Proceedings of the 1998 Winter Simulation Conference
D.J. Medeiros, E.F. Watson, J.S. Carson and M.S. Manivannan, eds.

WASHINGTON DULLES INTERNATIONAL AIRPORT PASSENGER CONVEYANCE STUDY

Robert G. Kyle, Jr.

Sim X, Inc.
(*SIMulation eXperts*)
5702 Woodlawn Green Circle B
Alexandria, VA 22309, U.S.A.

ABSTRACT

Washington Dulles International Airport transports passengers concourse to concourse using mobile lounges. The airport itself is continuously expanding the number of gates that it will serve to meet airline and passenger demand. A discrete-event simulation model was constructed to show how existing and future operations would impact the mobile lounge fleet. The model is able to show how many mobile lounges to assign for each route, number of docks for each concourse, and headway times.

1 INTRODUCTION

In past studies, the analysis of the passenger conveyance system has focused on near-term operational and capacity issues associated with relatively modest changes in the mobile lounge planemate system. Dulles is about to undertake several major construction projects that will significantly alter midfield facilities and the associated passenger conveyance system. In addition, given the long time in designing and construction of a people mover system, it is anticipated that the existing passenger conveyance system will have to serve a significantly expanded midfield complex.

Washington Dulles International Airport has a unique way of transporting its passengers. After passengers check-in at the main terminal and go through security, they board mobile lounges or planemates to achieve their final destination. This destination can be the actual airplane itself or a concourse. The majority of passengers board a mobile lounge which takes them to one of the concourses. Planemates are primarily used to transport passengers to and from hardstand areas or international gates. Mobile lounges were the primary focus of this study, with a secondary interest in planemates.

Dulles has three major concourses in service as of July 1998. The C-and D-concourses, as well as the newly opened B-concourse. For domestic arrivals, there are five docks serving the B-and D-concourses and four docks serving the C-concourse. For international arrivals there are four docks at the C-concourse and twelve docks at the B-concourse. Twenty-five docks exist at the Main Terminal to serve these concourses, as well as the planemates which serve remote hardstand gates. There are eight docks at the International Arrivals Building which service planemates and mobile lounges from all of the concourses.

The fleet size consists of thirty mobile lounges and nineteen planemates, of which 80% can be relied upon for service at anytime. Mobile lounges typically leave about every five minutes (headway) during peak times, and can hold up to 110 passengers. Planemates leave as requested for particular flights, and hold about 100 passengers.

2 PROBLEM DEFINITION

2.1 Objectives

The first objective was to construct a simulation model of the existing operations at Dulles (see Figure 1). This model will be capable of accepting airline schedules as input, sensitive to the difference in vehicle types in terms of capacity and operations, and produce graphic and tabular output suitable for analysis and presentations.

The second objective was to modify the initial model inputs to replicate the impact of anticipated changes to the passenger conveyance system from the opening of the Commuter concourse, rehabilitation of the A- concourse, and construction of the pedestrian tunnel. New mobile lounge routes were created to serve future dock areas.

The third objective involved long-term facility development. This included a build-out of the B-concourse, creation of a new, more remote, hardstand area, and the need to provide concourse-to-concourse connecting services. In addition, the airline schedule was expanded to reflect a significant increase in passenger volumes.

