INTRODUCTION

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In civil aviation, many problems arise in the interface of the aircraft with the airport and its environs. One facet of Transportation Research Board (TRB) aviation activity concerns the development and application of technology for analyzing and improving this interface, particularly on the ground, to provide a basis for decisions involving the design, construction and operation of aircraft and airports which are compatible, well integrated and cost effective.

In 1981, a TRB-sponsored workshop (reported in TRB Circular 247) addressed the above-described subject of compatibility and identified many existing or potential compatibility issues which could conveniently be grouped into four specific categories: airport configurations and facilities; operations at the airport; interactions between the airport and the surrounding community; and the relating of aircraft and airport characteristics to compatibility. Oftentimes these categories are interlinked as exemplified by several of the seven papers reported herein.

The first two papers address the selection of transport aircraft by the air carriers from two different perspectives: the first paper examines a proposed total systems cost process, which includes the cost of airport facilities and operations as well as costs of aircraft and their operations; the second paper describes the present real-world process followed by air carriers which places more importance on those costs pertaining to the aircraft rather than to the total system.

The next three papers pertain to aircraft-compatible airport facilities: a paper describing a greatly improved ramp lighting system recently developed and placed in operation at Chicago; a report concerning an analytical modeling technique to predict the behavior of water runoff from grooved runways; and lastly a companion paper to the modeling study which reports subsequent results of laboratory experiments of water runoff plus associated refinement of the predictive model. The predictive model for water runoff can support not only facility design but also development of improved operational procedures during and after heavy rainfall at airports.

The sixth paper describes an improvement in technology for predicting community noise impact by adding to existing noise footprint prediction techniques the dimensions of a noise/discomfort transfer function and population density distribution. Using a mainframe computer, it proved very useful in trial studies of alternative relocation of runways or flight paths. The computer program is a prime candidate for abridgement to desk-top machines to provide an inexpensive method for meaningful prediction of community noise impact.

The seventh and last paper reports the application of a previously developed compatibility prediction model to a specific, dramatic, real-world situation. The results indicate the predictive model is capable of analyzing complex compatibility issues in an efficient and meaningful manner. While it can be a powerful tool in checking compatibility of new aircraft and airport designs, its future use will depend primarily on the development and maintenance of a comprehensive data base of the several thousand factors which enter into the model.

AIRPORT EFFECTS OF AIRLINER SIZE ON TRANSPORTATION SYSTEM EFFICIENCY

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Abstract

In serving a given passenger flow, the use of larger airliners usually reduces direct operating costs and runway time requirements. A significant disadvantage shown here is that larger airliners spend more time at terminals, thereby reducing aircraft utilization and increasing apron area requirements. That in turn increases airport circulation distances and facility costs. Other disadvantages of larger airliners include reduced service frequency, reduced flexibility in matching capacity to demand, and difficulties in operating within the constraints of existing airports.

This paper quantifies the effect of airliner size on terminal time and apron/gate space requirements, and suggests several ways of reducing those requirements. An optimization of total system costs rather than direct operating costs in the design of airliners is recommended for integrating various elements into an efficient air transportation system.

Introduction

In the air transportation industry it is sometimes taken for granted that larger planes are more efficient, provided that passenger volumes are sufficient to justify their use. In addition to providing lower cost air travel, larger planes are also expected to alleviate the capacity constraints at the busiest air carrier airports. While larger planes do indeed offer some cost and capacity advantages, it does seem that the negative effects of airliner size are underestimated. This paper examines several effects of airliner size on airports and airline operations, identifies remedies for the negative effects, and proposes a method for dealing with such effects in the design optimization of airliners.

Unless otherwise stated, aircraft size will refer to the number of seats per airliner.

To consistently compare airliners of different size it is important to stipulate the proviso "other things being equal." However, other things are rarely equal. For instance, the larger airliners tend to use newer technology, to be designed for longer runways, and to be operated on longer routes. While there are good reasons for these tendencies (as well as many exceptions), the large number of factors hidden in empirical data greatly complicates a purely statistical analysis of airliner size effects. Therefore, technical arguments are used here to supplement the statistical evidence.

The emphasis in this work is on quantifying the effects of airliner size on time spent at terminals and on apron space requirements. These effects have significant implications for the utilization of aircraft, terminal area capacity of airports, circulation distances within airports, and traveller delays. However, several other effects of airliner size are qualitatively reviewed beforehand.

Effects on Direct Operating Costs

In airline cost accounting the direct operating costs (DOC) are the costs directly associated with flying aircraft, namely (1) aircraft depreciation or rental; (2) aircraft maintenance; (3) flight crews; (4) fuel and oil; and (5) insurance. These