Managing the Transition to Aviation 2.0

Threats and opportunities for an industry and modality in transition

Gerben Broekema

Norwegian Aviation Conference
Bodo, 28 January 2020

Today's presentation focuses on three key messages related to the future of aviation

1. **There is a very bright future ahead** even though the near future will be challenging

2. **The changes ahead are much more fundamental than just becoming sustainable** with wider implications for spatial planning, future of mobility and regional development

3. **The real challenge is the transition to Aviation 2.0** with a serious risk of reduced regional air accessibility requiring a careful selection of aviation policy measures

My view on aviation is based on my academic training and professional experience

1992 - 1997

1997 - 2007

McKinsey &Company

Aviation expert
project manager

2007 - 2017

Schiphol Group

Head of Group Strategy
& International
Development

2017 -

BROEKEMA AVIATION
ADVISORY SERVICES

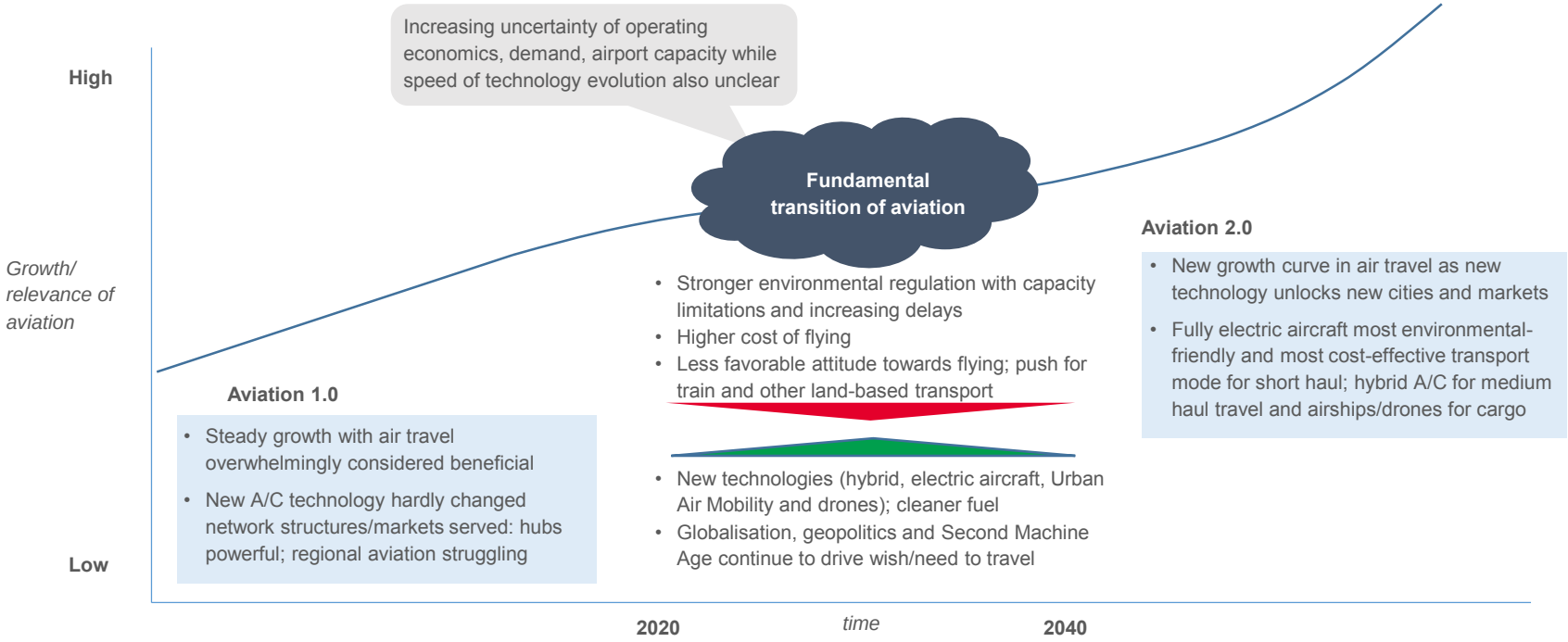
McKinsey &Company

AIRBUS

M3 consultancy

Owner & Principal consultant/
External senior advisor

Aviation 1.0 is under increasing pressure with more uncertainty for stakeholders but with a bright prospect of Aviation 2.0 after a fundamental transition



