	74
	start to complete	0.00	0.00	0.00	0.00	0.00	0.00	0
	resume to comlplete	0.00	0.00	0.00	0.00	0.00	0.00	0
	resume to suspend	27.63	3.48	0.21	63.79	1.63	61.34	7

3.9   Time Spent Waiting on Applicants

There are several key points in the process when time is spent waiting on applicants:

1. The customer may be required to provide further information before a loan application can be accepted.   This takes on average a day and a half, and usually less than a day (**A_Concept** to **A_Accepted**). During this time, the **W_Complete Application** workflow captures the time spent working with the customer to complete the application. Calculating the time between the **suspend** and **resume** workflow activities, it appears to take on average 20 hours (includes non-working overnight / weekend time) to get a response from the customer, but usually less than 3 hours.

Application Outcome
(impact of time waiting for offer return)
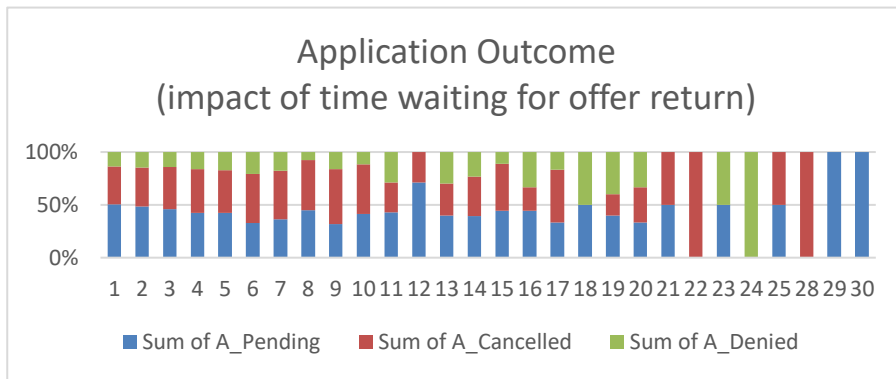
2. Once the application is complete (**A_Complete**) a loan offer is sent. The time to receive the documents for validation (**A_Validating**) takes around 10 days but most are returned in less than 8.   This includes non-business hours, so we assume weekends and postage times could impact these times. During this time, the **W_Call after Offers** workflow captures the time chasing the customer to accept and return the documents. Calculating the time between the **suspend** and **resume** workflow activities, it appears to take on average 4 days (includes non-working overnight / weekend time) to get a response from the customer.

Application Outcome
(impact of time waiting for response)
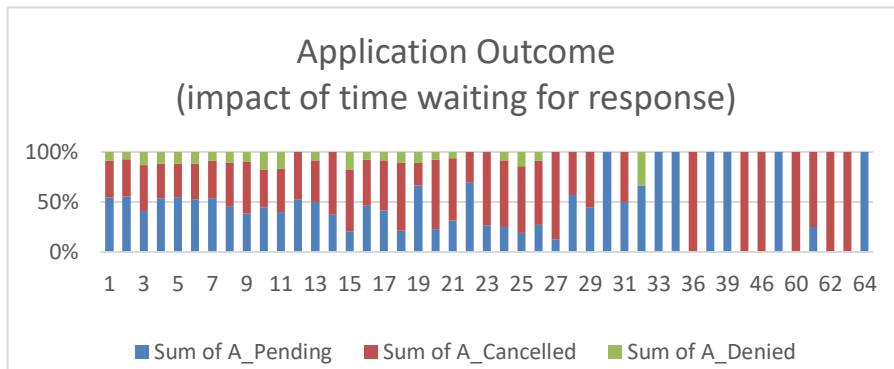
3. If the documents provided are incomplete then the applicant will need to provide further documentation (**A_Incomplete** to **A_Validating**). The average time to complete this step takes under 3 days, and usually just over 1 day. During this time, the **W_Call incomplete** files workflow captures the time spent working with the customer to collect the correct documents. Calculating the time between the **suspend** and **resume** workflow activities, it appears to take on average just over 1 day (includes non-working overnight / weekend time) to get a response from the customer, but usually less than 3 hours.

