Airports – challenges for research and innovation

28-May-2014
Chris Schneider

Content:

Munich Airport

The airport environment

Innovation challenges for airports

Conclusion

Munich Airport

Munich and Bavaria – an attractive destination …

Garmisch-Partenkirchen

Zugspitze

Octoberfest

City of Munich

Nymphenburg castle

Prinzregenten Theatre

Kranzbach Castle and Karwendel
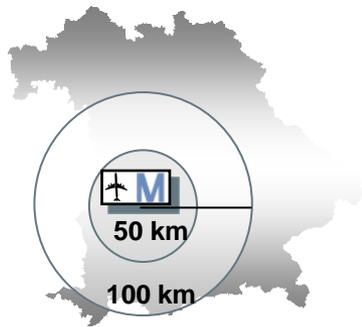
Neuschwanstein Castle

Olympic Stadium

… and a prospering economic region

Ranking of Munich Airport

		2000	2003	2006	2009	2013
Germany		2	2	2	2	2
Europe		9	8	7	7	7
Worldwide		37	33	30	30	30

Source: ACI, January 2014

Munich Airport maintains a high international reputation for quality

2014	Airport	2013	2012	2011	2010	2009	2008	2007	2006
1	Singapore Changi Airport	1	2	2	1	3			
2	Incheon International Airport	2	1	3	2	1			
3	Munich Airport	6	6	4	4	5	5	4	3
4	Hong Kong International Airport	4	3	1	3	2			
5	Amsterdam Schiphol Airport	3	4	6	7	8			
6	Tokyo International Airport Haneda	9	14						
7	Beijing Capital International Airport	5	5	5	8	17			
8	Zurich Airport	7	7	7	6	4			

Source: 2014 Skytrax

- 7 times best airport in Europe

- Since 2005 one of the best 6 airports worldwide

- Worlds best airport serving 30 to 40 million passengers

Munich Airport Infrastructure

Structured layout plan allowing sustainable growth and efficient processes

Runway System:
- **2 independent runways (4,000 m long, 60 m wide)**
- **Declared capacity: 90 mvts/hr, max 58 T/O or Ldgs**

The decentralized Terminal 1 is optimized for O&D – traffic (opened in 1992).

The centralized Terminal 2 serves as a hub terminal for Lufthansa and Star Alliance partners (opened in 2003)

Capacity of Terminal 2 will increase by 11 million passengers with the addition of a satellite building (to be finished in 2015)

The spacious Munich Airport Center (MAC) forum connects the terminals ...

... and is the perfect location for various events

MUC – 1st European airport to be approved for A380 ops

- ✓ 1 A380 Position Apron 1
- ✓ Code F TWYs
- ✓ 2 A380 Positions Apron 2
- ✓ Distance TWY/TWY 120 m
- ✓ Bearing Strength Bridges 750 t
- ✓ TWY width 30m
- ✓ RWY / Apron PCN 90/R/A/W/T
- ✓ Distance RWY – TWY 300m
- ✓ RWY width 60m
- ✓ OFZ / Holding Positions

The airport environment

Airports are 'multi-stakeholder environments'

Several stakeholders (→ business entities) are involved e.g. in passenger processes

- Public transport providers
- Check-In / gate staff
- Security control staff
- Border control / immigration staff
- Custom officers
- Airport information staff
- Baggage handlers
- Retailers and F&B providers
- Service providers for PRMs
- Medical staff
- ....

Airports are 'multi-stakeholder environments'

Several stakeholders (→ business entities) are involved e.g. in aircraft processes

- Ground Handling (pax/crew transport, loading / unloading, aircraft servicing)
- Aircraft maintenance technicians
- Ramp agents
- Airline crews
- Cleaning staff
- Fueling staff
- Cargo handlers
- Aircraft caterers
- Load planners & controllers
- Ramp / tower controllers
- Aircraft towing staff
- Aircraft de-Icers
- ....
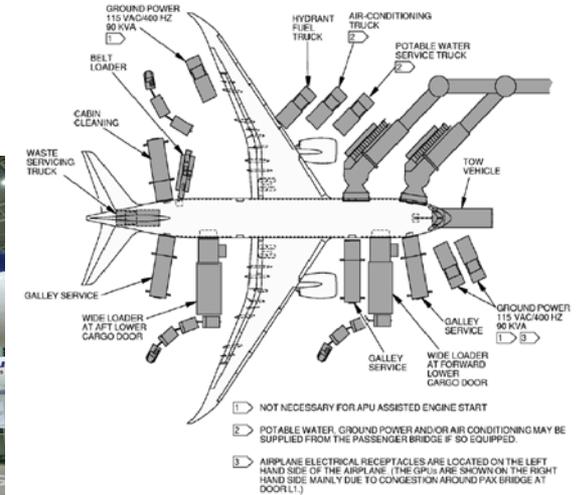
Airport processes usually have some degree of randomness…

e.g. with regards to the
aircraft sequence / availability

- Late arrival or last minute changes of

  - crews,

  - passengers,

  - baggage,

  - cargo or

  - aircraft

- Weather changes (e.g. fog, snow, thunderstorms...)

- Aircraft turnaround process

- Technical issues

- ....

and **aircraft performance / behaviour**

- Aircraft approach speeds

- Missed approaches

- Runway occupancy times departure / arrival

- Use of rapid exit taxiways to vacate runways

- Pushback & engine startup times

- Taxi speeds

- Pilot reaction times

- Short term effects (cabin not ready, technical issues)

- Times required for lineup

- Takeoff times and distances, etc.

Operations on airports will hardly ever be completely predictable, so operational flexibility is a key requirement !

The business environment ...

Airports...

- operate in a highly competitive market

- differ a lot in ownership, business models, traffic loads and structures

- generally do not make money from their aviation business

- as such have to develop business not directly related to air transport

  - The non aviation business has the greatest potential for growth in the coming years.
  - Primary areas for growth are retail, F&B, parking and real estate.
  - Primary revenue source is the passenger.

- bear the brunt of aviation security rules and associated cost

Aviation: 52%

Non-Aviation: 48%
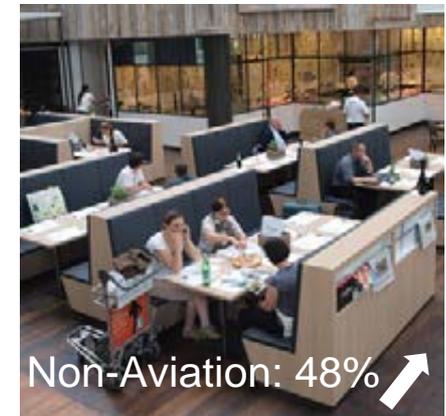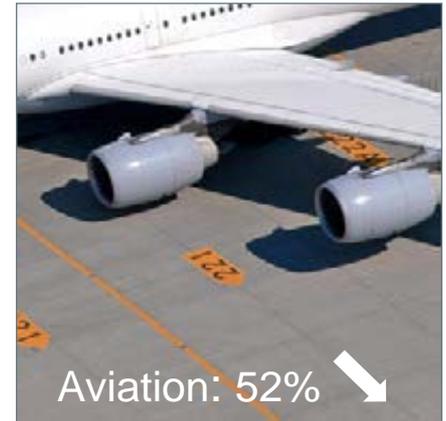
The societal environment ....

Airports...

- are the access points to the globalized world

- are a key locational factor for industry

- have a large impact on employment and economies

... but ...