Several new sustainable aircraft technologies will enter the market in the next 10 years

Technology	Description	Examples
Electric/ hybrid aircraft  	• Fully electric aircraft initially with 8-15 seats (2030); later up to 50 seats (~2035)) for distances up to 750 km. Very low direct operating cost • Hybrid aircraft (electric/(bio)jet fuel) with 20-50 seats with much reduced CO2 and noise	• **Eviation Alice**: 9-seater fully electric; 914m runway; 970km range; US$ 165 Direct Operating Cost per hour (2022) • **Faradair**: 18-seater, hybrid, 1800km, 300m runway; 2025) • **Airbus-SAS:** MoU for hybrid A/C large scale commercial use within 10-15 yrs
Urban Air Mobility  	• 'Air taxis' operating with electric Vertical Take-Off and Landing (VTOL) with 2 – 6 passengers for distances of 50 – 300 km • Particularly effective for remote areas with poor transport links (islands;	• **Uber Air**: 4 seater ride sharing (2023) • **CityAirbus:** 4-seater up to 27km (2023) • **Volocopter 2X:** 2-seater, pilot optional (2022) • **Lilium Jet:** 5-seater for distances up to 300km (before 2025)
Cargo drones/ (hybrid) airships  	• Drones for cargo transport at much reduced cost (no pilots) allowing to much better serve remote regions. For short range express parcel delivery up to long haul heavy loads • Airships capable of heavy loads to remote areas	• **Elroy Air**: express cargo drone 100 kg/ 450km (2021) • **Natilus:** heavy lift drone (up to 120 ton for long range (intro ?) • **Sabrewing Rhaegal RG-1**: hybrid VTOL 450kg/1800km (2023) • **Flying Whales** (hybrid Large Capacity Airship ~60 ton; (2022)

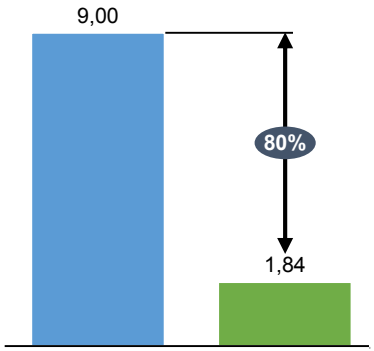
BROEKEMA AVIATION ADVISORY SERVICES

Source: company websites

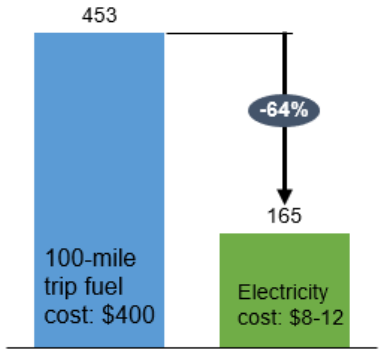
Operating performance improvement of Aviation 2.0 vs. Aviation 1.0 is mind-boggling

NOTE: provisional data for Aviation 2.0 technology released by new technology developers

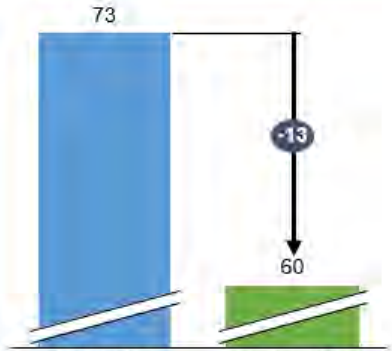
Direct operating cost per mile fo a 3-4 seater VTOL (US$ cents)



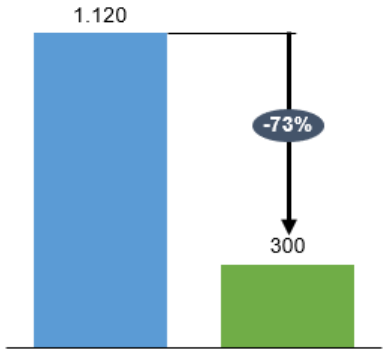
Direct operating cost per block-hour for a 9-seater aircraft (US$)



