The Heuristic Aircraft Boarding Solution

Boarding sequence templates (BST) implementation guide

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Introduction:

Scope:

This document describes the suggested best, most efficient and convenient method to implement the use of Heuristic Boarding Sequence Templates (BSTs) provided to client airlines by ***Conseil Optimum Heuristique Inc.***

Context:

The airline industry has been historically plagued by boarding problems, namely, time delays and inconvenience to the passengers resulting in added costs, schedule and turnaround time issues.

In the last decade many airlines have attempted to solve or reduce the problem by organizing the process allowing passengers to board based on various classifications of boarding privileges: such as social status (families with young children, veterans, elderly, or other), frequent flyer or fidelity programs, class and even premium pricing. These approaches have resulted in reducing the size of the "general" boarding population but have not brought on any gains in terms of total boarding time and have made the process more complex and even created some form of resentment due to a feeling of inequality amongst passengers. Many airlines have used "groups" and some have gone as far as providing boarding numbers to allay the rush of passengers at the boarding gate.

It is by now obvious that there is no magic bullet or simple pattern, and numbering is the only viable solution to improve both boarding time and passengers boarding convenience, but to achieve these goals, the numbering has to be intelligent and cannot be simply based on rear-to-front or window-middle-aisle or even both.

We (C.O.H Inc.) have developed a true artificial intelligence algorithm which will achieve both goals with an impressive reduction of boarding time by 50% and make the process less stressful and more convenient for passengers removing the main issue of aisle congestion within the aircraft.

Approach:

The mathematical model to support these results is simple: Any two passengers have a 50/50 chance of boarding in the proper sequence (or not). As a result, for each passenger pair, being in the proper sequence simply cuts their boarding time by half and congestion makes this sum up worse for the whole. As simple as the problem appears to be, the mathematical, artificial intelligence algorithm to achieve improved boarding is not simple. It requires a multi phase mixed approach, based on linear programming and fuzzy logic, finished by a simulation AI process to pick passengers one by one, ensuring in each case that placing this passenger at this rank in the sequence will not only ensure he or she is not inconvenienced but also that he or she will inconvenience as few other passengers as possible. This third and last phase applies a set of 6 rules in order to achieve near-perfect boarding and the 50% time reduction.

Perfection is impossible due to the nature of aircraft configurations, attempting to pack the maximum number of passengers in a limited size cabin with only one or two aisles, but we get as close to it as possible with this mix of AI and mathematics.

Procedural implementation:

There are very limited changes to the boarding procedure. Essentially the overall process can continue mostly unchanged. Whatever categories or boarding groupings of passengers the airline currently uses can continue.

Boarding by Class:

Usual boarding privileges for First Class, and Business Class passengers can remain unchanged and it is not necessary to request that these passengers line-up by sequence number. In fact it is not an issue to indicate or not their sequence number on their boarding passes. The low number of passengers in these classes, the aisle width and the limited number of seats per row alone are sufficient to curtail congestion for these.

Social groups:

Passengers requiring assistance such as families with small children also need not be asked to board in sequence as the number of such passengers is usually very limited and they will have staff assistance to ensure their boarding is convenient.

Other privileged boarding groups:

Fidelity categories such as frequent flyers or other may or may not be asked to board in sequence. This is the airline's choice and mostly dependent on the number of such passengers in each flight. Less than 40% of the capacity is not likely to cause congestion, also including a significant number of "business" passengers who elect to board last and prefer aisle seats in order to exit first and fast upon arrival. If there is an expected number of such passengers in excess of 50% of the aircraft capacity and the number of "late" boarders is not significant the airline may choose to suggest that they board in sequence and passengers will rapidly realize it makes their own boarding more convenient.

Non privileged group (or groups):

This is normally by far the largest and most problematic category of passengers and this is where time and convenience gains will be important. The process is very simple and is to be substituted for whatever method has been used in the past. Instead of calling passengers by sets of rows or window-middle-aisle or pyramid or other pattern, simply call passengers by sequence numbers ranges. Select the range size based on the airport gate area space availability. More space available allows larger groups, and makes calling passengers simpler.

In order to ensure that the division by groups does not cause delays, the airline may provide guidance to passengers to line-up in advance with signs indicating where each group should assemble. If there is not sufficient space to pre-assign queues, the airline staff should try to call successive groups with minimal delay. The suggested rule is to call the "next" group no more than 3 seconds times the number of passengers in the current group. As an example, if calling groups of 50 passengers, call group number 2, no more than 150 seconds (3x50, or 2 and a half minute) after the first passenger of group 1 is approved to board. Apply this logic for all subsequent groups. Ensure also that the boarding approval process is as quick as possible.

