Air Transportation in 2030-50 and Data Analytics in Aviation

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AIR TRANSPORTATION IN 2050
World in 2050 - Demography

<table>
<thead>
<tr>
<th>Rank</th>
<th>1950</th>
<th>2000</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>554.8</td>
<td>1,275.2</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>357.6</td>
<td>1,016.9</td>
</tr>
<tr>
<td>3</td>
<td>U.S.A.</td>
<td>157.8</td>
<td>285.0</td>
</tr>
<tr>
<td>4</td>
<td>Russian Federation</td>
<td>102.7</td>
<td>211.6</td>
</tr>
<tr>
<td>5</td>
<td>Japan</td>
<td>83.6</td>
<td>171.8</td>
</tr>
<tr>
<td>6</td>
<td>Indonesia</td>
<td>79.5</td>
<td>145.6</td>
</tr>
<tr>
<td>7</td>
<td>Germany</td>
<td>68.4</td>
<td>142.7</td>
</tr>
<tr>
<td>8</td>
<td>Brazil</td>
<td>54.0</td>
<td>138.0</td>
</tr>
<tr>
<td>9</td>
<td>United Kingdom</td>
<td>49.8</td>
<td>127.0</td>
</tr>
<tr>
<td>10</td>
<td>Italy</td>
<td>47.1</td>
<td>114.7</td>
</tr>
</tbody>
</table>

World population forecast [UNO4]
Comparison of year-over-year GDP growth (left), Trips over GDP per capita (right) [Airbus13]
World in 2050 - Enabling Technologies

• ATM/Aircraft Manufacturers
  – 3D/4D Printing
  – New materials
    • Ultra light metal alloys
    • Repairable composites
    • Hybrid & smart materials
  – New Engine Technologies
    • Quiet engines
    • Ultra high bypass ration turboprops
    • Open rotor engines, scramjets
  – New wing designs, longer and thinner structures
  – New inner designs
    • Bionic structures, self-cleaning spaces
    • Energy harvesting adaptable seats
  – Hybrid rocket technology
  – All electrical aircraft
World in 2050 - Enabling Technologies

• Airlines / Aircrafts / Aircraft Manufacturers
  – Advanced guidance, navigation, control & communication
    • Air Traffic Service Unit (ATSU)
    • VHF data radio (VDR3)
    • Data link control and display units (DCDUs)
    • Controller - pilot data link communications (CPDLC)
  – Eco-climb
  – Express skyways
  – Free glide approaches and landing
  – Autonomous ground operations

• Data Analytics for
  • Targeted Advertisement
  • Maintenance Optimization
  • Delay Estimation and Flight Planning
World in 2050 - Enabling Technologies

- Society
  - Advanced virtual and augmented reality
    - Real time sensitive feedback
  - Internet of things
    - Network of everyday smart devices
  - Quantum computing
    - Ultra efficient computing paradigm
  - New energy sources
• Air Navigation Service Providers
  – Favor functionality over supremacy by 2050, deal with political barriers
  – Create new job areas
  – EUROCONTROL vision:
    • Delays will be mitigated by highly efficient night operations
    • SESAR will be implemented by 2050
    • Airspace capacity will increase by 80% to 200% by 2050 [EU11]
  – FAA vision [JPDO10] :
    • Collaborative capacity management
    • Collaborative flow contingency management
    • Efficient trajectory management
    • Flexible separation management
World in 2050 - Stakeholders of Air Transportation in 2050

- **Airlines**
  - New airlines by 2050 with a higher percentage of them being low-cost carriers
  - Mitigating delays will help airlines to save billions of dollars

- **Airports**
  - In 2050, traditional hub airports expected to have high utilization rates
  - Airline owned hubs for creating a more integrated infrastructure
  - Airports can unbundle the prices for airlines for increasing the interoperability [IATA11]
  - Vertiports, heliports, high-speed trains, regional short-distance flights to interconnect with other means of transportation
  - More passenger oriented
  - Utilizing smart and renewable power
  - Increased security with enhanced equipment and infrastructure
World in 2050 - Stakeholders of Air Transportation in 2050

