



Aviation 2035

Scenarios for value chain recomposition and value sharing in aviation post the era of hyper-competition

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Authors:



Mathieu Blondel

Partner Travel & Transportation
Global head aviation competence center,
Paris
blondel.mathieu@adlittle.com



Delphine Knab

Partner Automotive & Manufacturing
Global head aerospace competence center,
Paris
knab.delphine@adlittle.com



Akitake Fujita

Principal
Travel & Transportation,
Singapore
fujita.akitake@adlittle.com



Julien Vialade

Principal
Travel & Transportation,
Paris
vialade.julien@adlittle.com



Stephan Becker

Principal
Travel & Transportation,
Frankfurt
becker.stephan@adlittle.com



Alexander Ovanesov

Managing partner Russia
Travel & Transportation,
Moscow
ovanesov.alexander@adlittle.com

Executive summary

Aviation will transform more between today and 2035 than it has over its first 80 years as a commercial industry

By 2035, Aviation will experience a greater change than it went through over its first 80 years as a commercial industry. It has already been through three strategic eras, from (i) the era of monopolies (until the 1980s), to the eras of (ii) continental competition, until the mid-2000s. Then it entered the era of (iii) hyper-competition, which is now at its peak. The industry will soon go through a transition phase between hyper-competition and the next era, (iv) hyper-cooperation, which we can foresee now thanks to early signs.

The previous eras saw great changes, such as hub & spoke and low-cost airline operations, new generations of narrow and wide-body aircraft, the emergence of commercial activities at airports, and the first cooperation between “different species” (e.g., interline agreements between low-cost carriers and legacy airlines, joint ventures to develop new aircraft programs). But the pace of change is much faster now, and most of all, none of the previous changes triggered major changes among the different (a) clusters and (b) players in each cluster that compose the aviation industry ecosystem.

In 2035 we will see a fundamentally different aviation industry in terms of business and operating models, driven by demand evolution, technological breakthroughs and changes in regulation. This Arthur D. Little report thus proposes tentative answers to the following questions:

- What could be the possible [scenarios for the fifth strategic era of commercial aviation](#) by 2035?
- How might clusters and players move along the value chain?
- How will the revenue and profit pools be distorted?
- What are the key factors that will drive possible scenarios?

Fifteen megatrends and disruptions will reshape the aviation industry...

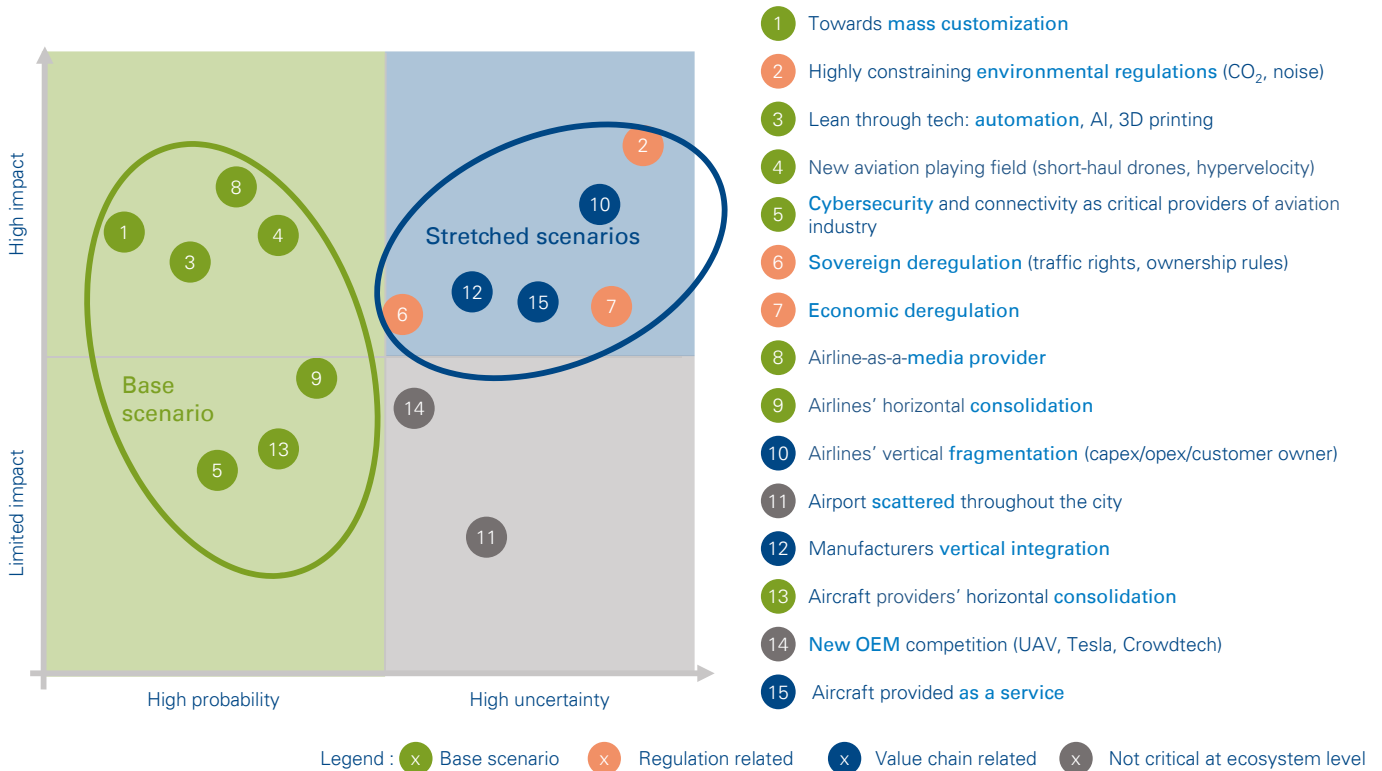
To answer those questions and define possible scenarios for aviation in 2035, Arthur D. Little analyzed more than 130 trends and possible disruptions impacting the nine main players. These comprised the three main clusters of commercial aviation: aircraft providers (tier 1s, OEMs, MROs, lessors), air transportation providers (airlines, distributors) and infrastructure providers (airports, air navigation service providers, ground handlers).

We identified 15 key megatrends and disruptions among the following dimensions: demand, competition & offering, regulation and technology. We assessed them in order to understand if they embodied simple evolution or deep transformation of the industry.

Demand will continue to grow at a fast pace, but the “mass-customization” travellers expect, the emergence of “last-mile aviation for people and goods”, and regulation could shape very different growth trajectories.

Technology will also play a leading role in enabling the future of aviation. Connectivity, cyber-security, blockchain, artificial intelligence and automation have the greatest impact at ecosystem level, because they are key enablers of moves along the value chain and reinvention of operating & revenue generation models. Other technologies, such as green energy and new materials, are important, but have limited impact focused on the emergence of “new products”.

Figure 1: Mapping of megatrends and disruptions



Source: Arthur D. Little

Greater possible changes are to be considered within the aviation ecosystem itself:

- Airlines' business models could move towards fully integrated and consolidated global players or to white-label aircraft operators, evolving from generating revenues and profits by selling transportation services to becoming media (or platforms) offering "free tickets", but monetizing their client bases to third parties.
- Aircraft providers are seeking to offer aircraft-as-a-service, while investing to consolidate horizontally and offer smarter and more versatile next-generation flying machines.
- Infrastructure providers will need to make fundamental changes to their operating models in order to cope with anticipated growth and price pressure.

... but (de) regulation and recomposition of the value chain could result in four possible futures

Our scenarios are thus based on the "main uncertainties": the ones with high impact and high certainty of occurrence make up the "base" (but unstable) scenario, and the ones with high impact and high uncertainty of occurrence define key possible directions from the base scenario.

In our base scenario, the whole industry moves towards automation of processes and improves margins by leveraging new technologies (data analytics, AI, 3D printing, etc.). Cybersecurity and connectivity enablers become critical for the industry and enable UAV emergence. Consolidated regional, multi-brand airline groups cover numerous customer segments. Airlines have also twisted their revenue generation models towards becoming media platforms, with the most advanced players offering free tickets. Aircraft OEMs compete against mega-tier 1 companies to capture value-add in the aircraft supply cluster and in the market for last-mile aviation.

From there, it appears that fundamental drivers will be (i) (de)regulation of the aviation industry (in terms environment, economic, sovereignty, etc.) on one side, and (ii) strategic moves along the value chain on the other.

- On the regulation side, we consider a "closed" world versus an "open" world. These two worlds are characterized by loose or tight rules for open-sky agreements, airline ownership, personal data ownership, utilization and monetization options, and pricing of air tickets and scarce infrastructure resources. All these regulatory aspects would enable different degrees of consolidation and monetization of key assets by incumbent players (client bases, infrastructures, etc.). Last but not least, environmental regulation would highly impact the demand for air travel.

- On the value chain evolution side, we consider two opposite options involving airlines and aircraft suppliers, respectively, either expanding or shrinking vertically. We could thus see the emergence of a full-fledged “aircraft-as-a-service” provider (i.e., fleet supplier, manager and operator). We also could see the emergence of “client owners” (e.g., independent loyalty programs) that would reduce the added value of airlines. Or we could see airlines resisting those trends to avoid becoming “white-label” operators.

This unveils four “stretched scenarios” for the next strategic era of the aviation industry.

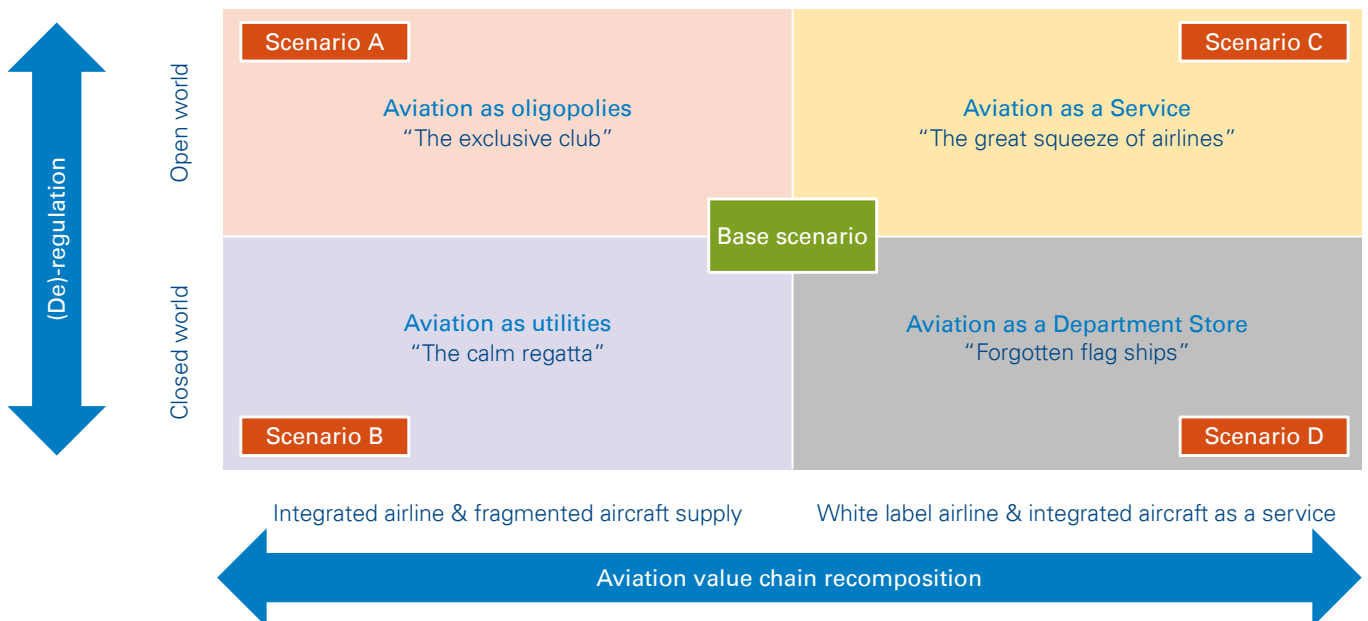
In scenario A, “Oligopolies, the exclusive club”, the aviation industry is structured around a set of “global champions” in each cluster of the ecosystem, with large degrees of consolidation and the ability to monetize scarce resources. This enables them to increase the value pool significantly.

In scenario B, “Utilities, the calm regatta”, the aviation landscape is shaped like the landscape of utilities today, i.e., around a set of regional champions, with regulated demand, pricing and ownership. Total revenue for the industry is, however, limited by strong environmental regulation, which limits passenger demand. But these conservative regulations are beneficial in that they contain competition and value capture by new entrants.

In scenario C, “Aviation-as-a-service, the great squeeze”, airlines are becoming white-label operators, with downstream and upstream suppliers able to capture more value by (a) integrating vertically (“aircraft-as-a-service” companies, airports and air navigation service providers merging to become “total infrastructure providers”), (b) getting client control (mobility platforms, ticket marketplaces, etc.) or (c) yielding their scarce resources (infrastructure providers). This scenario generates higher revenue at the ecosystem level, driven by reduced air-travel ticket prices... but is actually more detrimental to profit because airlines are weakened.

In scenario D, “Department store, forgotten flagships”, airlines retain control of customers, but their brands are disappearing: aircraft cabins are monetized to third parties looking for their own brands/products/service exposure, and fleets are managed (but not operated) by “aircraft-as-a-service providers”. Economic and personal data regulation limits the loss of profit for airlines by preventing too much value capture by distribution platforms or infrastructure providers.

Figure 2: 5 possible scenarios for Aviation in 2035



Source: Arthur D. Little

Despite proposing four distinct global scenarios, we believe aviation in 2035 will be a regional patchwork of these. Indeed, considering differences in regulation appraisal and value-chain maturity, each global region (the US, Europe, India, China, etc.) could go into one scenario or another.