Application Outcome
(impact of time waiting for Infomation)

Legend: ■ Sum of A_Pending   ■ Sum of A_Cancelled   ■ Sum of A_Denied
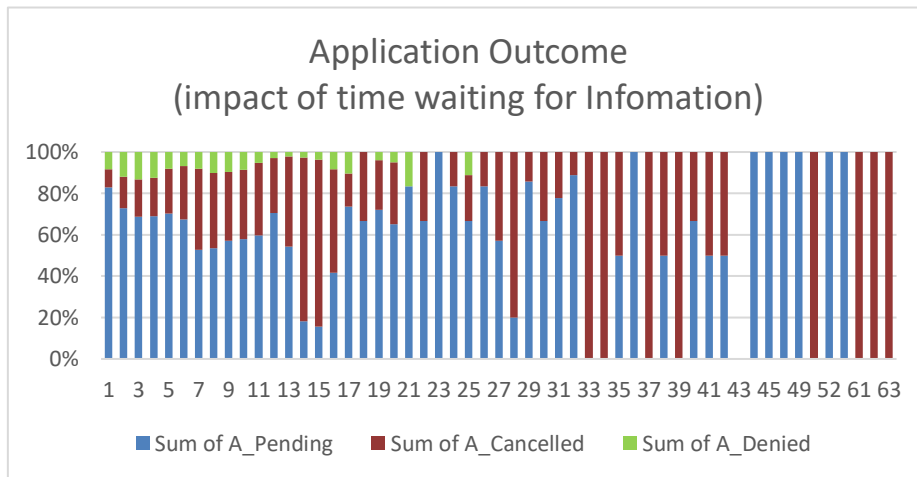
4   What is the influence on the frequency of incompleteness to the final outcome. The hypothesis here is that if applicants are confronted with more requests for completion, they are more likely to not accept the final offer.

Here incompleteness refers to the scenario where documentation that the customer has sent in after having received a loan offer is incomplete and the Bank needs to request further documents from the customer, i.e. the application reaches the **A_Incomplete** event.

In order to understand whether or not the frequency of incompleteness impacts the final outcome of the loan we have looked at the relationship between the number of times a loan application reaches **A_Incomplete** and the number of loans that end up in either **A_Pending**, **A_Denied** or **A_Cancelled**. Here we are only concerned with applications for which the customer has returned files so exclude those applications for which no files were ever sent in (i.e. only look at applications that make it to the **A_Validating** state, which excludes 9636 applications which never enter validation).

The assumption made here is that if the customer returned files for validation then they wanted to take out the loan. Therefore, if the loan is cancelled after this status then this represents the scenario of the customer deciding not to accept the final loan offer.

If the bank decided not to finalize the offer it is assumed that the application would be denied rather than cancelled.

# A_Incomplete	A_Pending	A_Denied	A_Cancelled	#N/A
0	4581 (67%)	2227 (32%)	59 (1%)	0 (0%)
1	7666 (82%)	1001 (11%)	631 (7%)	19 (0%)
2	3471 (87%)	254 (6%)	227 (6%)	18 (0%)
3	1088 (88%)	72 (6%)	70 (6%)	4 (0%)
4	307 (87%)	24 (7%)	19 (5%)	2 (1%)
5	89 (88%)	4 (4%)	7 (7%)	1 (1%)
6	20 (100%)	0 (0%)	0 (0%)	0 (0%)
7	6 (67%)	1 (11%)	1 (11%)	1 (11%)

Table 4.1: End states by number of **A_Incomplete** loops

Looking at this data it shows three key points:

1. There is an increase in the proportion of validated applications which are cancelled between zero instances of incompleteness and one instance. Implying that if the applicant does not send in a complete set of files first time then they are less likely to see the offer through to completion by subsequently sending the missing files.
2. After 1 iteration of **A_Incomplete** 7% of cases were cancelled. This percentage then stays roughly consistent (between 5.4% and 7%) for 2-5 iterations. This would imply that if an applicant returns additional files at least once then these applications are not more likely to end up being cancelled as the frequency of incompleteness increases.
3. The proportion of applications reaching the pending state rather than the declined state tends to increase with the number of iterations of incompleteness.

