Prior
NASA General Aviation Research
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Topics

- A Retrospective View of What Worked and What ...mmm... not so much (2003-2006)
  - AGATE
  - ERAST
  - GAP
  - SATS
- The Evolution of Mobility Demand and Supply
- Current Needs
- Approaches to Government – Industry Collaboration
- Summary Remarks

This presentation provides my views through the lens of past NASA experiences and startup entrepreneurial endeavors - aiming at game-changing innovations in air mobility.
RETROSPECTIVE ON DISTRIBUTED, DEMOCRATIZED AIR MOBILITY From three industry CEO’s shared perspective...
Strategic Innovation Premise

• A large underserved market opportunity exists for personal on-demand (mobility) air transportation (ODM)
• ODM is “strategic” or “blue ocean” in the sense that it stimulates new demand, previously unreachable and unfulfilled
• The lessons of the first-to-market have been learned (e.g., DayJet, SATSair)
• Many past barriers to market success have been lowered
• New barriers will require attention (e.g., cost, automation)
• The market is in need of new solutions
• The solutions generate significant value for our nation
A portfolio of integrated national technology development projects spanning the late 1980’s to 2005, with industrial and governmental investments exceeding $2 billion, was implemented on the premise that the results would lead to significant market uptick in the use of community airports and advanced technology smaller transportation aircraft for public transportation.

The evidence of the recent ten years, following completion of these investments, reveals an absence of intended effect; the premise failed to reach fruition, to date.

Why?
What is the relevance of the premise today?
What good came of the investments?
What technology strategies are relevant now?
**Context: Total US Travel, All Modes**

*(Charter flying is a small fraction of the potential demand)*

<table>
<thead>
<tr>
<th>Travel Categories</th>
<th>2013 Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Trips - Planes, Trains, Autos</td>
<td>2,052 million</td>
</tr>
<tr>
<td>Leisure Travel Person-trips – All modes</td>
<td>1,600 million</td>
</tr>
<tr>
<td>Business Travel Person-trips – All modes</td>
<td>452 million</td>
</tr>
<tr>
<td>Scheduled Carrier Enplanements 5/13-4/14</td>
<td>747 million</td>
</tr>
<tr>
<td>Non-Scheduled/Charter Enplanements</td>
<td>5 million</td>
</tr>
<tr>
<td>Business Travel Person-trips by Air</td>
<td>150 million</td>
</tr>
<tr>
<td>Leisure Travel Person-trips by Air</td>
<td>597 million</td>
</tr>
</tbody>
</table>

On-Demand Mobility

Enplanements – Scheduled 99% + Charter 1%: 752 million

All Trips – Business 28% + Leisure 72%: 2.052 billion

- Planes, Trains, Autos

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Additional resources:

- [www.businesstravelnews.com/Business-Travel/Business-Travel-To-Grow,-But-Slowly,-U-S--Travel-Association-Forecasts/?a=mgmt](http://www.businesstravelnews.com/Business-Travel/Business-Travel-To-Grow,-But-Slowly,-U-S--Travel-Association-Forecasts/?a=mgmt)
Legacy GA Not Growing With GDP

Data reveal weak coupling of GA demand with GDP, indicating that **new strategies are required** to move this market’s needle.
Market Penetration

AirMarkets uses “Consumer Awareness” as a measure of Market Penetration to account for passenger knowledge, comfort, confidence, and access to the Personal Jet mode.

Assume Value of 0.5 (50%) can be achieved in 12 years

Conservative Value of 0.05 (5%) is used for this initial Personal Jets demand study

Cumulative Consumption or Market Penetration, “Awareness Factor”
Evolution of Transportation Demand

As per capita income rises,
per capita annual travel rises,
personal daily travel time budgets remain constant,
and
high-speed modes gain market share

High-Speed Transport in 2020 – as large as all transport in 1960 and as all auto transport in 1990
The Interstate Highway Challenge

• For 30 US states, road congestion is a serious issue for more than 1/3rd of the population.

• For the Nation, the Interstate Highway System in completed, while demand grows.
Industry and Government Motivations

- Evolution of Transportation Demand
- Constellation of NASA-Industry-FAA Investments
- Industrial Response
- Outcomes
- Opportunities
Constellation of NASA-Industry-FAA Investments

AGATE Alliance 1994-2001
GAP Project 1995-2000
SATS Project 2001-2005

Outcome: Technology, Regulatory Policy, Infrastructure Investment supporting expanded use of community airports and smaller aircraft for public transportation; however, we did not go far enough.
Industrial Response

And Several Others
Expanded use of community airports and smaller aircraft for public transportation

**Result:** Significant Infrastructure Advancements
- e.g., Virginia airports, AWOS III
- Nationally, LPV-WAAS >> ILS
SATS Assessment
(From 2005 NASA Review)