Noise from typical take-off (dBA)



Required runway length for a ~ 20-seater aircraft (m)

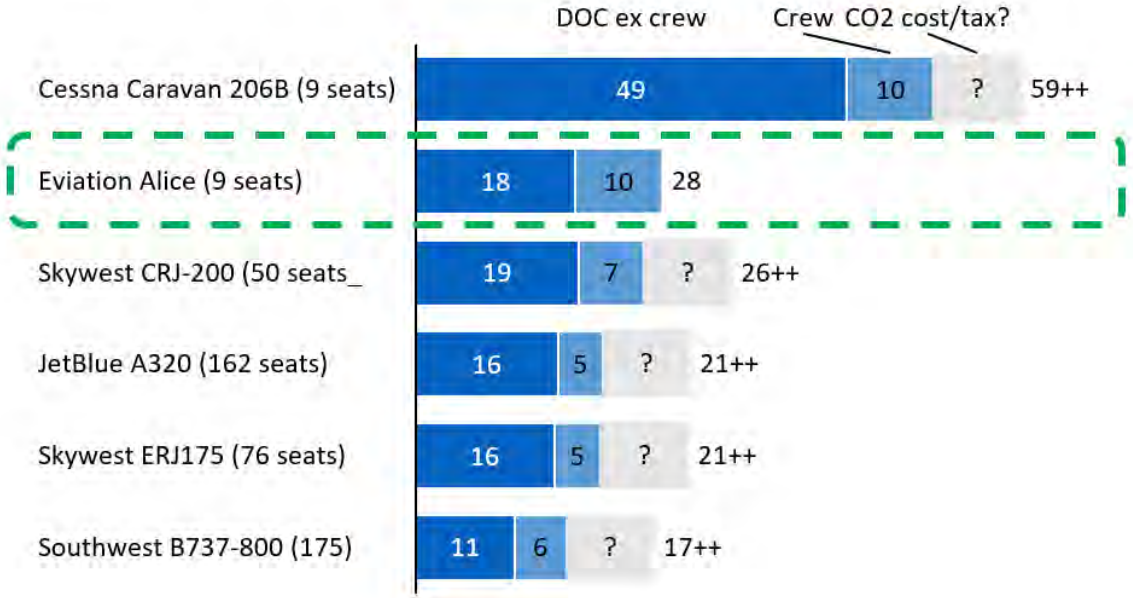


BROEKEMA AVIATION ADVISORY SERVICES

- https://www.researchgate.net/publication/318235979_A_Study_in_Reducing_the_Cost_of_Vertical_Flight_with_Electric_Propulsion
- https://blog.wepushtin.com/blog/5-cheapest-turboprops-operate/
- https://prijet.com/performance/Beechcraft%201900D
- https://www.aviationtoday.com/2019/01/24/ubers-air-taxis-will-succeed-helicopters-failed/
- ***The Future of Regional Air Transport by Neil Cloughley – Managing Director Faradair***

New technology brings small scale air travel to a seat-cost level close to current regional/narrowbody jet levels – becomes more competitive with CO2 pricing/taxes

