An Analysis and Design for the Repair Process of Late Show Shipments in the Export Cargo Process at SPL HUB

Sjoerd van Rooden[1], Catya Zuniga[1], Bart Krol[2] and Elias Olivares-Benitez[3][a]
[1]*Faculty of Technology, Amsterdam University of Applied Sciences, Weesperzijde 190, Amsterdam, The Netherlands*
[2]*KLM Cargo, Schiphol, The Netherlands*
[3]*Facultad de Ingenieria, Universidad Panamericana, Zapopan, Mexico*

Keywords: Late Shipments, Late Shows, Repair Process, Acceptance Process, Business Process Modelling, Air Cargo Operations.

Abstract: Export shipments arriving late at the freight building of KLM Cargo at Schiphol Airport is a trigger to deviations in the standard acceptance process. These Late Shows are currently handled ad-hoc making it difficult to plan and predict these events. By conducting a data analysis to quantitatively identify the characteristics of the Late Shows, and by conducting stakeholder interviews to understand the current process and discuss the future process, this research tried to design the operational process of the Late Shows to improve the operational excellence and quality of the acceptance process. The research shows that currently, late shipments are often still tried to be build up for the planned flight. It is found that 13% of these shipments do eventually not depart on the planned flight. The research concludes that the design of the Late Show process should include a check on whether the shipment was delivered on time, before acceptance of the shipment. By only accepting the shipment once it is decided that the planned flight is achievable or when it is rebooked to another flight, it is assured that the Late Show will be on time at the build-up buffer for the booked flight.

1 INTRODUCTION

The analysis of airport operations is of great importance to improve the efficiency and quality of the processes (Blonk, 2017; Henriksson & Petersson, 2019). KLM Cargo found that export shipments arriving late at their freight building at Schiphol Airport (SPL) is a trigger to deviations in the standard process of accepting shipments from forwarders. Late shipments are defined as shipments that are unloaded from the truck after the latest acceptance time and before flight departure. These shipments are called "Late Shows". In order to create more time for the ground processes resulting in a reduced chance of shipments missing their flight, KLM Cargo implemented two changes to the acceptance process on January 11, 2021. First, the Freight on Hand (FOH) moment is moved from the Documentation station to the warehouse. Thus, the moment of acceptance of the shipment is no longer when the driver reports at the Documentation station, but when the shipment is unloaded and available in the warehouse. Second, the latest time before flight departure that shipments delivered by forwarders are accepted, the Latest Acceptance Time (LAT), is increased. The new LAT's differ per product type.

Currently, there is no standard process for shipments arriving late, meaning they are being handled ad-hoc. Therefore, it is not possible to plan these events, causing the process to be less predictable, which negatively influences the operational excellence of the process. In addition, shipments arriving on time is currently not a criterion for acceptance. However, when the shipments are accepted, they should be able to catch the flight on which they are booked, or the quality of the process deteriorates. This can be explained by the definition of "quality" and the definitions of two messages in the standard acceptance process. This research considers the definition of Slack, Brandon-Jones, & Johnston (2016), who define quality as "consistent conformance to customer expectations" (p. 573). Further, IATA defines two messages, or status events, in the acceptance process. IATA mentions that after

[a] https://orcid.org/0000-0001-7943-3869

van Rooden, S., Zuniga, C., Krol, B. and Olivares-Benitez, E.
An Analysis and Design for the Repair Process of Late Show Shipments in the Export Cargo Process at SPL HUB.
DOI: 10.5220/0010797500003117
In *Proceedings of the 11th International Conference on Operations Research and Enterprise Systems (ICORES 2022)*, pages 123-130
ISBN: 978-989-758-548-7; ISSN: 2184-4372

the truck is unloaded, the "Freight on Hand" message is sent. This message indicates, "The consignment is on hand on this date at this location pending 'ready for carriage' determination." (IATA, 2019, p. 1). Then, after the necessary checks for safe and secure carriage are conducted and the shipment information is validated against the booking, the "Received from Shipper" (RCS) message is sent. This message indicates, "The consignment has been physically received from the shipper or the shipper's agent and is considered by the carrier as ready for carriage on this date and this location." (IATA, 2019, p. 1). Considering these definitions of IATA, it is important to understand the difference between the acceptance of shipments in terms of receipt in the warehouse (FOH) and the acceptance of shipments as ready for carriage (RCS). Further, it can be understood from these definitions that a shipment should depart on the booked flight at the moment of acceptance (RCS). Whether the shipment departed on the flight on which it was booked at acceptance is indicated by the DEP-R.

