

# **AOS' View of the Current Trend in the Airlines Industry Moving Toward A Seniority Based Preferential Bidding System**

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## **Overview**

Today, most of the Crew Planning problems in North American Airlines consist of two parts: pairings and bid line constructions. Pairing construction is usually done using computer software to generate a set of pairings that cover all flight legs while minimizing total cost. The constraints of bid line construction, which is also performed by computer aided programs, reside on total number of lines, line legality, and line quality.

## **Traditional Bid Line Systems**

With a traditional bid line system, crewmembers are presented with a set of pre-constructed lines. After viewing this set of pre-built lines, the crewmembers submit bids for the lines they wish to fly. These lines are then awarded by seniority. Since lines are pre-constructed without considering carry-in trips and pre-assigned activities (training, vacation, medical leave, or military leave, etc.), conflicts may arise during the awarding process. The line awarded to a crewmember may conflict with his/her pre-assignments or carry-in trip.

As a result of these conflicts, open pairings and under-valued lines need to be handled in a secondary process. Predicting these conflicts is hard, thus Airlines usually need more reserves to cover the beginning of the month and the dates with the most open time. Crewmembers will then go through a trip trade process, that lets them swap for the pairings they like.

## **Disadvantages of Traditional Bid Lines Systems**

### **❖ *Limited Choices***

One drawback of the traditional bid line system is its limited choices available to crewmembers. Crewmembers can only choose from the pre-constructed set of lines. While many other desirable lines could have been constructed, crewmembers are restricted to the pre-constructed choices.

### **❖ *Conflicts with Pre-Assignments***

As mentioned earlier, there comes a time during the awarding process when all lines a crewmember bids for conflict with his or her pre-assignments. This arises from the fact that lines are pre-constructed and then allocated sequentially, utterly disregarding an individual crewmember's situation.

### **❖ *Secondary Process for Resolving Conflicts***

Another drawback of a traditional bid line system is the need for a secondary process after the initial construction and awarding, a cumbersome and time-consuming process.

## **An Alternative: Preferential Bidding System**

The Preferential Bidding System (PBS) is a revolutionary means of awarding pairings to crewmembers and assigning reserves. With a PBS, crewmembers have more choices to tailor their awarded lines toward

their personal needs and situations. In addition, airlines need fewer reserves to handle conflicts that may arise, because PBS does not require any secondary processes to handle conflicts.

## **The Bidding Process**

The two major components of a PBS are the bidding and awarding processes. The bidding process begins with the construction of pairings, followed by the awarding process. In the bidding process, pre-assignments are presented to crewmembers, so that crewmembers can enter their preferences in a form that can be interpreted by the PBS software without conflicting with the pre-assignments.

The two most frequently used approaches for optimization are pairing pool and weighted preference. In either approach, PBS needs to provide the crewmembers with an efficient search engine to view the desirable pairings and use the bid preferences to make the bids.

### **❖ *The Pairing Pool Approach***

For the pairing pool approach, crewmembers use a search engine to find the pairings they like and put them into different pools for line construction. For example, a crewmember can use the search engine to find all pairings that do not include weekends and fly through Boston. The search engine will return all matched pairings, allowing the crewmember to then select individual pairings and place them into pairing pools, or insert all of the returned results into pairings pools. The first pool contains the pairings they like the best and the second pool contains additional/new pairings they find slightly less preferred than the pairings in the first pool. The third, fourth, and subsequent pools are defined similarly.

During the awarding process, PBS will begin to construct a feasible line for each crewmember by using pairings in the first pool. If the first pool cannot complete a line, then PBS will try to construct a feasible line by using a combination of the first and second pools. This process continues until a feasible line is constructed or the best possible partial line can be found for the current crewmember. The reserve bids can also become a separate pool.

### **❖ *The Weighted Preference Approach***

The weighted preference approach requires the crewmember to assign a weight or score to each of their bid preference.

### ***Advantages of the Pairing Pool Approach over the Weighted Preference Approach***

- Visibility of bids

In the pairing pool approach, the crewmember can predict which pairings are being placed in the first pool, second pool, and so on. With the weighted preferences approach, the bidder enters weights and the resulting rankings of pairings are combinations of these weights. The results are less intuitive and the bidder has less control over the rankings of pairings.

- Hard to assign weights and predict the results

Additionally, in the weighted preferences approach, it is difficult to assign weights appropriately to each preference in order to get the desired result.

