Newsletter

NASA FutureFlight Central
Fourth Quarterly Newsletter

November 2001

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1. The LAX Story Part IV: LAX Controllers Test Drive Airport Safety Enhancements

In previous issues of our newsletter, we have described NASA FutureFlight's studies of runway incursion at LAX (first quarterly newsletter), including our efforts to recreate a highly realistic air traffic simulation of LAX (second quarterly newsletter). In our last

issue, we reviewed how both the judgments of controllers and our objective operational measures
(The LAX Story Part III: How Real Did It Get?) showed that FutureFlight was indeed able to capture some of the essential elements of complex and high intensity LAX air traffic.

LAX controllers played a critical part in the success of the FutureFlight simulation of LAX. Most prominently, Elliot Brann (NATCA Safety Representative for the Western Pacific Region) participated as a "knowledge expert," collaborating with NASA scientists in devising each test scenario. NASA FutureFlight's Phase II LAX study examined several potential "candidate" airport changes (either in geometry, procedures, or both) thought to potentially mitigate the runway incursion issues at LAX. In each test airport layout, experienced LAX controllers directed air traffic. After each 45 to 60 minute run, controllers answered questions about the safety and efficiency of the airport. In addition, FutureFlight recorded several objective measures of the air and ground traffic flow, e.g. taxi times, departure rates, runway occupancy time, etc.

Figure 1 shows how each airport configuration performed in terms of perceived safety and efficiency as well as on one objective measure, namely departure rate.

Controller Subjective Ratings vs. Departure Rate

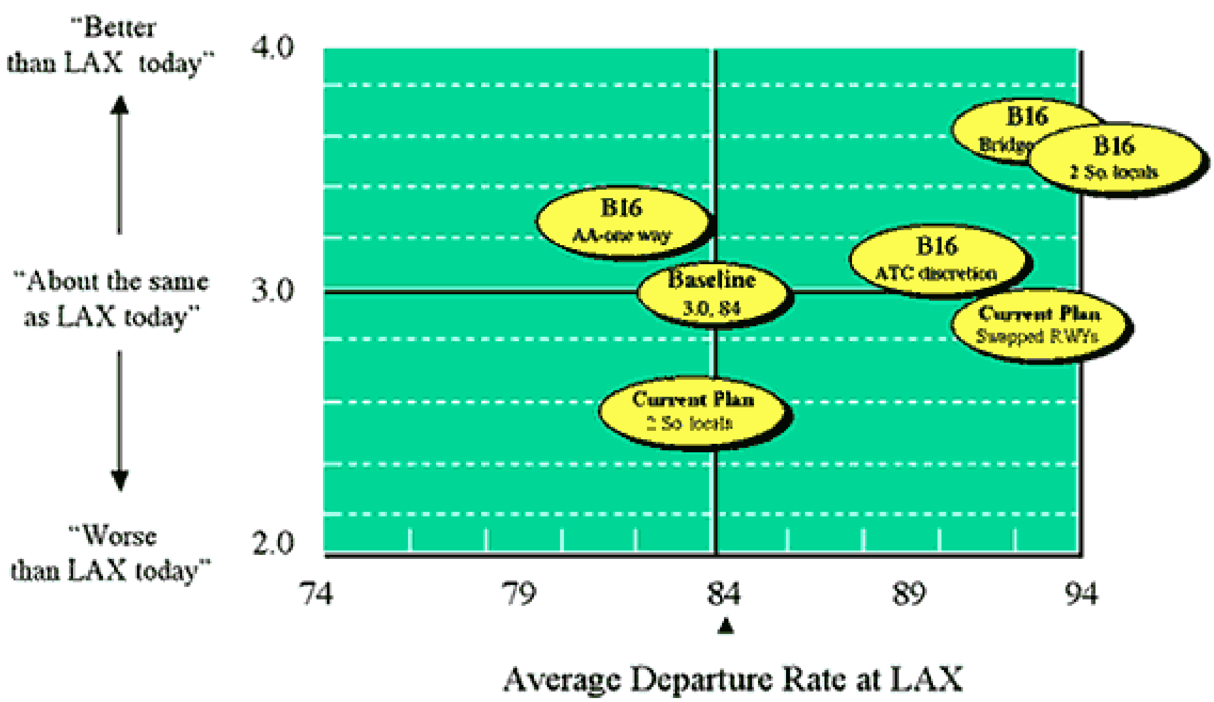

Figure 1: Controller Subjective Ratings during Peak Departure Scenarios

Each circle identifies a particular airport configuration simulated. Note that for a peak departure rush, the baseline or center point is defined as 84 aircraft/hour with a safety and efficiency rating of 3.0 or "About the same as LAX today," in the view of the LAX ATCs.

