A Simulation Approach to Enhancing Aircraft Availability

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ABSTRACT
This study presents a simulation approach to evaluate a potential strategy for dispatching aircraft at Embry Riddle Aeronautical University. The current method of assigning aircraft to students is based on the highest utilization. A new strategy is proposed where the maintenance time is also incorporated into the aircraft utilization. Various performance measures such as aircraft availability, number of cancellations due to unavailability of aircraft, maintenance manpower and number of aircraft at maintenance hangar are examined under both methods. The analysis of the two methods suggests that changing the priority method in aircraft dispatch does not produce significant change in the system. Although both models are similar, the large deviations and variations in the proposed dispatch method discourage it from being implemented in its current form.

Keywords: Dispatching Aircraft, Federal Aviation Administration (FAA), OR in Aviation, Scheduling, Simulation, Strategy

INTRODUCTION
The Flight Training department at Embry-Riddle Aeronautical University provides training approved by the Federal Aviation Administration (FAA) to students. A flight student acquires certification though Private, Instrument, Commercial, Multi-Engine and Flight Instructor courses. Students can choose to complete the entire program or take individual courses depending upon their needs. Currently the Flight Department operates a fleet of 72 aircraft which includes Cessna 172, PA-28 Arrow and Diamond DA-42. The department on the average conducts 250 flight operations per day to satisfy the needs of 800-1000 students in any given semester.

The project was initiated to study the utilization of aircraft and maintenance facilities and recommend strategies to assign aircraft to students. Since the aircraft is integral to any training and the main source of revenue, the
unavailability of this resource for maintenance purposes needs to be minimized. The aircraft are mandated by the FAA to go through a series of inspections every 50 hours of flight time at the maintenance hangar. It therefore becomes important that not only the aircraft availability is maximized but the maintenance resources are utilized optimally. The Flight Training department was interested in the effects on availability of the aircraft for flight operations if the changes are made in the method by which aircraft are prioritized, allocated and dispatched for flight.

LITERATURE REVIEW

This case study has some similarities to multiple asset management, which have been extensively studied in the literature. In multiple asset management, the focus is to manage multiple resources to meet demand typically at different locations. Examples include rental cars (see for example Pachon, et al., 2006, Li & Tao 2010), rail cars (Papier & Thonemann, 2007, Bojovic, 2002) and truck assignments (Miao, et al., 2009). In these research streams the focus is typically at assigning multiple resources to a number of customers at different locations at minimum cost. They do not, however, address varying cost of maintenance with usage. These problems adopt a variety of network optimization models to satisfy demand at different locations. A particular paper by Hertz, et al. (2009) considers varying maintenance cost in a rental car company. The scope of their research is an inventory control model where the number of cars is identified by examining the existing fleet and purchasing new ones.

Other related research work include parallel machine scheduling (see for example Cheng et al., 2011; Kubzin & Strusevich 2006) where only one maintenance activity is allowed throughout the makespan. The airlines’ aircraft dispatching/assignment in the literature is primarily studied under a series of interrelated optimization models starting with schedule, fleet and tail assignment/routing (Bazargan, 2010). In these models, maintenance is included as a side constraint to insure the aircraft is at the right hub for maintenance after certain number of flight hours (See for example Barnhart, 1998; Li & Wang 2005).

Although the above research works provide some information on standardized problems, they do not capture the scope and nature of the current case study where maintenance cost varies with usage.

Scheduling

A major task of Flight Operations is to assign students, instructors, and aircraft to the flight blocks. In the present method of scheduling approach, students are assigned to specific instructors for the entire duration of a course. Each instructor submits a request for an aircraft during the assigned flight block. The scheduling looks at the availability of the fleet and makes the resources available accordingly.

Dispatch

The Flight Deck or the dispatch has all the flight records of the aircraft available and the dispatcher allocates the aircraft to the student for a flight. The dispatch also updates the flight records of the aircraft at the completion of each flight.

Flight Activity

Once the aircraft is assigned to a student by dispatch, it usually goes for a flight to complete the training activity. Typically the training activity is either conducted in a local training area or on a cross-country flight. The actual flight time varies considerably due to a multitude of factors including weather and intensity of air traffic.

Maintenance

Embry-Riddle Aircraft Maintenance is responsible for maintaining and keeping the aircraft airworthy by performing both scheduled and unscheduled maintenance. FAA stipulates that an aircraft undergoes through inspection and maintenance at a scheduled tach and calendar
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