The objective of this research is to design the collaborative operational process for repair of the Late Shows in the export acceptance process of KLM Cargo at SPL. This should result in a DEP-R improvement of 0.5% and 98% of the shipments should be delivered on time at the buffer for buildup. The main research question is formulated as: *How can the process of export CARGO acceptance be designed in such a way that shipments will be on time at the buffer for buildup for the booked flight?*

The research is focused on the acceptance of shipments delivered to freight building 3. Further, the research is conducted before and during the implementation phase of the Late Show process for the first product types.

2 METHODOLOGY

The research is approached using a combination of both quantitative and qualitative methods. First, a data analysis (desk research) is conducted using quantitative methods to identify the characteristics of the Late Shows. This data is collected using two data sources. One of these sources is the leading source for the analysis and the other is used as backup and to validate the data collected from the first source. The data is exported into Excel-sheets, after which it is analyzed using pivot tables, graphs and other (statistical) functions. The data analysis exists of a statistical analysis into the predictability of the number of Late Shows and total shipments and more detailed analyses into the characteristics of the Late Shows. The statistical analysis is conducted on four levels: the number of shipments per month, per week, per day of the week and per day. On each of these levels, the number of shipments during the analyzed

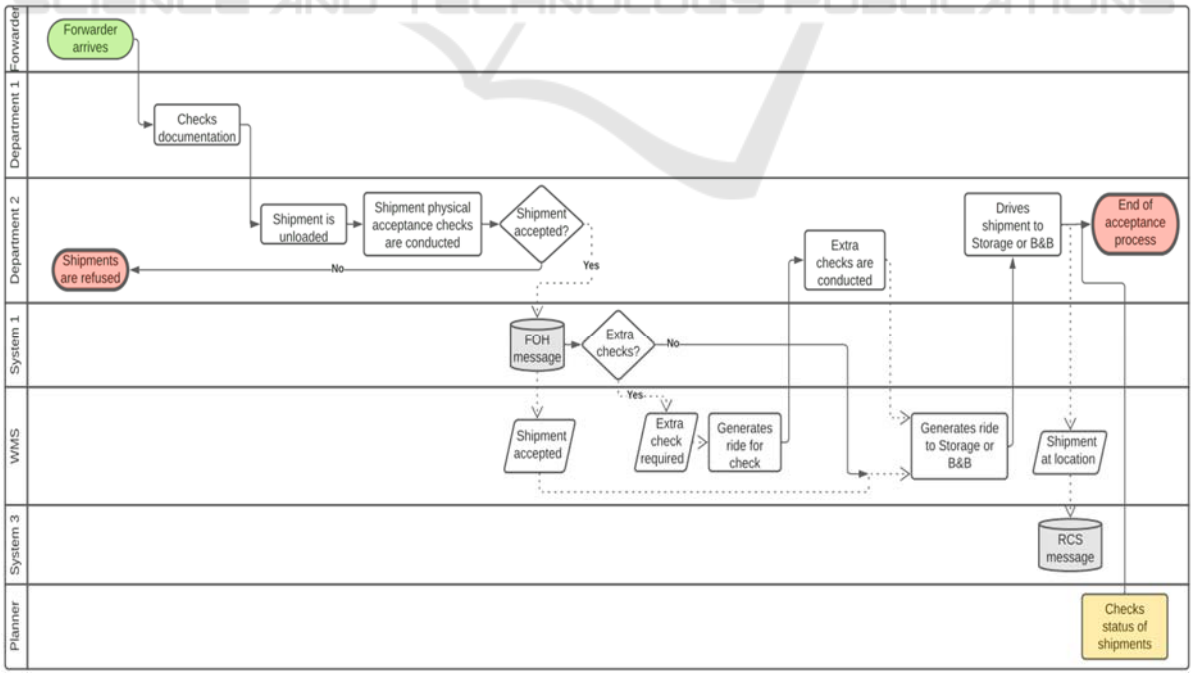

Figure 1: General acceptance process at KLM Cargo SPL.

period of January, February and March 2021 is plotted in boxplots. This figure presents the distribution of the data points (number of shipments), giving information such as the mean, median, minimum, and maximum value in the data set. For the number of Late Shows, another level is analyzed, presenting an overview of the Late Shows during each hour of the day.