- seem to fight a losing battle when it comes to societal acceptance of air transport

- have to deal a lot with complaints about emissions of air transport

- face large obstacles when it comes to securing or increasing capacity levels

Source: http://www.op-online.de/lokales/rhein-main/neues-system-anflug-flughafen-fluglaerm-reduzieren-2894236.html

The market environment ...

Only domestic traffic within China is forecast to outperform intra-European and North American traffic growth until 2032 (absolute growth, RPK):
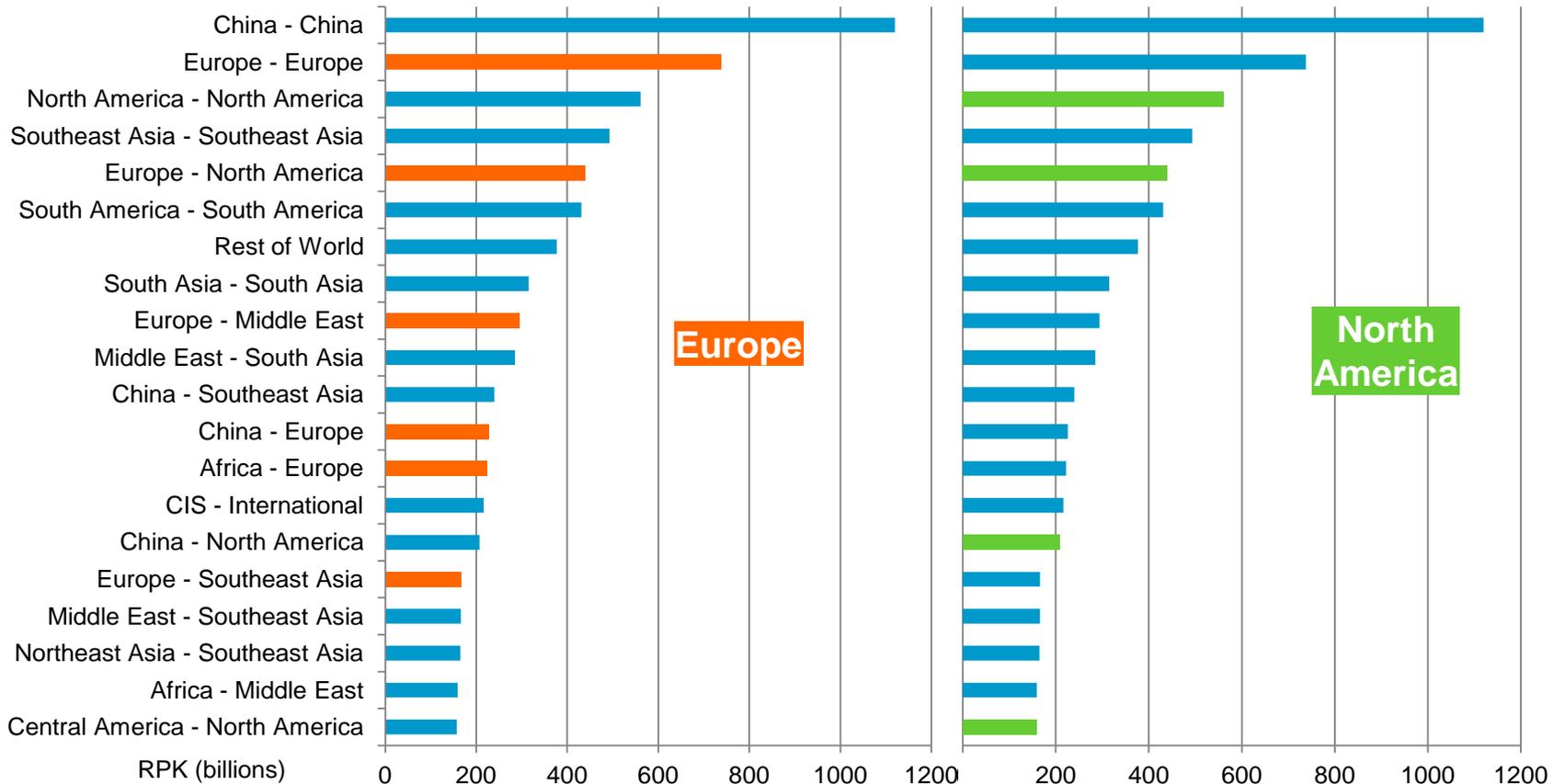
Data source: Boeing CMO 2013

The market environment ...

Europe and North America will be among the top three regions with regards to absolute traffic growth until 2032 (RPK):

Traffic growth
2012-2032

RPK (billions) from / to / within
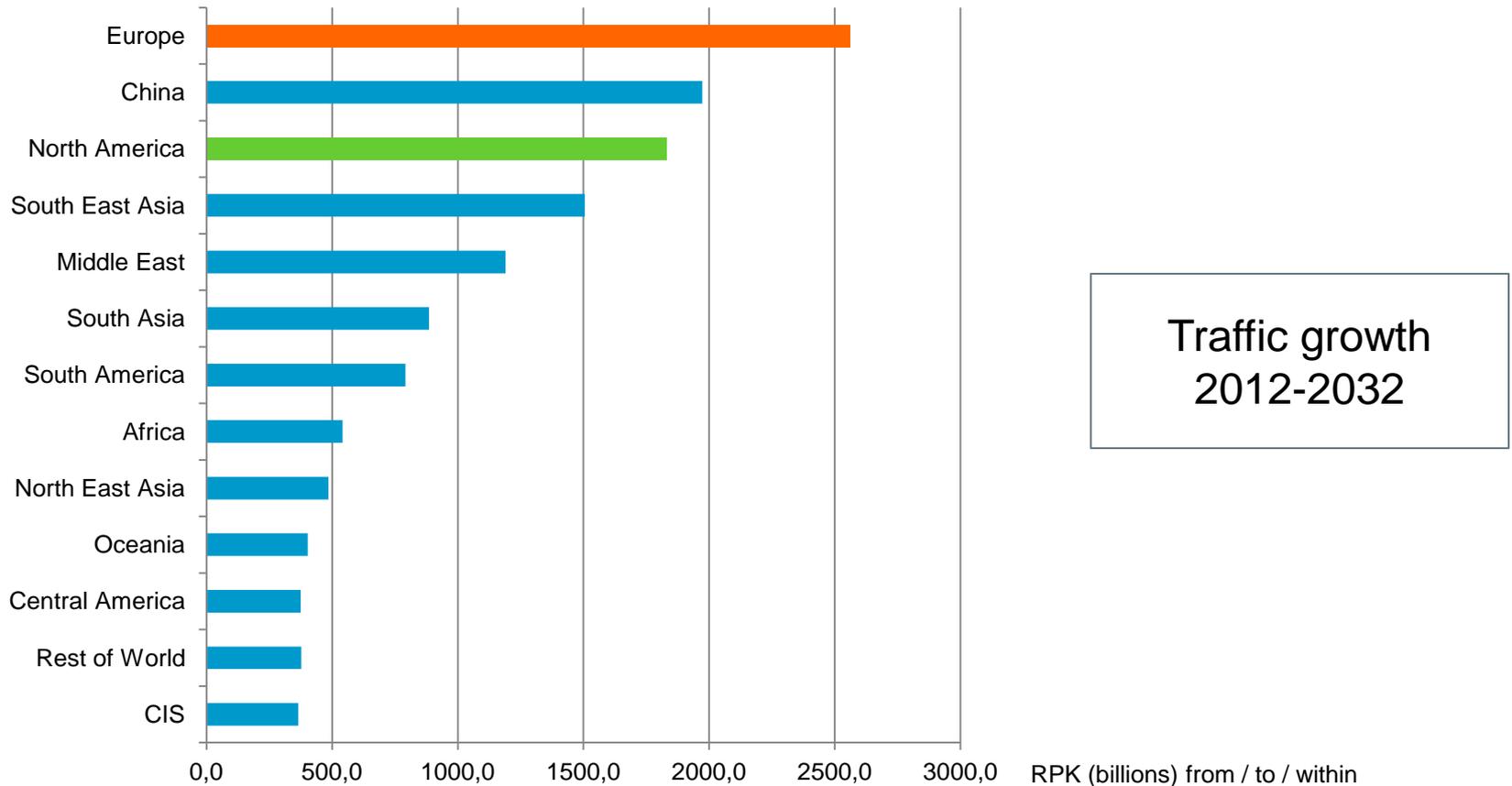
Data source: Boeing CMO 2013

Collaboration between aviation stakeholders is essential because .....

