Seam
BOARDING CON

SLOW BOARDING IS BAD FOR OPERATIONAL EFFICIENCY, PASSENGER SATISFACTION AND AIRLINE PROFITS. NEW IDEAS COULD HELP SOLVE THIS 'PAIN POINT' OF THE PASSENGER EXPERIENCE

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IMAGE: ARTISTICCO/STOCK.ADOBE.COM

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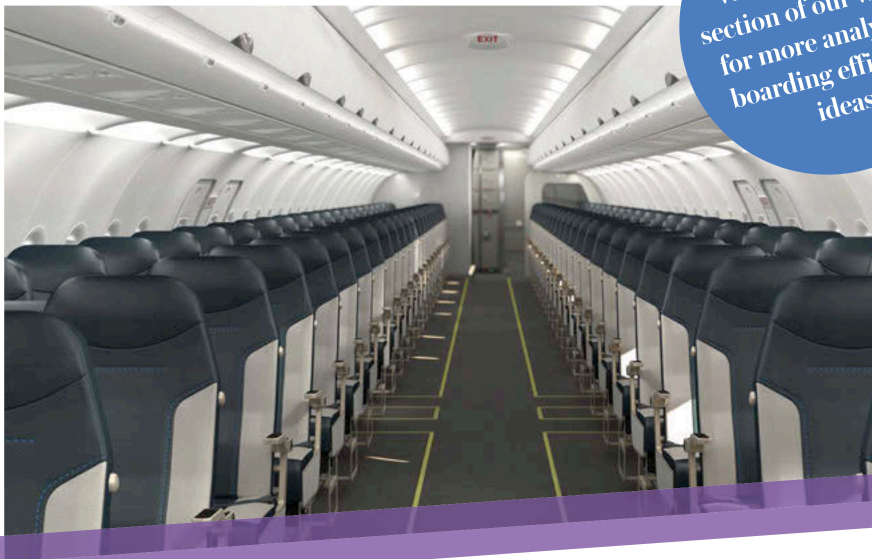
CEPTS

A high degree of standardisation in operational processes is required to ensure efficient and effective air traffic management, during the flight stages and ground-handling stages. Deviations and disruptions in the complex and closely interlinked handling processes often lead to delays, which as the day progresses can have an increasingly negative effect on airline operations – and indeed of the entire air traffic network.

Ground-handling processes can be collectively considered under the term 'turnaround' and consist of the unloading and loading of freight and baggage, refuelling, cleaning, inflight catering, and the boarding and disembarking of passengers. In this context, aircraft turnaround is mainly controlled by operational experts.

On the other hand, the critical aircraft-boarding process is to a large extent driven by passengers, and the speed of boarding is influenced by their prior experience of flying and their willingness or ability to follow procedures. Passengers also demand ever-greater efficiency and comfort from their travel experiences, and 60% of passengers see non-efficient queuing at the boarding gate as major 'pain point' in their desired seamless journey[1].



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"We should follow fundamental and applied research contributions"

Perhaps the first analysis with regards to speeding-up passenger boarding was provided by Marelli *et al* in 1998[2]. They compared what they regarded as the most promising approaches for boarding a single-aisle aircraft, namely the use of two doors and a concept called 'outside-in' (window seats boarded first, then middle seats, and then the aisle seats). They found that the use of a second door (a middle door) cut boarding times by 20%, while the outside-in approach halved boarding times.

The key philosophy behind these approaches is the pre-definition of an optimal sequence for passengers entering the aircraft, a sequence which can mitigate waiting times in the aisle caused by people stowing luggage in overhead compartments, or taking time to locate and access their seats. Today, 21 years later, airlines are still researching how to make boarding more efficient, and many still consider Marelli's ideas, often in a four-year cycle. Airlines are still re-inventing, testing and implementing these 'new' technologies. Instead of watching '*MythBusters Episode 222: Airplane Boarding*', we should follow fundamental and applied research contributions and ask ourselves if they are the right way to push aviation into the future.

Marelli *et al* used computer simulations to discover and evaluate efficient boarding strategies. But with today's mobile devices, Internet of Things, Industry 4.0, Big Data, digitisation and machine learning, we should use the tremendous potential of such state-of-art technologies and really pursue the motivation of Marelli's first research: gaining control of the sequence of passengers.

In this context, faster boarding doesn't mean passengers waiting in the jetway instead of in front of a quick-boarding gate, but rather that all passengers should be seated in the aircraft faster – and reliably faster. Successful tests of biometric scans at boarding gates have shown that they can shorten the time required for passenger authentication, but that can just result in passenger queues in the jetway growing nearly 25% faster. With efficient boarding in mind, three operational questions arise: how can the queue in the jetway be reduced by faster seating; how can operators get control over the passenger sequence, dynamically?; and how can current technologies support aircraft boarding?