• Deployed new transportation system demand analytical modeling.
• Conducted Business Case studies for:
  – North Carolina
  – Ohio
  – Upper Great Plains
  – Virginia
  – Michigan
  – Northeast Corridor & the Southeast
• Conclusions from 2005 reports
  – Profitability between $1.50 – $2.00 psm
  – Demand exists to support new aircraft
  – Costs still too high

**However:** Purpose-designed aircraft are needed to achieve fares $1/seat-mile
A DayJet Lesson on Aircraft

11 months of revenue service
- Average Trip Length = 252 nm
- Shortest leg – 97 nm
- Longest leg – 450 nm
- Typical Altitude – FL 180-210
- $1.25/psm< Fares < $4/psm

Eclipse 500
- Max Range – 1,100 nm
- Optimum Cruise Altitudes – FL 350-410

SATSAir Story Very Similar (Cirrus SR 22, 4 years service)

Revenue Inefficiencies = Aircraft Mismatch + Airspace Inefficiencies + Two-Crew Operation: More than 40% “loss”
On-Demand Air Carrier Sector

Business Models (Parts 91K, 125, 121, 135)
- Branded Charter
- Brokered Charter
- Fractional
- Subscription Transport
- Jet Card
- Leasing
- Networked Air Taxi, per-seat
- Prop Card
- Pure Charter
- Corporate Shuttle
- Ride Sharing
Data illustrate decoupling of demand from GDP, indicating that **new strategies are required** to move this market’s needle.
Medium Term Market Driver: Scheduled Air Service Contraction

The continuing contraction of the scheduled air carriers creates a market vacuum as communities lose service.

Based on data from the US Department of Transportation, Bureau of Transportation Statistics.
Enablers for Innovation in On-Demand Air Mobility Service

The “Right” Airplane

A higher-volume, purpose-built aircraft for thin-haul, networked, on-demand service reduces operating costs by >15%

Real-time Logistics

Demand-Supply satisfaction and scheduling software enables per-seat fairs with 2-4X reduction in fares

Small World Networks

Autonomy reduces crew costs by about 25%

Autonomy and NextGen

NextGen reduces fuel costs by 5 – 15% (estimates during FAA Test Bed project)

The regulatory, technical, and operational needs converge between UAS and On-Demand air service
On-Demand Personal Air Travel
Consumer Value Proposition

On-Demand Network Performance
- Point-to-Point efficiencies
- Reduced network fragility

Quality of Service
- Individualized preferences
- Door-to-door speed
- Value of Time, Command of time

Community Access
- Air access and economic development
- Quality of life
Lessons and Opportunities

• Airplane Requirements
• On-Demand Transport Market Size and Nature
• Logistics Capability Requirements
• Small World Network Design
• Effects of NextGen (TBO, ADS-B, DataComm, ...)
• Prospects for and path to Autonomy

We have lived through one of the largest industrial-governmental “experiments” in air mobility innovations, learned the lessons, and see the prospects for overcoming remaining barriers.
Necessary Advancements

• Airspace with highway-equivalent operating simplicity
• Air Portals with seamless interconnectivity between roads and airspace
• Autonomous air vehicles with car-equivalent operating costs
• Outcomes that are beyond the ROI time horizon for the private sector (10-15 years)
  – Pre-competitive standards, guidelines, certs
  – Trust in autonomy
  – Host culture change in century-old industry

Create Blue Ocean strategic innovations
The 21st Century model for innovation requires new organizational processes.

The 20th Century Innovation Life Cycle
(Integrated within the innovation organization)

21st Century Innovation Organizations
Alliance Strategy
(An Historical Example)

A Constellation of Alliances led to the public good outcome sought by NASA and new industrial capacity deployed by industry.
Innovation Alliance Strategies
Design Architecture

Key:
Start here

Solution Seekers/
End Users

If you’ll need it, we’ll do the research.
If you’ll do the research, we’ll build it.
If you’ll write standards, we’ll use them.
If you’ll buy it, we’ll finance it.
If you’ll finance it, we’ll build it.
If you’ll do the research, we’ll build it.
If you’ll finance it, we’ll build it.
If you’ll write standards, we’ll use them.

Standards &
Certification

Supply
Chain(s)

Finance

R&T Providers
Bottom Lines

• We have lived through one of the largest industrial-governmental air mobility innovation experiences, learned the lessons, and see the prospects for overcoming remaining barriers.

• U.S. NextGen and E.U. SESAR programs are favorable to infrastructure for ODM operating capabilities.

• Modern market demand modeling tools, based on Agent-Based Models, provide improved and deeper insight into market opportunities and design decisions.

• Current aircraft are challenged to meet the cost and quality of service needed to make a breakthrough in air charter for On-Demand Mobility.

• The potential exists to achieve market fares that could drive demand to reach consumers and markets not served today.

• The global demand for democratized personal air mobility vastly exceeds the supply.
Thank You!
Bibliography


Continued
Bibliography, Concluded