One of the most salient features of the diagram is that the two simulations using today's airport geometry (labeled "Current Plan") were perceived as "worse than LAX today." Interestingly, the test scenario using increased staffing, namely, two locals on the South-side (one per runway), was judged as considerably **less safe** by controllers.

In contrast, every test simulation incorporating a south-side taxiway extension (See Figure 2 below) was judged as safer and more efficient than the simulation of LAX today.

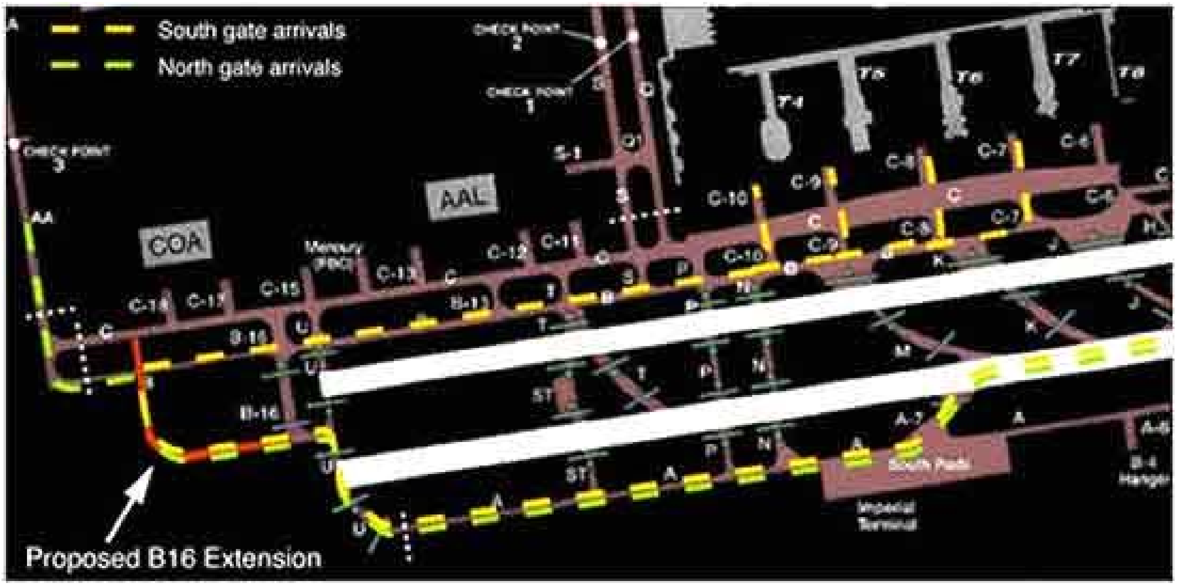

Figure 2: Operations with a B-16 Taxiway Extension

Because the taxiway effectively rerouted aircraft outside the LAX "hot spots" (midfield near the high speed taxiway exits J, K, L and M), the B16 simulations reduced the congestion and hence the chance for collision in the midfield area.

Figure 1 also shows that some test versions of the B16 taxi extension were judged safer and more efficient than others and, objectively, some versions moved more aircraft than others. This result captures one of the more powerful aspects of NASA FutureFlight as a test facility: the simulations of the B16 taxiway that were both subjectively and objectively preferred were in fact **later** tests that were *procedurally refined by the controllers*. In other words, the LAX controllers, by participating in the simulation, were able to make successive procedural improvements in directing traffic with the taxiway extension.

An important conclusion of Figure 1 is that it was possible to identify safer and more efficient configurations of the airport that did not negatively impact the departure capacity of the airport. However, perhaps our most striking result is demonstrating that air traffic procedures by themselves can have a dramatic impact on how much safety and capacity an airport gains from a given geometry. This underscores the much underrated human factor as an element in efficient and safe airport design.

(The complete reports, The Los Angeles International Airport Runway Incursion Studies: Phase II Alternatives Simulation and Phase I Baseline Simulation are posted on our web site at http://ffc.arc.nasa.gov/our_customers/lax.html. They are both downloadable as Adobe Acrobat PDF files.)

