Self bag drop: 1-stop or 2-stop?

Summary *Airports and airlines world-wide are considering the implementation of self bag drop to speed up the departure process of passengers: service to passengers is improved and handling costs are reduced. One of the key issues to decide upon is whether or not to split the bag drop process into multiple steps. Should bag tagging be done at the self bag drop point (SBD), or is it more efficient to do this at a separate kiosk? Based on simulation results, this introductory paper specifically addresses the impact of a 1- vs. 2-stop self bag drop process on passenger queuing time and shows that a 2-stop process is in fact more efficient. The goal is to provide understanding about why the 2-stop process is more advantageous and give insights that can be helpful when making decisions about the implementation of self bag drop.*

1 Passenger handling model

Important aspects of the check-in facilities in an airport are costs, capacity and the resulting queue lengths. These can be determined by simulating the flow of passengers through a model of the terminal layout and the process steps involved. A simple model of such a step is shown in Figure 1, which contains the following elements:

- *Passengers* arrive according to a specific pattern
- They line up in a *queue*
- A *server* (e.g. a check-in counter) handles them one-by-one

These elements can be connected in several ways to construct more extensive airport models. An example hereof is provided in section 5 of this paper.

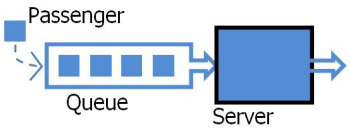

Fig. 1: Simple queuing model

2 1-stop and 2-stop process

In a 1-stop process, all bag drop actions are performed at a single machine. In the 2-stop process, the actions are split over two simpler machines: a kiosk for bag tagging and a separate device for baggage drop-off. Table 1 shows how the different actions are split over the two steps. Note that for the sake of comparison, passenger check-in is not included in this paper.

Tab. 1: Actions in a 2-stop bag drop process

Step 1: kiosk	Step 2: SBD
Identification	Identification
Bag tagging	Bag drop

So how can a passenger benefit from a 2-stop process? Will splitting the process into two steps prolong the passenger's process time or will queue lengths shorten? To answer these questions, the queue length and waiting time for a 1-stop and 2-stop process are compared using simulation. Table 2 shows the average process times that were used as input to the simulation. Note that the values in Table 2 serve only as an example and do not represent a particular SBD solution.

Tab. 2: Average process time per passenger with 1 bag [min]

	Kiosk	Bag drop machine	Total
1-stop	-	1:50	1:50
2-stop	1:10	0:40	1:50

Note that the total time per passenger is equal in both cases.

3 Simulation

Queues arise from a lack of capacity as well as fluctuations in the passenger flow and process times. Simulation makes it possible to generate such fluctuations and determine the resulting queue lengths and waiting times, given a maximum capacity. For this paper the rate at which outbound passengers arrive in the terminal was modeled as a pattern that is common for a B747 flight (see Figure 2). A total of 240 pax check in; transfer passengers are not included for check-in.

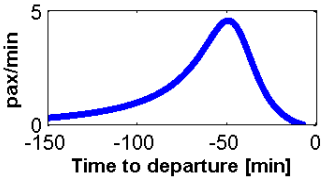

Fig. 2: Common passenger arrival rate for a B747-400 flight

Following the pattern as in Figure 2, the simulation model processes all the passengers step-by-step through the bag drop process. For the 1-stop process, 4 servers are used. All actions are performed at a fully equipped SBD. In the 2-stop process the actions are split over two simpler machines: 4 kiosks and 4 simpler SBDs. The simulation uses the modelled service times of Table 2. A schematic overview of both layouts is shown in Figure 3.

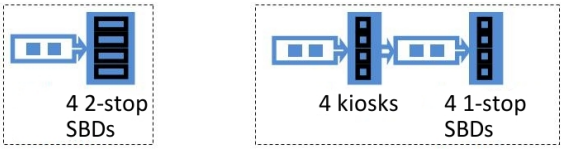

Fig. 3: Schematic overview of 1- and 2-stop layout

The results of the simulation are shown in Figure 4. During the quiet early hours, both set-ups perform similarly, as no queuing yet occurs. However, as more passengers arrive, the 2-stop process can handle far more passengers than the 1-stop process: the maximum queue is over three times shorter for the 2-stop process (9 pax compared to 32 pax) and the maximum waiting time is reduced to 2 minutes. In the 1-stop process, the longest waiting time is 15 minutes.