Society Politics

Manufacturers

Suppliers

Airlines

Airports

ANSPs

Picture source: thor-aloc.de
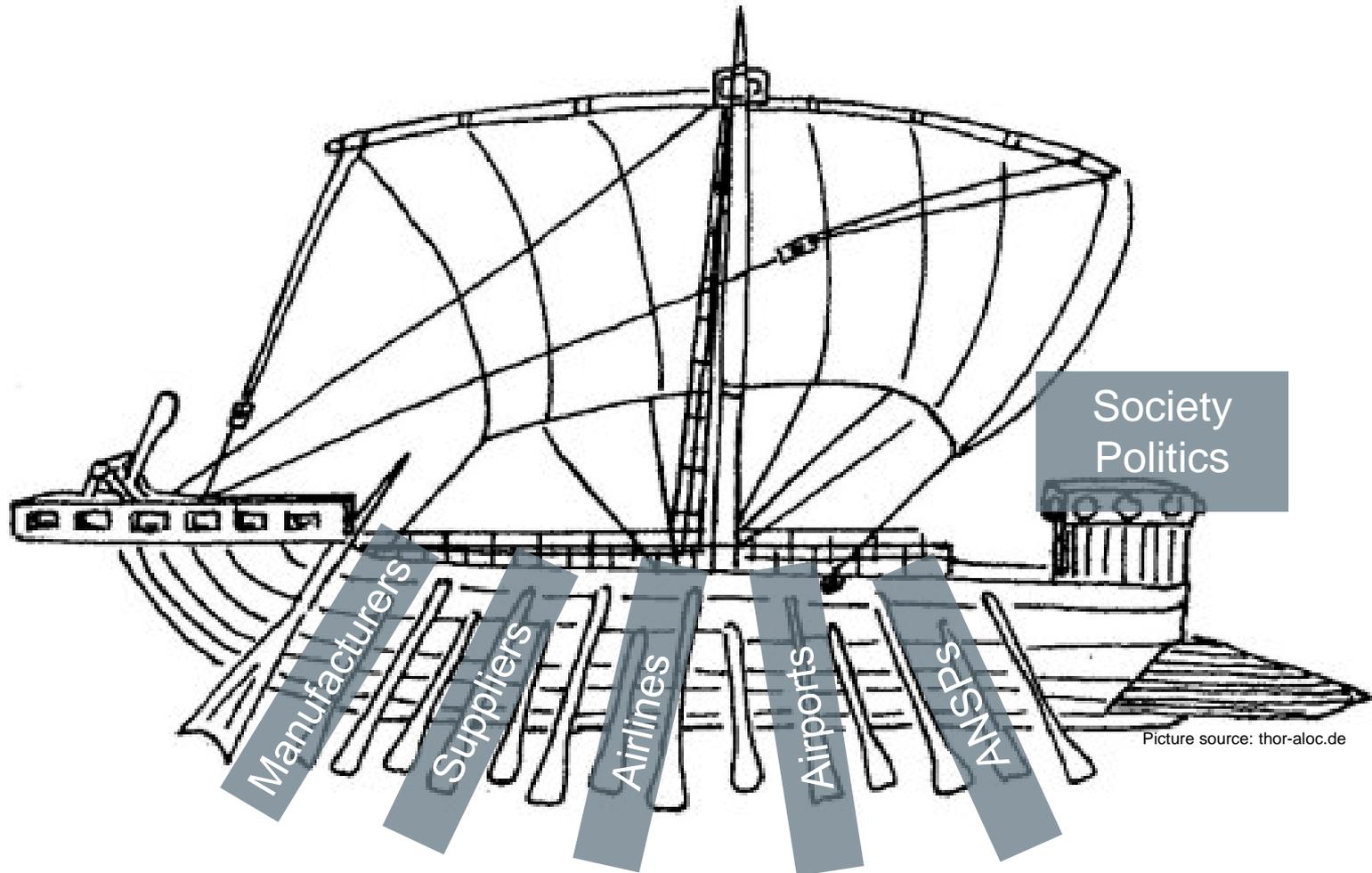
... aviation needs a license to grow from society

Innovation challenges for airports

Research & Innovation for airports

Research:

✈ Little potential for airports to differentiate by technological product development activities

✈ Very limited basic research ('L0', 'L1') activities of airports

Innovation:

• … happens at airports !

• goes beyond technological readiness of systems

• has to bring added value to (all) stakeholders, otherwise there is no market acceptance

• is successful only when innovation critical factors are considered in the development process

Key innovation challenges for airports ...

Capacity

Community Impact

License to Grow

Public Perception

Customer Experience

Inter-modality

Key innovation challenges for airports ...