4.1   Exploring the W_Call Incomplete Files Workflow

Exploring this question further we now focus on the question of how frequently an applicant is confronted with a request for completion. Here we look at a related activity to **A_Incomplete**, namely the **W_Call Incomplete Files** work flow.

Looking at the data it appears that an instance of the **W_Call incomplete files** workflow is scheduled corresponds exactly to the number of instances of **A_Incomplete** for a particular case.

This workflow can be suspended and resumed a number of times throughout the lifecycle of a loan application. It is not clear from the data whether or not each time that the workflow is resumed the customer is contacted or whether each of these cycles represents an attempt to contact the customer which may or may not succeed. In a similar way to the previous chart, the chart below shows the proportion of loan applications reaching the states **Pending**, **Denied** and **Cancelled** according to how many times the **W_Call incomplete** files workflow was started or resumed:
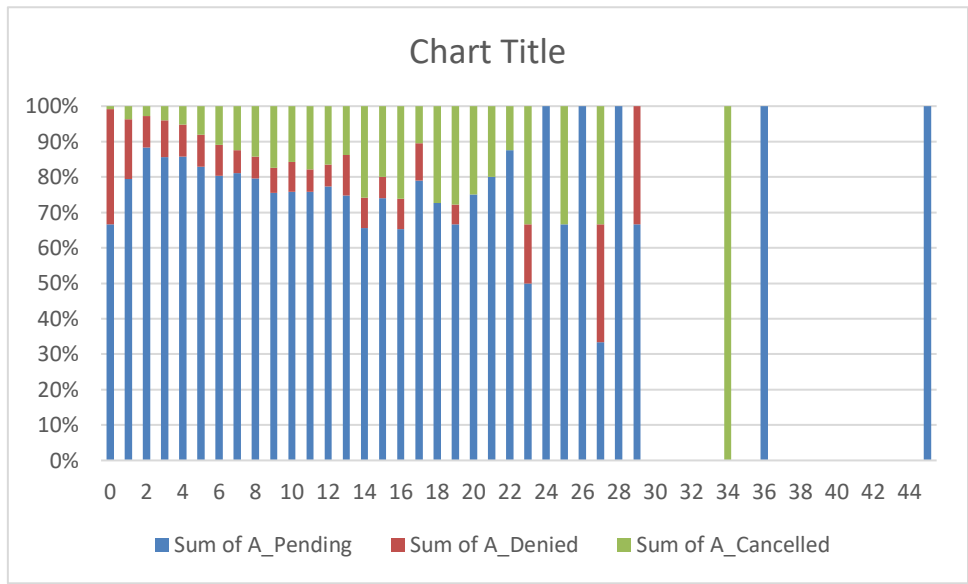
Figure 4.1: End state of application by number of calls for incomplete files

Looking at this data a clear increase in the proportion of cancelled cases can be seen as the number of **W_Call incomplete** files activities increases. This may imply that an application is likely to end up being cancelled if the customer is confronted with many requests for completion. However, this could also be related to the age of the application as older loan applications are more likely to be no longer be required by the customer.

5   How many customers ask for more than one offer (where it matters if these offers are asked for in a single conversation or in multiple conversations)? How does the conversion compare between applicants for whom a single offer is made and applicants for whom multiple offers are made?

5.1   How many customers ask for more than one offer in a single conversation?

In order to determine how many customers ask for more than one offer in a single conversation, we need to define what is meant by a conversation. Looking into the data, specifically the time differences between consecutive offers, it can be seen that there are two general cases:

1. Short times (minutes to several hours) between offers
2. Long times (over a day) between offers

Based on this observation for the purposes of this analysis any offers sent on any given day are deemed to relate to the same conversations. If offers are sent on different days then these relate to separate conversations.

On this basis, the number of customers asking for more than one offer in a single conversation is 3364.