## **The Awarding Process**

The heart of PBS is the award algorithm. AOS proposes a number of evaluation criteria so that awarding algorithms can be measured and compared. A successful award algorithm can achieve the following objectives:

- 1) Honor seniority.
- 2) Produce acceptable results.
- 3) Maximizing the overall crew satisfaction.

❖ ***Honoring Seniority***

The most important part of the award process is to honor seniority. For each crewmember, seniority is honored as long as there is no pairing that is more preferred yet awarded to a more junior crewmember.

❖ ***Producing Acceptable Results***

The PBS should not leave too much open time on any given day, or too much overall open time. In other words, it should produce the targeted number of lines and reserves. For example, on Christmas, most of the crewmembers may submit preferences for Christmas off. In this given situation, the PBS has a mechanism to avoid results with too much open time on Christmas, while still honoring seniority. Since PBS does not require a secondary process, it can deal with situations where crewmembers' preferences cannot be fully satisfied.

❖ ***Maximizing Overall Crew Satisfaction***

The most difficult task is to maximize overall satisfaction. While it is easy to satisfy the preferences of senior crewmembers, the satisfaction of the junior crewmembers set apart the differences among PBS algorithms. A good PBS algorithm will yield better results for both senior and junior crewmembers, without sacrificing seniority and the quality of lines produced.

## **AOS' PBS Product**

AOS advocates a global approach to the PBS award process. Through this method, the bid preferences of all of the crewmembers are considered before setting aside the first line. For each of the crewmembers, AOS' algorithm builds a number of feasible lines that are equally preferable for the current crewmember, allowing a large number of feasible lines to equally satisfy a crewmember's preferences. Considering the effect on all junior bids, the algorithm would select a line best allocated to the remaining crewmembers. Therefore, the selected line for the current crewmember will have a minimal effect on the junior crewmembers. It is important to understand that the current crewmember preferences have not been compromised because this line is chosen among the equally preferred lines. The ability to consider crewmembers' preferences globally and award lines that ensures seniority and maximizes crew satisfaction distinguishes our product from the rest.

❖ ***Bidding Process***

AOS has implemented the pairings pool method whose merits are described in the bidding process section. Facilitated by a web-based bidding interface and a user-friendly search engine for bid entry, our bidding system offers the capability to search for pairings based on a variety of practical and valuable attributes.

❖ ***Honoring Seniority***

AOS' PBS algorithm honors seniority by ensuring that there are no pairings that are more preferred yet awarded to a more junior crewmember. The only situation where this is not the case is in force flying, further examined below.

❖ ***Producing Acceptable Results***

As described above, a key element of a PBS software is the production of acceptable results without too many open days or slots on any given day. The example shown during Christmas serves to demonstrate that producing acceptable results may force crewmembers to fly pairings that were not preferred. AOS uses the concept of “force flying” to resolve this situation. Some crewmembers will need to be allotted Christmas pairings. By reversed seniority, if a crewmember is allotted a Christmas flying, all subsequent crewmembers without pre-assignments for Christmas will also be allotted Christmas flying. It’s important to note that, the amount of “force-flying” is kept to a bare minimum.

❖ ***Maximizing Overall Crew Satisfaction***

Junior crewmembers are skeptical about results from traditional PBS software and believe that more senior crewmembers will receive all of their preferences, leaving them with the remaining undesirable pairings. This observation is warranted, because traditional PBS software uses a greedy algorithm, employed with little forward-looking capabilities. This algorithm begins with sequentially assigning pairings to the most senior crewmembers and tries to change the already built lines only when it realizes that it cannot satisfy the preferences of more junior crewmembers. This process becomes inefficient and difficult to complete as it moves further down the line of seniority. Thus, preferences of junior crewmembers are given far lesser considerations and acceptable results cannot be delivered. AOS’ PBS software has resolved this argument. With its global optimization algorithm, our preferential bidding system significantly improves satisfaction of all crewmembers.

**Conclusion**

The fundamental concept of a preferential bidding system is to benefit all crewmembers when awarding their lines. PBS software, therefore, should be evaluated via practical and quantitative measurements. AOS has always believed that a successful PBS software needs to be easily understood by crewmembers and the bids must be convenient to enter. The awarding algorithm should protect seniority, all the while producing an acceptable solution. Overall satisfaction of the awards for all crewmembers should be measured and compared between PBS software. AOS’ PBS software satisfies these criteria to the greatest extent, and we welcome you to learn more about our PBS product.