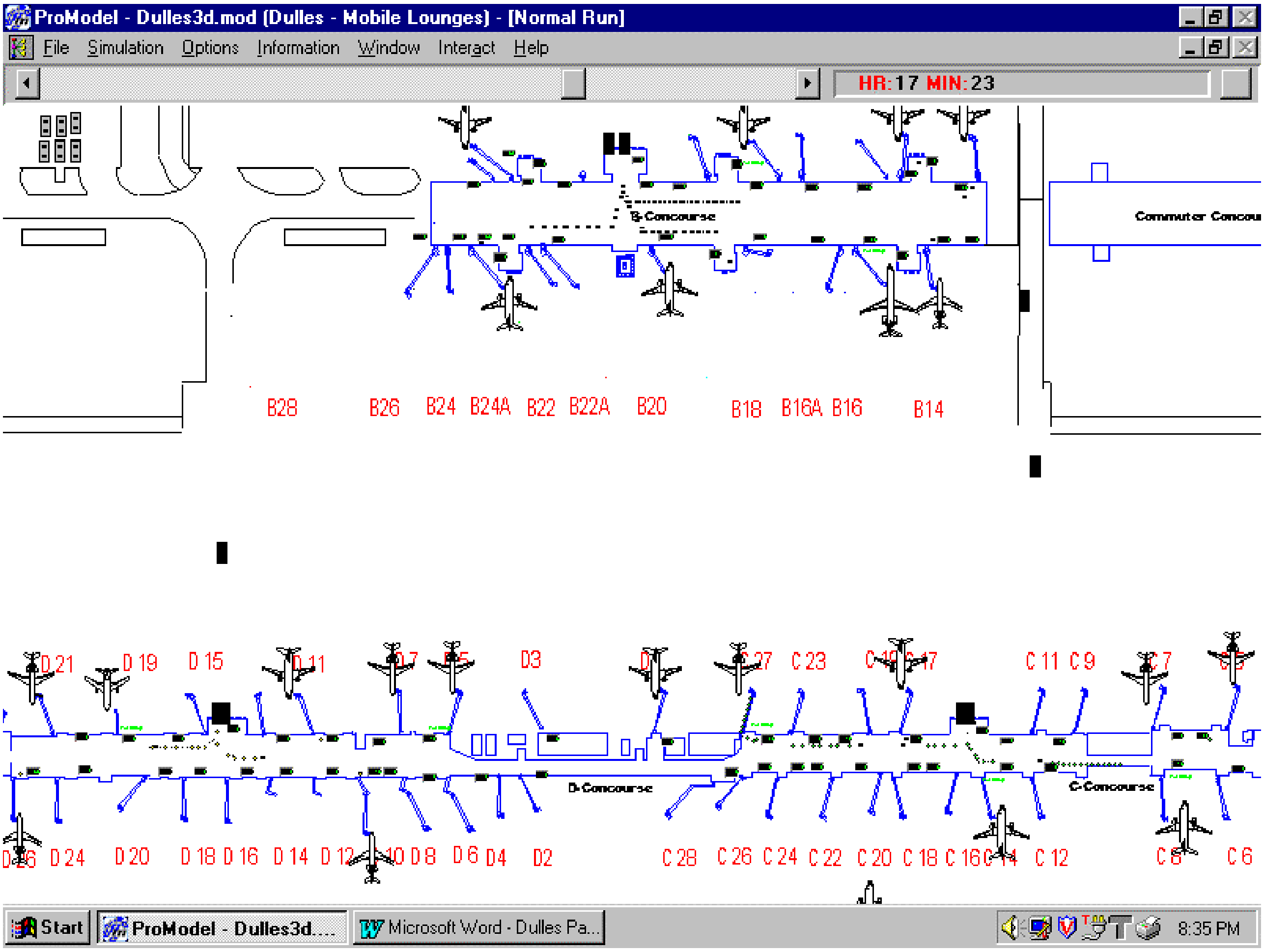

Figure 1: Existing Operations at Dulles

These were the main objectives of this study. Additionally, the user will be able to use this model on a daily basis for a variety of scenarios. These include changes in flight schedules, construction projects which would occupy docks, abnormal downtime of the fleet, unusually high holiday traffic, adverse weather conditions, and many other scenarios that might present themselves.

2.2 Model Scope

The model scope covers every aspect associated with the mobile lounge system. This includes the loading and unloading of passengers, mobile lounge routes, and dock areas. Also included are the arrivals of aircraft and passenger movement inside the airport.