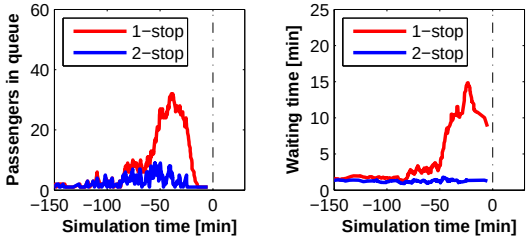

Fig. 4: Simulation results: queue lengths & waiting times

4 Explanation and discussion

The large differences in performance might feel unintuitive at first, but the results are in agreement with queuing theory. As the average process time of the 1-stop process used for the comparison in section 3 is 1:50 minutes per passenger (pax), the capacity with 4 machines amounts to 130 pax/hour. In the 2-stop process the bottleneck is the group of 4 kiosks, which have a higher combined capacity of 205 pax/hour. With a total capacity of 360 pax/hour, the four simpler SBDs do not restrict the flow in the 2-stop process. With the higher capacity, the 2-stop process can realize a significantly higher throughput of passengers than the 1-stop process which results in shorter queues and reduced waiting times. Besides, splitting the bag drop process into two separate steps provides a number of additional advantages:

- The higher capacity of the 2-stop process makes the process stable up to a higher arrival rate of passengers: queues form less frequently than in the 1-stop case
- The two steps in the 2-stop process both have smaller fluctuations in process times, so queues and waiting times are more predictable and show less fluctuation
- The capacity of the two steps can be balanced according to airport/airline specific needs or constraints - eg. by placing additional kiosks for bag tagging, the bag drop capacity in of the example of section 3 could be increased to 360 pax/hour without having to add more SBDs
- The 2-stop process provides flexibility in anticipation of future industry trends and technologies, such as current (IATA) initiatives with at home tag printing and permanent RFID bag tags.

On the other hand, a potential downside of the 2-stop process is that actions have to be performed at two separate devices. Sufficient effort should thus be put into providing clear signage in the terminal to guide passengers through the bag drop process.

5 Tailor-made simulations

For this paper the simple models of Figure 3 were applied. Using the same simulation tool and modelling approach, all kinds of facility layouts and process designs can be tested and compared. QuinTech, for example, uses the simulation tool to assess a hybrid process wherein manual bag drop desks and SBDs (2-stop) are combined. For this an extended model of the terminal layout is applied which splits the passenger flow into two: the majority is able to use the fast SBDs (standard passenger and baggage), while a minority of passengers with special requirements (e.g. out-of-gauge baggage) uses the manual desks. See Figure 5 for an example model of this process design.

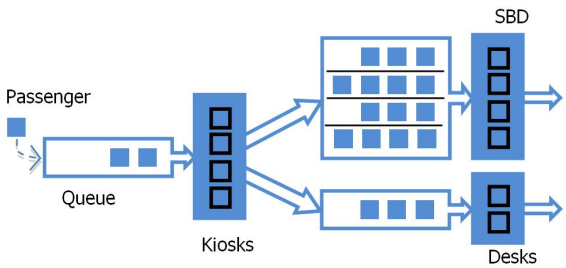

Fig. 5: Extended terminal layout model

The simulation tool provides insights about how best to balance the different flows as well as how to optimize terminal capacity and passenger service level. The results can, amongst others, help to determine:

- The optimal number of SBDs, kiosks and desks
- The best type of queues (bank line or dedicated lines)
- The required queuing area

Another example for which the simulation tool may be used is to compare dedicated queues per flight with common-use queues for all flights. While current practice consists of desks that are dedicated to a flight, common-use SBDs could drastically reduce peak hour queue lengths.

6 Conclusion

The focus of this paper has been on capacity and queuing time. Based on simulation results, it has been shown that splitting the process into two steps significantly increases bag drop capacity and reduces passenger queuing time. Two important aspects that were deliberately left out of the analysis are *costs* and *required area*. The effect of the 2-stop process on these two factors will be discussed separately in a follow-up paper.

Finally, please note that for the purpose of this paper (introductory insights into the difference between a 1- vs. 2-stop self bag drop process) a number of simplifications and assumptions were made. Details that should be accurately taken into account when assessing a specific airport/airline situation include:

- Composition of the passenger flow at an airport, such as the percentage of passengers that checks in online and the distribution of the number of bags per passenger
- Airport terminal physical constraints
- Specific process times (deviating from the values in Table 2) in accordance to airport/airline specifications for the SBD process and SBD equipment

Using these details, a particular airport/airline situation can be analyzed. The results of such an analysis are useful to decide upon the best suitable implementation form of (self) bag drop.

Should you have any questions with regard to the content of this paper or would like to know more about a particular aspect of SBD solutions, please do not hesitate to contact us: info@quintech.nl or +31 15 256 9300

7 About QuinTech

QuinTech is where baggage meets technology and creativity. We believe self bag drop can bring key benefits to airline, airport and passenger alike. Providing SBD solutions that are simple, fast, easy to fit into (current) airport facilities and, above all, are fun to use, is what we do.

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