5.2   How many customers ask for more than one offer in multiple conversations?

The table below details the number of applications where more than one offer was made and the number of conversations held for that application. 4895 customers ask for more than one offer in multiple conversations.

# Offers	#Conversations					
	1	2	3	4	5	6
1	22950	0	0	0	0	0
2	3282	3296	0	0	0	0
3	256	724	368	0	0	0
4	103	167	131	42	0	0
5	13	43	47	20	3	0
6	6	6	9	5	2	2
7	1	8	1	1	4	1
8	2	1	7	2	1	0
9	0	0	1	1	0	1
10	1	0	1	0	0	0
Average	1.158337717	2.296113074	3.538053097	4.647887324	6.3	7

Table 5.2: Number of conversations per number of offers

As shown in the table, the average number of offers made increases as the number of conversations increases which may imply that offers are having to be refined as these applications progress. This is explored in the next section.

5.3 How does the conversation compare between applicants for whom a single offer is made and applicants for whom multiple offers are made?

For applications where a single offer is made there is only ever a single conversation. When multiple offers are made, there can be up to six separate conversations. Looking at the underlying data in detail it is clear that not all of these offers are made at the same point in the process. Offers can be created:

- As initial offers which are made once the application has been accepted by the bank
- During the **Call After Offers** Workflow, potentially because when speaking to the customer it is determined that a variation in the original loan proposal would suit the customer's needs better
- During the validation process. Potentially due to reviewing the detailed customer files and finding that there is another loan variation more suitable to their needs or that they do not qualify for a particular type of loan

These different scenarios represent separate conversations with the customer and are illustrated in the figure below:

From this figure it can be seen that:
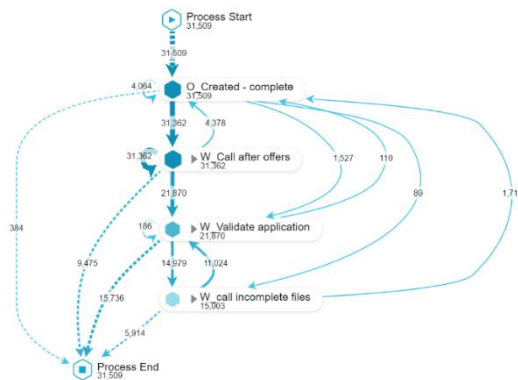
- There are 4,378 cases where during the call after offers workflow the application results in new offers being created, it should be noted that this cycle can happen more than once per application.
- There are 1,714 cases where during the call incomplete files workflow new offers are created, where there can also be more than one cycle per application
- There are 110 instance of new offers being created after the validate application workflow.

The first two of the workflows above both represent conversations with the customer where the outcome is that further insight from the customer results in new offers being made. This scenario does not happen for applicants for whom only a single offer is made.