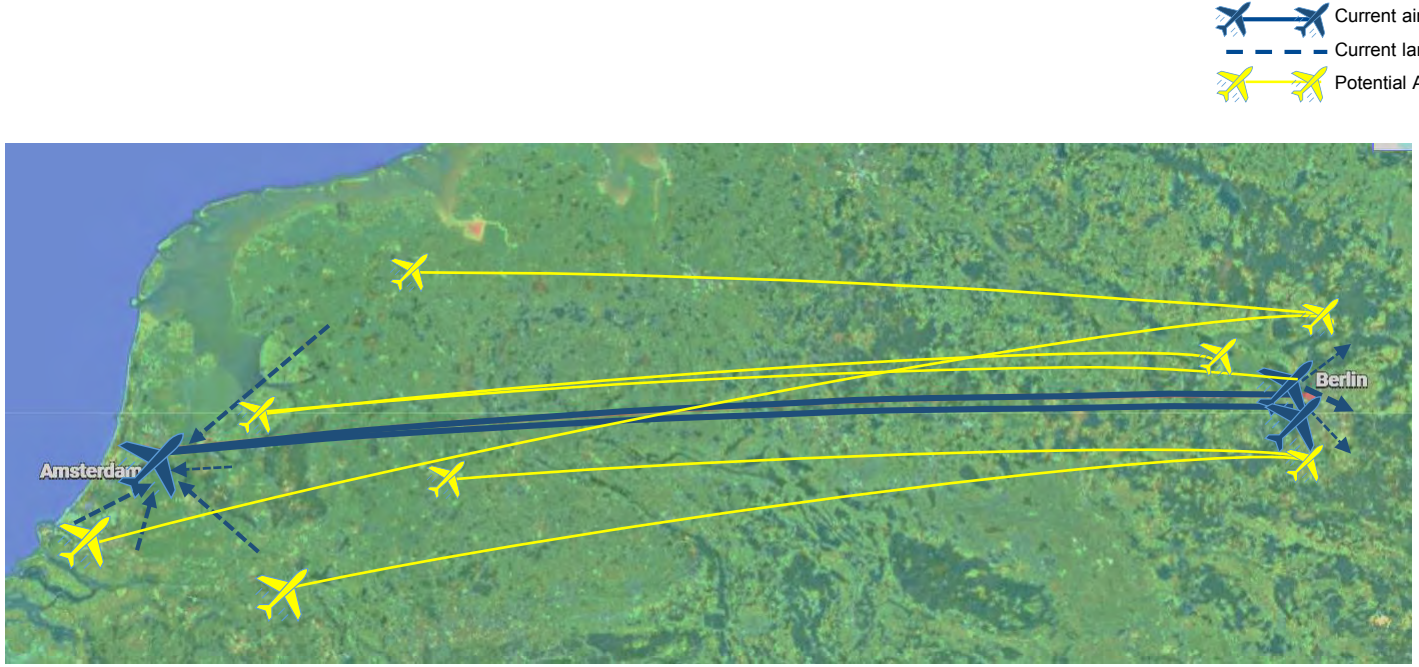
Approx. cost per seat per block hour in US$ (based on 2017 data (low jet fuel price year)



BROEKEMA AVIATION ADVISORY SERVICES

Source: Broekema Aviation analysis; Planestats.com; Forbes

Small-scale Aviation 2.0 technology will not replace current routes but serve regional flows that are not viable with Aviation 1.0 technology



BROEKEMA AVIATION
ADVISORY SERVICES

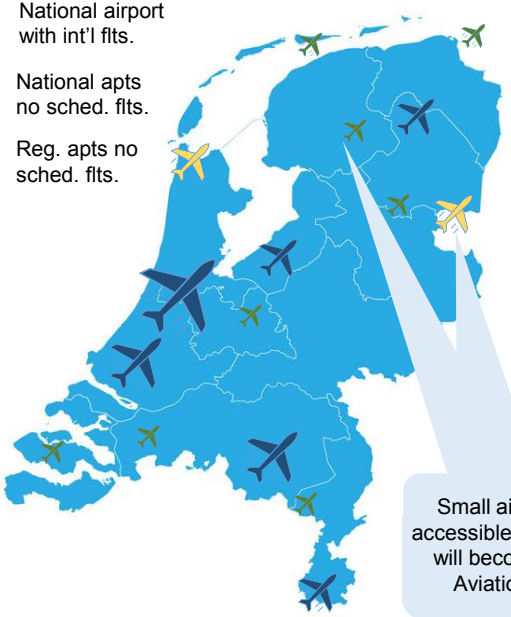
New aircraft technologies will profoundly change aviation networks

Many new small airports will become accessible for passenger/cargo air transport

National airport with int'l flts.

National apts no sched. flts.

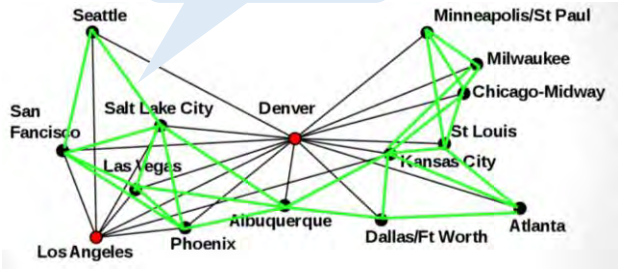
Reg. apts no sched. flts.