The model begins with the generation of mobile lounges for each route, and the number of docks available for these routes. This is handled via input parameters in the model. Next, aircraft arrive into the model through a spreadsheet that is read in automatically. When the aircraft lands, greeters are created and travel to the corresponding gates via the mobile lounge network. Aircraft proceed to their corresponding concourse and gate, and drop off two types of arriving passengers. Those that need connecting service to another concourse for a connection, or those passengers that terminate their travel at Dulles. For those that need connecting service, they travel to the appropriate dock and board a mobile lounge. For those that are terminating their travel at Dulles, they travel to the dock area for that concourse, of which some meet up with their greeters, and board a mobile lounge for the Main Terminal. Next, according to the flight schedule, departing passengers are created and travel to their corresponding concourses using the mobile lounge network. Some of these departing passengers are accompanied with well wishers, who return to the Main Terminal after traveling with their colleagues. Once a plane is close to take off, passengers board and exit the system.

3 MODEL DEVELOPMENT

The Dulles simulation model was developed using ServiceModel® from *ProModel Corporation*. The *Metropolitan Washington Airport Authority* (MWAA) contracted out to *Lea+Elliott, Inc.* for the study. *Sim X, Inc.* was consulted to develop the model.

The model itself was built in two parts. The first part consisted of modeling the existing mobile lounge network. This included visits to Dulles to ensure proper decision making logic of the current system. The second part consisted of constructing the new concourses (commuter and the B extension – see Figure 2) and routes to serve each. Also in this second phase, routes were created to transport passengers from concourse to concourse which are not available today. For instance, if somebody landed at the B-concourse and had to connect at the C-concourse, they would have to board a mobile lounge at the B-concourse, travel to the Main Terminal, and then board another mobile lounge to finally arrive at the C-Concourse.

4 MODEL DESCRIPTION

4.1 Model Inputs

The model is designed to be as flexible as possible. The flight schedule is read in through a spreadsheet. Cells in the spreadsheet include:

- ETA, ETD
- Concourse and gate number
- Domestic or international flight
- Number of passengers on flight
- Percent of passengers connecting to specific concourses

Other inputs can be changed in the model itself. These can be manipulated in the scenarios page, and saved for future reference. They include:

- Number of mobile lounges for each route
- Number of planemates for the model
- Number of docks available at each concourse for service
- Headway times for each route
- Percentage of passengers that are accompanied by a well wisher/greeter
- Percentage of passengers that will use the new underground moving side walk
- Mobile lounge travel time to each concourse