Major shifts are ahead for growth and profit sharing among aviation ecosystem players

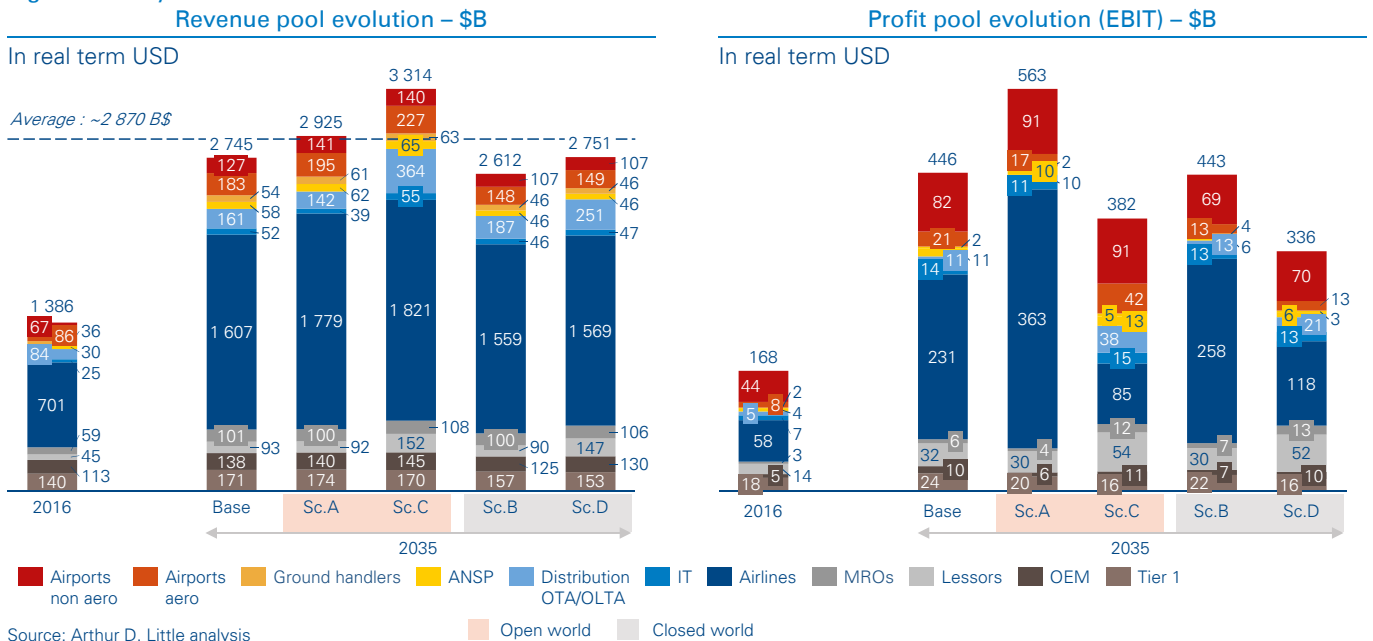
Our scenario and economic modeling approach shows very different total revenue and value creation for the aviation industry by 2035 – and possibly even more differentiated revenue and value sharing among players of the ecosystem.

Indeed, the total revenue growth of aviation will be driven by demand evolution, which will mostly be impacted by (i) regulation (competition law, allowance of last-mile aviation, environmental tax, etc.) and (ii) pricing power of airlines. Profit for aviation players in 2035 will be also driven by new operating models, enabling reduction of CAPEX and OPEX – up to the point that each player will be able to retain profit instead of sharing it with its customers. This value capture will be driven by the ability of players to (i) expand in the value chain and (ii) consolidate their own industry while (iii) keeping away new entrants. Hence, the very different revenue and profit pools associated with each scenario:

This report highlights key factors that aviation stakeholders (clients, regulators and industrial players) should monitor and influence in order to shape the future of aviation:

- Overall, **environmental performance** is key to ensuring long-term growth for the entire ecosystem, with new energy storage, AI, cybersecurity and connectivity as cornerstones for “last-mile aviation”
- Airlines must **keep control of scarce resources and clients** due to a new perspective of “mediatization”/“platform play.” In addition, **Ownership and personal data regulation** will be key for transport providers to transfer data from airlines to gatekeepers and consolidate the industry.
- Aircraft-as-a-service is the new goal of aircraft providers, and **cooperation** is the best way to achieve it.
- Economic regulation** of infrastructure providers will be key to driving profit sharing with clients, while automation and concentration will create a larger profit pool.

Figure 3: Key economics



The aviation ecosystem will need to be “future proof”

Our aviation 2035 scenarios are a basis from which to **identify actions** to be taken at industry and organization levels, in order to (i) facilitate and take advantage of a preferred scenario (thanks to bold strategic moves) or (ii) mitigate potential risks (by grasping “strategic insurance”). Aviation stakeholders must **now prepare to be future proof** by answering the following questions:

- How to reshape the offering and revenue generation model of my company (product/service/pricing)?
- How to transform the operating model and the innovation engine of my company?
- How to reallocate capital to extend my strategic value by moving across the aviation ecosystem and my cluster?

1. Envisioning the future of aviation and managing uncertainty by 2035

What this report is about

Aviation is a long-cycle, heavy-investment industry (in either R&D or CAPEX). Until the 2010s, strategic moves and evolutions have been relatively slow, but the competitive environment, the rules of the game and technologies are changing much faster now, and the ecosystem landscape will be transformed. Still, a long-term view, i.e., beyond the next 10 years, is key for industry players to reallocate capital and refocus scarce resource management.

Our report aims to envision the future of aviation by 2035 and help players of the ecosystem assess and manage uncertainty.

It does not, however, pretend to identify the future of aviation that we will experience in 2035. The purpose of the report is to consider the most probable futures for the industry to provide insight into the directions that the aviation industry could follow, while being very cautious about contradictory forces that could affect the ecosystem's players. We thus have identified a base scenario that is fundamentally unstable and should transform itself into one the four other scenarios we have defined.

Last but not least, we estimated how the revenues and EBIT of each of the players would be impacted for each scenario, considering the global industry would follow one or the other. We nevertheless advise our readers to consider this a limit of our study, because each region – for instance, North America, Europe, China, India or South East Asia – could go one way or the other.

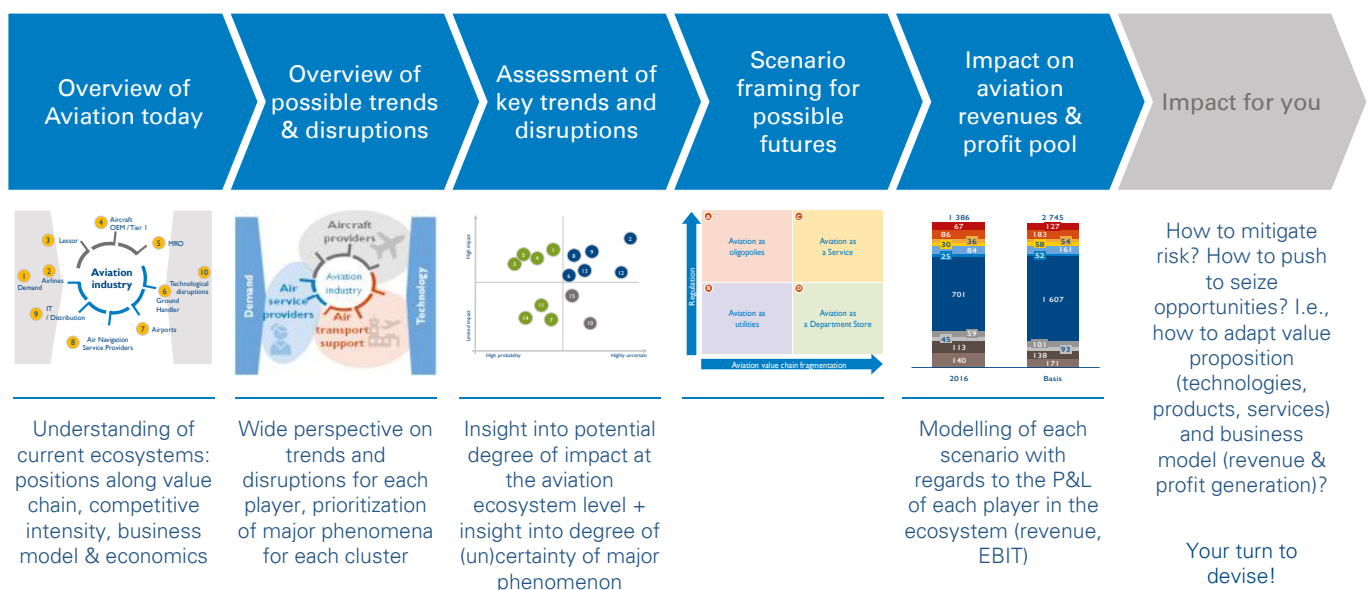
Please read the appendix of this report to get more details about what this report is about, and which impacting factors we consider “unchanged versus today”, and which we consider evolving.

Five-step methodology

Our approach is thus based on five key steps:

- Step 1: drafting a panorama of the ecosystem today: its key players, their economics and their revenue and value shares. We actually considered three strategic clusters and the main players within them: aircraft providers (tier 1s, OEMs, MROs, lessors), air transport service providers (airlines,

Figure 4: Scenario building Methodology to imagine Aviation in 2035



IT & distribution) and infrastructure providers (airports, air navigation services, ground handlers and caterers).

- Step 2: Identifying key trends and disruption that could impact players by 2035 in several domains: demand, competitors' strategies, offerings, regulations, and technology.
- Step 3: Assessing (i) the potential impact of each megatrend and disruption in terms of strategic positioning and value capture for players of the ecosystem, and (ii) their likelihood of occurrence.
- Step 4: Framing scenarios based on those trends from a 2035 perspective.
- Step 5: Evaluating the impact of those scenarios on (i) the strategic added value of each player in the aviation ecosystem, and (ii) how the revenue and value shares among players could be transformed.



2. Aviation today: hyper-competition and hyper-cooperation at the same time

1950–2030: The four eras of the commercial aviation industry

The commercial aviation industry was a c.\$1,400 billion market in 2017, with more than 3.5 billion air passengers and 9.9 million direct employees¹ serving its clients. It is a vast ecosystem made up of three macro-clusters, each composed of sub-clusters:

- Aircraft providers, namely tier 1s , OEMs, MROs and lessors supplying airlines with up-and-running assets.
- Infrastructure providers, which facilitate the processing of aircrafts, passengers, luggage and cargo flows in the air and on the ground, namely airports, air navigation service providers (ANSPs) and ground handlers.
- Transportation service providers, which enable clients to book their tickets and fly, namely distribution players, IT solution vendors and, of course, airlines.

Today, aviation is a major global industry accelerating growth and socio-economic development across the planet. But since its debut 70–80 years ago, the commercial civil aviation industry has been through three strategic eras: it has evolved from

(1) local monopolies to (2) continental competition, and is now in the middle of (3) the era of hyper-competition.

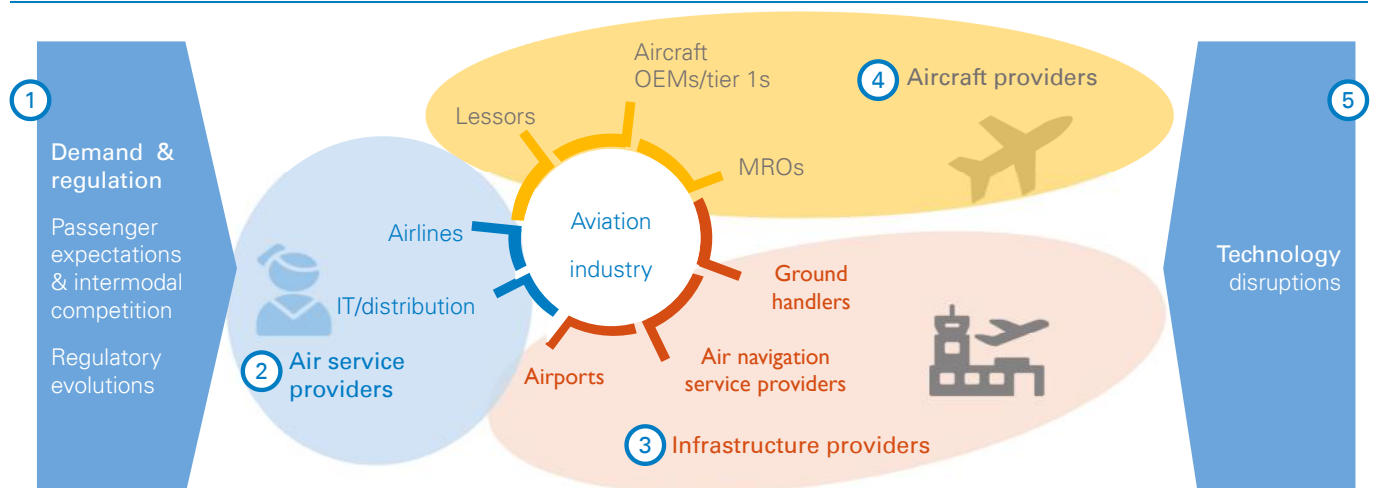
Today's era of hyper-competition is the result of entry barriers for new airlines being at a historical low, thanks to easier-than-ever accessibility to scarce resources (namely airport slots, traffic rights, aircrafts, IT solutions, qualified crew and technicians, and capital).

Of course, some tensions will arise for the supply and control of some resources (such as airport slots at mega-hubs, technicians and pilots), but looking long-term, these have never been as abundant as they are today, and neither has supply been so "fluid." In this era of hyper-competition, a growing number of competitors are addressing all strategic and tactical segments of the commercial air transport market: medium-haul or long-haul markets, point-to-point or connecting flows, premium or ultra-basic customers. No niche is immune.

Coming up now and certainly enduring until 2025–2030 is (4) the era of hyper-cooperation, in which all clusters in the aviation industry will try to limit internal competitive intensity thanks to consolidation.