Capacity

Community Impact

License to Grow

Public Perception

Customer Experience

Inter-modality
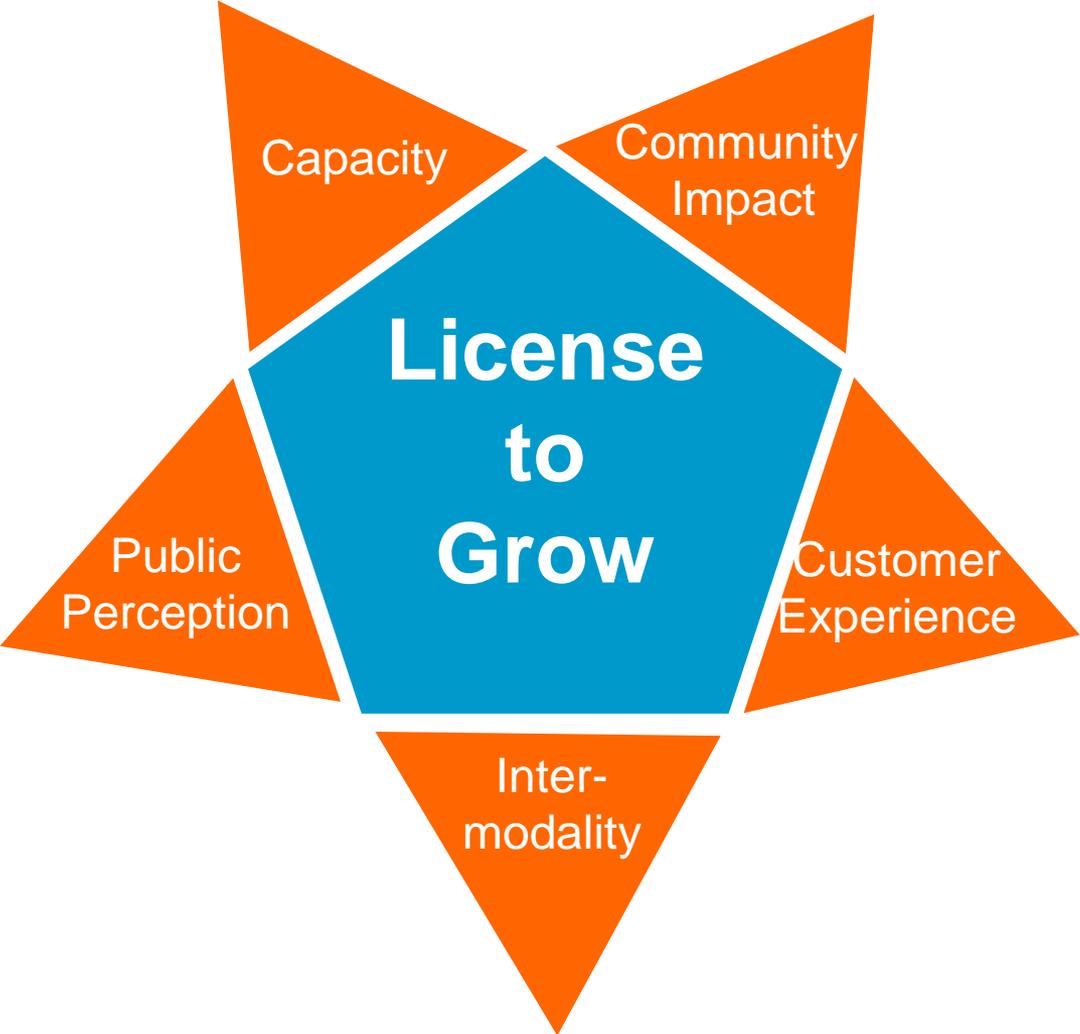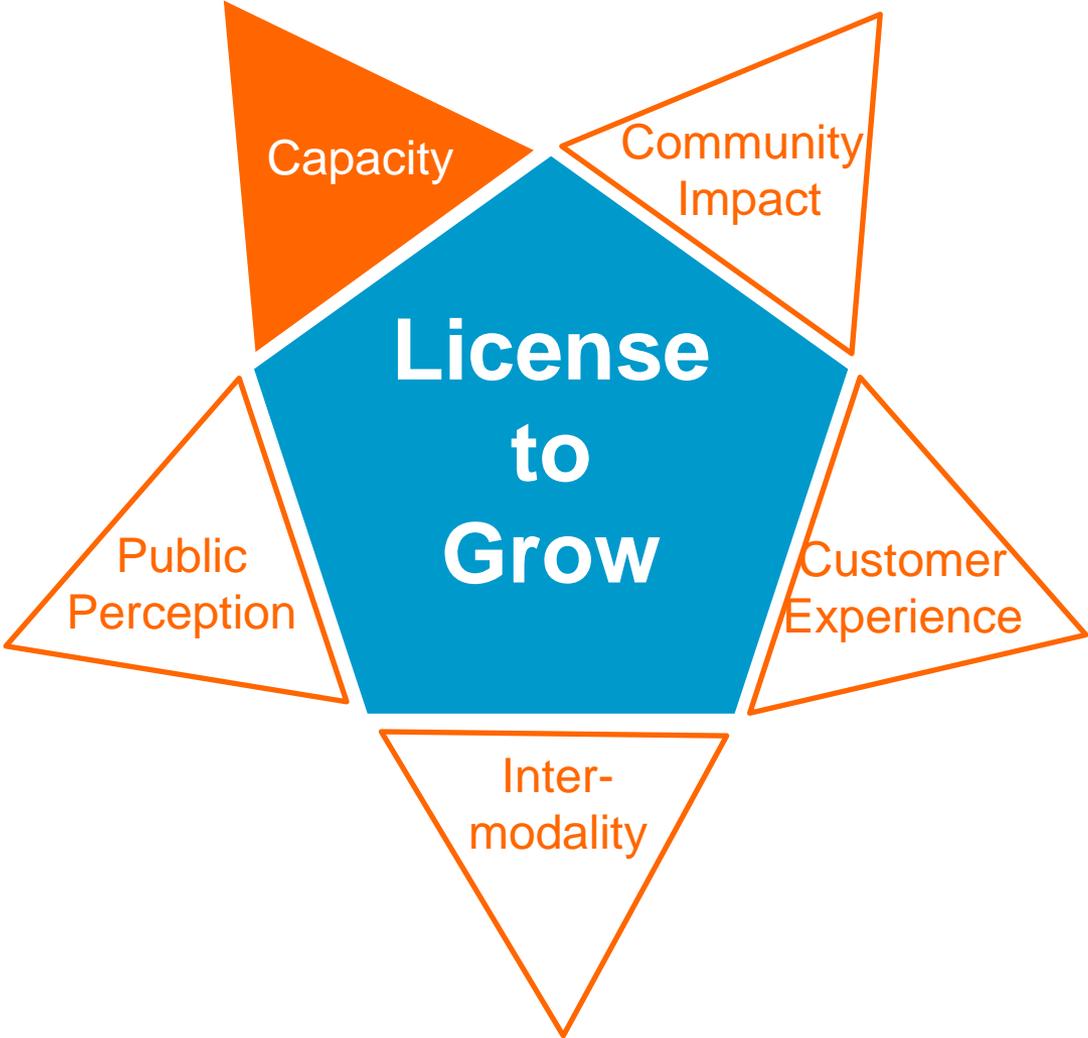
Airside (Runway) Capacity Curve

Saturation Capacity / max. Throughput: The expected ("average") number of operations (takeoffs and landings) that can be performed in one hour on a runway without violating ATC rules, assuming continuous aircraft demand.

Saturation Capacity

Average Delay [min]

Declared Capacity: The capacity per hour used in specifying the number of slots available for schedule coordination purposes; no standard method for its determination; generally set to about 85–90% of saturation capacity

Capacity Assessment

Declared capacity

4

Practical Capacity

?

?

movements / h

Practical Capacity: The average number of operations that can be performed in one hour on a runway with an average delay per operation of 4 minutes.

Factors affecting Airside Capacity (excl. WX)

Airport
→ Runways (Number, Layout, Geometry, Surface, Concept of Use)
→ Rapid Exit Taxiways
→ Taxiway-System
→ Apron Layout
→ De-icing Areas & Procedures
→ Infrastructure for Departure Sequencing
→ Taxi Procedures
→ Noise Abatement Rules
→ ...

ATC
→ Departure/ Arrival Route Structure
→ Approach & Landing Systems
→ Layout of terminal airspace
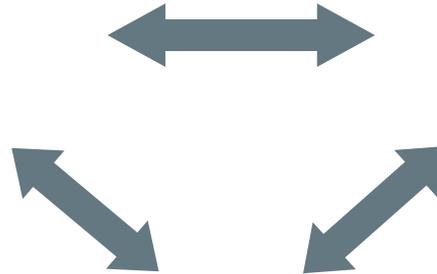→ Procedures
→ ARR-/ DEP-separations
→ Capacity of adjacent sectors
→ HIRO (High Intensity Runway Operations) Procedures
→ Controller Performance
→ ...