In the second phase of the research, it was tried to understand first the current (ad-hoc) handling of the late shipments. The data used to map this current process is collected using interviews with the stakeholders of the process (field research). During these interviews, the new Late Show process, that already had been tested, was also discussed with the stakeholders. They were asked about their opinion on the new Late Show process as well as already considered possible improvements for the process, as identified during process test evaluations. A representative (or sometimes two) of each involved department is selected for the interview, chosen because of their expertise on the individual process steps of their department and because they were already involved in the Late Show project via earlier process tests. Based on the recordings and notes, the interviews were transcribed and encoded. In order to present the current Late Shipment process and the design of the new Late Show process, the data collected for both designs is merged and processed into Swimlane diagrams using Lucidchart tooling. According to White (2004), Swimlanes have the ability to represent different functional responsibilities. Further, Swimlanes are part of the Business Process Modeling Notation (BPMN) technique, which scores best in the research of Recker, Rosemann, Indulska, & Green (2009) on the degree of completeness for the system with the features of the one analyzed in this work.

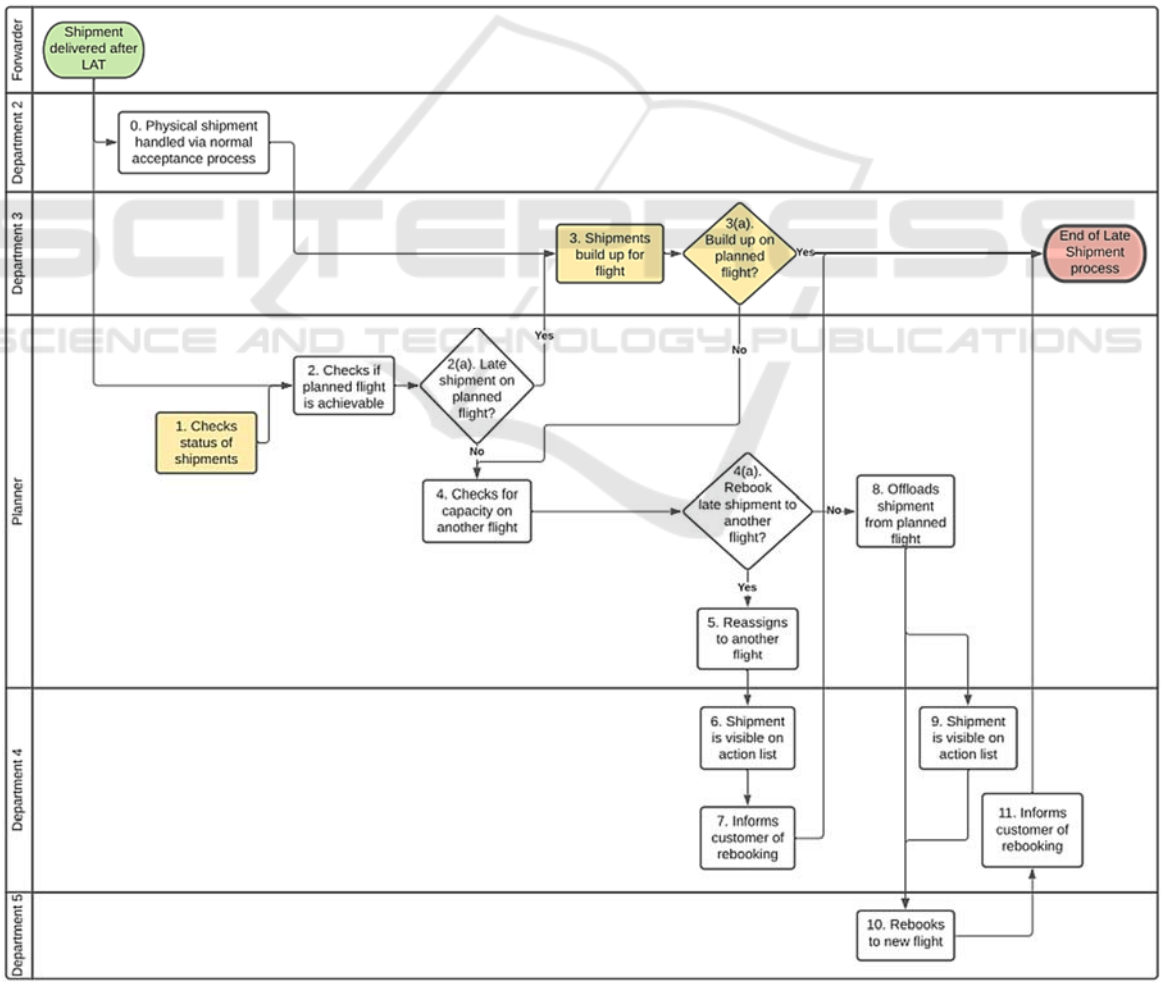

Figure 2: Current Late Shipment process diagram.