Figure 5: Strategic clusters and key players in the aviation industry

Overview of aviation industry stakeholders



Source: Arthur D. Little

¹ Source: aviationbenefits.org , Oxford Economics

Figure 6: The four eras of the commercial aviation industry

	1950	1960	1970	1980	1990	2000	2010	2015	2020	2025	2030
	Era of monopolies		Era of continental competition			Era of hyper-competition			Era of hyper-cooperation		
Dominant geo-economic zones	Nations		Larger continental free-trade zones (NAFTA, UE, etc.)			Global megacities			Global megacities		
Wealth & mobility	"Jet set" Airport traffic: from 2% => to 30% of world population		"Mass transportation" Airport traffic: 30% => 80% of world population			"Hybrid and fragmented clients" Airport traffic: 80% => +100% of world population			"Hybrid and fragmented clients" Airport traffic: 80% => +100% of world population		
Traffic & ownership rights	National airlines, bilateral agreements, with traffic rights down to airport-to-airport level		Deregulation at continental level (USA, Europe, India, China, etc.)			ASEAN opens skies Global open skies			Lifted ownership rights		
Aircrafts	Long-haul jets		Efficient medium-haul jets and short-haul turboprops			Next-generation long-haul jets enable tapping into smaller markets			Last-mile aviation		
Airlines	Local & national flag carriers		National flag carriers & global alliances			New entrants ("LCCs")			Multi-brand airline holdings		
Infrastructure providers	State-owned players/ subsidiaries of airlines		State-owned players/ subsidiaries of airlines			Global independent leaders, but long tail of local players			Global independent leaders		
Aircraft providers	US "oligopoly"		US-EUR duopoly			US-EUR duopoly			US-EUR-China JVs for specific programs		

Source: Arthur D. Little

We thus see aircraft tier 1s and OEMs consolidating. It will be the same with top 10 players in industries such as MRO, ground handling and airline catering, as these already control between 50 and 80 percent of the accessible market and are pursuing dynamic merger & acquisition strategies.

Airlines themselves are initiating a movement towards consolidation because of (i) market exit, (ii) acquisition and creation of multi-airline groups and (iii) new forms of alliances and cooperation, such as medium-haul, low-cost airlines feeding long-haul operations of peers or even legacy airlines.

Unbalanced revenue & profit pool sharing at the expense of airlines

Each "cluster" of the aviation industry has its own economics. They can be labor- or capital intensive, and they can be exposed to the increasing number of units composing the commercial aviation fleet, the actual asset utilization, or the number of passengers transported. Each of these must also deal with very different internal competitive intensity.

However, the fight between parties to capture the largest share of the industry's revenues and profit pools is intense, and so far the battle has ended up at the expense of airlines: their share of the profit pool has been much lower than their revenue share, as shown above.

Although they are the cornerstone of the industry, airlines have not managed to protect their share of value. They have seen aircraft suppliers preserving their margins and infrastructure providers converting their rather small share of revenues into a large share of profits².

The fifth era of the aviation industry: What future and profit share by 2035?

Now, the pace of occurrence of (r)evolutions that have impacted the aviation sector has been accelerating. New players might enter the game to disrupt with new technologies, new business models or fresh capital – sometimes all at the same time.

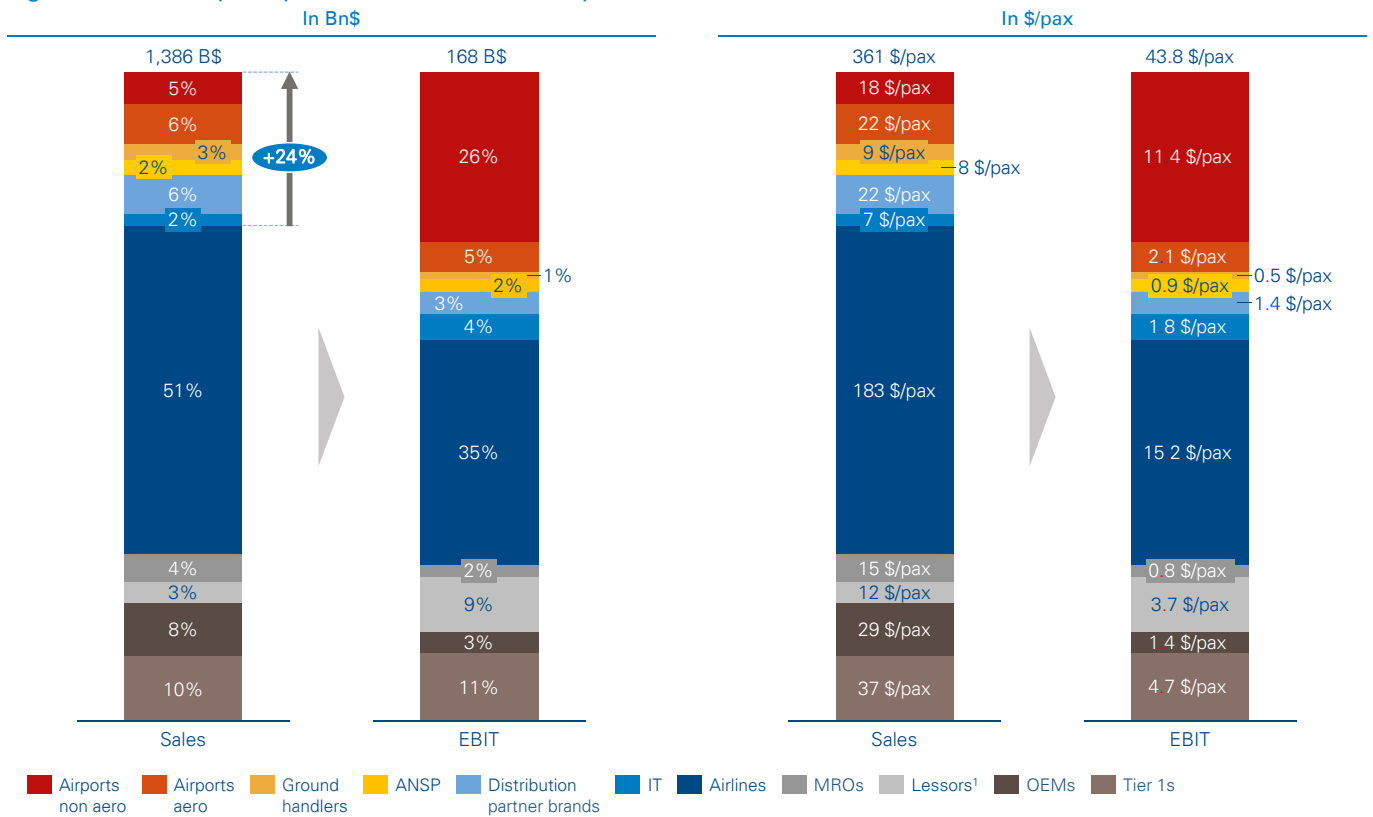
It is therefore time for the industry to look ahead to the fifth era of its history.

This Arthur D. Little report is proposing tentative answers to the following questions:

- What are the possible scenarios for this first strategic era of commercial civil aviation by 2035?
- How might clusters and players move along the value chain?
- How could the revenue and the profit pool be distorted?
- What are the key factors that would drive possible scenarios?

² Note: this mapping of the sales & profit pool in the aviation industry excludes oil suppliers, which represent approximately 30 percent of airlines' costs and revenues.

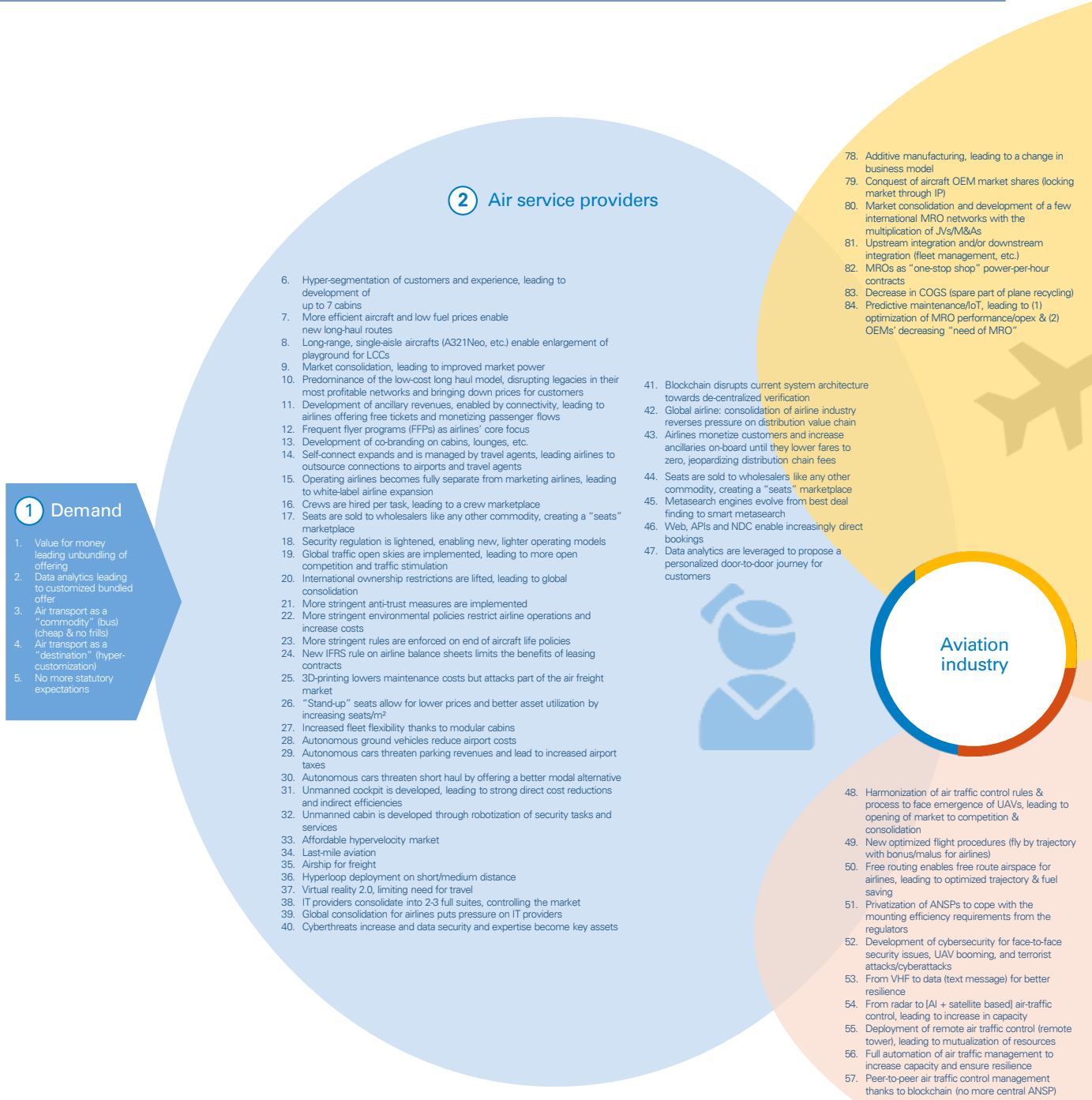
Figure 7: Sales & profit pool of the aviation Industry – 2016, Global



Source: Arthur D. Little analysis
 Note: 1) EBT margin

To answer these questions and define the possible scenarios for aviation in 2035, Arthur D. Little analyzed trends and possible disruptions impacting the eight main players that compose the three clusters of commercial aviation.

3. 135 Trends and disruptions that shape the industry by 2035



Arthur D. Little conducted a series of interviews and brainstorms with aviation specialists and experts, and identified a list of 135 individual trends and disruptions impacting all the clusters of the industry .

These trends were grouped into 15 MT and disruptions. We considered these the most important topics to explore during scenario development, based on their impact on new business models and value creation, or sharing for the industry.

4 Aircraft providers

- 85. Expansion of service sphere for OEM and suppliers, aggravating competition for new value sources (training, MROs, crew management, fleet management, scheduling, etc.)
- 86. Strategic move of OEMs towards distribution of cabins, getting closer to "one-stop-shop" model
- 87. Standardization and modularity of cabins, to the extent airlines can operate as white labels for different players, transforming BFE into SFE
- 88. New entrants in the OEM industry increasing competition between OEMs and diversifying opportunities for suppliers
- 89. Continuation (or reversal) of the consolidation trend of OEMs and tier 1s, impacting competition fundamentals
- 90. Crowdsourcing and/or crowd-financing for design engineering, lowering entry barriers and potentially leading to the emergence of new OEMs and tier 1s
- 91. Entry of non-aerospace players in connectivity or entertainment related solutions, aggravating competition
- 92. A/C end-of-life management becomes a key market, with strong players competing against traditional spare-parts suppliers
- 93. Reduced aircraft lifetime/programmed obsolescence, leading to possibly more frequent or cheaper new platforms
- 94. Move to a more generalized pay-by-the-hour model (BFE and other new systems, maintenance), transforming fundamentally OEM/tier 1 economics
- 95. More stringent environmental regulation (full green aviation), leading to anticipation of aircraft renewal or new platforms
- 96. New digital technologies (AI, blockchain) accelerate certification processes and lead to large savings
- 97. Bilateral aviation safety agreements between China and Western countries smooth out COMAC certification by FAA and EASA
- 98. All electrical aircrafts could drastically change the aircraft design and open opportunities for new entrants
- 99. New engines (hybrid engines, distributed propulsion or open rotors) could open the game for new players
- 100. Supersonic aircraft and/or passenger rockets emerge as viable transport means, opening new segments to the industry and possibly new players
- 101. Modular/fully integrated systems become the norm in civil aviation, improving weight, development/ops/maintenance costs
- 102. "Standing seats" adoption by airlines necessitates floor reinforcement and cabin certification
- 103. Virtual reality in-flight could imply strong modification of cabin interiors
- 104. Connected aircrafts open new possibilities for IFE, but also for avionics and maintenance, disrupting the servicing chain
- 105. IoT and predictive analytics allow easier lock-in of MRO value through proprietary management of IoT information used in predictive maintenance
- 106. Use of quantum computing in aircraft design and testing may lead to accelerated processes, new players emerging from cheaper and less expert-led design processes
- 107. New materials (carbon, super-alloys, cellular structures, etc.), enabling redesigned aircrafts
- 108. Massive use of additive manufacturing may lead to accelerated production, reduced complexity of aircraft parts and supply chain, and easier aircraft customization
- 109. Use of robotics, AR, etc. in manufacturing, enabling accelerated production and the emergence of new, smaller players
- 110. Unmanned aircraft emergence disrupts avionics and aircraft interiors, as well as responsibility & insurance models
- 111. Urban taxi & freight drones become viable and open a new segment, with possible new players emerging
- 112. Aircraft purchasing through crowd-financing enables new players to enter leasing business through easier access to funding, and allows existing players to tap crowd-finance
- 113. White-label airlines would mean standardized aircrafts, rendering leasing fleet easier to manage
- 114. From aircraft "provider" to value-added services (fleet management)
- 115. Development of blockchain would improve cost structure through reduced transaction costs (smart contracts)
- 116. IoT & data analytics lower entry barriers to be a lessor, as less specific technical expertise is needed to evaluate aircraft residual value
- 117. Use of artificial intelligence in aircraft trading improves liquidity of secondary market through automated trading
- 118. High fuel, increased environmental regulation would mean Airlines need to lease more recent aircrafts – a positive for lessors
- 119. Low fuel, relaxed environmental regulation would mean airlines do not seek recent aircrafts, a negative for lessors
- 73. Market consolidation to reduce local risk of contract loss and increase in pricing power vs. airlines
- 74. Self-check-in/self-boarding process, leading to disappearance of PAX services segment for ground handlers
- 75. Autonomous GSE, leading to reduction of ramp staff
- 76. No more push-back thanks to electrical landing gears
- 77. Modular cabins development, leading to a need for new equipment and higher capex

