Aviation Infrastructure Economics

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NATIONAL AIRSPACE SYSTEM (NAS) INFRASTRUCTURE MANAGEMENT OVERVIEW

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What is a System?

“A system may be considered as constituting a nucleus of elements combined in such a manner as to accomplish a function in response to an identified need… A system must have a functional purpose, may include a mix of products and processes, and may be contained within some form of hierarchy…”

What is the National Airspace System?

“The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.”

Pilot/Controller Glossary
Background

Why Do We Need Reliable and Modern Aviation Infrastructure?

• The United States accounts for approximately 30 percent of all commercial aviation and 50 percent of all general aviation activity in the world.

• Prior to September 11, 2001 the NAS handled 1.9 million passengers traveling on 60,000 flights daily.

• NAS moves over 600 million passengers per year. Projected enplanements in year 2013 is over 900 million.

• NAS conducts over 26 million operations per year. Projected number of operations in 2013 is over 33 million.

Source: ACE 2002
• 546 commercial service airports:
  422 have more than 10,000 enplanements and are classified as primary airports (Commercial service airports are defined as public airports receiving scheduled passenger service and having 2,500 or more enplaned passengers per year).

• 31 large hub airports account for 70 percent of all passenger enplanements.

• 37 medium hub airports account for 19 percent of all enplanements

• 74 small hub airports account for 8 percent of all enplanements

• 50 airlines

Source: NPIAS
Background

Number of Airports by Ownership and Use (January 2001)

19,306
Total U.S. Airports

5,314
Open to Public

13,992
Closed to Public

4,160
Public Owned

1,154
Private Owned

3,489
NPIAS Airports

3,364 Existing
3,226 Public Owned
138 Private Owned

125 Proposed

Source: NPIAS
Background

Runway Pavement Condition

Runway Pavement Condition (2000)

Source: NPIAS
### New Runways in OEP

Source: OEP

<table>
<thead>
<tr>
<th>Airport</th>
<th>Runway</th>
<th>FY Runway to Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orlando (MCO)</td>
<td>17L/35R</td>
<td>2004</td>
</tr>
<tr>
<td>Cleveland (CLE)</td>
<td>6L/24R, Phase 2</td>
<td>2005</td>
</tr>
<tr>
<td>Minneapolis (MSP)</td>
<td>17/35</td>
<td>2006</td>
</tr>
<tr>
<td>Cincinnati (CVG)</td>
<td>17/35</td>
<td>2006</td>
</tr>
<tr>
<td>St. Louis (STL)</td>
<td>12R/30L</td>
<td>2006</td>
</tr>
<tr>
<td>Atlanta (ATL)</td>
<td>10/28</td>
<td>2006</td>
</tr>
<tr>
<td>Boston (BOS)</td>
<td>14/32</td>
<td>2006</td>
</tr>
<tr>
<td>Washington (IAD)</td>
<td>1W/19W</td>
<td>2008</td>
</tr>
<tr>
<td>Seattle (SEA)</td>
<td>16W/34W</td>
<td>2009</td>
</tr>
</tbody>
</table>
National Airspace System is:

- highly technical
- highly integrated
- extremely complex.

- It is the largest of all civil infrastructure systems.
- It operates 24 hours per day, 7 days a week and contributes to the air transportation commerce that constitutes six percent of the nation’s gross domestic product.

Source: http://www.faa.gov/nasarchitecture/blueprnt/nasmod2.htm
Background

NAS Inventory

• NAS has about 44,000 pieces of equipment and services that provide air traffic management (ATM) services.

• NAS’ large inventory of capital assets are in various stages of approaching physical or technical obsolescence.

Source: http://www.faa.gov/ats/aaf/
Background

NAS Inventory

Source: NAPRS data

Frequencies of Scheduled (Cause Code 60) and Unscheduled Outages (Cause Code 80) for Airport Surveillance Radars (ASR)
Background

NAS Inventory

Downtimes of Scheduled (Cause Code 60) and Unscheduled Outages (Cause Code 80) for Airport Surveillance Radars (ASR)

Source: NAPRS data
Background
NAS Inventory

Source: NAPRS data

Frequency of Scheduled (Cause Code 60) and Unscheduled Outages (Cause Code 80) for Localizers (LOC)
Background

NAS Inventory

Downtimes of Scheduled (Cause Code 60) and Unscheduled Outages (Cause Code 80) for Localizers (LOC)

Source: NAPRS data
Background

NAS Inventory

60 and 80 for all NAPRS equipment

Source: NAPRS data

Frequency of Scheduled (Cause Code 60) and Unscheduled Outages (Cause Code 80) for All NAPRS Equipment
Background

NAS Inventory

60 and 80 cause codes for all NAPRS equipment

Source: NAPRS data

Downtimes of Scheduled (Cause Code 60) and Unscheduled Outages (Cause Code 80) for All NAPRS Equipment
Background

NAS Inventory

- ~ 500 FAA Managed Air Traffic Control Towers
- ~ 180 Terminal Radar Control Centers (TRACONs)
- 22 Enroute Centers – Air Route Traffic Control Centers (ARTCC)
- > 730 Sectors with more than 100 additional sectors under consideration
- ~ 60 Flight Service Stations
Background

NAS Inventory

• 20,000 – 25,000 administrative and mission support computers

• 1,800 people to maintain and operate NAS software

• $100 million contract costs to maintain NAS software
The maintenance of individual equipment or systems supporting air traffic control of the NAS requires technicians trained in many disciplines deployed over the entire country.

Maintenance workforce is managed out of a national network of cost centers.

Each cost center has a limited number of technicians who are responsible for providing scheduled and unscheduled maintenance and repair for the equipment assigned to that center.
Background

NAS Infrastructure Management

• Different types of equipment have different repair time characteristics.

• Technicians are trained to repair specific types of equipment.

• To date there is no centralized system for equipment maintenance.
- Facilities are the equipment and systems which are serviced by technicians.

- A subset of specific facilities in the cost center comprise a service. For example, an Instrument Landing System (ILS) is composed of a glide slope (GS), localizer (LOC), inner marker (IM), middle marker (MM), outer marker (OM), distance measuring equipment (DME), runway visual range (RVR), and an approach lighting system (ALS).

- Technicians and facilities are grouped together into FAA-defined cost centers.
Background

Relevant NAS Measures of Performance and their Relations

- Ideal Capacity
  - Reliability
  - Availability
    - Maintainability
  - Capacity and Delay
    - Demand for Services
      - Income
      - Structure of Production
  - Air Transport System Performance
  - Social and Economic Benefits of Aviation