Boarding gate setup & groups size:

Ideally the boarding gate area should be large enough to accommodate the expected number of passengers for the assigned flights. There may be more than one opening in the counter through which passengers will be granted access to the bridge and aircraft after validation of their credentials and identity, manual or automated.

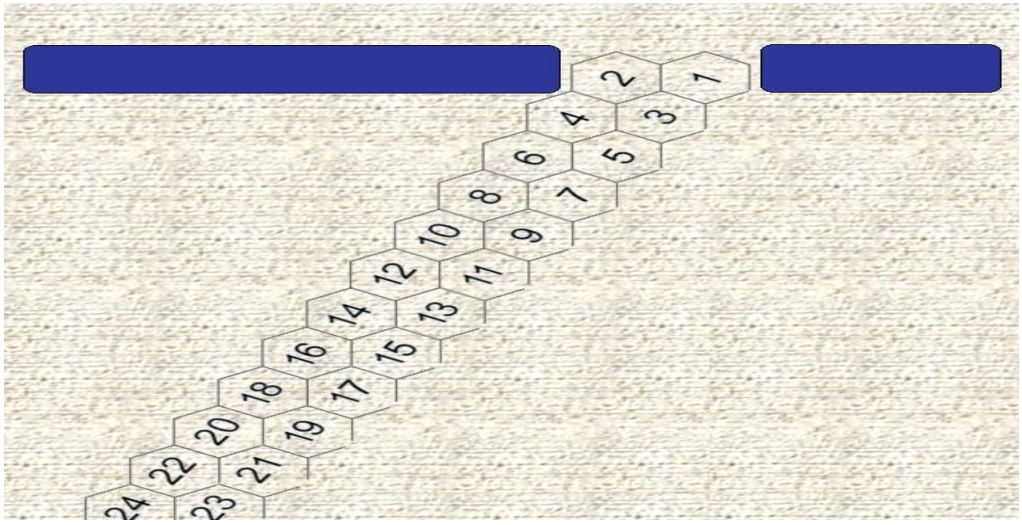
Basic setup:

Boarding groups may be assigned a code letter or name and the number only needs to be indicated on the floor. The most simple, recommended format for the Heuristic Sequence codes is Letter-Number such as A-1 to A-nn where nn is the number of passengers in the group.

Letters assignment to groups may be simple a simple alphabetic list A, B, C, etc. or use significant letters such as F (first class), B (business), P (premium), E, F, G, etc (Economy groups), or other, and groups should be sized in accordance with the available space for passengers to line up facing the access points. Each access point may be staffed appropriately.

Social distanced secure boarding:

We suggest the use of floor markings to facilitate proper social distanced line-up of passengers using a dual line, single numbering hexagonal spaces of 6 feet (1,8 meters) or more in each direction as shown in the diagram below:



This pattern allows for dual approval stations ensuring a pace of approvals and boarding which is appropriate to maintain proper distancing throughout the process, as passengers walk towards the aircraft door, yet ensuring an adequate pace to allow for fast boarding.

Estimating approximately 4 to 6 seconds for the approval of each passenger (or couple of co-travellers), this will translate to one passenger every 2 to 3 seconds and at the normal walking speed of 3 feet (0.9 m) per second, passengers remaining 6 to 9 feet away from each other (except in the case of co-travellers, approved and seating together).

IT/DCS implementation:

DCS modifications:

The essential modification the IT-DCS consists in printing the seat-code based sequence number on the boarding pass, be it physical (paper) or virtual (smart phone).

Method:

The heuristic BST is provided as a file (text or Excel worksheet), providing a sequence number for each seat on the aircraft (for the specified make, model, setup and configuration):

Item	Type	Description
Row	Number	Seat row number
Seat	Text	Seat Letter (a, b, c, … etc.)
Rank	Number	Absolute rank number (1 to capacity)
Sequence	Number	Rank by class (101-1xx in First class, etc.)

Implementation:

Every airline DCS will already have a table in the DCS database providing the link from flight number to tail number. We suggest your IT staff add a new table to record the BST by Tail Number:

Item	Type	Description
Tail-Number	Any	Aircraft tail number
Row	Number	Seat row number
Seat	Text	Seat Letter (a, b, c, … etc.)
Rank	Number	Absolute rank number (1 to capacity)
Sequence	Number	Rank by class (101-1xx in First class, etc.)

This table intended as a reference to provide the sequence number for every seat on the aircraft. The airline may choose to use the rank or the Sequence as preferred.