3 Infrastructure providers

- 58. Environmental consideration of CO2 emission restriction and noise restriction, leading to limit on airport constructions and on operations
- 59. Optimization of air-side capacity of ATC automation
- 60. Continuous privatization & consolidation trends around few international airport operators
- 61. Multiplication of mega-airport (>100Mpx) with development of housing and services, resulting in urbanization
- 62. Emergence of last-mile city airports with development of air-taxi
- 63. Fragmentation of the airport with remote terminals (e.g., in city centers), leading to possible competition between terminals, with player acting as terminal provider only serving the same runways
- 64. Reduced/free aeronautical fees for airlines in case of stringent regulation and/or strong increase in commercial revenues
- 65. Deployment of self-connect services (direct lever for new traffic development, new source of revenue)
- 66. Decrease in retail and car parks revenues for airports due to new mobility, e-commerce, and on-board wifi retail, leading to (1) strong need to activate efficiency levers & (2) possible exposition of aero fees
- 67. Seamless security/custom process, leading to drastic dwell time (decrease in revenues)
- 68. Leverage big data & AI to understand "hyper-consumers", develop CRM and boost both customer experience and commercial revenues
- 69. Leverage data analytics & AI to optimize capacity & improve opex performance (automation of airport process, flow monitoring, intelligent building management systems, predictive solutions)
- 70. New market open for competitive ground handling
- 71. Full leasing model, leading to increase in competition and entry of new type of ground handlers (airport security providers entering GH, etc.)
- 72. Emergence of pooling of ground-support equipment (already the case) and staff (potentially providers at airports)



5 Technology

- 120. Smart predictive analysis
- 121. Smart manufacturing processes (predictive maintenance, production planning, optimization, cross-factoryline best-practice transfer, process quality management and virtual documentation, etc.)
- 122. Intelligent virtual agents to reduce staff/improve efficiency
- 123. Flight operations optimization: reduced consumption of energy, delay prevision, crew deployment, etc.
- 124. AI-powered autonomous pilot systems
- 125. Personalized advertising and offers based on customer preferences and needs
- 126. Intelligent virtual agents to improve customer experience
- 127. Suppression of intermediaries such as GDS and OTA, allowing the reduction of costs
- 128. Peer-to-peer air traffic control management thanks to blockchain, replacing ANSP
- 129. Value-chain transparency: better tracking of provenance and maintenance history of aircraft assets
- 130. Blockchain-based identity management, in combination with biometrics technology: ensure the authenticity and protection of data
- 131. Tokenizing loyalty programs: turn airline miles into something much more valuable outside the defined boundaries of airlines and their limited <= unfinished sentence?
- 132. Blockchain driven in-flight entertainment, bringing more adaptability and reducing costs
- 133. Development of hybrid planes
- 134. Development of electric planes
- 135. Development of solar planes

Macro-trends and disruptions

- 1 Towards mass customization
- 2 Highly constraining environmental regulations
- 3 Lean through tech: Automation, AI, 3D printing
- 4 New aviation playing field
- 5 Cybersecurity and connectivity as critical providers
- 6 Sovereign deregulation
- 7 Economic deregulation
- 8 Airline-as-a-media provider
- 9 Airlines horizontal consolidation
- 10 Airlines vertical fragmentation
- 11 Airport scattered throughout the city
- 12 Vertical integration of aircraft providers' value chain
- 13 Aircraft providers' horizontal consolidation
- 14 New OEM competition
- 15 Aircraft provided as a service

New clients' expectations

Passenger expectations and the emergence of new, relevant playing fields for aviation are key elements to consider when anticipating possible scenarios for the future of the aviation industry, in terms of value chain recomposition and value sharing.

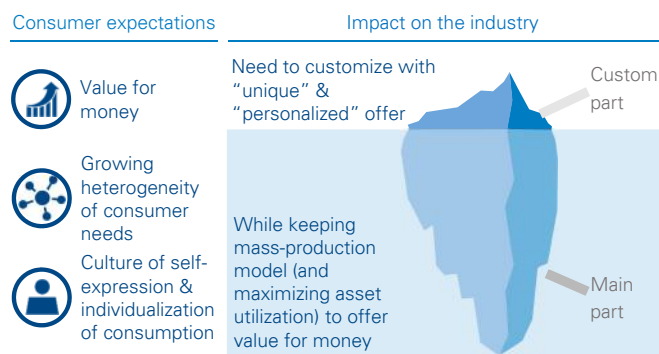
MT#1: Towards "mass customization"

By 2035 generation Y ("millennials") and generation Z will make up the bulk of air travelers. Accustomed to digital retail and hospitality, as well as to seamless connectivity underpinned by strong individual value in which personal experience and self-fulfillment are key, these travelers will increasingly ask for tailored offerings. In addition, demand for air travel will be multiplied by at least two, thanks to an increase in the wealthy middle class globally, with aviation becoming a mass market – if not a "commodity".

As a consequence, aviation will have to adapt to "mass customization" of its offerings. The entire value chain will be impacted: from aircraft OEMs offering flexible cabins to airlines offering continuous ranges of experiences, from "value for money" (travel essentials plus ad-hoc options) to full "branded experience" in the air and on the ground (i.e., asking infrastructure providers to enable it).

Mass-customization will thus be enabled by standardized assets and operating practices (with safety and cost efficiency as a given). On top of this, some "versioning features" with strong impact on customer experience will provide the tailored touch – and enable industrials that supply them to grab greater shares of the value.

Figure 9: The growing need for "mass customization"



Source: Arthur D. Little

MT#2: Rising environmental concerns

Even though aviation has been one of the most proactive and ambitious industries to foster sustainable growth, environment regulations could still constrain its growth and may be the greatest strategic risk for the industry.

Indeed, the relative impact of aviation on global emissions will triple in the next 20 years, considering efforts made by other sectors. Noise is not yet considered a major issue in some regions where 24/7 operations are common practice, but growing urbanization and concerns for living comfort might shift some borders.

Citizens could then push governments to increase environmental regulations further, and thus to limit air transport growth. On one hand, despite some failed attempts a decade ago in Europe, carbon taxation could be more heavily levied on aviation in the future, increasing ticket prices and thus lowering the demand. On the other hand, noise constraints could increase and limit slots and airport expansion, and have a strong negative impact on the supply.

Of course, this will foster innovation across the industry to meet this challenge, but with limited effect by 2035 because the commercial aircraft in service will be broadly the ones we know today in terms of air-frame and propulsion technologies.

An extreme consideration is regulation of CO2 emissions at individual level, based on quotas for total emission rights and personal arbitrage for consumption of those quotas. In such a scenario, demand for aviation would be severely reduced, because needs other than long-distance transportation would be fulfilled before or because substitutes to air travel would have been developed. This extreme scenario might also limit the emergence of "last-mile aviation" (i.e., drones). However, we did not consider such an option for severe environmental constraints by 2035, as it seems too extreme to be realistic.

Technologies enabling new aviation playing fields

MT#3: Lean through technology: automation, AI, 3D printing

By 2035, the entire aviation ecosystem will be able to drastically reduce its operating costs and increase its asset utilization by leveraging technology.

By 2035, air transport service providers could decide to go for "human-less crews": Single-pilot should at least become common practice, underpinned by three phenomena:

- Acceptance of autonomous vehicles (i.e. pilot-less aircrafts) may increase as self-driving cars become a mainstream feature in transportation (possibly after metro and just before trains).
- AI and machine-learning technology will enable airplane autopilot services to reach higher levels of performance.

- Air transportation service providers might find that pilot-less aircrafts are a strong answer to (i) pilot shortages and (ii) tense social relations.

Cutting on-board service in lower classes until there is no cabin "human crew" could also be expected, as long as this can be safely managed.

Infrastructure providers can also expect major gains from automation technologies and AI: automated ground processes and AI-based resource management at airports, unmanned traffic management (UTM) for air navigation service providers, and autonomous ground support equipment for ground handling companies all increase productivity and capacity.

Last but not least, operations 4.0 (including robotization, 3D printing and predictive technologies) will transform aircraft suppliers' (OEMs, MROs) productivity.

A key uncertainty will be the ability of each party to retain parts of these efficiency gains instead of giving them away to clients. Each party in the aviation value chain is exposed to different constraints regarding this.

- For example, recent studies of the airline industry show that more than 70 percent of the benefits of fuel-price decreases are given away to passengers through lower prices because of intense competition.
- As for aircraft OEMs, MROs' and ground service providers' internal rivalry is very high, preventing a lasting value capture...
- ... while airports and ANSPs could certainly keep part of the gains generated by operations 4.0 – but only if economic regulation of their businesses allows it.

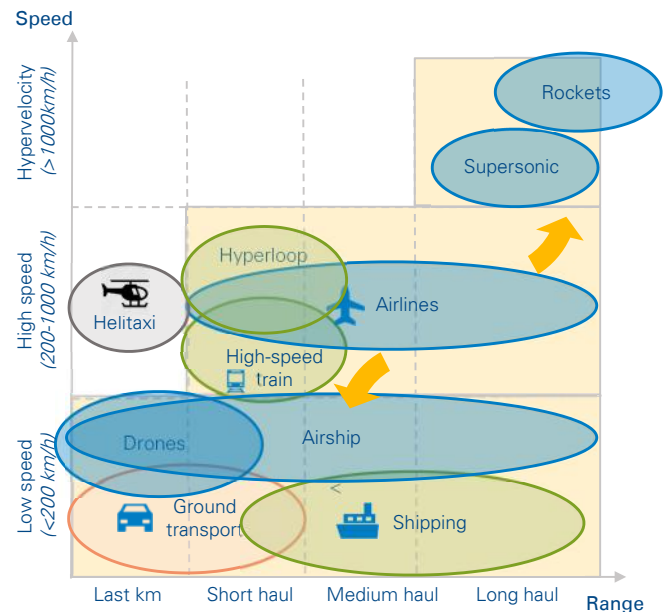
MT#4: New playing fields with "last-mile aviation" everywhere and emerging "hyper-velocity"

Aviation will explore two new playing fields by 2035: "last-mile transportation" and "hyper-velocity".

By 2035, drones and autonomous aerial vehicles will already be operating across the globe and have transformed the ecosystems of logistics, surveillance and emergency medicine, as well as personal short-distance transportation. "Last-mile aviation" will be a new industry, and in Europe, for instance, could represent 15 to 30bn€ revenue.

Last-mile aviation will not compete with current commercial aviation; instead, the above-mentioned ecosystems will be the most disrupted. However, a completely new, parallel value chain will emerge, with new aircraft suppliers (today's tier 1 might be

Figure 10: Speed and range matrix of transportation modes



Source: Euromonitor + extrapolation based on GDP, UAV Serving Surveillance (Agriculture, Police ...), Delivery (last mile), Air Tax services

tomorrow's key player), transportation providers (leaders or new entrants in the mobility industry) and infrastructure providers.

The greatest challenge for current players in the aviation industry will be to adapt to a much more fragmented market, with a multitude of small assets and operators/owners compared to those of commercial aviation: Eurocontrol forecasts more than 400,000 autonomous aerial vehicles in Europe by 2035, versus approximately 40,000 commercial aircraft today globally. Infrastructure providers (airports, air navigation service providers) will be at the front line of this challenge because they could be the only remaining player serving both "aviations" and have to manage potential conflicts of interest in airspace and ground-area utilization.

At the other end of the spectrum, "hyper-velocity aviation" might only be emerging by 2035, with scattered experiments around the globe, and could anyhow be limited to a niche market compared to "traditional" commercial aviation, given the high associated costs and strong operational constraints.

MT#5: Cybersecurity and connectivity as "must-haves"

Cybersecurity and connectivity will be "must-haves" by 2035 in order to enable the Aviation 4.0 operating model. Indeed, the future of Aviation, like many other industries, will be based on lean processes, automation and artificial intelligence, i.e., it will rely on (semi-) autonomous vehicles, self-decision-making infrastructure and traffic management systems, real-time monitored assets, and automated client interfaces. In this

context, cybersecurity and connectivity providers will capture a significant share of value: IT service providers have already increased their revenues from other pioneer industries by 20 percent for cybersecurity and connectivity. IT costs for the aviation industry should follow the same trend.

Regulation as a key driver to unleash possible futures for aviation

MT#6: Sovereign deregulation (traffic rights, ownership rules)

The long-term trend clearly points to the vast majority of countries operating under an open-sky philosophy, in terms of both traffic rights and airline/airport ownership rules, which will enable, first, higher competition between airlines, and then faster consolidation of the industry.

Impact of open-sky policy is significant, with IATA measuring

However, certainty is not a given in that area because countries' vital economic interests are the prevailing factor in terms of sovereign deregulation. A reverse or slower trend cannot be ruled out when looking 20 years ahead.

MT#7: Economic deregulation

Ruptures in the economic deregulation of the aviation industry are impacting measures, and can be regrouped around two major themes: (i) regulation of data ownership, usage and monetization, and (ii) pricing regulation for scarce resources (i.e., airport and air navigation slots).

Data monetization regulation will be a major enabling or blocking factor for the emergence of two new business models (see "Next trends" for detailed description): (a) the "mediatization"/"platform-ization" of airlines, which are tending to monetize their client data more and more, and (b) the emergence of "aircraft-as-a-service" solutions offered by aircraft suppliers (OEMs, MROs). In addition, regulation of ticket naming is key to the emergence of a ticket marketplace between passengers facilitated by new or existing players.