Aircraft Operators
→ Schedule / Traffic Patterns
→ Fleet Mix
→ Destinations
→ Occupancy Times (RWY, Gate etc.)
→ Aircraft types (e.g. A380)
→ Pilot Training / Awareness
→ Crew performance
→ ...

Key innovation challenge: Airport Capacity (1)

- Improved use of runway system

  - updated runway operating modes based on new CNS/ATM technology (for new and existing infrastructure)

  - reduced separations at increased safety levels

  - reduced runway occupancy times (e.g. Brake-To-Vacate)

  - Increased predictability of runway operations and performance

  - improved AWO systems and procedures

- Optimised terminal flight procedures

- Improved system resilience in adverse weather situations

Improving capacity while enhancing safety is a prerequisite for innovation !

Key innovation challenge: Airport Capacity (2)

- Increasing predictability of operations

- Total Airport Management

- Integration of green taxi technologies and procedures

- Integration of new air vehicle concepts (UAVs, RPAS, new configurations)

- Facilitating change and adoption of new technologies (e.g. GBAS)

- Role of automation ?

A system approach is usually required for improvement

Key innovation challenges for airports ...

Capacity

Community Impact

License to Grow

Public Perception

Customer Experience

Inter-modality
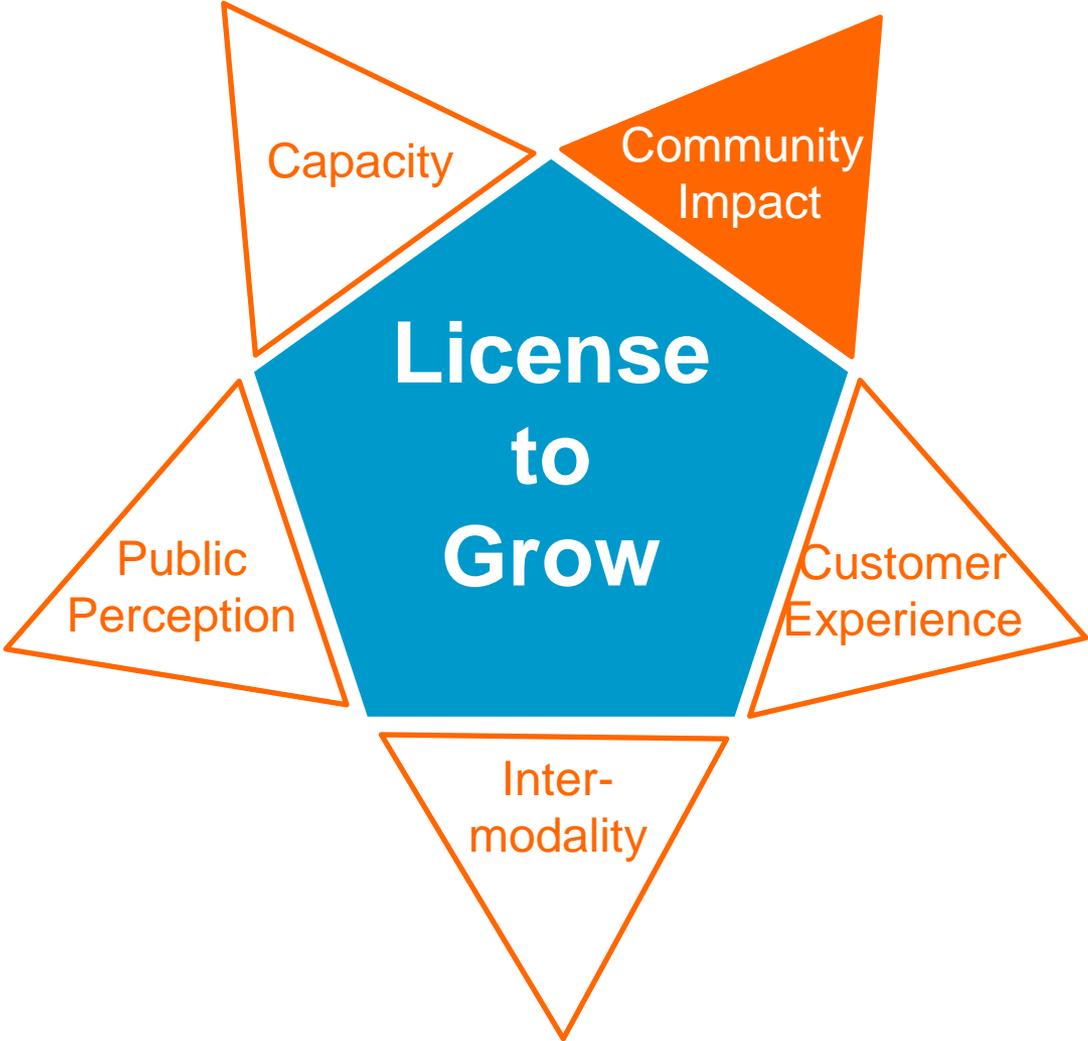
Key innovation challenge: Community / environmental impact

- Significant noise reduction

  - Aircraft/ propulsion technology

  - Low noise departure / arrival procedures

- Significant reduction in gaseous emissions (incl. particulate matters)

  - Aircraft/ propulsion technology

  - Flight procedure design

  - Green taxiing technologies & procedures

- Carbon-neutral airports

  - Power generation

  - Airport operations

  - Ground handling

- Reduced environmental impact of de-/ anti-icing operations

Lower community impact is key for demand driven development

Key innovation challenges for airports ...

Capacity

Community Impact

License to Grow

Public Perception

Customer Experience

Inter-modality
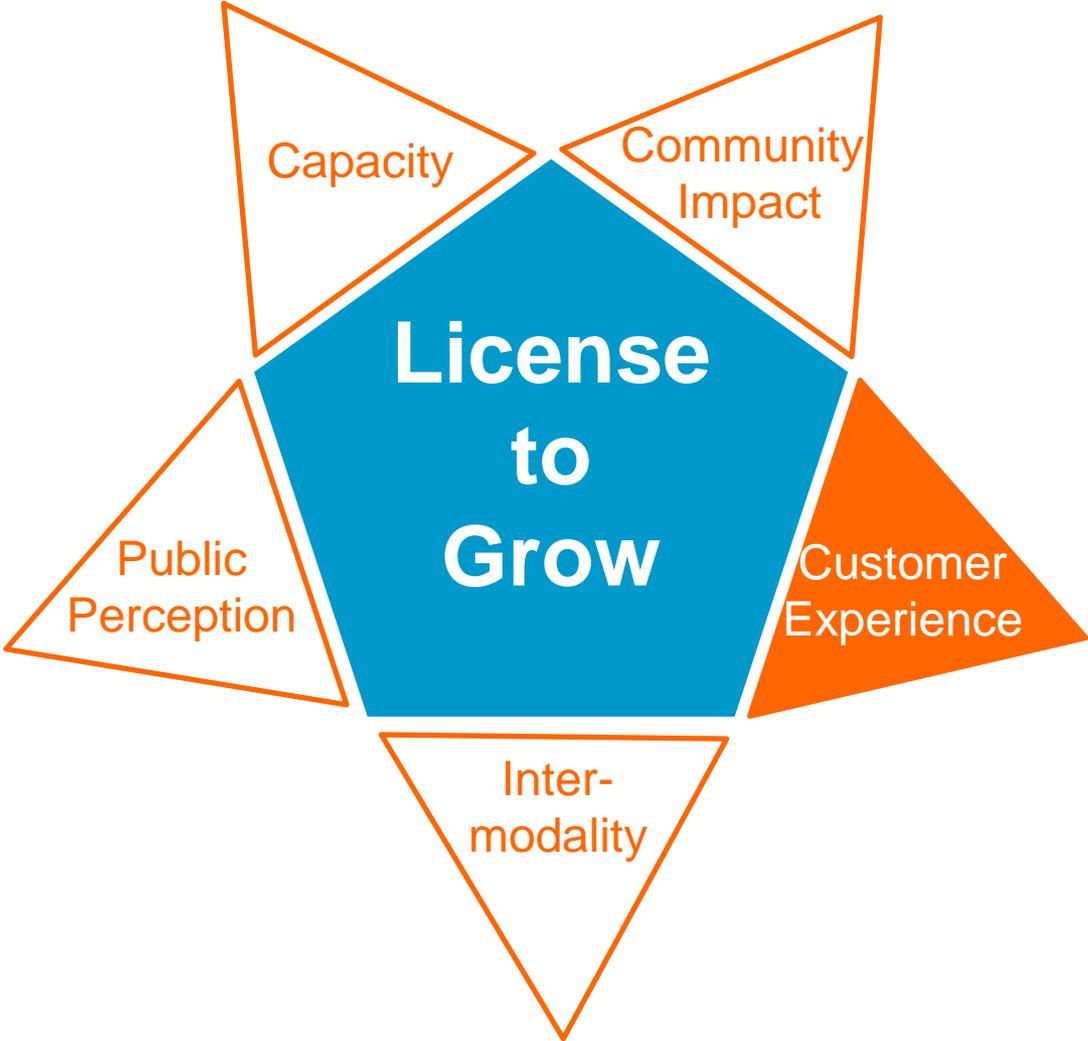
Key innovation challenge: Customer experience

