KPMG

Highways and skyways

Building the next generation of Air Traffic Control (ATC)

Aviation 2030 series

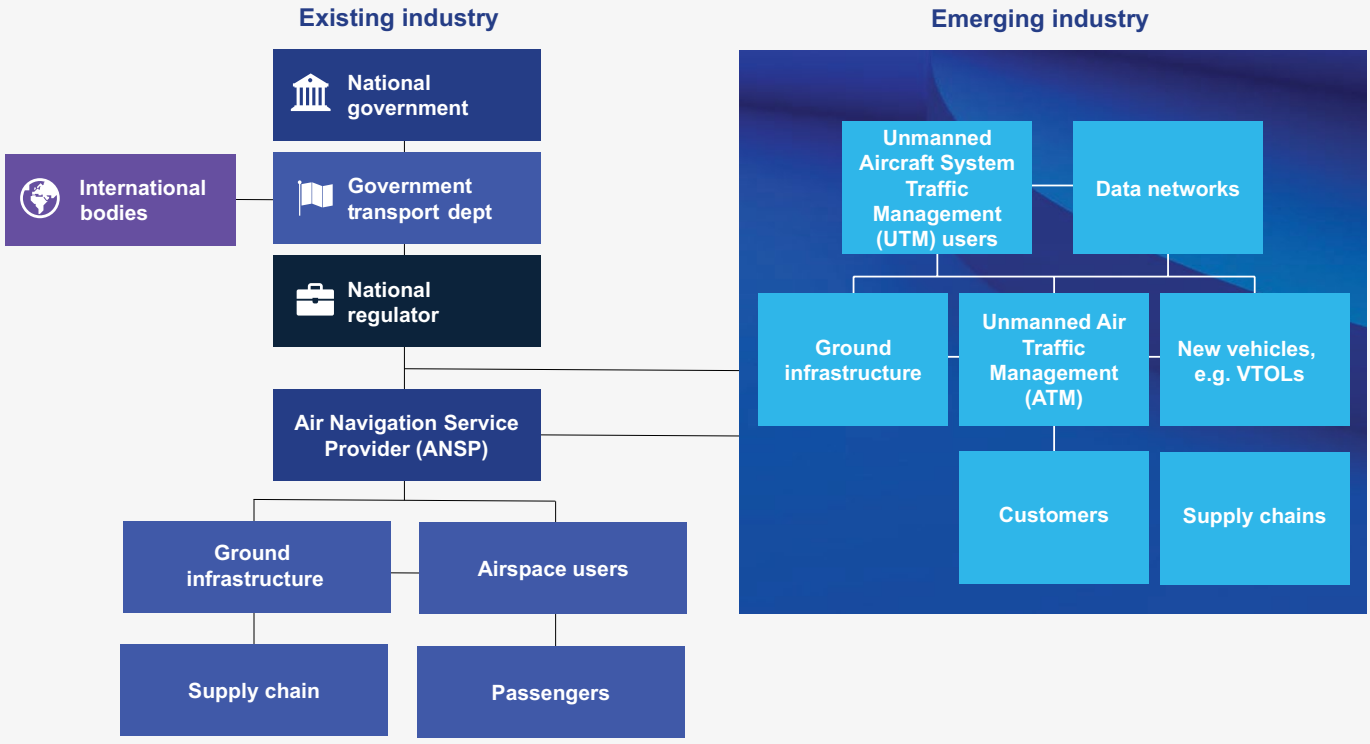
Many litres of ink have been spilled discussing the nascent revolution in aviation. Barely a day goes by without fresh news of air taxis, unmanned vehicles, or new propulsion systems, and our own Aviation 2030 series has delineated in detail the implications of technology and consumer-led disruption in the sector. So far though, the hype has focused overwhelmingly on aviation hardware: vehicles, propulsion systems and vertiports. But to function effectively and safely, next-generation aviation will need powerful new software as well: the ecosystem of regulatory protocols and standards that keep the machine running. Whilst this infrastructure will be invisible to the eye and naturally less media-friendly than, say, concept eVTOLs (electric vertical take-off and landing vehicles), its development is no less critical to the next generation of aviation than was the foundational work of laying tracks to the triumph of the first trains. This paper explores what exactly is needed and the challenges in getting there.