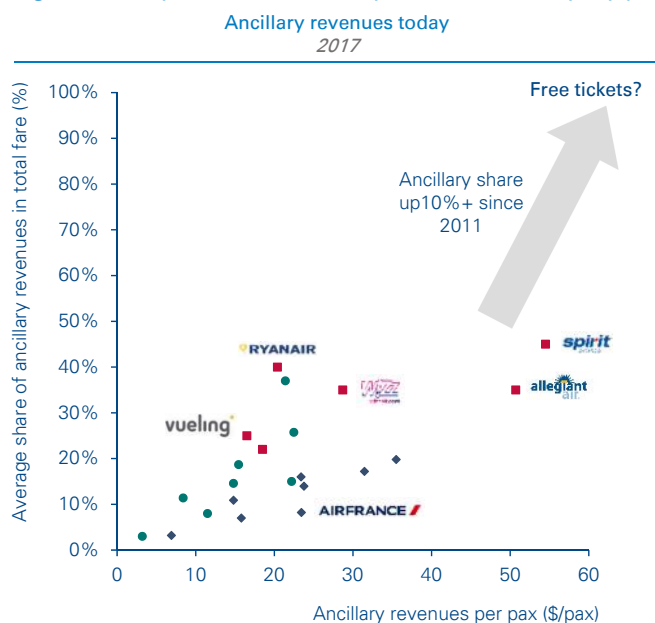
Regulation of pricing among infrastructure providers could increase their profitability significantly if they can implement a "free market" or, to lesser extent, "significantly differentiated pricing" according to the scarcity of the resources they supply. Whether this additional marginal profit would go into public or private pockets is an different question, and depends on the ownership and revenue-share strategy that each country might implement.

Reshaped landscape among air transportation service providers

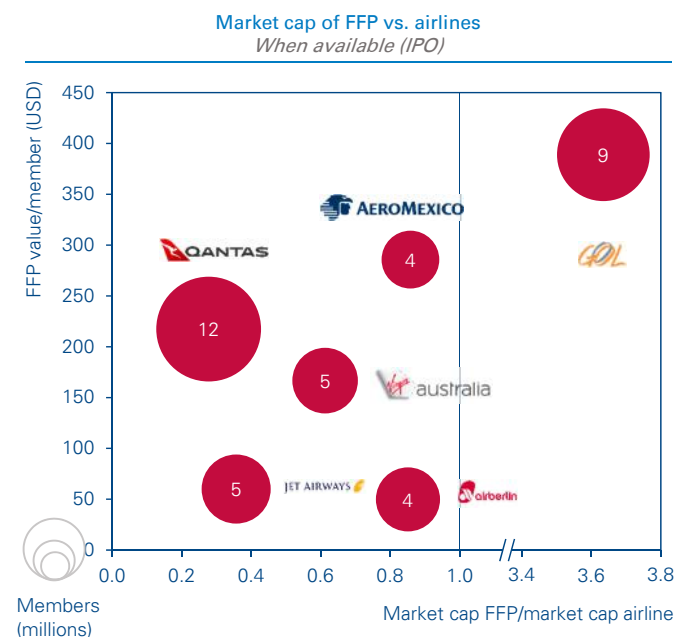
MT#8: A new business model: airline-as-a-medium/-as-a-platform

Airlines are transforming into media (or platforms), i.e., entities whose objectives are to capture large audiences by providing "initial services" at low prices (or even for free), and then monetize these audiences by (i) selling complementary services and/or (ii) enabling other parties to sell their offerings.

Figure 11: Importance of ancillary revenues and loyalty programs



Source: Arthur D. Little



Indeed, we can see strong evidence of this phenomenon, such as:

- Share of ancillary revenues (i.e., non-ticket related) within airlines, which has been quickly increasing. This trend is set to continue until these eventually enable free travel.
- Airlines going for co-branding of their aircrafts or cabins (e.g., La Première lounges by Clarins for Air France passengers and United partnering with Sak's Fifth Avenue for a unique window display experience).
- The increasing value generated by airlines' frequent flyers programs (FFPs): some listed FFPs show value per member above 150–200US\$ and market capitalization of those FFPs that is bigger than 50 percent of the market capitalization of the airlines themselves – sometimes even larger than 100 percent.

Passenger data as well as passenger time could be taken advantage of even more than they are now, with many players willing to “monetize” airline passengers:

- In-flight retail might be transformed by accessing large vendor platforms through IFE or wi-fi.
- Car-sharing platforms propose compensating the airline ticket price in exchange for the passenger leaving a car at the airport to be rented out.
- Many start-ups are remunerating passengers for performing small tasks such as classifying photos, watching ads and answering polls.

In one extreme vision, airline brands could progressively disappear to let others exploit and harvest the audience they own before, during and after the flight. The transformation of airlines' business models is already significant and might be radical – from a transportation service provider to a platform service provider.

MT#9 & MT#10: New airline group boundaries: horizontal consolidation, vertical fragmentation

As we explained in our introduction of the “business eras” of the aviation industry, airline consolidation is now picking up on each continent, with industry specialists forecasting the emergence of three to four main players per global region/large market (on the basis of the trend happening in the US or the situation of the Chinese market). In case of full deregulation of ownership rules, airlines could even consolidate worldwide around six to seven main players and a range of smaller niche players.

Distribution and IT providers also consolidating to retain leverage versus their clients and to gain sufficient investing and talent retention capabilities.

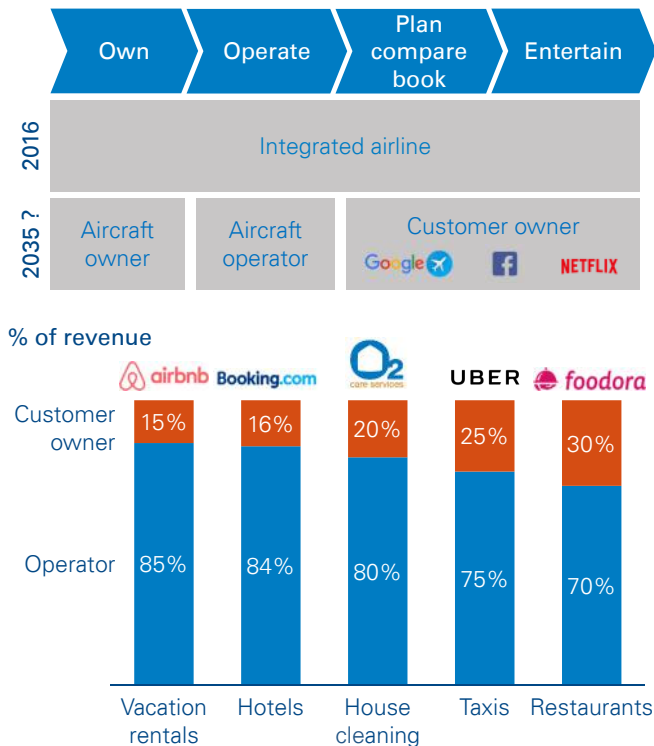
In parallel to the horizontal consolidation, the current “vertically integrated” airline model could eventually split into several players: a capex owner that provides the assets, a customer owner that acts as a gatekeeper for airline customers, and the airline as a white-label operator. This phenomenon of “vertical disintegration of the operating and business models” has already hit adjacent industries such as hospitality, food and personal transportation.

Figure 12: Monetization of passengers to third parties



Source: Arthur D. Little

Figure 13: Value chain fragmentation and value capture by customer owners



Source: Le Figaro, L’echo touristique, blogTO, Le Figaro

Customer owners always capture a great share of revenues (see above illustration), and an even greater share of the profit pool, because their platform business models, based on software technology, are highly scalable.

In the aviation industry, many platforms try to position themselves as customer owners – and if they do not fully succeed, they at least disrupt the revenue management strategies of airlines. For instance, Kiwi enables self-connection and Skiplagged allows travelers to fly the first legs of connecting flights at lower fares, versus one-leg trips. Both are disrupting the hub-and-spoke operating and pricing models of airlines, potentially narrowing to zero the 5 percent revenue increases (and thus EBITDA margins) that revenue management strategies are supposedly bringing to airlines. (R)evolution for infrastructure providers

(R)evolution for infrastructure providers

Infrastructure providers will be impacted by the megatrends we previously exposed – as well as by specific ones that that could transform their strategic roles in the aviation industry.

New infrastructures for new aviation

The emergence of last-mile aviation (cf. MT#4, e.g., drones for passenger transportation, goods delivery and surveillance, among other services) represents a new field for the whole aviation infrastructure industry.

Short-haul drone terminals will be needed to enable last-mile aviation. But air navigation service providers will be the most impacted players in the current value chain. ANSPs will have to shift from (i) models in which they will deal with small flows of large aircrafts and air transportation providers (approximately 300 commercial airlines operating around 30,000 commercial aircrafts) to (ii) models in which they will deal with virtually infinite volumes of small units (drones), clients and routes. Unmanned traffic management will be necessary: in 2035, IT suppliers will capture value in the context of ANSPs considering staff to be of decreasing importance – and the transition period 2020–2035 will be a major challenge.

Evolving business models for infrastructure providers

A new playing field will emerge with last-mile aviation, but infrastructure providers will face a triple challenge. They must (i) invest to cope with sustained traffic growth that will see traffic double by 2035, (ii) transform their operations into infrastructure 4.0 models, and (iii) defend their revenues (with aeronautical revenues under strong pressure from airlines and regulators, and non-aeronautical revenues challenged by potential substitutes). Last but not least, their value-add might be transformed, and regulation could create opportunities for higher value capture.

In the very short term, new technologies from automation and artificial intelligence (see MT#3) will enable better use of the installed asset bases of infrastructure providers. It will increase the capacity of airports (automated processes, intelligent management, and allocation of scarce resources such as stands and gates), ANSPs (with the development of unmanned traffic management – UTM) and handlers (with self-driving ground support equipment and intelligent planning). The current best estimate is a 30 percent capacity increase, but by 2035 this gain could be even higher. At the same time technologies contributing to an infrastructure 4.0 operating model should reduce the operating costs of infrastructure providers, and thus enable them to cope with the expectation of airlines to lower the burden of infrastructure costs.

However, non-aeronautical revenues will be a challenge, as revenues from car parks (because of self-driving cars and shared mobility services) and commercial businesses (with online, in-flight duty-free available or simply e-retail becoming more competitive) will be endangered.

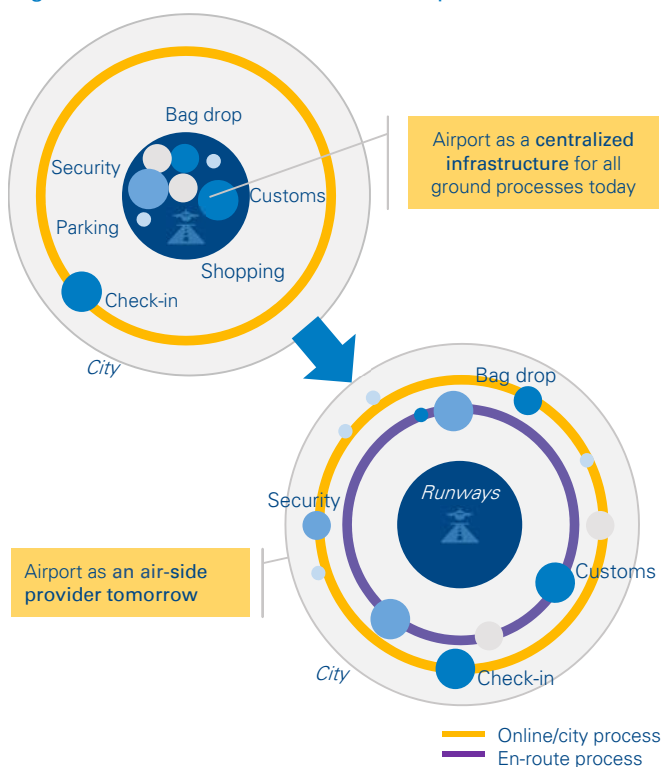
As explained in MT#7, economic regulation of infrastructure providers will have a great impact on their business models: in the context of deregulation, ANSPs and airports could be allowed to monetize highly demanded routes, slots and gates with the introduction of yield management for airport resources and air routes.

MT#11: Airports scattered throughout cities

For airports, the disruption might be even deeper; airport processes (check-in, bag drop, security) could be scattered throughout cities. Early signs of these trends can be seen already: many start-up players, together with airlines, are proposing managing luggage pick-up and delivery as a separate flow, and city-center check-in terminals are expanding.

Airports would then be sent back to their core functionalities: boarding/deboarding planes and enabling take-off with limited dwell-time for passengers in terminals. This could have a strong negative impact for key in-terminal revenues such as retail, advertising and F&B, which together represent approximately 15 percent of airports’ revenues around the world – but more than 30 percent in the Middle-East and approximately 20 percent in Asia, for instance. It could also have consequences for airline tariffs to compensate for this loss (with either a regulated increase in airport charges or accelerated deregulation of the pricing of scarce and costly capacities).

Figure 14: Illustration of a scattered airport model



Source: Arthur D. Little

A big merge within the cluster of aircraft providers?

OEMs and tier 1s appear to have consolidated both vertically and horizontally in response to new players and internal rivalry in the cluster. With transformed operations, they are also continuing to move toward industry 4.0 models. All this enables them to position themselves in the UAV market along with new entrants, and to innovate to propose more autonomous (single-pilot operations) and versatile (quick-change, highly customizable) aircrafts. MRO players are also adopting operation 4.0 and expanding their service lines with predictive maintenance and fleet management services. However, even if these are already significant changes for aircraft providers to manage, the big strategic change is how this cluster could merge from four types of players into one that would provide aircraft-as-a-service and become the outsourced fleet management and operation departments of airlines.

Smarter and more versatile flying machines

Major changes in transverse technologies appear to be the cornerstone of the future of the flying machines. Artificial intelligence, blockchain, cybersecurity, connectivity, crowd techs, energy storage, and new materials are all key themes in the invention and production of the “aircraft of the future”.