3 RESULTS

In this section, first is described the Current process. Next, the Data Analysis is presented. After that, the New process designed is shown. Finally, the comparison of the results obtained to the objective is explained.

3.1 Current Process

In the acceptance process of KLM Cargo at SPL, the FOH message is generated after the shipment is unloaded from the truck and certain acceptance checks are conducted. In case the shipment does not require any further checks, a ride is generated by the Warehouse Management System (WMS) for the shipment from the receiving area to either the storage facility or the buildup buffer (B&B). At the buildup buffer, the shipments are made ready for transportation. The moment the shipment is delivered at the right location, the RCS message will be sent, which means the shipment is accepted and considered ready for carriage. This process can be seen in Figure 1.

It is found that this standard acceptance process is also followed when the shipment is delivered late. Thus, the late shipment is always accepted (RCS message). Further, it is experienced that currently late shipments are often still transported to the buildup buffer, while the WMS gives the instruction to drive late shipments to the storage. The Flight Planners are responsible for regularly checking the status of shipments and whether the shipments on their respective flights are already delivered to the freight building. However, in practice it is seen that, especially when these flights are departing close after each other, the Planner does not have time to continuously check this for each flight. The Planner will screen at least three hours before the flight departs, which is the moment that the buildup buffer closes, whether the shipments are at that location. Because the late shipments are often still transported to the buildup buffer and because the Planner does not always immediately know that a shipment is delivered late, it will often be tried to build up the shipment, even though there is sometimes not much time left. Besides, due to a fault in the WMS, in case a Planner decides to offload a shipment from the planned flight because it is late, the shipment can still be scanned and build up by the buildup employees. Because of this, the Planners are reluctant with rebooking and offloading shipments, and it is often tried to build up a late shipment on the planned flight. However, in case it was eventually not possible for the buildup employees to build up the late shipment on the planned flight, the shipment is left on the buildup buffer and must be rebooked. This process can be seen in Figure 2.

3.2 Data Analysis

From the statistical analysis on the total number of shipments and the number of Late Shows, it is seen that there are on average 282 shipments and 11 Late

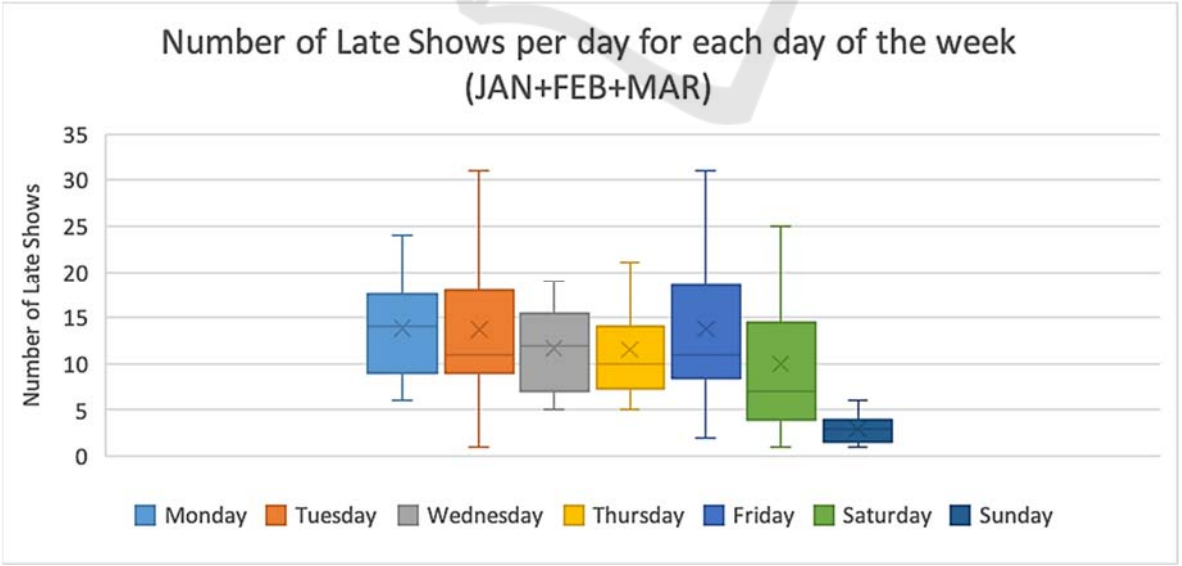

Figure 3: Boxplot number of Late Shows per day for each day of the week (January, February & March combined).