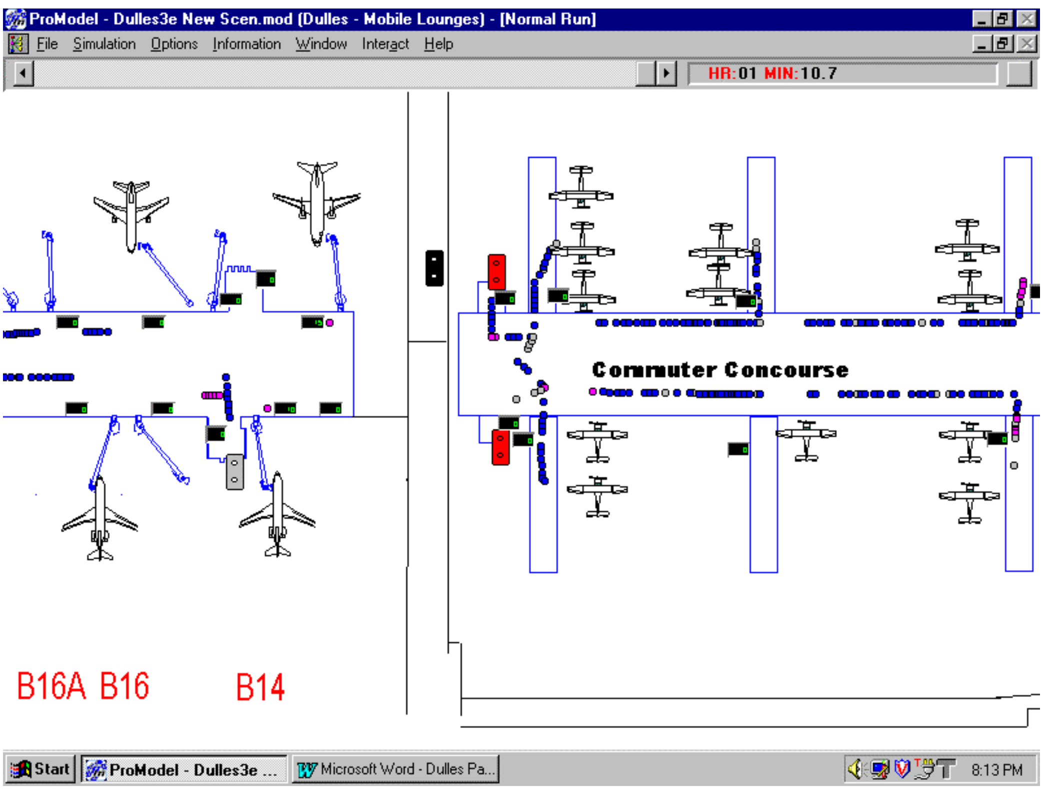

Figure 2: Future Commuter Concourse

4.2 Model Features

The Dulles model details the movement of passengers from concourse to concourse. This includes walk times inside the Main Terminal and all of the Concourses, as well as travel times between buildings using the mobile lounge network.

A detailed CAD drawing was constructed to scale for the background of the model. Passengers and mobile lounges travel at specific speeds to accurately represent true travel times. Plane and mobile lounge deboarding rates were collected and incorporated into the model as well.

The model itself has many entities. These include different mobile lounges for each route, planemates, arriving passengers, connecting passengers, departing passengers for each concourse, and well wisher/greeters.

4.3 Model Outputs

Many performance measures are collected in multiple output reports. ServiceModel allows the user to save previous output windows such as detailed graphs and charts, which allows for a quick analysis of multiple scenario runs. Such graphs include:

- Mobile lounge load size over time for each route (see Figure 3)
- Cycle time for each passenger over time
- (cycle time only includes pertinent time in the system attributed to the mobile lounge network)
- Queue size at docks over time (passengers waiting to board a mobile lounge that has not arrived)
- Dock utilization rates for each concourse

Other statistics pertinent to this model are easily found in the ServiceModel General Report which include:

- Average, minimum, and maximum passenger cycle time
- General entity activity in the model

