We can indeed do better!

- **A field in need of a ‘re-think’**
  - A systems approach
  - All across spectrum
  - Excessive fragmentation of industry

- **Probably needs a reorganization**
  - Possibly driven by cost conscious airline
    (this is case of JetBlue, Fedex)
  - Might be by larger international airport management companies
JetBlue at NYC/JFK: gate area, work station, food court
JetBlue at NYC/JFK: Common lounges
JetBlue at NYC/Kennedy: Industrial design
Example of Good Airport Systems Design

• JetBlue Terminal 5 at New York/Kennedy airport (opened 2008)
  → About $750 million
  → About 25 gates ($30 million/gate)
  → About 250 operations/day (10/gate/day)
  → About 10 million passengers/year

• Very extensive systems planning, design, and management
Why this happens: empty space

- **Practice sizes each element separately:**
  - Lounge space for each gate
  - Space for each store, space for corridors

- **But: a person uses only 1 at a time**
  - Great double counting

- **Also, needs arise at different times**
  - Opportunities for different functions to share

- **Up to 50% savings possible**
Moreover, for queues...

- **A direct relation between: speed of processing and space needed**
  - The faster the processing, the less waiting in queue, the less space needed!

- **Good management uses this to save on waiting areas**
  - Example Singapore – excellent processing times, reduces need for waiting areas.
Why this happens: queues

- **Two reasons:** Misunderstanding, Poor management co-ordination

- **Misunderstanding of “capacity”**
  - As use/capacity = ρ “rho”, both delays and unreliability increase exponentially
  - Thus, “realistic capacity” < nominal capacity

- **Delays in queues => less time in shopping => less revenues**
  - But parts of airport do not coordinate…
Observations

- Two conflicting operational facts
  - Queues, waiting, congestion “everywhere”
  - Much of airport building “unused” most of time!

- Queues: you’ve experienced them
  - Check-in, security, boarding gates…

- Some facilities busy, others empty
  - Check-in peaks for different airlines
  - Many gates, gate lounges not busy

- Efficient management Opportunities
Agenda Item

Not Managing airport coherently, specifically queuing processes, space sharing
What could be different

- Recognize that airport buildings are billion dollar business investments
- Develop layered system architecture (as for computer systems) to enable
  - Standardization
  - Economies of scale
  - Continuous learning
- Need to move from “handcrafted” to “industrial” design
Why does this matter?

• **Cost**, mistakes, passenger confusion

• **Cost**: No learning, no economies of scale – structures difficult to build
  → $7 Billion for London Terminal 5!!

• **Mistakes**: Denver bag system -- $30 million/month, 15 months, ½ billion!

• **Passenger confusion**: it’s all different
  → 14 turns at Madrid, 17 levels at Frankfurt
Madrid: “The Roof”
Richard Rogers
London/Stansted: “Jewel Box”
Norman Foster
Osaka: “Bird in Flight”
Renzo Piano
Denver: “Tepees on Plain”
Fentress Associates
The traditional approach

- Almost every airport building is “original” – everything different
- “Signature architect” fantasies
- A lot of attention to roof lines, one-of-a-kind custom-built interiors
- In all shapes, sizes, and interior conveyances (often local suppliers)
An observation

- Design loads on airports common internationally – common aircraft, people and bags all nearly same
- Runways correspondingly virtually standardized by ICAO
- But Passenger Buildings “all different” – no standardization
Agenda item

Not Designing individual airports as systems
What could be desirable

- Major airport groups that could create coordinated systems of airports with economies of scale
  - Fedex suggests a model – as a shipper it has established a chain of airport assets built to its specs
  - Hotel Chain model – coordinated design and management of assets (airport companies not yet there)
Why does this matter?

• Errors of Commission and Omission!

• Wasted investments
    -- $1.1 billion runway opened in 2006

• Inadequate forward planning
  ➔ UK – London needs capacity, cannot possibly get it for a decade – too late
Actual situation

- **US:** has NPIAS – National Plan of Integrated Airport Systems
  - BUT – it’s just an inventory of Assets

- **Governments have stopped investing**
  - Canada – devolved to local authorities
  - Australia – airports privatized

- **A Global business run at retail level -- uncoordinated plans by participants with minor market shares**
An observation

- **Airports have different functions**
  - Transfer hubs – continental, intercontinental such as Denver, DFW, Dubai, Singapore
  - Business destinations – New York/LaGuardia
  - Regional and low-cost – Miami/Ft Lauderdale

- **They form a hierarchical network**
  - In other fields we collectively devote great effort to analyze and design such systems