- Hassle free, non-intrusive security procedures

  - Risk based approach to security

  - Use of biometrics

  - Improved screening technologies

- Time efficiency & process predictability

- Airport / travel experience

  - Indoor location & route-finding systems

  - Tailored & integrated services

  - Innovative passenger information channels

- Usefulness of time spent at airports and travelling

- .....

Source: http://www.engadget.com/2011/06/08/iatas-checkpoint-of-the-future-uses-biometric-ids-to-separate-d/

The customer has to enjoy the air travel experience

The story about the passenger at an airport

- The passenger is customer of the airline and anonymous to the airport.

- What does an Airport know about the passenger?

- How can the airport reduce the stress level for the passenger?

- Is there a communication channel with the passenger?

- Is there a sales channel to the passenger?

Some touchpoints with a passenger at an airport

- (Booking)
- Travel to airport
- Parking
- Entering the terminal
- Check-in / baggage drop
- Information counter
- Security check
- Shopping / F&B / lounge
- Waiting area

- 'Welcome'
- Baggage claim
- Landside area (Shopping, way-finding to car rentals, parking, public transport)
- Leaving the terminal

Generalized customer journey at an airport …

Landside		Airside – Terminal		Airside – Apron		

Landside

- Travel to airport (Parking)
- Information-/ Reservation Services
- **Home / Destination**
- Customer Feedback
- Departure from Airport
- Check-In / Baggage Drop
- Landside Retail, F&B & Services

Airside – Terminal

- Ticket- & Security Check
- Emigration
- Lounge, Gate & Boarding
- Airside Retail, F&B & Services & Connection
- Customs
- Baggage Claim
- Immigration
- De-Boarding

Airside – Apron

- Ramp Service
- Bus Transfer
- Pushback/ Off-Block
- Taxi-Out
- Take-off / Flight / Landing
- **Home / Destination**
- Departure / Flight / Landing
- Bus Transfer
- Ramp Service
- On Block
- Taxi-In

Parallels between A-CDM and the PAX process

Milestones in PAX process

| Flight Booking | Travel to Airport | Parking | Shopping F&B (Landside) | Check In / Bag Drop | Security Check | Shopping F&B (Airside) | Boarding |

⭐ Flight booked / offer parking or public transport

⭐ Location of PAX / probability of arrival, time of arrival at airport

⭐ PAX arrived at airport

⭐ PAX in Terminal (check in or bag drop)

PAX at security check ⭐

PAX seen at POS ⭐

PAX boarded ⭐

Full Data Support for Travel Chain

Using every touch point with the passenger for data gathering improves process quality, customer satisfaction and non aviation revenues.

Use all available passenger information

Improve process quality

Increase non-aviation revenue

Improve customer satisfaction

… makes the airport less pain and more fun ;-)

Key innovation challenges for airports ...

Capacity

Community Impact

License to Grow

Public Perception

Customer Experience

Inter-modality

The mobility challenge set out by ACAREs 'Flightpath 2050'

- European citizens are able to make **informed mobility choices**

- 90% of travellers within Europe are able to complete their journey, **door-to-door** within 4 hours.

- A coherent ground infrastructure is developed

- Flights land within 1 minute of the planned arrival time

- An air traffic management system is capable of handling 25 million flights a year in Europe

ACARE
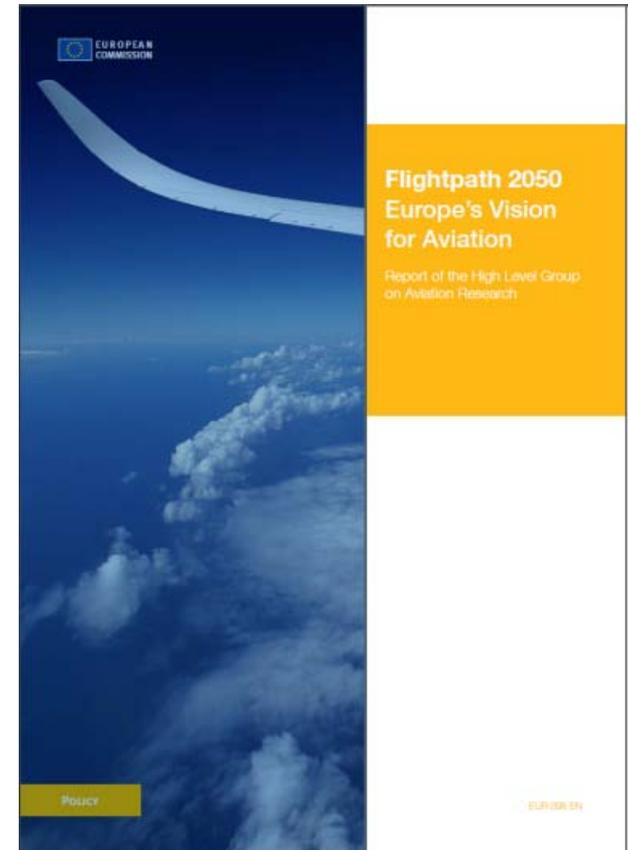
Advisory Council for Aviation Research and Innovation in Europe

Addressing this mobility challenge means ….

- A shift from 'mode-specific' to 'integrated transport solutions'
  (door-to-door vs. airport-to-airport)

  - Need to harmonize processes and interfaces between travel modes
  - Need to enable seamless flows of passengers and freight through the system in order to meet d2d mobility performance targets
  - Need to significantly improve predictability and punctuality of transport operations

- Customer-centric system also means liberalised and competitive transport market

- Informed mobility-choices by customers require guidance provided without any bias towards providers or modes

→ ACARE goals span across transport modes !