Small airports currently not accessible due to runway length will become accessible with Aviation 2.0 technology

Thinner routes will become viable resulting in much expanded networks (reduced need for PSO)

Green lines are routes becoming viable with new green technology



City airports will get a new lease of life due to reduced noise footprint

Example: Paris Le Bourget airport

BROEKEMA AVIATION ADVISORY SERVICES

Aviation 2.0 will have significant implications for spatial development and other means of transport and will boost regional development

Spatial development

- Noise footprint of airports will shrink enabling housing/commercial property development in typically highly valuable locations near airports
- Need to identify locations for new VTOL ports or short runway airports

Other modes of transport

- Aviation becomes most sustainable operation (as infra already in place mostly with no impact on land)
- Business cases for ferries, new long distance rail links and hyperloop will be affected as Aviation 2.0 will offer lower cost of air travel and much denser network and/or higher frequency

Regional development

- Better connectivity of regional cities will be a powerful counterforce against the trend of concentration of people and economic activities in centrally-located big cities
- Where we live and where we work will profoundly chance in the long term

The current sustainability approach will improve aviation's footprint but comes at a cost especially to regions highly dependent on aviation

An increasing environmental pressure is put on aviation…

Growth and capacity measures
- Annual traffic caps or limits to growth
- Block opening new airports or runways

Rapidly deteriorating support for aviation
- Negative stance towards
- Inability of aviation sector to formulate compelling narrative

Increasing cost and changing aircraft economics
- Ticket taxes, CO2 costs, VAT on tickets, excise duties on jet fuel and noise/emission-based airport charges

Hub model's fundamental mismatch with environment

Likely future fundamentals at risk:
- Airline pricing based on willingness to pay
- Discounts given by airports for transfer passengers

…which will reduce environmental footprint but at a cost

Direct effects
- Reduced (growth) in CO2
- Locally improved air quality
- Reduced noise (as older aircraft are being replaced with newer, less noisy aircraft)
- More airlines to face financial difficulties,
- More airports (especially regionally airports) face financial difficulty

Indirect effects
- Reduced airline profitability will make investments in cleaner technology more difficult
- Reduced benefit of connecting people and businesses. Countries highly dependent on aviation and inbound tourism affected the most
- Risk of losing infrastructure that will be needed again once new aircraft technology is maturing

There are some do's and don'ts in managing the transition to Aviation 2.0

Underlying believes/objectives

- **Growth in mobility** is the result of fundamental (and mostly desirable) socio-economic developments **providing value** to people, organisations and regions
- **Aviation will likely become the most sustainable mode of transport** for short/medium haul travel by 2050
- Aim for aviation **policy measures** that:
  - Maintain/strengthen air accessibility
  - Stimulate innovation and adaption of new green technology
  - Reduce 'waste' (inefficiencies in the current aviation business model)

Policy aspect	Better Not	Preferably Yes
Airport capacity	• Hard movement cap • Government steering on desired network (e.g., NL)	• Decreasing cap on emissions/noise • (New) slots priority/only available to hybrid/electric A/C operations • Market forces to determine network
Airport charges	• Discounts for transfer pax • Balance of landing charges vs. per pax charges favoring large aircraft regardless of emissions	• No discount for transfer pax • Charges highly linked to emissions per pax for aircraft
Ticket taxes/duties and sustainability funding	• Ticket tax income flowing into national budget • Transfer pax exempted from aviation tax	• Income from aviation tax used directly for funding transition to Aviation 2.0 and bio/synthetic fuel • Aviation tax also for transfer pax • Part of general sustainability funding (e.g., NL Invest) allocated to aviation
Airline pricing/ CO2 pricing	• Leave airlines fully free in pricing based on willingness to pay • Market to determine who pays for CO2 compensation (pax, airlines?)	• Limit airline pricing freedom to price indirect routing lower than direct flights • CO2 compensation by airlines (included in pricing) based on standardized practices

International alignment is key! But avoid prisoner dilemma

BROEKEMA AVIATION ADVISORY SERVICES

As a final conclusion…

Aviation 2.0:

Bringing so much more than a better environment

Let’s make it happen!