- **But no one designs “airport system”**
Agenda item

Not Planning Airports as Systems
Flexibility

• A central theme of book

• The issue:
  ➤ Given uncertainty, best not to overcommit when future is unclear
  ➤ Maintain flexibility to take advantage of new opportunities
  ➤ Have ‘insurance,’ ability to avoid bad situations, to avoid downsides

• “Flexibility in Engineering Design,” de Neufville and Scholtes, MIT Press, 2011.
Turmoil, Uncertainty

• Airport/Airline industry is in middle of enormous change
  ➤ Airline Bankruptcies, Consolidations
  ➤ Low-Cost Carriers (Southwest, Ryanair, AirAsia – and many others)
  ➤ Open skies agreements permitting airlines to fly to many destinations in a country
  ➤ New hubs and routes – for Example Dubai, and Qantas shift from Singapore to Dubai

• We really don’t know what is next!
New Chapter: Environment

• “Aviation Environmental Impacts and Airport-level mitigations”
  ➔ Author: Dr. Tom Reynolds

• Focus
  ➔ Noise: airline procedures
  ➔ Air Quality: on airport mitigations
  ➔ Climate change: What about sea rise?
  ➔ Water Quality and Wildlife

• A shift in emphasis, less on noise, more on other factors
New Chapter: Airlines

• “The Evolving Airline Industry: Impacts on Airports”
  ➤ Author: Dr. Peter Belobaba

• Focus
  ➤ Fleet trends: ‘smaller, wide-body aircraft’
  ➤ Hubs: Connecting hubs as central model
  ➤ Schedules: frequency and ‘IROPS’
  ➤ Airport ops: faster turn-around times
  ➤ Airline costs: consolidations, mega-carriers

• Flexibility is crucial
US Airport Cooperative Research Program

- **Since 2005, sponsored by FAA**
  - “industry-driven, applied research program…. practical solutions for airport operators”

- **Research Reports**
  - About 20 reports a year, now at ACRP 90
  - [http://www.trb.org/Publications/PubsACRPPProjectReports.aspx](http://www.trb.org/Publications/PubsACRPPProjectReports.aspx)
  - ACRP 76: “Addressing Uncertainty about Future Airport Activity Levels in Airport Decision Making”

- **Much useful material**
Airport/Airline Industry

• **Industry practice focus: airports**
  - Ideas were: airlines and routes change slowly, airlines do not greatly influence traffic

• **But world is changing!**
  - Airlines now freer to choose where to fly
  - Open skies agreements, alliances, low-costs
  - Examples: Delta “quits” Cincinnati; US Air abandons Pittsburgh hub, TWA out of St. Louis

• **Needed Focus: airport/airline industry**
Airport Systems Planning, Design, and Management (3)

- Plan, Design, Manage – integrated
  - Design as extension of Planning: to enable range of possible future choices.
  - Examples to avoid: London/Stansted, Boston’s “International” terminal

  - Management and Design linked: capacity of a facility depends upon how it is managed (e.g., dwell time control in departure lounges)
  - Bad examples: Amsterdam, Bangkok/S.
  - Good example: Singapore
Airport Systems Planning, Design, and Management (2)

- Emphasis on Systems perspective
  - Among Airports: Role in world where airports compete regionally and globally – alternative hubs, London vs. Dubai – opportunities for airline alliances
  - On Airport: elements need to fit together well – not standard practice, which tends to plan projects individually, independently
  - Over Time: each project is part of a portfolio of possible projects over time, thus part of a long-term strategy
Airport Systems Planning, Design, and Management (1)

• **It’s a ‘new’ text**
  - ‘New’ because about 50% rewritten
  - A lot has changed in past decade!

• **What’s new?**
  - Airline, airport privatization now a fact
  - Results of US ACRP research [Airport Cooperative Research Program]
  - New Chapters: airline needs, environment
  - Great turmoil, uncertainty in markets
  - Emphasis on ‘Flexibility in Design’
Agenda Item

• Airport Systems Planning…

• … for airport/airline industry
Outline

• Agenda
  → Airport Systems Planning…… for airport/airline industry

• Issues
  → Not Planning airports as systems
  → Not Designing individual airports as systems
  → Not Managing airport processes efficiently, specifically queuing behavior, space sharing

• A field in need of a ‘re-think’
Welcome!

• To the MIT Webinar

• Organized by the MIT Program in Systems Design and Management

• A Master of Science Program for experienced design professionals
Airport Systems Planning, Design, and Management

Systems Approach
To
Airport Planning, Design, and Management

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