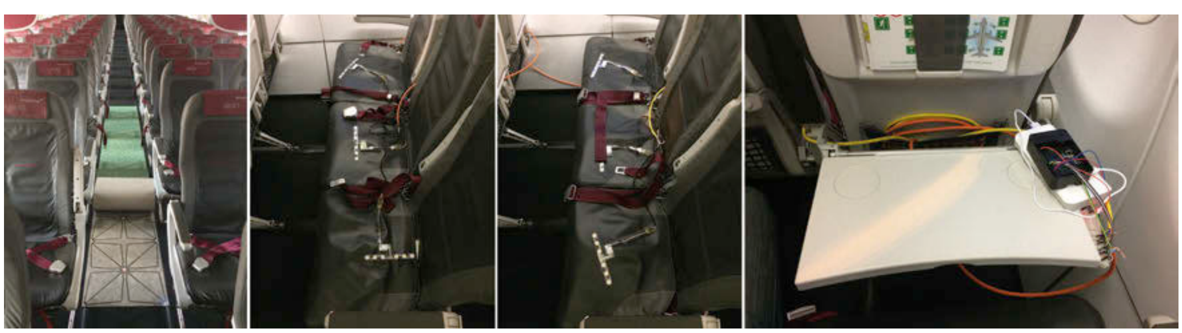
ABOVE: MOLON LABE'S SIDE-SLIP SEATS CAN SLIDE ACROSS TO ENABLE A WIDER AISLE DURING BOARDING

BELOW: A PROTOTYPE CONNECTED CABIN, WITH A SENSOR NETWORK IN THE SEATS AND UNDER THE FLOOR TO DETECT PASSENGER POSITIONS WITHIN THE AIRCRAFT

FASTER SEATING PROCEDURES

The scientific, engineering approach to answering these questions can be structured as follows: developing a model that covers a broad range of passenger behaviours (such as group behaviour and prior flying experience); operational constraints (such as seat load factors and late arrivals); conducting field observations to provide a solid database for each parameter modelled; and testing the standard approaches to calibrate the model with simulations. These steps are required in order to provide reliable and meaningful evaluations of new and innovative solutions.

Different approaches to speeding-up aircraft boarding can be divided into three categories: strategies and technologies with minor impact (0-10%), medium (10-20%), and high impact (20-35%). It should be mentioned that the stochastic boarding model demonstrates deviations smaller than 5% between simulation and field measurements, and some of the minor reductions in boarding times are below this level of significance. Small benefits could be achieved by the application of block boarding, as well as the introduction of hand luggage



"All passengers should be seated in the aircraft faster – and reliably faster"

The June issue of Aircraft Interiors International features all the latest seating innovations

ABOVE AND BELOW: WITH THE SIDE-SLIP SEAT, THE AISLE SEAT IS INITIALLY POSITIONED OVER THE MIDDLE SEAT DURING BOARDING AND IS THEN MOVED INTO THE TTL POSITION IF A PASSENGER WANTS TO SIT IN THE MIDDLE OR AISLE SEAT

strategies. The application of outside-in boarding and infrastructural changes, such as the Side-Slip Seat (see below), results in medium benefits, according to analysis. The largest benefit, in terms of faster boarding times, can be attained through the parallel use of the rear aircraft door and individual-based pre-sorting of passengers.

The factor that has perhaps the largest negative effect on boarding times is a blocked aisle, created when passengers store their luggage overhead, or wait to enter their seat row. One solution could be the Side-Slip Seat from Molon Labe, an unusual staggered design which allows the aisle seat to be slipped over the middle seat during boarding, doubling the width of the aisle so passengers can pass each other during boarding (the seat is slid back in place towards the end of boarding). The design of the Side-Slip Seat has two additional benefits: the wider aisle enables full-size wheelchair access, and the middle seat is 2in wider than the aisle and window seats. Overall, this seat design results in medium benefits for boarding times.

During a live boarding trial, a 22% time saving was reported using the seatNow system

CONTROLLING BOARDING SEQUENCES

All current boarding procedures define a fixed set of rules for passengers, and non-compliance with these rules can lead to considerable disruptions during boarding. Furthermore, airlines are keen to generate a range of additional value-added services, including preferred boarding. Thus boarding procedures always have to consider services for premium customers, as well as establish an optimal boarding sequence.

One possible solution is seatNow, a dynamic seating allocation system whereby passengers only book seat categories, such as window seats or group seating. The system assigns specific seat numbers as the ticket holders pass through the boarding gate, with the optimal sequence recalculated as each passenger boards. The process retains customer satisfaction, as passengers are still able to book their preferred seat type.

The concept benefits from the digitisation of handling processes and the fact that more than half of passengers use their smart devices for check-in (65% in Asia, 50% in America, 49% in Europe)[2]. Thus, boarding passes with assigned seats could be transmitted to personal devices or printed out directly at the self-boarding gates. Short-haul flights, which have particularly tight turnaround times, would benefit most from this approach.

The dynamic optimisation process reduces negative interactions between passengers to a minimum (75% fewer negative interactions compared with conventional boarding procedures). When seatNow underwent a field trial at Cologne Bonn airport with a Eurowings A319, the partners reported 22% faster boarding, which was more efficient than the outside-in procedure, tested in parallel.

From an operational perspective, today's aircraft cabins offer no information about boarding status. However, the sensor-filled environment of a connected cabin could provide a valuable set of information. Thus, a hardware prototype was developed and used in field trials for the seatNow concept[6]. The sensor environment consists of seat sensors sourced from the automotive industry and sensors under the floor of the aisle that detect passenger movements and aisle congestion. This prototype sensor environment has been used to demonstrate the reliable detection of passenger positions, which are a useful input for real-time progress evaluation[7] and prediction of aircraft boarding times using machine-learning algorithms[8].

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