6   Other findings:

6.1   How the final outcome of an application changes with duration

The chart below shows whether or not a loan is either taken out, denied or cancelled according to the end to end duration of the loan application.
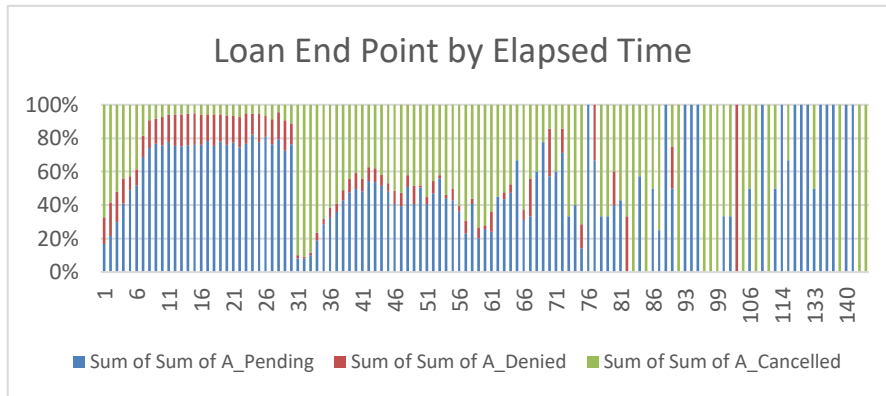
The problem with this view is that it is skewed by the high proportion of application cancellations that take place after 31, 32 or 33 days. Therefore, a revised chart has been produced below which spreads these loan cancellations evenly over 1 day through to 33 days (assuming that in effect these loans could have been cancelled at any point, but the procedure is to wait until approximately 31 days). This produces the chart below:
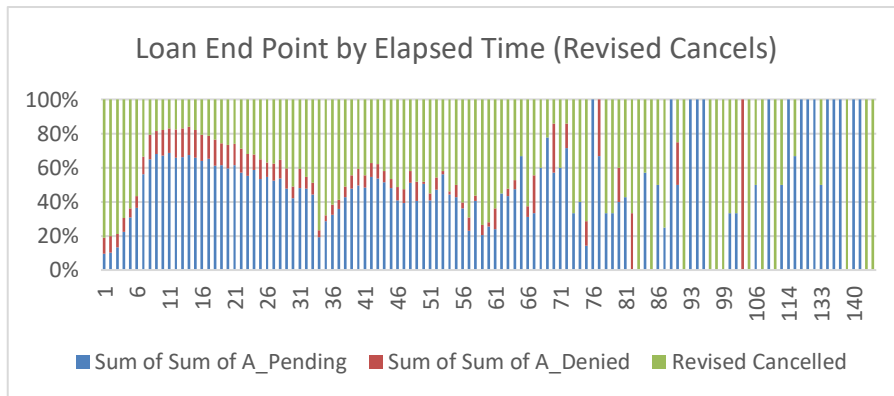
This chart shows a clear trend of increasing cancellation rates after around 16 days. There is also a high cancelation rate up until day 7, further analysis would be required to understand the reasons for this. Data to the far right should be ignored due to the low volume of cases reaching this stage.

7   Appendix A: Full Process Timings

7.1   A_Activities

	A_Submitted to A_Create Application	A_Create Application to A_Concept	A_Concept to A_Accepted	A_Accepted to A_Complete	A_Accepted to A_Denied	A_Accepted to A_Cancelled	A_Complete to A_Validating	A_Validating to A_Pending	A_Validating to A_Denied	A_Validating to A_Cancelled	A_Validating to A_Incomplete	A_Complete to A_Cancelled	A_Complete to A_Denied	A_Incomplete to A_Denied	A_Incomplete to A_Pending	A_Incomplete to A_Cancelled
# Cases	20423	31509	31509	31362	3752	10431	21870	17228	3583	1014	15003	10321	3715	1356	12647	955
Average	0.00	0.03	1.42	0.13	15.04	28.23	9.83	6.99	5.02	18.64	1.90	28.36	15.04	6.60	6.75	17.47
Median	0.00	0.00	0.86	0.00	12.91	30.70	7.78	4.96	3.97	11.85	1.03	30.70	12.91	4.94	3.97	10.89
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	0.00	5.02	30.90	30.06	102.06	167.16	80.01	133.84	92.05	158.91	21.10	167.16	102.06	77.80	129.86	158.91
Q1	0.00	0.00	0.01	0.00	8.92	30.50	5.90	1.97	1.74	4.86	0.05	30.50	8.94	1.79	1.09	2.13
Q3	0.00	0.00	1.83	0.01	18.64	30.87	12.02	8.83	6.18	29.00	3.09	30.86	18.15	8.09	9.04	27.98

Table A1: Timings in Day for transitions between A_ Activities

7.2   W_ Activities

7.2.1   W_Handle Leads

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdraw	Average end to end
Average	6.31	1.67	1.77	6.61	78.71	377.11	1.52	66.26
Median	0.73	1.17	1.30	0.81	1.25	87.71	1.04	1.14
Min	0.04	0.02	0.03	0.04	0.43	0.51	0.27	0.27
Max	598.06	45.02	27.24	924.37	7233.98	4033.20	2350.88	7233.98
Q1	0.20	0.71	0.59	0.23	1.01	21.76	0.77	0.83
Q3	1.93	2.02	2.11	2.32	1.50	629.22	1.29	1.45
Count	906	2738	755	492	151	3493	16802	20446

