

ascend

Taking your airline to new heights

JET STREAM

A conversation with Wolfgang Prock-Schauer, the chief executive officer of Jet Airways.



Special Section

FUELING UP

A look at the rising cost of fuel and its effect on the industry.



INSIDE

6	Turboprops make strong comeback
36	WestJet saves US\$5 million annually
78	GOL scores big in Latin America



The Drive for Robustness: From Optimization to Simplicity

Recent advances in computer resources and modeling techniques offer the possibility for airlines to soon pursue concepts of robust and hybrid airline schedule planning.

■ By Michael Clarke | *Ascend* Contributor

The changing landscape of the airline industry has forced airlines to revisit the manner in which they schedule their limited resources — aircraft and crew members. Some airlines now proactively incorporate crew considerations into how they assign aircraft to schedule flights across their network. In addition, they place a greater emphasis on the impact of the proposed flight schedules and equipment assignments on airport operations.

The airline schedule-planning process has been traditionally subdivided into several discrete decision phases based on pre-existing functional divisions within the organization. These include schedule generation, capacity planning, aircraft maintenance routing, crew planning, airport resource management, revenue management, and operations control and schedule recovery.

This sequential approach to schedule planning has resulted in each airline group trying to achieve resource-specific objectives that often affect the outcome of downstream decisions. Additionally, there is very little feedback to upstream processes that could help improve the integrity of the final flight schedule. The ability to simultaneously consider multiple operational issues at each stage of the planning process had been considered unsolvable, limited by available computer resources and modeling techniques. However, recent advances in these fields have led researchers to pursue concepts of robust schedule planning and hybrid airline schedule planning, such as combining aircraft fleet assignment and crew scheduling.

There are two important criteria that affect how a flight schedule is designed and developed: profitability and feasibility. The profitability of a flight schedule depends on its ability to attract revenue from passengers and cargo as well as the inherent expense of operating it. Estimation of potential revenue requires understanding the competitiveness

HIGHlight

In recent years, major network carriers have started to emphasize some of the operational concepts pioneered and championed by low-cost, value-based and regional carriers such as hub/base airport isolation, station purity and closed-loop flying.

of an airline's schedule in each origin and destination, or pair of cities in which passengers or cargo may travel. In general, an airline will attract significant revenue if it offers relatively attractive service in O&D markets where there are large flows of passengers or cargo. Major components of an airline's costs include crew, fuel, aircraft ownership, facilities and other expenses. The feasibility of a schedule is based on the airline's ability to cover all flights with its pool of resources — aircraft, crews and airport facilities.

Flight schedulers typically begin the process of developing a flight schedule more than one year in advance of publication by following a sequence of steps:

- Identifying a basic schedule structure or list of routes and frequencies,
- Developing an initial feasible schedule as consistent as possible with that structure,
- Reviewing the schedule with various internal and external agencies and modifying it as appropriate.

Throughout this process, schedulers analyze possible changes to this schedule such as new routes, new aircraft, different con-



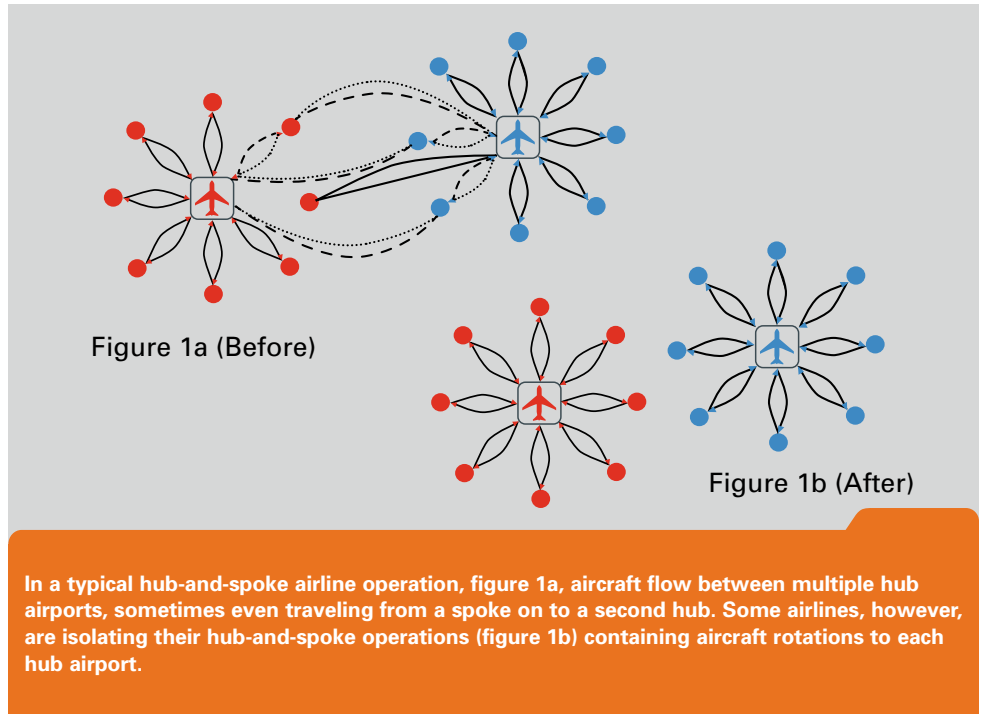
New technological developments and techniques are emerging that will enable airline schedulers to practice hybrid and robust schedule planning to better place crewmembers and aircraft.