2. Opening Trials of the Surface Management System: DFW Controllers Critique New Decision Support Tool

NASA FutureFlight Central completed the first of two simulations of the Surface Management System (SMS) in September 2001. Dallas-Fort Worth controllers managed DFW's East Tower traffic while utilizing SMS, an enhanced decision support tool.

Through its simulation expertise, the FutureFlight facility is supporting the NASA Ames Advanced Air Transportation Technology (AATT) Project and the Federal Aviation Administration's Free Flight Program Office in their development of SMS. This system will help controllers and airlines manage aircraft surface traffic at busy airports, thus improving capacity, efficiency, flexibility, and safety.

Since FutureFlight Central is designed as a test environment for the introduction of new technologies, four DFW controllers managed traffic as they would in real life, using SMS and then providing valuable feedback to the designers. Controllers from Memphis and Norfolk airports, airline representatives, and Free Flight Program Office representatives also took part in the evaluation. Stephen Atkins, NASA's Project Lead for SMS, was "very satisfied" with the SMS simulation.

"FFC allows the eventual users to experience SMS in a realistic environment. It's not until controllers try using a DST [decision support tool] that they can provide the feedback needed to design a usable and useful product," Atkins explained.

How does SMS help manage traffic? Currently, accurate information about future departure demand and the impact it will have on the airport is not available. SMS provides controllers, traffic managers, and airlines with information about future departure demand and predicts the impact that demand will have under various traffic management decisions.

SMS uses three types of displays to provide information and advisories: maps, timelines, and load graphs. SMS adds flight specific information, such as the first departure fix and runway assignment for departures or parking gate/hand-off spot for arrivals, to the map display. SMS's innovation relates to its ability to predict problems that may occur, thus enabling controllers to keep traffic moving. It provides timelines showing temporal information (e.g., future departure sequence) and load graphs showing trend information (e.g., total future departure demand for each fix). The information content in each display type is customized to the tasks for which the controller is responsible.

In January 2002, the second SMS simulation will evaluate the next iteration of SMS, including the interoperation of SMS and Traffic Management Advisor (TMA). TMA, one of the Center-TRACON Automation System (CTAS) tools, assists TRACON and Center traffic management coordinators in flow management planning. A complete description of the CTAS suite of decision support tools can be found at http://www.ctas.arc.nasa.gov/.

3. Tech Innovations @ FutureFlight Central: Software and Hardware Upgrades Bolster Realism

Greatly contributing to the FutureFlight environment are the Adacel Air Traffic Simulation software and SGI visual computing hardware. Both these components allow FutureFlight to simulate highly trafficked airports with intense realism.

In June, FutureFlight was upgraded to use Adacel's Maxsim 2.2 software. Some of the highlights of the new software capabilities include the following:

- Enhanced weather (e.g. rain, snow storms)
- Dynamic eye point (useful for tower siting studies and ramp studies)
- Record and Playback at all ATC and pseudo pilot positions
- VTOL (vertical takeoff and landing) aircraft capability (e.g. Harrier, Osprey)

Complementing the software enhancements, NASA FutureFlight will soon be upgrading the SGI Onyx 2 supercomputer to an Onyx 3 model. This upgrade will dramatically enhance both the visual realism as well as the capability to handle more traffic operations.

Faster processors and more memory will enable much higher resolution. These computer upgrades are key to FutureFlight's ability to simulate future air traffic demand levels at airports of greater than 300 operations per hour. The visual resolution upgrades are equally important in allowing a more lifelike"out-the-window" view for controllers.

4. Visitors to FutureFlight

NASA FutureFlight Central continues to host tours to members of the aviation community. Recent visitors included:

California Highway Patrol- Air Operations Group
Dallas Fort Worth International Airport
Department of Defense
Department of Transportation
FAA- Air Traffic Procedures Advisory Committee (ATPAC)
FAA- Runway Safety Office
FAA Í Safe Flight 21
Japanese Space Agency
Massachusetts Institute of Technology (MIT) - Sloan Fellows
Minneapolis-St. Paul International Airport
NASA- Kennedy Space Center
NASA Langley
NATCA- RTAC Committee
Science Applications International Corporation (SAIC)
Seattle-Tacoma International Airport
San Jose Airport Commissioners

5. Thinking of Doing Business with FutureFlight Central?

Contact **Nancy Dorighi**, FutureFlight Central Manager, Nancy.S.Dorighi@nasa.gov or call **650.604.3258** for more information and to explore what we can do for your airport or airline needs.

The Team at NASA FutureFlight Central
http://ffc.arc.nasa.gov

Experience the Future of Your Airport!