Table A2: Timings for W_Handle leads workflow in minutes

7.2.2 W_Complete Application

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdraw	Average end to end
Average	3.42	10.89	12.27	3.15	4077.01	1326.72	1486.70	2257.67
Median	1.26	9.61	11.17	1.29	2464.26	422.67	1238.46	1313.90
Min	0.02	0.13	0.02	0.03	2.96	0.63	3.71	0.63
Max	812.43	158.41	63.13	884.07	45954.82	44563.79	18796.55	45954.82
Q1	0.27	6.48	7.77	0.36	1268.98	9.32	273.05	19.46
Q3	2.63	13.86	15.51	2.56	4347.08	1868.37	2192.32	2730.81
Count	16994	12675	6429	16223	10565	19104	1863	31532

Table A3: Timings for W_Complete Application workflow in minutes

7.2.3 W_Call After Offers

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdrawn	Average end to end
Average	8.32	3.06	2.62	1.10	20364.63	1945.51	18120.70	19976.62
Median	2.36	0.46	1.56	0.49	12601.26	1.19	11682.65	12409.01
Min	0.03	0.03	0.18	0.01	0.35	0.03	27.01	0.03
Max	1147.35	180.42	17.70	815.10	115218.98	106477.43	77788.31	115218.98
Q1	1.30	0.12	0.58	0.38	8241.14	0.14	4715.54	7342.84
Q3	4.40	2.91	3.05	0.68	38632.89	6.63	38907.31	38691.20
Count	31144	286	56	29074	31085	342	3176	34603

Table A4: W_Call after offers workflow timings in minutes

7.2.4 W_Validate Application

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdraw	Average end to end
Average	5.00	3.03	16.57	8.21	2370.84	2406.55	N/A	2385.35
Median	2.23	1.59	13.10	0.44	1225.29	1221.04	N/A	1224.31
Min	0.02	0.02	0.08	0.02	0.13	0.02	N/A	0.02
Max	1026.17	125.08	349.14	962.00	25443.40	40288.90	N/A	40288.90
Q1	0.83	0.07	5.08	0.12	177.99	8.37	N/A	117.60
Q3	4.68	4.08	22.98	4.20	3786.38	4169.31	N/A	3996.76
Count	34736	4276	11572	22348	23161	15848	N/A	39009

Table A5: W_Validate application workflow timings in minutes

7.2.5 W_Call Incomplete Files

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdrawn	Average end to end
Average	2.83	1.79	5.59	4.30	5567.63	7042.17	N/A	5746.59
Median	0.52	0.44	3.54	2.05	1716.75	251.73	N/A	1573.75
Min	0.02	0.02	0.01	0.03	0.58	0.02	N/A	0.02
Max	811.65	33.12	388.45	925.48	201745.67	175870.45	N/A	201745.67
Q1	0.17	0.08	1.82	0.78	1055.51	90.15	N/A	394.25
Q3	1.62	1.84	6.65	4.30	7077.30	1539.28	N/A	6916.64
Count	22760	295	2498	36703	20220	2793	0.00	23013

Table A6: W_Call Incomplete Files workflow timings in minutes

7.2.6 W_Assess Potential Fraud

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdraw	Average end to end
Average	9.63	12.33	9.34	54.86	4470.65	5573.37	1763.76	5396.79
Median	0.57	0.62	0.63	1.01	1109.93	1571.49	910.42	1509.76
Min	0.04	0.14	0.09	0.04	0.50	0.14	278.35	0.14
Max	482.13	181.77	294.74	906.05	31809.47	127006.59	4102.50	127006.59
Q1	0.15	0.39	0.30	0.31	93.31	223.95	594.39	193.32
Q3	3.02	2.43	3.28	16.07	5835.52	5935.85	2506.46	5907.50
Count	302	22	260	736	42	282	3	327