Shows delivered per day in the combined first three months of 2021. Figure 3 and Tables 1 and 2 show that this number is highest on Monday, Tuesday, and Friday with 14 Late Shows. Compared to the other days of the week, the number of Late Shows per day on Sunday is relatively low, with on average 3 Late Shows. Further, on Tuesday, Friday and Saturday are the largest deviations in the number of Late Shows per day with a standard deviation of 7 or 8 Late Shows. In the distribution of the total number of shipments per day of the week, it is seen as well, that Friday and Sunday are the busiest and least busy day respectively. Further, on Friday and Saturday, the number of total shipments is hard to predict, as the standard deviation is largest on these days as well.

Continuing with the more detailed analyses on the characteristics of the Late Shows, it is calculated that 73% of the Late Shows are between 1 and 120 minutes late and almost 49% of the Late Shows have a delay between 1 and 60 minutes. Applying the 80/20 rule, the data analysis shows that 80% of the Late Shows have a delay between 1 and 152 minutes.

Next, a categorization of the Late Shows based on the product type shows that the top 3 products are responsible for more than 67% of the total number of Late Shows. Individually, product types 1, 2 and 3 represent 30%, 26% and 11% respectively. Another product type follows shortly after product type 3 based on the number of Late Shows. However, this product is generally delivered to freight building 1, while this research is focused on freight building 3. The eleven other product types represent small numbers of Late Shows compared to the already mentioned products.

Table 1: Data on number of Late Shows per day for each day of the week.

Day	Data points	Total observations
M	13	180
T	13	178
W	13	152
Th	12	138
F	13	179
Sa	13	130
Su	13	38

Table 2: Statistics on number of Late Shows per day for each day of the week.

Day	Mean	Med	Min	Max	Std Dev
M	13.9	14	6	24	5.9
T	13.7	11	1	31	8.1
W	11.7	12	5	19	4.3
Th	11.5	10	5	21	4.7
F	13.8	11	2	31	7.6
Sa	10	7	1	25	7.2
Su	2.9	3	1	6	1.5

Finally, an analysis on the DEP-R shows that 13% of the Late Shows were rebooked after the RCS