We consider it a given that by 2035, aircrafts will be both more cost efficient and smarter, thanks to autonomous decision-making systems (single-pilot, auto-pilot) and predictive maintenance and self-repair.

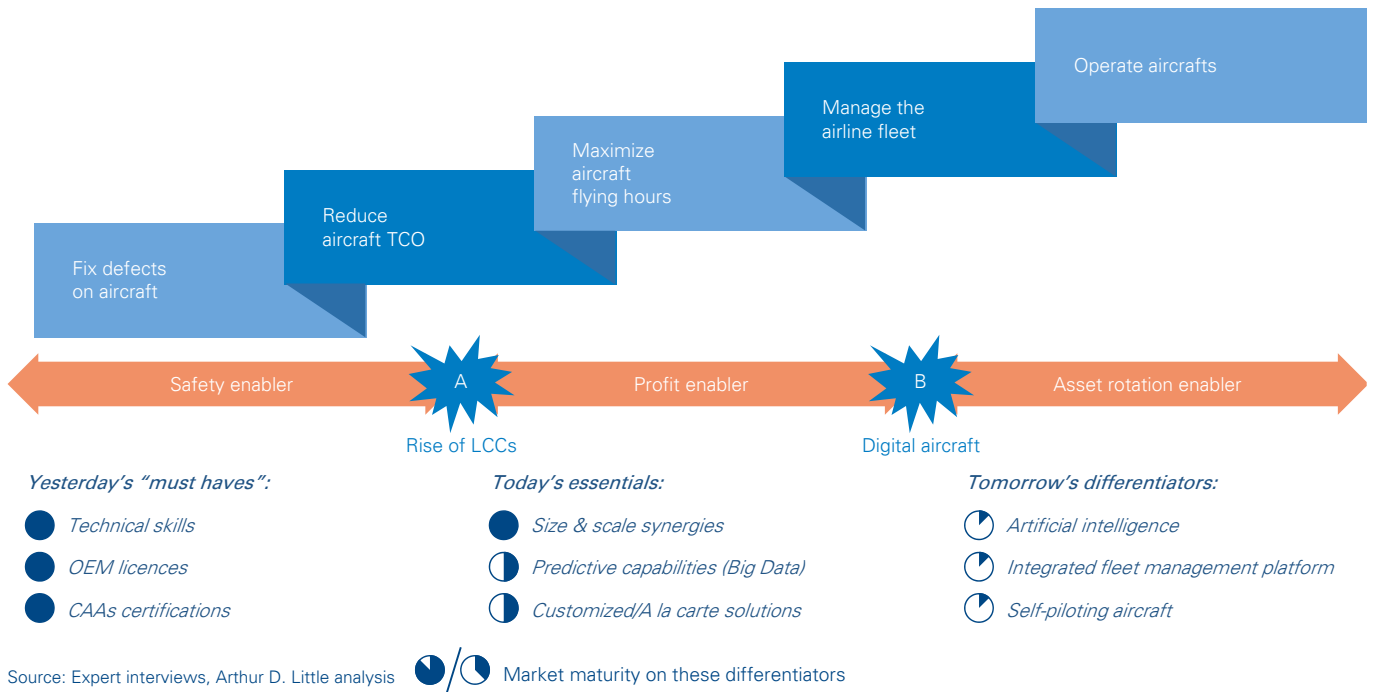
Aircrafts will also be more versatile: new passenger expectations and the quest for differentiation of airlines will drive “customization” of aircraft cabins and configuration, through smart and modular equipment and quick-change options. Autonomous flying machines for personal transportation would be a perfect test bed for those new “personalized” features.

Value chain evolution

MT#12 & MT#13: Vertical integration of aircraft value chain (OEMs, tier 1s, MROs, lessors)

In an upstream vertical integration move, OEMs are starting to consider re-internalizing some equipment design and production to respond to the emergence of mega-tier 1s that are now capturing most of the aircraft value. Horizontal consolidation among OEMs would also happen through co-funding of programs, or possibly even through large tier-1 partners or external parties.

Figure 15: Evolving role of MRO and OEM's service business units



Tier 1s are now adopting the same upstream vertical integration and horizontal consolidation. As OEMs increase cost pressures towards their suppliers and re-insource specific high-value aircraft segments, tier 1s may further consolidate to create advantage, while maintaining direct relationships with airlines. Two or three "mega-tier 1" players are already almost able to supply all equipment to compete with OEMs.

MT#14: New competitive landscape for OEMs

The emergence of a new aviation playing field (e.g., drones) represents a strategic opportunity to expand business and added value for all of the cluster of "aircraft providers":

Of course, incumbent OEMs will grab a significant piece of this cake, but mega-tier 1s could also become large, independent OEMs in the drone market, along with new pure-player entrants.

In this new aviation playing field, crowdtechs (with crowd design, crowd-funding, etc.) and decentralized manufacturing (with fab labs, 3D printing, etc.) could play a large role in creating a new landscape and new value sharing among players of the aircraft providers cluster.

OEMs financing, maintaining, managing and operating airline fleets

MT#15: Aircraft-as-a-service

The main strategic change in the aircraft providers cluster, already on the verge of happening, is "downstream integration"

of OEMs, which would transform their revenue models and risk management. So far, unlike other players in the aviation industry, OEMs are mostly exposed to one-off sales (of aircrafts), not to the entire value generation cycles of the assets they produce or to the growth of passenger traffic.

Therefore, OEMs are progressively turning towards selling flight hours per seat instead of aircrafts, hence the strategic moves of Boeing and Airbus into the maintenance business.

MRO providers, going into CAMRO and predictive maintenance services, are also shifting towards being "asset management platforms" in a maintenance 4.0 and digital aircraft world instead of simply fixing defects and performing planned checks.

We can witness now the early signs of a complete restructuring of the "aircraft providers" cluster, with blurring lines between players, up to the emergence of a single player that would design, manufacture, assemble, finance, maintain and manage airlines' fleets. This player would act as the fully outsourced fleet management and operations departments of airlines.

Ultimately, considering next-generation autonomous aircrafts enabled by (i) AI, (ii) hyper-connectivity and (iii) cybersecurity, one can easily imagine aircrafts sold as services: Airbus, Boeing and Coma would guarantee that the aircraft for a "Jakarta-Copenhagen" flight on Monday evening at 21:30 would be up and running for a "fixed" all-inclusive cost.



4. From global oligopoly to aviation-as-a-service: Five scenarios for 2035

We scrutinized the above-listed 15 megatrends in order to estimate (i) their potential impact on the growth or value sharing of the majority of players within the aviation industry and (ii) the degree of likelihood or uncertainty of each. This categorization is the second step of our scenario-building approach.

Three groups of trends were built (see illustration below):

- All macro-trends that we believed had high certainty were considered to create a “base scenario”.
- Macro-trends with low impact and high uncertainty of occurrence were not considered.
- Macro-trends with high impact but high uncertainty of occurrence were considered to derive future scenarios for aviation 2035. (See afterwards.)

Disruptions in (de)regulation and strategic moves are driving future scenarios

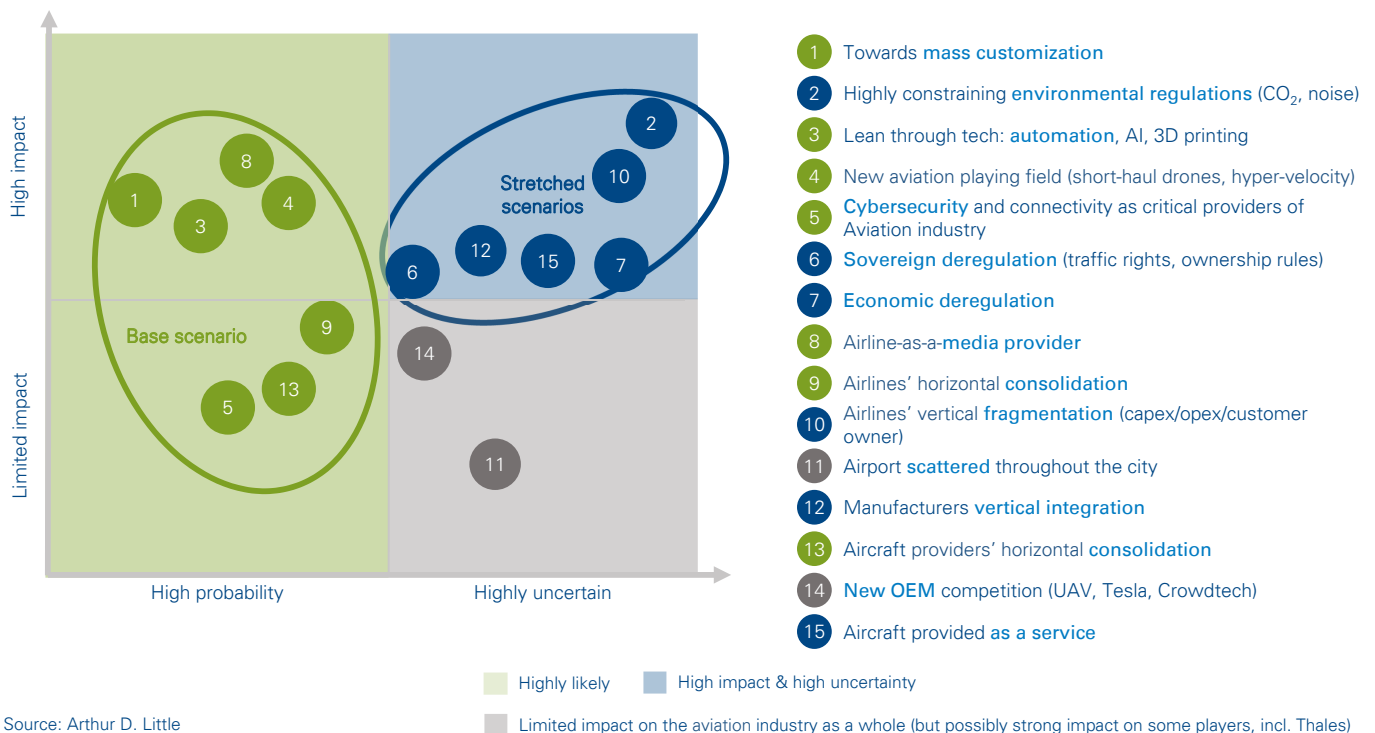
Our base scenario comprised all highly probable trends, and disruption is very unstable. This cannot be a possible future for aviation in 2035 that will be changed by other, more uncertain megatrends and disruptions.

The top six key disruptions in the blue area are therefore the critical ones to be considered. They all correspond to two major themes: (a) aviation (de)regulation and (b) strategic moves of players along the value chain of the aviation industry, within existing clusters or beyond the frontiers of current clusters.

Aviation (de)regulation

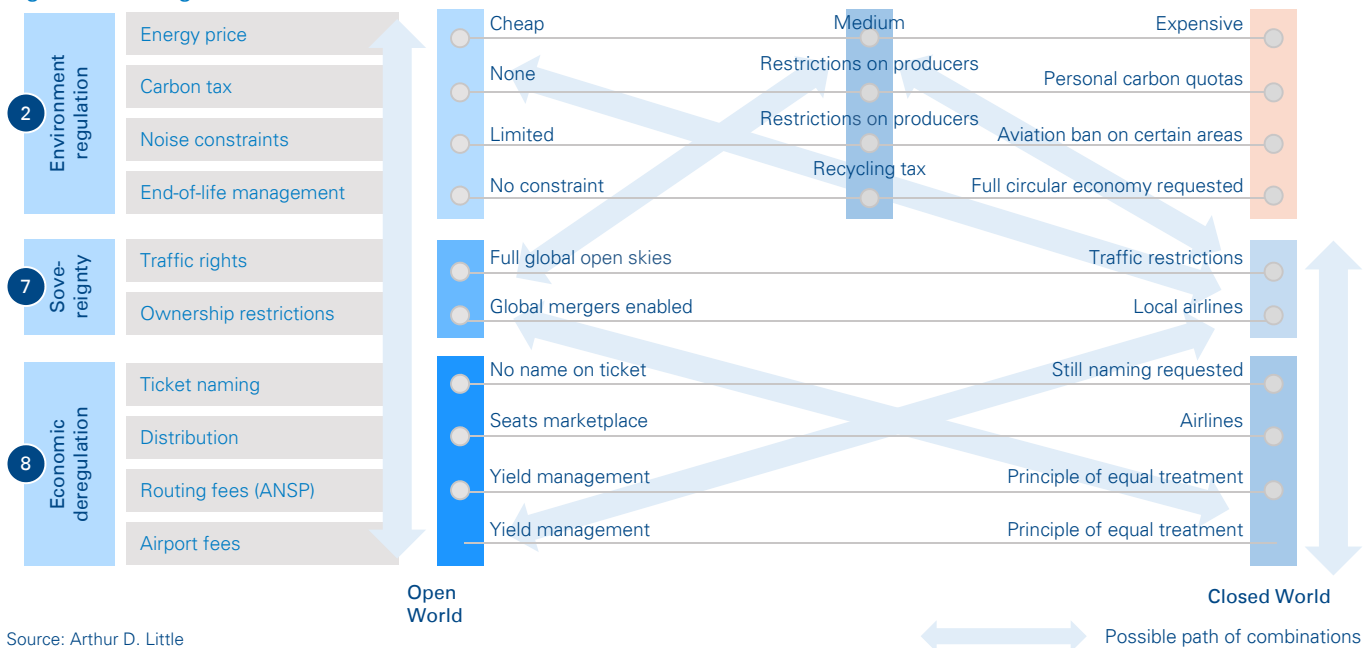
To embrace the full scope of the future of aviation de-regulation, the two extreme possible scenarios, Open World and Closed