Photo by Norman Chan/Shutterstock.com

necting opportunities, new frequencies and a different hub orientation. Flight schedulers typically complete this process and publish the flight schedule or submit it to their computer reservations system two to six months before the schedule is flown.

New Business Practices

In recent years, major network carriers have started to emphasize some of the operational concepts pioneered and championed by low-cost, value-based and regional carriers such as hub/base airport isolation, station purity and closed-loop flying. The majority of these carriers typically subdivide their operational fleets across base airports (those with a high frequency of service) and restrict the airport stations served by a given aircraft. For a given spoke station (low-frequency airport) served by multiple hub airports, a planned rotation will typically turn the aircraft to return to the inbound hub airport versus flowing through to another hub airport. In addition, airlines may restrict the type of equipment types assigned to a given spoke station through station purity to reduce overhead costs related to ground station equipment (ground power units, aircraft tugs). During off-schedule operations, the specific spoke station only has to deal with one type of equipment and one



given market. For example, American Airlines operates a fleet of more than 300 Boeing MD-80s and has restricted their assignment to its largest hub at Dallas/Fort Worth International Airport. Although MD-80s represent almost one-third of the carrier's operating fleet, only flights from Chicago O'Hare International Airport to D/FW use them, and all other flights from O'Hare use an alternate equipment type. This is substantial, as O'Hare is the second-largest station across American Airlines' network. Today, American Airlines maintains hub isolation scheduling restrictions at its three major hub airports — D/FW, O'Hare and Miami International Airport. Its affiliate regional carrier, American Eagle, practices a similar scheduling process wherein specific equipment types are restricted from operating to certain stations even though the majority of its fleet shares the same crew qualification.

Late last year, Lufthansa German Airlines went a step further and announced that it would refine its hub management strategy. Starting in January, the airline transferred network management tasks and processes to its hub airport. As part of the process, short-haul and medium-haul aircraft have been firmly assigned to the Frankfurt and Munich, Germany airport hubs or to focus (non-hub) stations based on their tail numbers. With its summer schedule, long-haul aircraft will be assigned on the same principle. Aircraft may be reassigned at the base for economic or operational reasons but would not be transferred to another hub airport. During the first phase of the hub isolation process, Lufthansa has assigned 40 medium-haul aircraft (Boeing 737s and Airbus A320s)

and 60 regional aircraft to Munich, its second-largest hub airport.

According to the airline, earlier results are positive in terms of more efficient daily rotations, maintenance planning and on-time performance. Lufthansa anticipates the new approach to schedule planning and execution will result in increased planning stability, strengthened hub operations, and an increase in both operational and planning efficiency. In addition, the carrier expects this move to enable it to establish a foundation for transferring greater operational and entrepreneurial responsibility to individual hub airports.

The concept of closed-loop flying involves an airline trying to reduce, if not prohibit, crew assignments that require aircraft swaps during the duty period. In addition, these assignments often start and end with duties at the same airport station. When a crew member is required to change aircraft at a given station, the incoming crew member is required by regulations to inspect the operational aircraft before each scheduled departure. In each instance, this inspection process can add 10 minutes to the required aircraft turn time, thereby reducing the aircraft utilization during the course of the day as well as the effective flying time of a crew member for his or her duty period. During the course of a typical day, this could amount to more than one hour of flying time unavailable for scheduling consideration. A beneficial byproduct of this assignment restriction is a reduction in the overall solution time of the crew planning process because less flight connection possibilities have to be evaluated.

Early last year, a major U.S. domestic network carrier decided to proactively ana-

HIGHlight

The sequential approach to schedule planning has resulted in each airline group trying to achieve resource-specific objectives that often affect the outcome of downstream decisions.

crew group. This significantly simplifies the airline's operations during both normal and irregular operations.