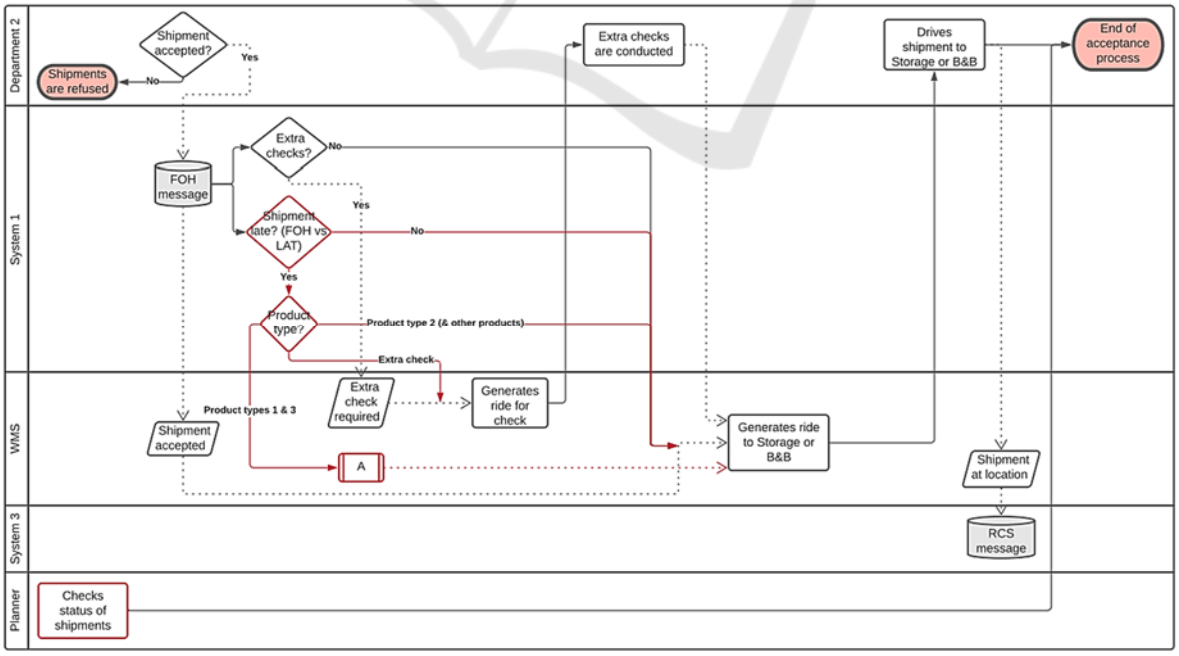

Figure 4: General acceptance process of KLM Cargo at SPL including adjustments for Late Show process.

message was sent, indicating that these shipments did not depart on the planned flight at RCS. As explained in the introduction, the customer expectations are not met for these Late Shows, which deteriorates the quality of the process. It is assumed that this percentage is caused by the late delivery of the forwarder.

3.3 New Process

Figure 4 presents the adjusted acceptance process considering the new Late Show process. This process is applicable for all product types. The red highlighted objects in figure 4 present the changes of the process compared to the diagram in figure 1. As can be seen in figure 4, it is checked in this new process whether the shipment is late, after the FOH message is generated. In case the shipment is late, different sub-processes follow based on the type of product. Because of the different characteristics of each product type, the Late Show process is not applicable to all products. Currently, the earlier mentioned product types 1 and 3 are considered for the Late Show process because of their high number of Late Shows and thus the large operational impact. In addition, they have a similar operational process in the warehouse. The product with the second largest number of Late Shows (product type 2), has a different operational process in the warehouse, because of certain storage requirements, which means this product type requires a different Late Show process. The same applies to the other products. Besides, many of the other product types represent small numbers of Late Shows, which means the high effort it requires to include these products in the Late Show process results in a marginal effect on the operation.

The Late Show process designed in this research is specifically for product types 1 and 3. These product types follow the extra steps presented in figure 5 because of the Late Show process. For product types 1 and 3, a message is sent to the WMS indicating the shipment is late. Based on this message, the WMS automatically blocks the shipment with the Late Show block. This block triggers the standard Late Show process, which is designed in figure 6.

Because of the Late Show block, the Late Show will not be driven to the buildup buffer or the storage, as a ride is generated in the WMS to the FOH-buffer. This FOH-buffer is currently located in the receiving area of the warehouse. With the Late Show in the FOH-buffer, time is taken for the decision-making process. The Planner checks for the Late Show in correspondence with the operation on whether the planned flight is still operationally achievable in the remaining time before flight departure. In case the Planner decides this is possible, he removes the Late Show block in the WMS, which generates a new ride from the FOH-buffer to the buildup buffer or the storage facility. In case the Planner decides it is not desirable to let the Late Show depart on the planned flight, the Late Show first has to be rebooked, after which the Late Show block is removed, and the shipment is transported to the buildup buffer or the storage facility. When the Late Show arrives at this location, the RCS message is triggered.

3.4 Objectives

As mentioned in the introduction, there are two objectives set by KLM Cargo for this project. The design of the Late Show process should result in a DEP-R improvement of 0.5% and 98% of the shipments should be delivered on time at the buffer for buildup.

Starting with the first objective, considering the Late Show process designed in this research, the Late Shows should no longer be rebooked after the RCS message is sent. This results in an improvement of the DEP-R. Considering the earlier mentioned 13% of the Late Shows, the DEP-R should be improved with 0.51%. This expected improvement meets the objective of 0.5% almost exactly. However, this

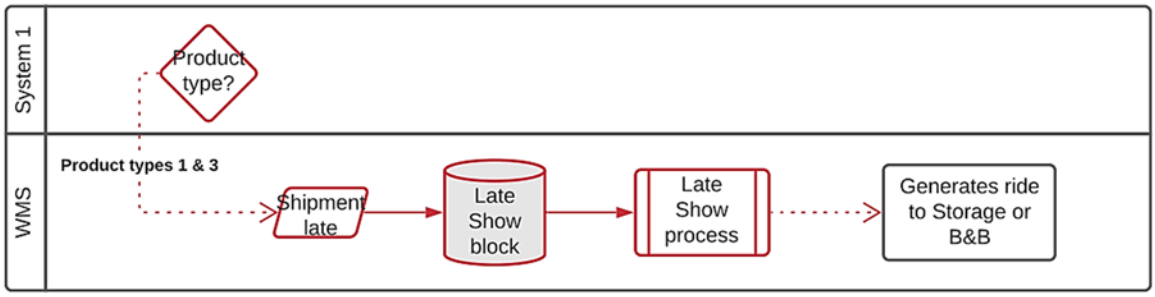

Figure 5: Late Show process steps in acceptance process (product types 1 & 3).