- Aircraft and ATM Equipment Manufacturers / Suppliers
  - New engine Technologies
  - Advanced robotics, unmanned workspaces, flexible automation
  - Instantaneously switch between components, totally reconfigurable factory.
  - Advanced manufacturing equipment, smart materials

- Society
  - Equity of access, safe and seamless flights
  - Reduced environmental impact on society
  - Passengers will be able to pick the optimum way of transportation by easily providing their requirements and constraints
Air Transportation in 2030s

GLOBAL NETWORK CARRIERS ARE THE LARGEST IN 2012, BUT LOW-COST CARRIERS ARE THE FASTEST GROWING BETWEEN 2012 AND 2032

Market shares of carriers (left) [Airbus13], Fleet composition change (right) [Boeing13]
Air Transportation in 2030s

• Main drivers of traffic and fleet growth toward 2030

RPK traffic by airline domicile (left), World annual RPK in the next 15 years (right) [Airbus13]
Air Transportation in 2030s

- Emerging economies and the impact on air transportation growth up to the 2030s

"...we must embrace the reality of an industry whose center of gravity is shifting away from our traditional leaders in the US and Europe. Asia-Pacific is already our biggest market. The continued development of China and India will keep this region at the industry’s forefront. We must engage the region to deliver leadership for change." [IATA11]
Air Transportation in 2030s

Until recently, the airline industry was viewed as the center of Europe

After 2020, the industry will move to the center to the East Cities, like Istanbul, Doha, Abu Dhabi and Dubai, will play a key role as centers of the new attraction

Source: Airbus Global Market Forecast 2012

Geographic centre of gravity of departing/arriving/connecting passengers per city
Traffic as month of September; estimates for historic passenger derived from offered seats; respective centres of gravity as median of city coordinates weighted by passenger traffic
DATA ANALYTICS IN AVIATION
• Analytics improved massively in recent years
  – Advances in operations research, computer science and statistics
  – Sustained improvements in computation power
  – Huge amounts of data
  – Success stories

Data Scientist: The Sexiest Job of the 21st Century
by Thomas H. Davenport and D. J. Patil
Features of Big Data

Source: SNIA 2012
### Big Data Applications

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Retail                    | • CRM – Customer Scoring  
• Store Siting and Layout  
• Fraud Detection / Prevention  
• Supply Chain Optimization |
| Advertising & Public Relations | • Demand Signaling  
• Ad Targeting  
• Sentiment Analysis  
• Customer Acquisition |
| Financial Services        | • Algorithmic Trading  
• Risk Analysis  
• Fraud Detection  
• Portfolio Analysis |
| Media & Telecommunications | • Network Optimization  
• Customer Scoring  
• Churn Prevention  
• Fraud Prevention |
| Manufacturing             | • Product Research  
• Engineering Analytics  
• Process & Quality Analysis  
• Distribution Optimization |
| Energy                    | • Smart Grid  
• Exploration |
| Government                | • Market Governance  
• Counter-Terrorism  
• Econometrics  
• Health Informatics |
| Healthcare & Life Sciences| • Pharmaco-Genomics  
• Bio-Informatics  
• Pharmaceutical Research  
• Clinical Outcomes Research |
Data Resources in Aviation

• Flight Data
  – Flight Plans
  – Airport Capacity Declaration
  – Radar Data

• Aircraft Data
  – QAR Data
  – Aircraft Health Data
  – Maintenance Reports

• Customer Data
  – Surveys
  – Transactions
  – Ticket Prices
  – Social Media
Data Driven Applications in Aviation

- Trajectory Optimization
- Predictive Maintenance
- Delay Estimation
- Targeted Advertising
- Crew Performance Assessment
- Sentiment Analysis
- Prediction of Customer Behavior
- .... And many more!

Richard Quest @richardquest · 10h
So @SouthwestAir charges $8 for Internet in the air @HiltonHotels charges $14.95 on ground. I realise they don’t care I am complaining
References

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• [Hansman14] Next Generation Air Transport Technologies, John Hansman, Turkish Aviation Academy, 2014.
• Turkish Airlines CEO Presentation (ICRAT 2014), Temel Kotil, Turkish Airlines, 2014.