Since 2001, many U.S. domestic network carriers have aggressively pursued the notion of hub isolation, restricting the routing of aircraft throughout the network system and limiting the equipment type that serves a



Photo supplied by Klaus Ecker/Airlines.net



Photo supplied by Lasse Kaija/Airlines.net

Many carriers such as Lufthansa and American Airlines have applied the practice of hub isolation, limiting aircraft routing throughout the network system as well as the equipment type that serves a given market. The airlines anticipate increased planning stability, strengthened hub operations, and improved operational and planning efficiency as a result.

lyze and modify crew connection assignments across its largest sub fleet. From a planned schedule of approximately 1,400 flights, it was able to reduce the number of required crew changes from 300 to less than 20 within a given planning period without any increased crew costs. This represents a more than 94 percent reduction in the number of crew changes at airport stations throughout the network. In fact, it was able to reduce its operational crew costs as a result of more efficient duty periods. To achieve this savings, the airline mixes both short-haul and long-haul aircraft turns within a given aircraft rotation while trying to maximize the assignment of crews to an aircraft during the course of the entire day. Based on the average aircraft utilization, an aircraft may require only one set of crew for the day, otherwise it would have to be covered by multiple crews. It has been seen as a win-win situation for the airline as crew members prefer staying with the aircraft, and these revised crew and aircraft assignments are easier to manage during off-schedule operations.

Future Concepts

The research group for the Sabre Holdings® company is working on two research projects — schedule analysis and evaluation methodologies — that will enable an airline to better design and develop flight schedules. By incorporating and accounting for more detailed operational and crew considerations during the schedule-development process, the group anticipates airlines will be better able to take full advantage of some of these concepts including hub isolation, station purity and

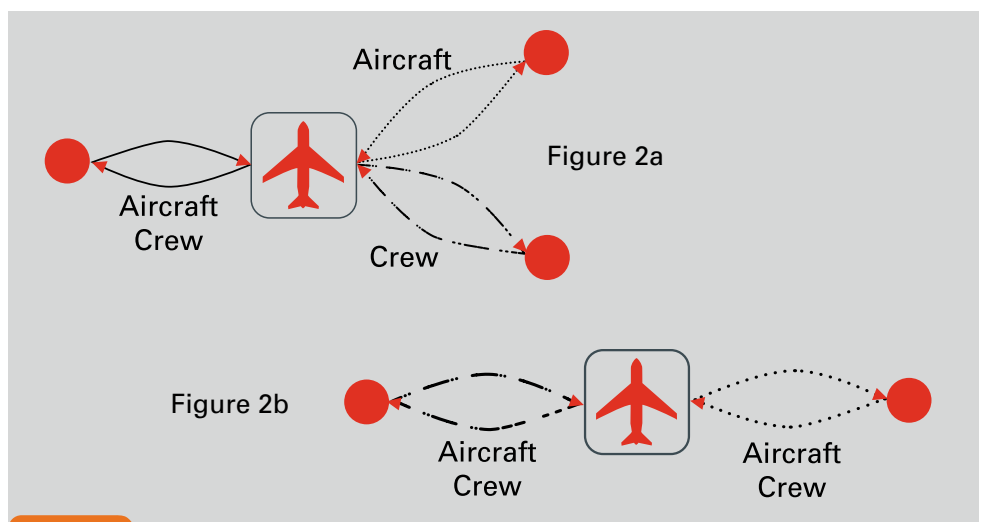
closed-loop flying. Since the flight schedule is the foundation of the airline planning process, identifying and modifying inefficiencies early in the process will only result in better flight schedules.

The first research project involves a schedule analysis methodology that will identify potential constraining resource requirements for a given flight schedule. These include crew legality limitations and aircraft maintenance routing requirements that typi-

cally arise once the flight schedule has been finalized by capacity planning. The implementation of the schedule-analysis process will locate possible resource bottlenecks and suggest potential equipment changes and/or flight re-timings that reduce crew and maintenance costs associated with the proposed flight schedule. The second project encompasses a schedule evaluation methodology that leverages past research initiatives in schedule recovery, schedule dependability analysis and airline operations simulations. By evaluating proposed flight schedules against historical operational data, an airline can identify, reduce and/or remove aircraft and crew inefficiencies that would occur during schedule execution. The ultimate goal would be to design and develop flight and resource schedules less susceptible to unexpected irregularities.

While it may be too early to empirically report on the overall long-term benefits of these new approaches to schedule planning and execution (hub isolation, station purity, closed-loop flying), it is safe to say that it has served low-cost and value-based carriers well during their short existence, and network carriers hope to achieve the same level of operational efficiency and ultimately profitability. The goal is to provide airlines the necessary decision-support tools and methodologies to make better and more effective decisions about the design and development of their flight schedules and associated resource schedules. **F**

Michael Clarke is principle research scientist for Sabre Holdings. He can be contacted at michael.clarke@sabre.com.



By moving away from the standard practice of having crewmembers change aircraft during airport layovers (figure 2a), airlines can shave an average of 10 minutes per flight off aircraft turn times by implementing closed-loop flying (figure 2b) where aircraft and crewmembers follow the same flight assignment.