result assumes all product types, while it was concluded earlier that the Late Show process is not applicable to all products. When only the product types 1 and 3 are considered, the DEP-R is improved with 0.33%. In this case, the objective is not met, but there is still a significant improvement. Finally, a calculation can be made which includes product type 2, as this product represents a large part of the total number of Late Shows. With the product types 1, 2 and 3, the DEP-R is improved with 0.37%. This means that the objective of a DEP-R improvement of 0.5% is still not met.

Regarding the second objective, the Late Shows will only be transported to the buildup buffer in the designed Late Show process when it is possible to build up the shipment for the planned flight. Thus, when the buildup buffer is closed, the Late Shows will not be delivered to the buffer. This results in an improvement of the percentage of shipments that are on time at the buildup buffer. It is calculated that in all earlier described scenarios, the objective to have 98% of the shipments on time at the buildup buffer is met. Thus, this objective is already met with the Late Show process designed in this research (only considering product type 1 and 3), with an expected improvement of 0.38%.

3.5 Limitations

During the course of the research, there have been discovered a couple of bugs and other differences between the two data sources used for the data analysis. It was found that there were significant differences between the numbers of Late Shows reported by the two sources. Therefore, it was hard to make a good validation of the results of the data analysis in this research. It was decided to continue the data analysis using the appointed leading data source, instead of waiting for the two sources to show similar values. Therefore, the results of this research could deviate slightly after the identified issues have been solved and a proper comparison between the two sources is made. However, the data analysis in this research does provide an indication that is useful for future decisions concerning the Late Show process.