ACARE ‚mobility challenge roadmap'

A detailed list of crossmodal R&I needs (in the fields of knowledge, policies, concepts, technologies and infrastructure) as well as their timeline and KPIs can be found in the ACARE SRIA Vol.2 (www.acare4europe.org)

2020 **2035** **2050**

Customer-centric mobility

2020:
- Evolution of customer mobility expectation and profile understood
- Market & societal opportunities and acceptance factors known
- Customer-centric mobility system design
- Planning, payment & single ticketing support for intermodal journey selection
- Seamless transport processes defined
- Legal framework for data privacy and availability

2035:
- Accountable door-to-Door integrated journey planning, payment and single ticketing used for the majority of journeys
- Automatic journey monitoring and disruption management for the majority of journeys
- Seamless processes implemented
- Indoor and outdoor route guidance
- Robust, high-speed and secure personal communication and notification links

2050:
- Door-to-Door integrated journey planning, payment and single ticketing & accountability for over 90% of journeys
- Automatic journey monitoring and disruption management for over 90% of journeys

Integrated transport

2020:
- Aviation at core of integration of transport modes
- Level-playing field for all modes of transport
- Intermodal business models incentivise seamless travel integration
- Mobility performance baselined
- Intermodal transport architecture & Stds
- Interoperability data-sharing regulation
- Collaboration on implementation & context at early stages of research

2035:
- Infrastructure planning and prioritisation based on contribution to Mobility Goal
- Choices of transport modes based on fair and unbiased comparison
- Resilient behaviour of the Air Transport Socio-technical System and supporting policies in place
- Strategic, tactical and real-time mobility modelling and simulation with forecasting functionality for Integrated transport system
- Mobility plans for large scale disruptions
- Optimised processes and interfaces between transport modes

2050:
- Fully integrated intermodal transport system
- Mobility goals achieved
- Various innovative mobility systems and services complementing each other based on their individual contribution
- Infrastructure development in line with mobility needs

Key innovation challenge: Intermodality

✈ Seamless intermodal security & safety

✈ Seamless connectivity

– Design of intermodal hubs

– Integrated processes

– Intermodal system architecture

✈ Integrated ticketing

✈ Integrated journeys

✈ Seamless and more efficient cargo processes

✈ .....

(See also ACARE SRIA challenge 1 ‚creating the basics' & ‚travel process management' clusters !)
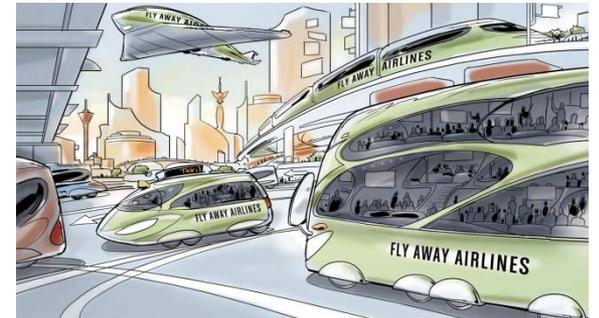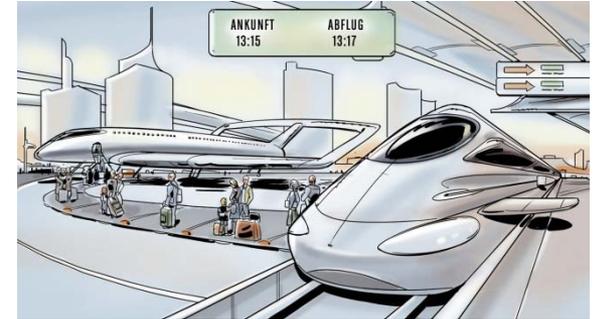
The airborne segment has to be an integral part of the journey

Key innovation challenges for airports ...

