SAFETY STOCK ESTIMATION OF UNIT LOAD DEVICES FOR INTERNATIONAL AIRLINE OPERATIONS

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ABSTRACT

Unit load devices (ULDs) are used to load air cargo and passengers’ checked baggage for wide-bodied aircraft operations. Since ULDs are reusable at the destination, airlines can invest in an appropriate fleet size for their requirements. The estimation of safety stock levels for every operating airport is a premeditated task because airlines must prepare enough devices for the outbound consignments of each flight. The variance of the number of used devices for each arrival and departure flight will influence the stock level of an airport. For scheduled international services, this study proposes an analytic method based on a cyclically time-sequenced network that can be used to express ULDs moving in and out of an airport. The safety stock level is defined as the minimum quantity that can support the utilization for the entire next cycle at the period end. The results of a case study on one company reveal that the airline normally establishes a high safety stock level.

I. INTRODUCTION

Unit load devices (ULDs) are the standard equipment for loading air cargo and checked baggage in wide-bodied aircraft operations. According to the definition of the International Air Transport Association (IATA), ULDs can be many items [6]. In practice, ULDs are commonly defined as devices that can be used to load freight, such as containers and pallets. The utilization of ULDs assists airlines in the standardization and unitization of loading and discharging handleings at airports. Airlines can select customized types of ULDs for matching the inner contours of the main and lower decks of various aircraft sizes. Since ULDs are also accommodated with a variety of aircraft, airlines normally seek the benefit of commonality to purchase as many similar types of ULDs as possible.

ULDs can be reused after emptying freight at the destination. When import shipments are typically greater than the export quantities, empty ULDs will accumulate at the airport. On the contrary, an airport with greater export shipments than inbound freight will lack loading equipment. The airline must appropriately reposition ULDs between airports in order to balance the difference of supply and demand and keep a sufficient and economical fleet size. Therefore, it is important for an airline to properly estimate the safety stock level for each operating airport in order to cope with its ULD repositioning operation.

The safety stock level is a crucial element in inventory theory. Two alternative methods of determining the safety stock level are used [8, 20]. The first technique is the analytic method, which is always based on a computation of the variance of demand. The second method develops a simulation processes. Zizka [21] used these two approaches to determine safety stock levels and compared their quantified difference. Tan and Tang [15] examined the demand variable as a Gauss fuzzy variable to estimate safety stock levels for a case without historical demand data. Considering international air transport services, ULDs are normally moved with a fixed flight schedule and without consideration of a better lead time for arbitrary supplements.

Marine container transport is another industry that follows the same decision process regarding equipment safety stock levels. The issue of safety stock levels in ports normally appears in the discussion of empty container repositioning [3, 9]. Since containers delivered through the marine system are connected with their origins and destinations by truck or rail systems, their buildup and breakdown operations are mainly completed at depots or customers’ factories. This procedure leads to uncertainties of timing and the quantities of empty containers reused [2, 4, 11, 14]. International air cargo services normally execute buildup and breakdown operations at the air cargo terminal.

In the airline business, several studies have dealt with various topics relative to air cargo operation and management. Cargo load planning is always viewed as a bin-packing prob-