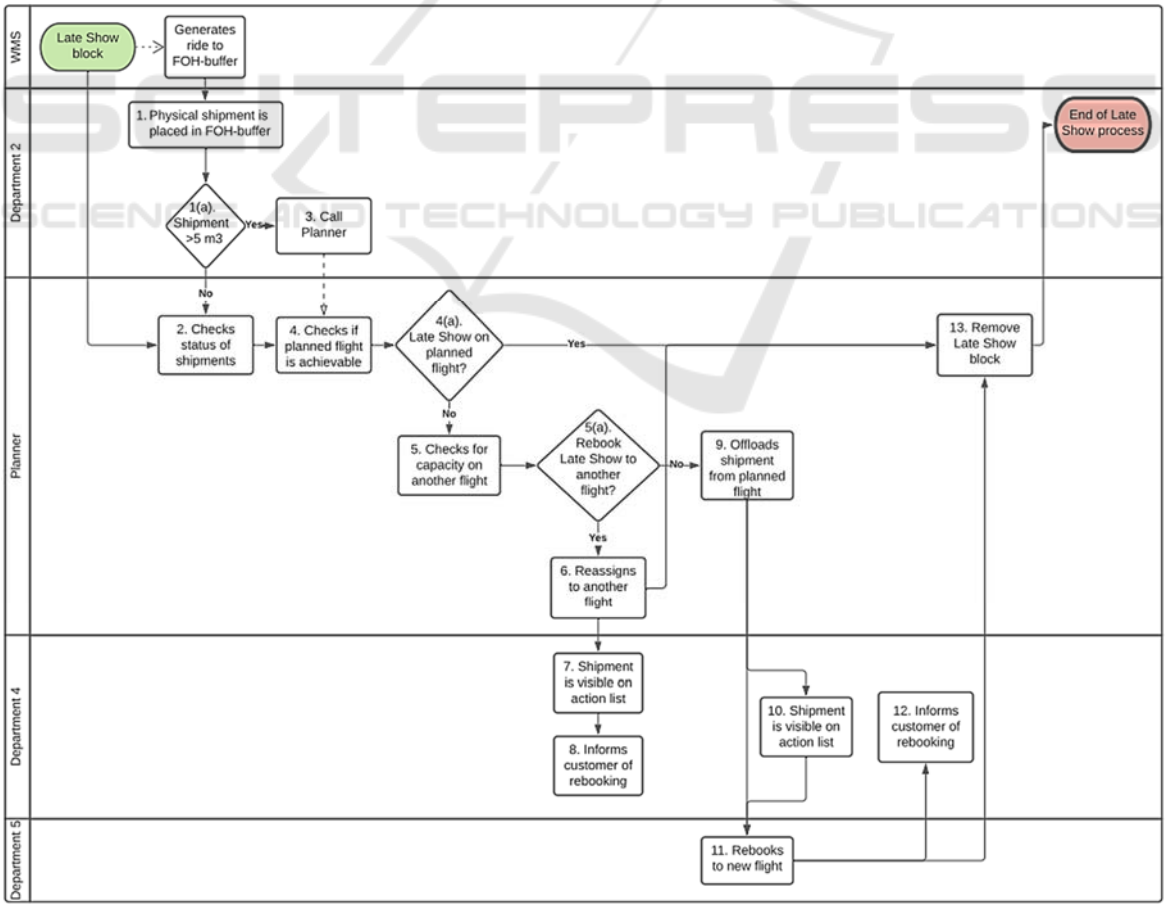

Figure 6: Late Show process diagram (for product types 1 & 3).

The second data source is used as back-up in case information was not available in the leading data source. Further, it must be considered that the data analysis does not make a distinction between freight building 1 and 3, as this is not possible in the leading data source. However, the designed process is focused on freight building 3.

4 CONCLUSIONS

This research found that without a Late Show process, there is no difference in the physical handling of a shipment in the acceptance process of KLM Cargo in case the shipment is delivered late. This means that the shipment is always accepted, and the Received from Shipper (RCS) message is always sent, indicating the carrier considers the shipment as ready for carriage. As a result, it is often tried to still build up a late shipment and let it depart on the planned flight, even though there is sometimes not much time left for this process. This research shows that 13% of the Late Shows do not depart on the planned flight at RCS meaning the commitment to the customer is not met, which deteriorates the quality of the process.

Based on this research, it is concluded that the design of a standard Late Show process must consider specific Late Show characteristics. It is important to consider the product types requiring a different design because of specific operational processes in the warehouse. Further, the design of the process should include a check on whether the shipment was delivered on time, before acceptance of the shipment and thus the sending of the RCS message. Then, in case the shipment is late, it should be checked whether the planned flight is still operationally achievable. When this is not possible, the Late Show first has to be rebooked to another flight before the RCS message is sent. By following this decision-making process while the shipment is stored in the FOH-buffer located in the receiving area of the warehouse, and thus before the shipment is driven to the buildup buffer, it is assured that the Late Show will be on time at the buildup buffer for the booked flight.

The research recommends to also include at least the product with the second largest number of Late Shows in the Late Show policy, as this product also has a large operational impact caused by the Late Shows. This means further research must be conducted into mainly the storage requirements of this product, and how a Late Show process for this product should look like. Further, it is recommended to further research the predictability of the Late Shows in more detail, as this research shows the number of Late Shows is currently difficult to predict. A more detailed analysis can lead to even better insights into the characteristics of the Late Shows and can help to decide on future improvements for the process. In addition, it is recommended to validate the data from the two data sources used in this research, after the identified issues that caused the differences between the two sources are solved

ACKNOWLEDGEMENTS

This research is conducted in the context of a graduation internship for the study Aviation Operations at the Amsterdam University of Applied Sciences at the request of internship company KLM Cargo.

REFERENCES

Blonk, M. (2017). *Dock & Yard Management at KLM Cargo.* Master Thesis. Eindhoven University of Technology. The Netherlands.

Henriksson, F. T., & Petersson, J. (2019). *Mapping of the Air Freight Handling at Stockholm Arlanda Airport.* Bachelors Thesis. Linköping University.

IATA. (2019). *IATA Master Operating Plan Glossary*. IATA/ Cargo iQ. Retrieved March 8, 2021

Recker, J., Rosemann, M., Indulska, M., & Green, P. (2009). Business Process Modeling- A Comparative Analysis. *Journal of the Association for Information Systems*, 10(4), 333-363. doi:10.17705/1jais.00193

Slack, N., Brandon-Jones, A., & Johnston, R. (2016). *Operations Management* (8th ed.). Pearson.

White, S. A. (2004, July 6). *Introduction to BPMN*. Retrieved from BPTrends: https://www.bptrends.com/bpt/wp-content/publicationfiles/07-04%20WP%20Intro%20to%20BPMN%20-%20White.pdf