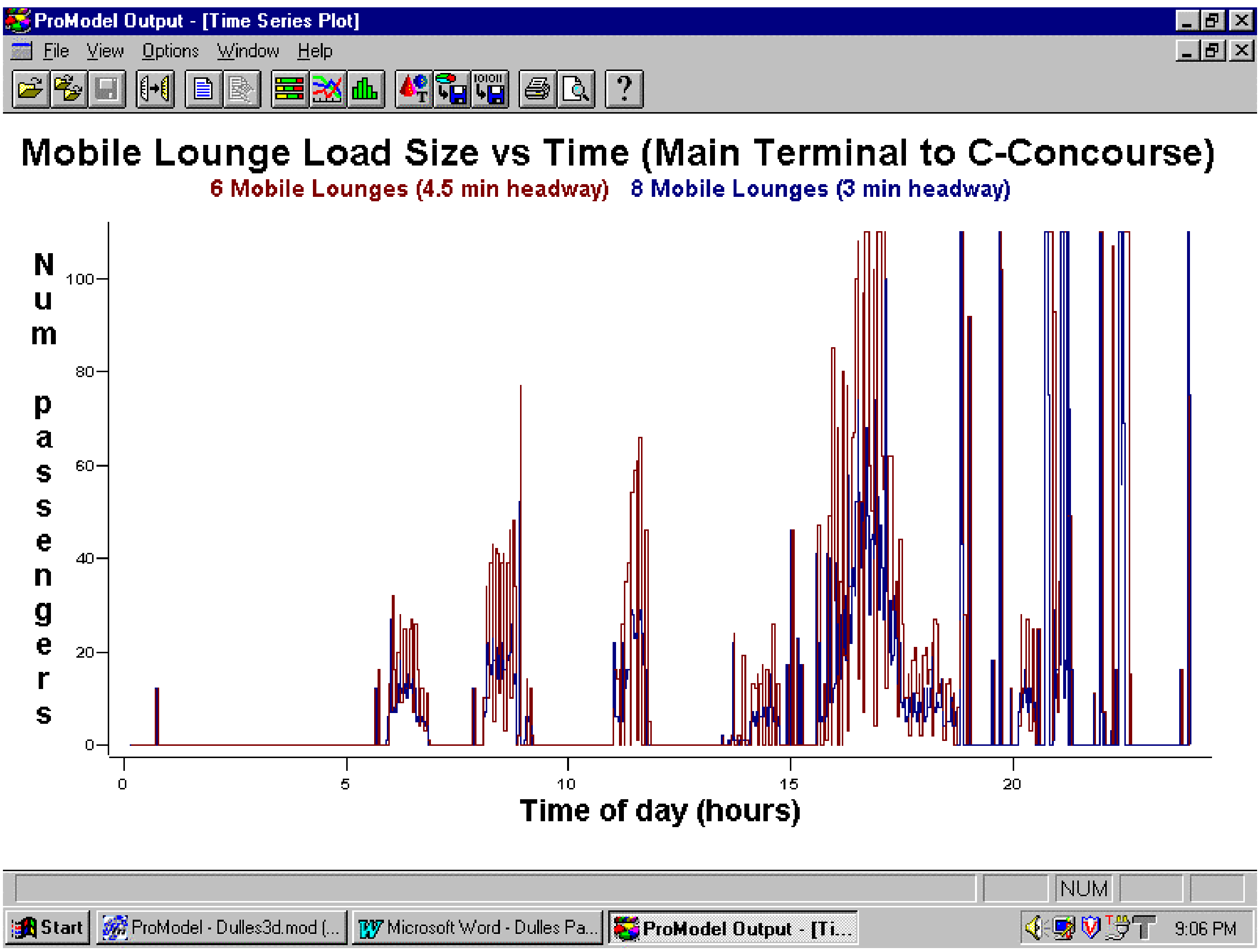

Figure 3: Output Chart

5 MODEL VALIDATION

The validation of the Dulles model is still ongoing. The main methods being used include visual inspection of the animation while the model is running, and detailed examination of the output reports and graphs.

Input data for the model was the first to be validated. Some data the animation while the model is running, and detailed examination of the output reports and graphs.

Input data for the model was the first to be came from previous studies of the airport, though, most of the data was collected again to ensure accuracy. Such input data included travel times, boarding and deboarding times, and mobile lounge/planemate capacities.

Other validation techniques involved showing the model and output charts to MWAA employees who were able to verify peak loads. For them to see their airport in action on a screen not only validated the model, but added confidence and excitement in the study.

6 SUMMARY

The Dulles model was developed as a flexible, data driven model to study the mobile lounge network at Dulles International Airport. The model includes mobile lounges servicing all existing and future facilities, with flight schedules and pertinent passenger data being read in through a spreadsheet. At the time of the writing, preliminary analysis has begun with experimentation on mobile lounge assignments and flight schedules. Initial
results have validated the model's portrayal of current operations, and with future experimentation, service to all concourses will be improved. The real excitement lies in its role in shaping future operations at Dulles. With the construction of the future Commuter Concourse in the model, the optimal number of docks and mobile lounge assignments can be determined. MWAA will also be able to discover the advantages and disadvantages of constructing an underground moving sidewalk. An added bonus will be in the day to day operations, where a user can execute the model with near real-time data prior to the days work, and highlight any potential problem areas and make necessary changes.

AUTHOR BIOGRAPHY

ROBERT G. KYLE JR. is president and founder of *SimX (SIMulation eXperts)*. He founded *SimX* in 1996, which is located in Alexandria, Virginia, and has over a dozen clients in the Washington D.C./Maryland/Virginia area. He is a licensed agent for *ProModel Corporation*. Activities in his business include selling ProModel products, consulting, and official training for ProModel Software. He is a 1997 graduate of Virginia Tech where he received his Bachelors Degree in Industrial & Systems Engineering. Prior to *SimX*, he worked with the Central Intelligence Agency and International Business Machines.