Airline Hangars Balanced Manpower Utilization: An Optimization Approach

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ABSTRACT

Airlines on average spend 10%-15% of their total operating cost on aircraft maintenance checks. Many airlines conduct their light checks in-house. These checks are inherently very labor intensive. This study offers a mathematical model to help airlines with scheduling their in-house light maintenance checks to achieve a high and even utilization of manpower among all hangars. The model attempts to minimize the utilization imbalances by assigning light maintenance checks, during their feasible time-windows, to available and certified hangars on daily, weekly and monthly. It incorporates daily flight schedule, maintenance requirements for each fleet type, certification and availability of manpower at each hangar. Furthermore, the model highlights the utilization imbalances and thus provides some guidelines in terms of increasing/decreasing manpower capacities at each hangar. The model is applied to 3 US and 2 European airlines with encouraging results.

KEYWORDS

Airlines, Maintenance, Manpower Planning

1. INTRODUCTION

Aircraft maintenance refers to the periodic inspections that need to be done on all aircraft after a certain amount of flight hours or usage. It is one of the critical aspects as well as a complex activity in the airline and aviation industry. For airlines in the United States, the Federal Aviation Administration (FAA) has provided recommendations on continuous inspection and maintenance programs. Each program has its detailed routine and inspections, commonly known as checks. Aircraft maintenance activities are performed based on two main metrics, the total number of flying hours (FH) and the number of cycles. A cycle is defined as one takeoff and one landing. The most commonly used metric to determine the type of light (categorized as A and B checks), or heavy (C and D checks) maintenance programs, is the number of flying hours on the aircraft (Global MRO 15).

The A checks are considered the lightest maintenance programs and differ based on the fleet type. B Checks are similar to A with more comprehensive activities. C Checks are structural inspections of the airframe and require opening access panels and detailed checks of individual systems and components. The heaviest types of maintenance programs are the D Checks, which the aircraft is taken out of service for around a month, disassembled and detailed inspections of the aircraft structure are performed. Some airlines do not use these terminologies and instead use light A and heavy A referring to A and B checks. They use C1, C2, ... to represent C and D checks.

According to the Global Maintenance, Repair and Overhaul (Global MRO 2015), civil aviation spent more than $70B on aircraft maintenance in 2014. Aircraft maintenance cost is among the major

DOI: 10.4018/IJASOT.2016070104
cost drivers within the airlines. Fuel and flight crew cost typically rank among the top cost components at the airlines. For comparison purposes, Figure 1 represents the average percentages of total and aircraft operating cost for fuel, flight crew and aircraft maintenance for 6 US airlines (Delta, American, United, Southwest, Alaska and US Airways) from 2003-2014. Aircraft maintenance programs are inherently labor intensive (McFadden and Worrells 2012). Airlines continually strive to save cost in the areas that they have control over such as more efficient crew scheduling and manpower planning.

The airlines conduct their maintenance programs at different hangars/hubs/airports depending on their network sizes, flight schedules, type of fleet and capacity. Many airlines outsource their heavy C& D checks while conducting light A & B checks in-house (Bazargan 2016).

2. LITERATURE SURVEY

The airlines’ aircraft light maintenance checks in the literature are primarily studied under a series of interrelated optimization models starting with schedule, fleet, tail and crew assignments (Bazargan 2010). In these models, maintenance is included as a side constraint to insure that the aircraft is at the right station for light maintenance checks after certain number of flight hours. Diaz-Ramirez et. al. (2014) provide a comprehensive review of such optimization models. In these models the airline’s flight schedule drives the aircraft maintenance checks and locations. These optimization models attempt to solve the aircraft routing while making sure the aircraft has light check maintenance opportunities. These models identify when and where the light maintenance checks occur based on the flight schedules. The maintenance departments then plan their daily workload accordingly. These models typically identify only maintenance opportunity for light checks and do not address workload and/or utilization of manpower at the hangars. It is up to the maintenance departments to meet the demand at different hangars. This practice continually results in variations and uneven utilization of manpower at hangars.

There are many studies in the literature on optimizing manpower planning, maintenance cost and processes at manufacturing and service industries. The manpower planning, sometimes referred to as workforce sizing have been studied for diverse industries. Ighravwe and Oke (2014) and Lieckens, et al., (2015) provide a recent and comprehensive overview of quantitative models for workforce planning.

Figure 1. Average percentages of major cost components in total and aircraft operating costs
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