Figure 16: Mapping of megatrends and disruptions



Source: Arthur D. Little

Figure 17: Deregulation scenarios

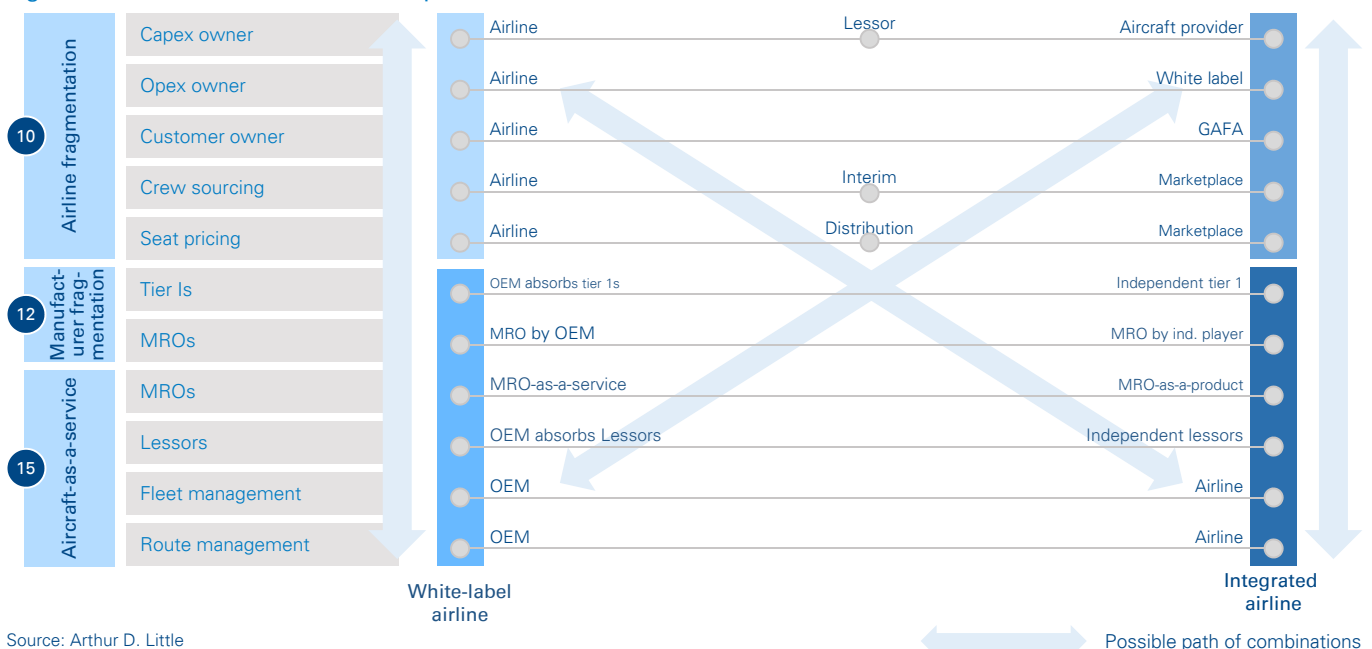


World, are proposed, combining different options among the following parameters:

- 2 **Environmental regulation:** High (or low) carbon tax or quotas
- 6 **Sovereign deregulation:** Lifting traffic rights and ownership rights (or not)
- 7 **Economic deregulation:** allowing (or not) a seats marketplace and yield management for infrastructure pricing (airports, ANSPs, etc.)

In this option space, we excluded a scenario in which environmental regulations would no longer only apply to goods & services producers (as they do today by imposing better environmental performance), but also directly to consumers. In such a scenario each individual would be allocated a yearly quota of pollution/CO₂ emissions and be free to arbitrate how to use it without going over the limit, or they would be heavily taxed. This scenario would be a major rupture to aviation growth, but we consider it improbable by 2035 from a global perspective.

Figure 18: Aviation value chain recomposition scenarios



Aviation value chain recomposition

Aviation value chain recomposition patterns can be grouped into four possible scenarios that combine options for either air transport providers or aircraft providers:

- 10 **Airline fragmentation:** Breakdown (or not) of airlines into capex, opex and customer owners
- 12 **Manufacturers’ vertical integration:** OEMs, tier 1s, MROs and lessors becoming single players (or not)
- 13 **Aircraft-as-a-service:** Manufacturing pivoting towards services and full management (even operation) of airlines’ fleets

To embrace the full scope for the future of the aviation value chain recomposition, the two possible extreme scenarios were taken into account in the report. White-label airlines and integrated aircraft-as-a-service were considered on one side, and integrated airlines and fragmented aircraft suppliers on the other.

An integrated airline would look at technology blocks aiming to differentiate, and should resist OEM/MRO integration. Conversely, in a fragmented air service industry, white-label airlines, reduced to only operating aircrafts, would most likely need integrated OEMs to provide aircraft-as-a-service.

Combining uncertain megatrends and disruptions to define five scenarios

The combination of the “certain” and “uncertain” megatrends and disruptions described above leads to five scenarios for aviation in 2035.

0 Base scenario: lean through automation

In this scenario, the whole industry moves towards automation of processes and improves margins by leveraging new technologies (data analytics, AI, 3D printing, etc.). Cybersecurity and connectivity enablers become critical for the industry and facilitate UAV emergence.

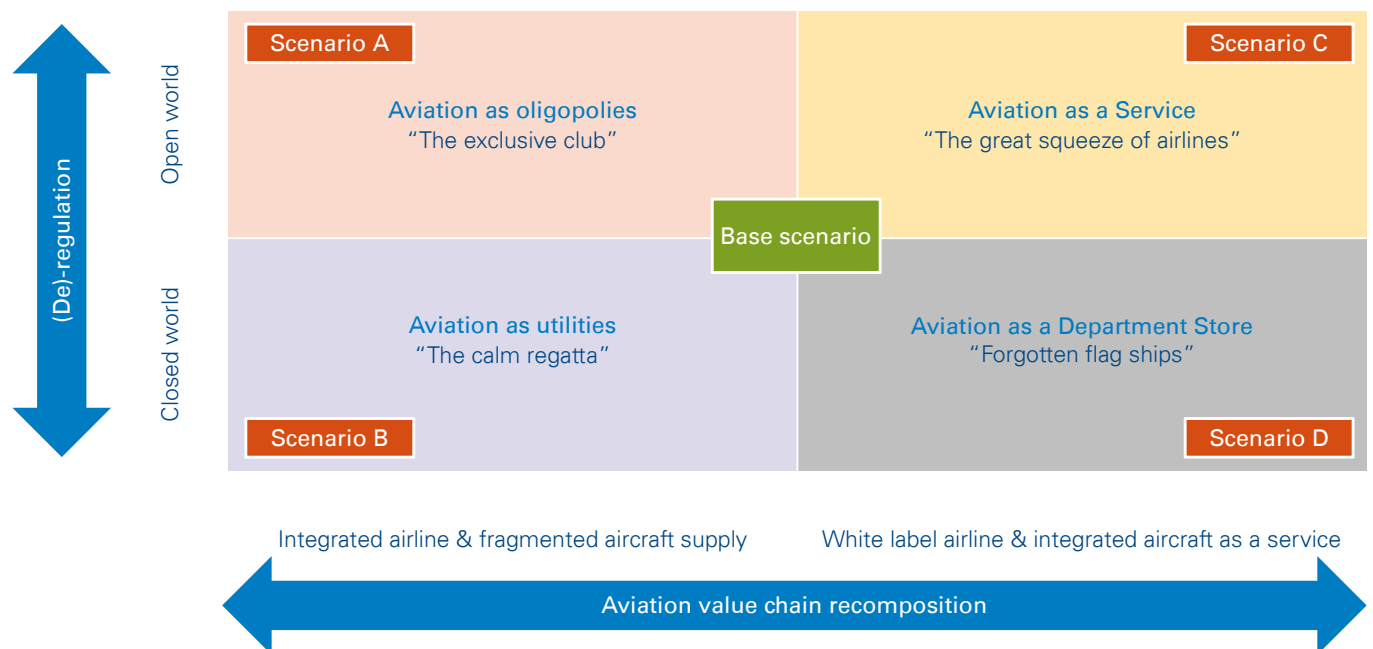
Consolidated regional, multi-brand airline groups cover numerous customer segments. Airlines have also twisted their revenue generation models towards becoming media platforms, with the most advanced players offering free tickets. Aircraft OEMs compete with mega-tier 1s to capture value-add in the aircraft supply cluster and in the market for last-mile aviation. Infrastructure providers are becoming more efficient, but keeping a stable role and value in the ecosystem

A Aviation as oligopolies: Integrated global airlines and fragmented aircraft production industry in a deregulated world

In this scenario, limited environmental regulations, coupled with low energy prices, stimulate aviation demand and growth.

Thanks to (de)regulated ownership rights, airlines are concentrated into a few groups of global players, which enables them to meet the competitive challenge with distribution

Figure 19: 5 possible scenarios for Aviation in 2035



Source: Arthur D. Little

service providers and regain huge bargaining power versus the rest of the value chain. However, infrastructure providers are still able to diversify profit generation sources thanks to deregulation. In this scenario, aircraft providers are in a tougher situation, as they are still fragmented and have failed to regain added value against their clients.

B Aviation as utilities: Integrated regional airlines and a fragmented aircraft production industry in a constrained environment

In this scenario, heavy carbon and energy taxation limits aviation growth and pressures producers. Consequently, the aviation industry is structured around regional groups – limited by national or regional control. Customers still value differentiated experience to a certain extent, although environmental concerns moderate expectations.

Intense competition exists between airlines that must deal with lower growth and higher cost bases, although operating according to different models (LCC versus customer experience). In any case, airlines remain in control of the customer relationship.

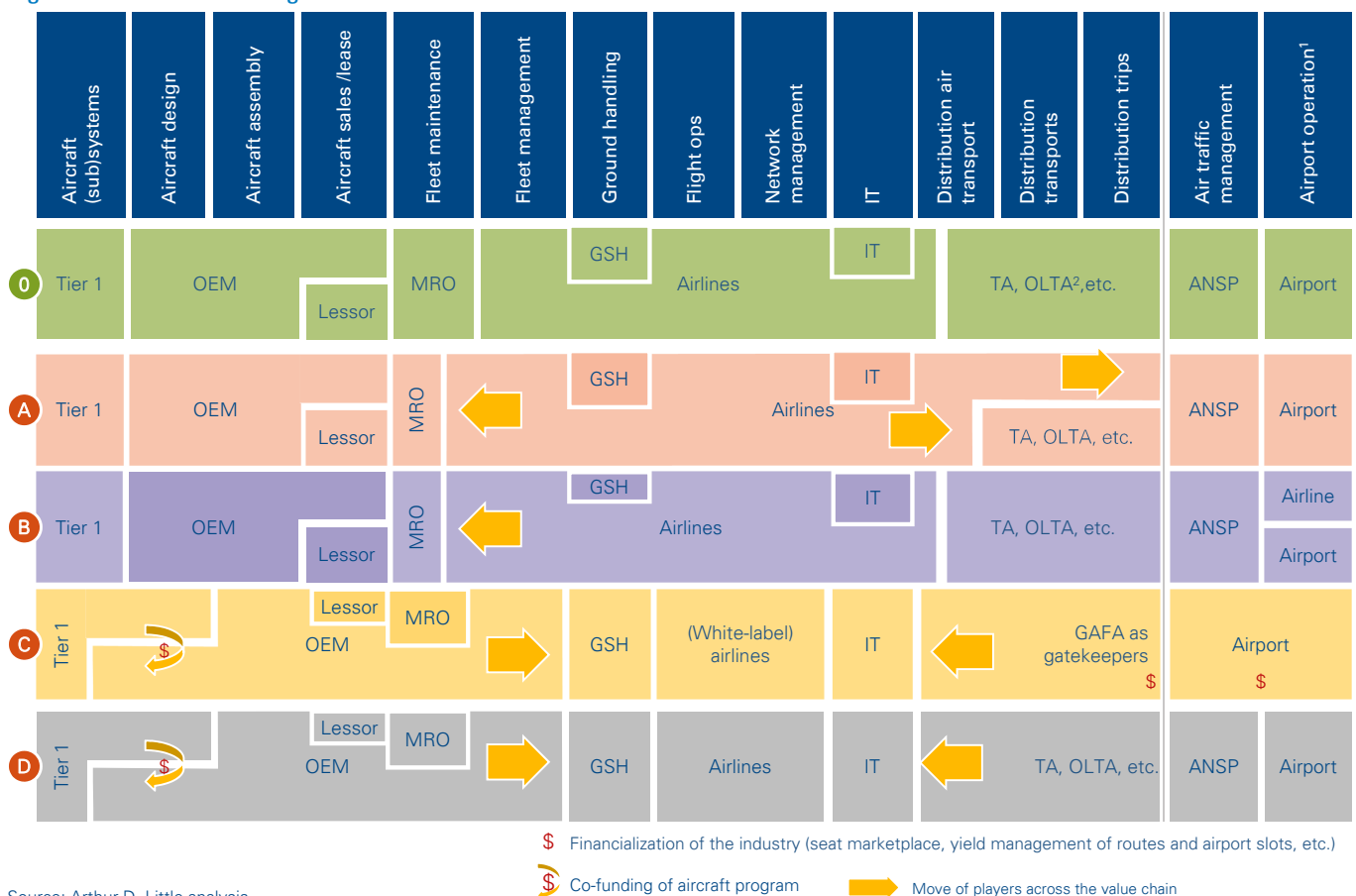
Infrastructure service providers are strictly regulated and can't aggressively capture value, while aircraft providers focus on green and autonomous products to make a difference.

C Aviation-as-a-service: White-label airlines and OEMs offering aircraft-as-a-service in a deregulated world

In this scenario, limited environmental regulations coupled with low energy prices stimulate aviation growth. Low entry barriers stimulate competition, while the lifting of ownership restrictions enables the emergence of global players in each segment of the value chain. The market is embracing "mass-customization", with price as a key selection criterion, while customers are still looking for personalized add-ons and experience.

Thanks to economics and personal data deregulation, distribution players have succeeded in owning the customers. OEMs are concentrated into a few total fleet provider and manager groups, providing modular assets as services. The cost of infrastructure is getting higher, with airports disrupted on non-aero revenues and ANSPs introducing yield management on routes.

Figure 20: Value chain fragmentation



Source: Arthur D. Little analysis
 Note: 1) Aero activity of airport. 2) OLTA = Online travel agent

As a result, airlines are cornered, as pure asset operators and their economics are thus under strong pressure from both downstream and upstream stakeholders.

D Aviation-as-a-department store: White-label airlines and OEMs integrated as services in a constrained environment

In this scenario, heavy carbon and energy taxation limits aviation growth and pressures producers. The aviation industry is structured around regional groups – and limited by national controls. The market is commoditized with standard products to which customers can add handpicked options.