Aviation 2.0: Hypothetical state of aviation towards 2050

Expert opinion

- **In 2050 aviation is the most sustainable mode for new transport links** and in time the most sustainable mode for all passenger and cargo movements resulting in no/very few new high speed lines nor new hyperloop links (domestic only, if any)
  - Little additional infrastructure investment needed, and if so, less impact compared to new high speed line
  - Air transport alleviates congestion both for road and rail
  - Fastest mode of transport
  - Fully electric up to 1000 km by 2040; above 1000 km no alternative (but also 25+% more sustainable than today)

- **Much more extensive airline short/medium networks** (>50%) connecting many more regional cities directly to hubs and more secondary-to-secondary regional connections. Hubs still very powerful despite no longer benefitting from discounted airport charges and no longer exemption from local (aviation) taxes for transfer passengers. However, in parallel revival of city-airports as well as new impulse for struggling regional airports. CO2 and NOx footprint reduced by 75%+%

- **Urban Air Mobility-services mainly serving regional city-to-city** (up to 100-150 km) markets with poor land transport connections or island-services with limited intra-city movements due to lack of landing sites and noise/safety concerns flying over built-up areas. **Big bet electric aviation-pure play operators hold dominant share** of the market (e.g., Uber Air)

- **Cargo drone and potentially airship networks** (especially serving large online retailers) **emerging at dedicated airports** including much faster delivery of shipments to remote areas but urban area deliveries most using ground transport networks

- **Peripheric areas revived**, more so from a living than from an economic growth point of view as new air links will allow living further away from workplace but businesses still clustering in metropoles due to agglomeration effect. **Locations around airports most valuable land for economic development and housing**

Summary profile – Gerben Broekema

Gerben Broekema

Senior Aviation Strategy consultant

Home base

Amsterdam

Contact

+31-6-22019166
gerben@broekemaaviation.com

Overview

Gerben is owner and principal consultant at Broekema Aviation Advisory Services. He has 20+ years' experience working in the aviation industry. Based in the Amsterdam area, he serves airports, airlines, governments, suppliers and investors around the world both directly as well as in a role of external advisor to leading global consulting organisations with a focus on strategy, policy and partnerships/investments

Before starting his own advisory practice in 2017 he spent 10 years at Royal Schiphol Group most recently as their Head of Group Strategy and International Development. Prior to that, Gerben was aviation expert consultant with McKinsey&Company

As an aviation strategist Gerben is an expert in the socioeconomic role of air travel and the transition towards a sustainable Aviation 2.0. Recent projects include strategy development for a Russian and Australian airport; airport privatization strategy for a Middle Eastern civil aviation authority and an Asian state investment organization; slot strategy for a large hub airport in Europe; serving a large African airline in turning around its MRO subsidiary ; conducting a commercial due diligence for an aviation MRO supplier and conducting a business case for introducing ATC services for a regional airport in Europe

Prior working experience

- **Head of Group Strategy & International Development – Royal Schiphol Group (2012-2017)**
  - **Lead the Group strategy** team responsible for coordinating Schiphol Group's strategic planning process and the development of the Five-year Strategic Plan and as well as the Group's international strategy and international business development.
  - Interacted **directly with the management board on matters of strategy**, aviation policy and international development.
  - **Between 2007 and 2012**, held positions of Chairman PMO coordinating the strategic alliance between Schiphol Group and Aéroports de Paris and Senior Advisor Airport Development at Schiphol Group
- **Expert – McKinsey & Company (1997-2007)**
  - Served a large range of international clients with focus on Airlines and Airports on projects related to strategy, turnarounds, business plan evaluations, M&A, P&RM, air cargo, MRO and fleet/network mgmt

Education & languages

- Gerben holds a Master in Science in Economic Geography specialized in Transport Economics from University Groningen, Netherlands
- Gerben is a native Dutch speaker, is fluent in English and has good conversation skills in German and French and basis Spanish and Portuguese

BROEKEMA AVIATION
ADVISORY SERVICES