Capacity

Community Impact

License to Grow

Public Perception

Customer Experience

Inter-modality
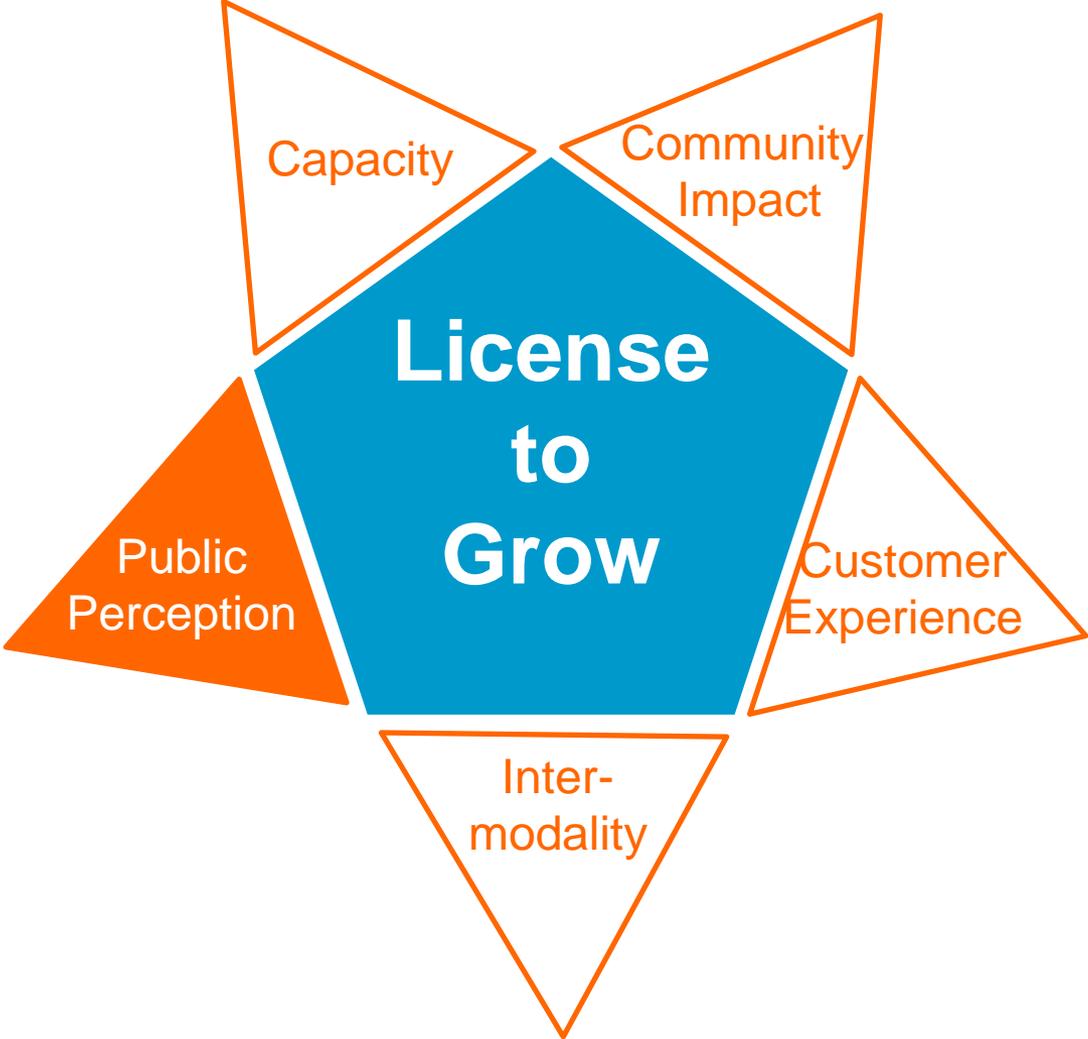
Official planning for a third runway began in 2005, legal approval was obtained in 2012 and confirmed in 2014...
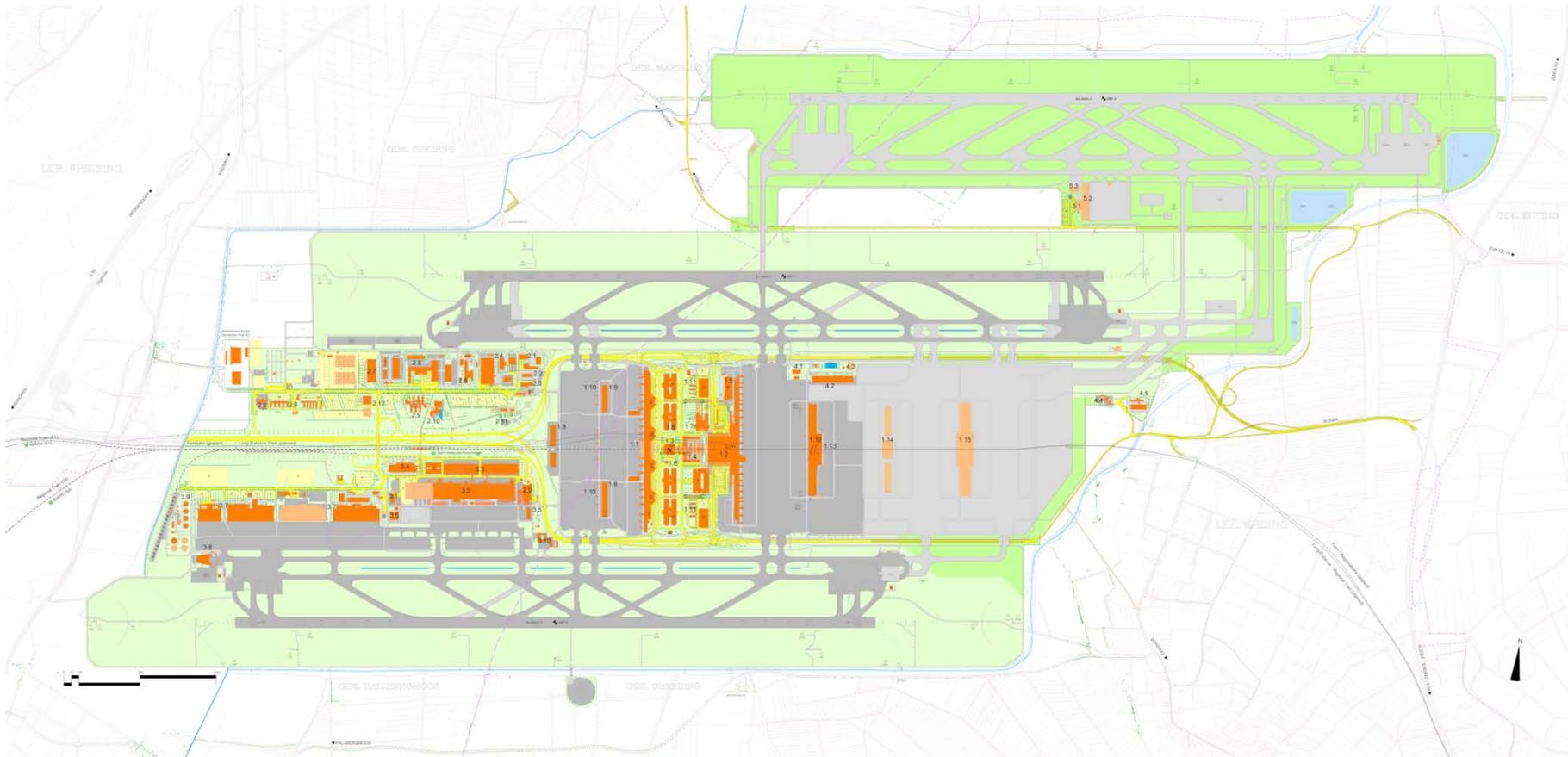
… but construction is blocked by the city of Munich, whose citizens voted against it in 2013

In spite of

- no additional noise exposure for Munich

- very limited additional noise exposure to airport neighbours

- no night operation (22:00 until 06:00) on new runway

- comprehensive plan of noise protection and soundproofing measures

- airport proven to be a key locational factor for local business and tourism industry

- 2.5 new jobs per day since airport opening in 1992

- 15.000 new jobs related to new runway

- Airport indirectly securing 250.000+ jobs in the region

- no taxpayers money used or required

- long term growth forecast of aviation

- .....

Source: www.keine-startbahn3.de

Key innovation challenge: Public Perception

- Even meeting the aforementioned innovation challenges is no guarantee for success as societal expectations may outpace innovation.

- We have to change the perception of aviation being a prime polluter only relevant for the wealthy

- We need much more transparency and an unbiased assessment of the different transport modes

- We need to actively lead towards intermodality, integrated journeys offering innovative and attractive services.

- We need to much better understand the societal acceptance factors of air transport and vastly improve our communication skills and means.
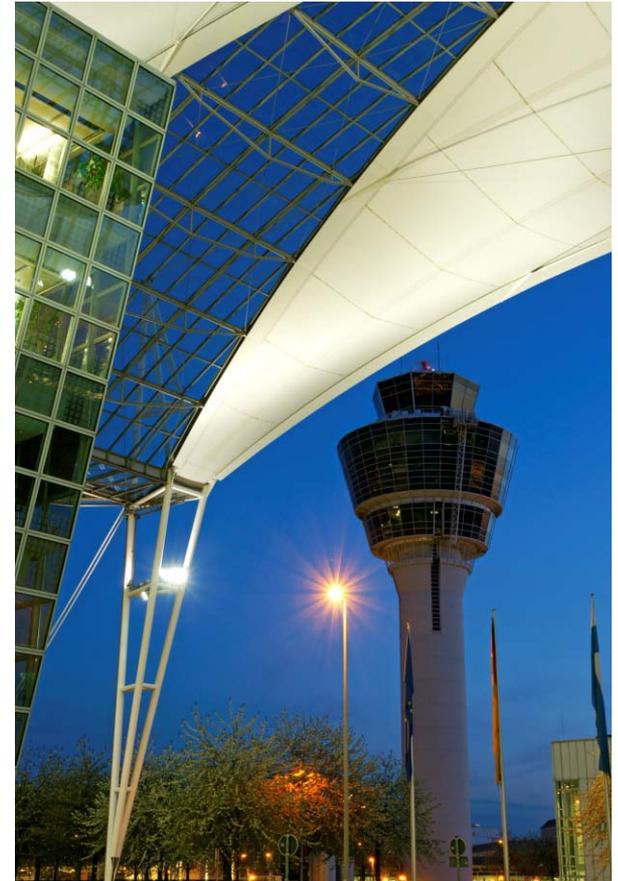
Aviation infrastructure should be regarded as an asset and not a burden

Conclusion

Conclusion

✈ Innovation is the key enabler for aviation growth and has to ensure that societal challenges can be met.

✈ Emerging markets of today are the mature markets of tomorrow - with very similar challenges

✈ Airport capacity is and will remain a scarce resource

✈ Air transport will become an essential part of the seamless, integrated and managed door-to-door mobility system of the future.

✈ New links and system partnerships between aviation stakeholders and other entities are very likely to emerge

✈ Close cooperation between aviation stakeholders is key

✈ Getting the license to grow is the ultimate challenge. This may require a departure from pure aeronautical research .....

Thank you