Air transport has become a media provider through which various brands express themselves in different parts of the cabin. This is just like today, when luxury hospitality or cosmetics brands “franchise” the first class of airlines.

Air transport service providers procure aircrafts from total fleet providers and managers, which capture an even greater profit pool versus infrastructure providers.

Major moves along the value chain ahead

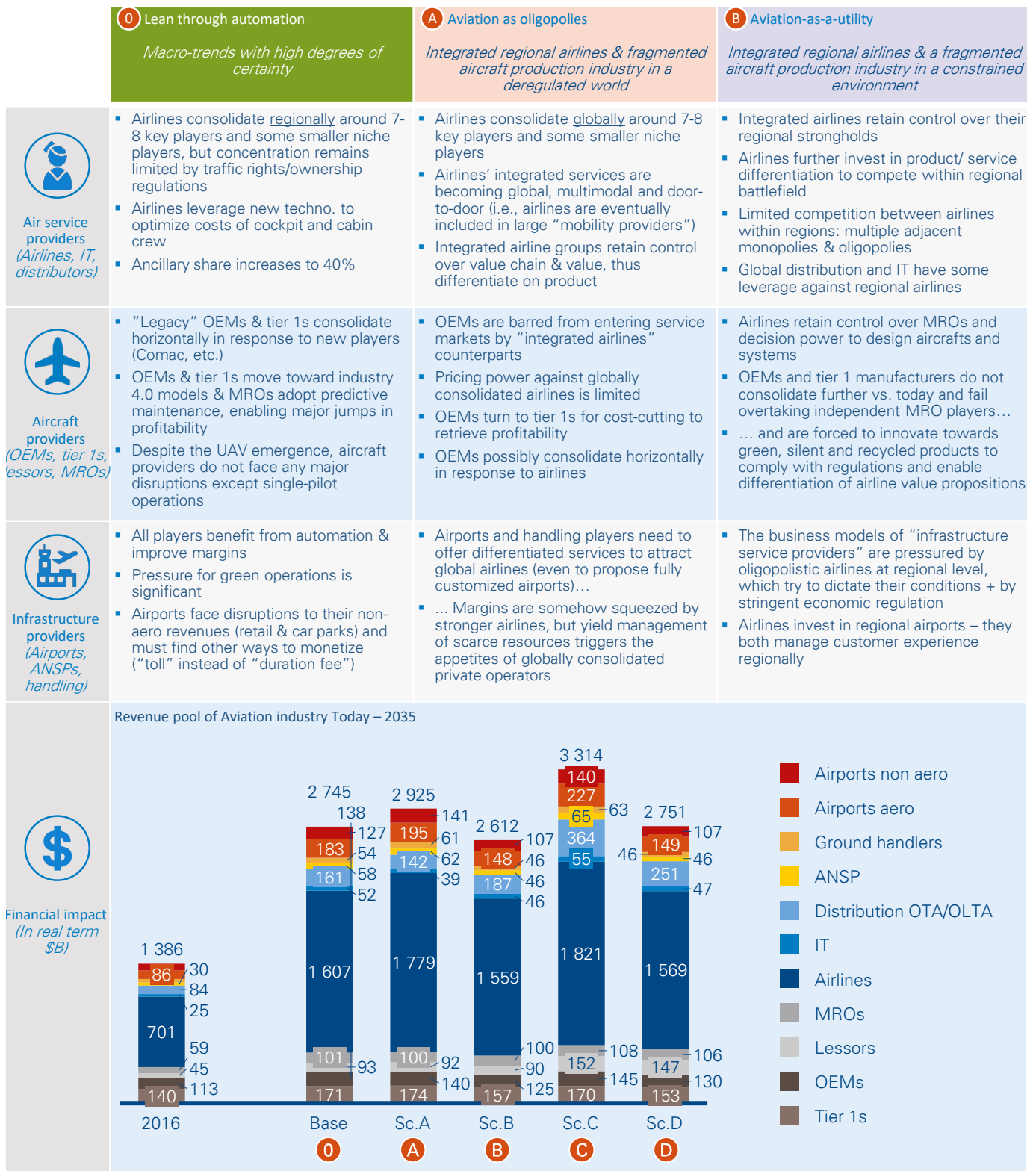
The illustration below summarizes the major shifts in the value-chain positioning of key players that correspond to each scenario. It is thereafter explicit which clusters and players are gaining strategic added value.

In the base case no major shift is expected; today’s situation continues. (For players such as airlines and OEMs, the landscape might change significantly, but we are looking at this from the ecosystem perspective.)

In other scenarios, the strategic roles fulfilled by airlines, OEMs, distributors and infrastructure providers can change a lot. This can include associated impact on their economic models, revenue generation and profit capture.

The next section of this report shows the results of our estimates, translating each scenario into revenue and profit sharing at the ecosystem level.

5. Impact of the five scenarios on value sharing in the ecosystem



C Aviation-as-a-service

White-label airlines & OEMs integrated as services in a deregulated world

- Customers are owned by gatekeepers (such as Google or a new "mobility platform")
- Gatekeepers are asset-less, but capture most of their value by distributing door-to-door, multimodal, global solutions operated by multiple partners ... with gatekeepers pushing airlines to become media providers to enable new sources of revenues (with ticket prices falling sometimes to zero)
- Airlines also tend to cost+ model (white-label air transport provider)

- OEMs seize the opportunity of weakened airlines to support them with services from MROs up to fleet and route management
- Aircraft "hardware design" is heavily standardized but connected components are key for gatekeepers' mass-customization (e.g., Google's connectivity ecosystem)

- Ground products are standardized but can support customization
- Economic deregulation allows for innovative congestion pricing for airport slots and air routings, bringing additional value to support providers... which can consolidate and also benefit from weak airlines

D Aviation-as-a-dept. store

White-label airlines & OEMs integrated as services in a constrained environment

- Airlines are regionally consolidated but globally fragmented
- Airline brands can "fade away" to let other brands express themselves in the aircraft ("branded cabins"); airlines operate like department stores and must be able to "quickly" reconfigure their assets (i.e., terminals & aircrafts)
- Airlines thus are driven to emphasize monetization of the customer base through a "media" model

- To support "white-label" airlines, aircraft providers move towards full-services scope, from MROs to fleet and route management
- Value & risk are thus transferred from airlines to manufacturers
- Manufacturers pressure regulators to relieve green constraints so they can focus their investments in the move towards service (capital intensive in the transition phase)

- Infrastructure services providers focus on optimizing services to serve "branded airlines"
- Very strong pressure to innovate for greener operations



Air service providers
(Airlines, IT, distributors)

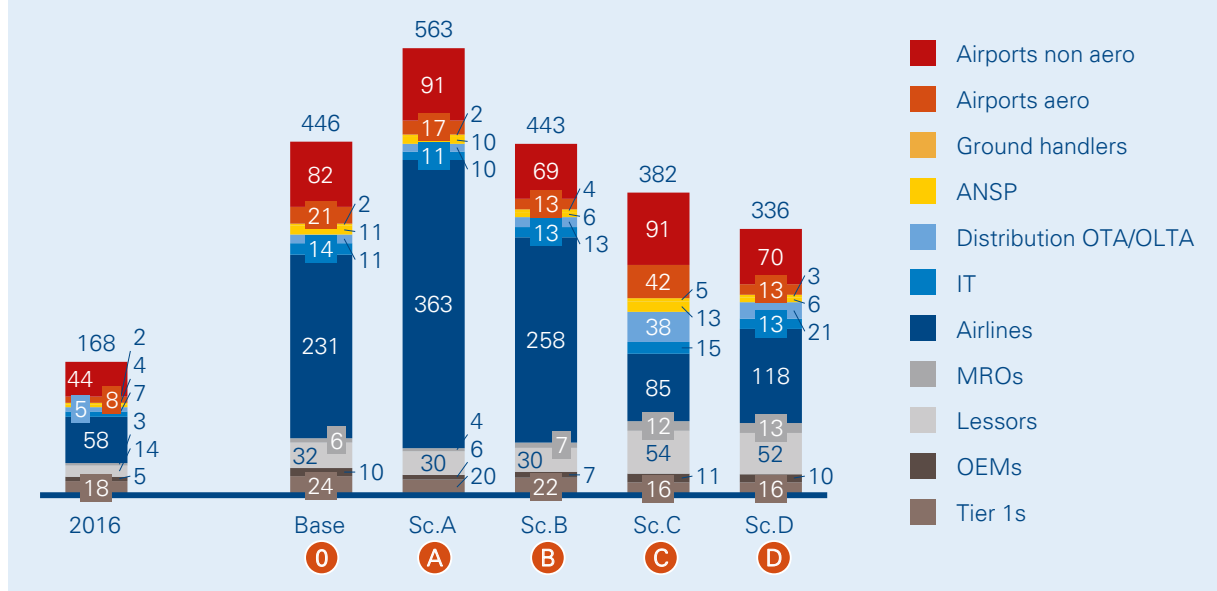


Aircraft providers
(OEMs, tier 1s, lessors, MROs)



Infrastructure providers
(Airports, ANSPs, handling)

Profit pool of Aviation industry Today – 2035



Financial impact
(In real term \$B)

Conclusion

This report highlights key factors to be monitored by aviation stakeholders (clients, regulators and industrial players) in order to shape the future of aviation.

Our scenario and economic modeling approach shows very different total revenue and value creation for the aviation industry by 2035 – and possibly even more differentiated revenue and value sharing among players in the ecosystem. Indeed, by 2035, aviation will experience a greater change than it has already gone through over its first 80 years as a commercial industry.

Demand will continue to grow at a fast pace, but “mass-customization” that travelers expect, emergence of “last-mile aviation for people and goods,” and regulation could shape very different growth trajectories.

Technology will also play a leading role in enabling the future of aviation. Connectivity, cyber-security, block-chain, artificial intelligence and automation have the greatest impact at the ecosystem level, because they are key enablers of moves along the value chain and reinventing operations and revenue generation models. Other technologies, such as green energy and new materials, are important, of course, but have more limited impact; this stimulates the emergence of “new products”.

However, most possible changes are to be considered within the aviation ecosystem itself.

- Airlines’ business models could move from fully integrated and consolidated players or white-label aircraft operators, generating revenues and profits from selling transportation services, towards becoming media offering “free tickets” but monetizing their client bases to third parties.
- Aircraft providers are seeking to offer aircraft-as-a-service while investing to consolidate horizontally and offer next-generation smarter and more versatile flying machines.
- Finally, infrastructure providers will see fundamental changes in their operating models to cope with anticipated growth and price pressures.

We encourage our readers to use these Aviation 2035 scenarios to identify actions they could take at the levels of industry and their organizations (i) to facilitate and take advantage of their preferred scenarios thanks to bold strategic moves; or (ii) to mitigate potential risks they can foresee by grasping “strategic insurance”.

In any case, we hope players can prepare to be future proof for Aviation 2035 by answering the following questions:

- How to reshape the offering and revenue generation model of my company (product/service/pricing)?
- How to reshape the operating model?
- How to reallocate capital to extend the strategic reach and value of my company by moving within the aviation ecosystem (and outside, if necessary)?

Appendix

This report is about:

- Focus commercial civil aviation
- A scenario-based approach, embracing and managing trends and uncertainties for the aviation industry to 2035 in terms of demand, regulation, new technologies and business models
- A modeling exercise for business change evolution's impact on revenues and profit pools on a global scale

This report is **not** about:

- Regional differentiation of scenarios, revenues and profit pool
- Assessing the probability of each scenario
- Defining the "ramp-up" trajectory by 2035
- Evolution of market share between individual players within each segment (e.g., Delta versus Emirates or Airbus versus Boeing)
- Impact on any given individual player in terms of:
 - Product & technology
 - Revenue & profit generation model

We considered the following factors to be "stable," as:

- Interest rates evolution is not modeled
- Inflation is not integrated per se, to keep all comparisons in real value. But this real value is corrected for discrepancy in inflation variations across regions
- GDP & demographics forecasts are not directly modeled per se (they are embedded in air demand forecast)
- Fuel variations not modeled: fuel prices indexed on inflation

We considered changes for:

- Demand evolution:
 - Based on IATA, Boeing and Airbus
 - Price elasticity taken into account based on macroeconomic studies (IATA and others)
- New and emerging technologies
- New and emerging transport modes
- Evolutions in regulation for:
 - Airlines' legal issues (traffic rights, ownership rules)
 - Economic regulation
 - Environmental issues

Contacts

If you would like more information or to arrange an informal discussion on the issues raised here and how they affect your business, please contact:

Austria

Karim Taga
taga.karim@adlitttle.com

Italy

Francesco Marsella
marsella.francesco@adlitttle.com

Norway

Lars Thurmann-Moe
thurmann-moe.lars@adlitttle.com

Belgium/Luxemburg

Francois-Joseph VanAudenhove
vanaudenhove.f@adlitttle.com

Japan

Akitake Fujita
fujita.akitke@adlitttle.com

Russian Federation

Alexander Ovanesov
ovanesov.alexander@adlitttle.com

China

Russell Pell
pell.russell@adlitttle.com

Korea

Kevin Lee
lee.kevin@adlitttle.com

Spain

Salman Ali
ali.salman@adlitttle.com

Czech Republic

Dean Brabec
brabec.dean@adlitttle.com

Latin America

Alejandro Gonzales
gonzales.alejandro@adlitttle.com

South East Asia

Akitake Fujita
fujita.akitke@adlitttle.com

France

Mathieu Blondel
blondel.mathieu@adlitttle.com

Middle East

Morsi Berguiba
berguiba.morsi@adlitttle.com

Turkey

Coskun Baban
baban.coskun@adlitttle.com

Germany

Ralf Baron
baron.ralf@adlitttle.com

The Netherlands

Martijn Eikelenboom
eikelenboom.martijn@adlitttle.com

UK

Russell Pell
pell.russell@adlitttle.com

India

Srini Srinivasan
srinivasan.srini@adlitttle.com

Nordic

Nicolas Cougot
cougot.nicolas@adlitttle.com

USA

Mitch Beaumont
beaumont.mitch@adlitttle.com



Aviation 2035

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