Table A7: W_Assess Potential Fraud workflow timings in minutes

7.2.7 W_Persoanl Loan Collection

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdraw	Average end to end
Average	0.32	0.00	0.00	0.64	0.00	0.00	0.00	0.00
Median	0.32	0.00	0.00	0.42	0.00	0.00	0.00	0.00
Min	0.17	0.00	0.00	0.12	0.00	0.00	0.00	0.00
Max	0.47	0.00	0.00	2.31	0.00	0.00	0.00	0.00
Q1	0.24	0.00	0.00	0.20	0.00	0.00	0.00	0.00
Q3	0.39	0.00	0.00	0.61	0.00	0.00	0.00	0.00
Count	2	0	0	7	0	0	0	0

Table A8: W_Persoanl Loan Collection workflow timings in minutes

7.2.8   W_Shortened Completion

	start to suspend	start to complete	resume to comlplete	resume to suspend	schedule to abort	schedule to complete	schedule to withdraw	Average end to end
Average	3.47	0.00	0.00	27.63	0.00	0.00	0.00	0.00
Median	0.71	0.00	0.00	3.48	0.00	0.00	0.00	0.00
Min	0.03	0.00	0.00	0.21	0.00	0.00	0.00	0.00
Max	27.35	0.00	0.00	63.79	0.00	0.00	0.00	0.00
Q1	0.08	0.00	0.00	1.63	0.00	0.00	0.00	0.00
Q3	4.30	0.00	0.00	61.34	0.00	0.00	0.00	0.00
Count	74	0	0	7	0	0	0	0

Table A9: W_Shortened Completion workflow timings in minutes

7.3   O_ Activities

	Min	Q1	Median	Q3	Max	Average	Count
O_Create Offer O_Created	0d-0h-0m	0d-0h-0m	0d-0h-0m	0d-0h-0m	0d-0h-0m	0d-0h-0m	42995
O_Created O_Sent (mail and online)	0d-0h-0m	0d-0h-0m	0d-0h-0m	0d-0h-1m	15d-4h-30m	0d-0h-26m	39707
O_Sent (mail and online) O_Cancelled	0d-0h-0m	15d-23h-38m	30d-15h-10m	30d-20h-2m	134d-1h-16m	25d-9h-42m	16365
O_Sent (mail and online) O_Returned	0d-0h-0m	5d-20h-44m	7d-4h-35m	11d-1h-23m	62d-14h-44m	9d-2h-31m	22272
O_Returned O_Accepted	0d-0h-0m	1d-4h-0m	4d-1h-40m	7d-7h-11m	117d-3h-15m	5d-23h-22m	17228
O_Created O_Cancelled	0d-0h-0m	0d-0h-1m	0d-0h-4m	3d-3h-29m	81d-23h-29m	5d-4h-52m	1203
O_Created O_Sent (online only)	0d-0h-0m	0d-0h-0m	0d-0h-0m	0d-0h-0m	8d-21h-36m	0d-0h-47m	2026
O_Sent (online only) O_Returned	0d-0h-0m	0d-18h-38m	1d-18h-18m	4d-20h-32m	30d-16h-34m	3d-11h-31m	1033
O_Returned O_Refused	0d-0h-0m	1d-6h-6m	3d-21h-43m	6d-1h-37m	92d-1h-14m	4d-19h-0m	3573
O_Sent (mail and online) O_Refused	0d-0h-0m	8d-0h-6m	13d-14h-32m	21d-18h-9m	90d-17h-59m	16d-4h-41m	962
O_Returned O_Cancelled	0d-0h-1m	5d-4h-7m	9d-22h-28m	20d-18h-32m	158d-21h-44m	15d-4h-18m	2455
O_Sent (online only) O_Cancelled	0d-0h-0m	4d-19h-6m	13d-17h-2m	30d-16h-3m	125d-14h-10m	17d-21h-51m	875
O_Sent (online only) O_Refused	0d-0h-23m	6d-2h-56m	8d-5h-20m	19d-5h-48m	81d-0h-34m	13d-16h-41m	101
O_Created O_Refused	0d-0h-0m	0d-0h-10m	2d-7h-12m	10d-23h-19m	30d-1h-16m	6d-10h-10m	59

Table A10: Timings for O_ activities