A mature aviation ecosystem for manned vehicles

Today's aviation regulation is highly mature, having evolved over the best part of a century. It is built around highly familiar closed routes between airport security checkpoints, managed primarily by human operators and ground-based systems, to facilitate primarily fixed-wing aircraft flying long distances. Regulation is formally managed by a range of national bodies, standards are agreed and well understood at the international level, and the Air Traffic Management infrastructure is owned and operated by central national monopolies. This is a human-centred industry, with pilots and controllers communicating by voice.

The old and the new: merging the emerging Advanced Air Mobility (AAM) space into traditional aviation

As the ecosystem evolves, decisions need to be made about how the emerging industry is integrated, segregated, or interfaced with the existing aviation ecosystem, and what roles and responsibilities the different actors need to adopt.



Advanced Air Mobility (AAM) - Air transportation systems that move people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible.

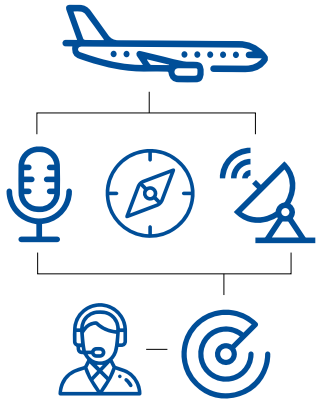
NASA

The current model of airspace management has been successful in controlling the existing air traffic comprising of manned fixed wing aircrafts and helicopters. However, with proliferation of aerial vehicles in the sky and with the introduction of a new generation of unmanned vehicles, it is unlikely that the existing model would suffice. Emerging airspace infrastructure will need to accommodate a host of new aircraft and journey types, as well as consumer segments, all of which are being developed at breakneck speed by a vibrant and so far generously-funded private sector. Vehicle numbers are set to explode as light, electric aircraft compete with current inter and intra city mobility options, making totally new demands on regulators and necessitating a new reliance on voiceless, computer-based systems.

The new aviation reality

Traditional Airspace Infrastructure

- Human centred activity
- Controller talking to pilot over radio ground based systems



Operating Environment

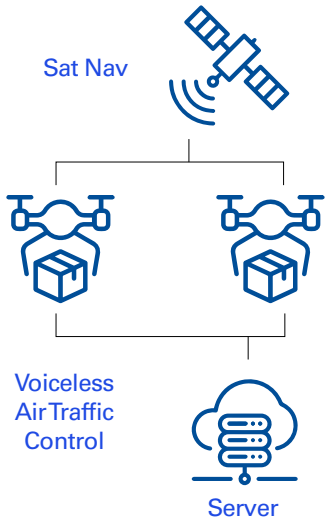
- Standard, fixed wing aircraft for long journeys
- Airspace concept largely the same over 60 years
- National entities provide and regulate services
- Approvals for new concepts are rigorous
- Agreed processes, standards and practices
- Dominated by one operating environment

Demands on the Regulator

- Complex institutional interactions nationally and internationally
- Well documented and internationally agreed standards and processes
- Lengthy but robust approval processes based on regulated safety methodology
- Facilitate change which is evolutionary

Emerging Airspace Infrastructure

- Voiceless, automatic separation software
- Mobile and space based systems



Operating Environment

- Light, electric, autonomous aircraft
- New aviation concepts and business models
- Potential for private alternative infrastructure
- Rapid pace of development
- Exists mainly in uncontrolled airspace and the airspace above cities

Demands on the Regulator

- New challenges from completely different technology and concepts
- Processing quick moving and novel ideas with existing processes and procedures
- New industry players without the incumbent view of aviation
- Maintain safety whilst allowing faster innovation

Building the new aviation: no mean feat

The challenges posed by new aviation concepts such as drone delivery and air taxis are highly complex and distinct from those of traditional aviation, implying a greater range of customer types, as well as a far greater volume of aerial traffic in urban environments, flying much more closely to the built environment. Most of the new vehicles will necessarily occupy lower tiers of airspace and land in a wider variety of sites, whilst traffic regulation systems will be cloud and software-based, with distributed ownership, making cybersecurity far more complex.

The management of risk in aviation is therefore migrating from system-based security based on a known and bound system, to collective and distributed security based on multiple dynamic operational concepts and environments. This cannot happen overnight. Today's regulatory environment has been built around traditional aviation, meaning that its rules and procedures often impinge upon the development of new business models.

National air traffic control services often have jurisdiction over the entire upper airspace of a country from border to border, confining experimental concepts to 'uncontrolled' airspace, in small volumes and close to the ground.

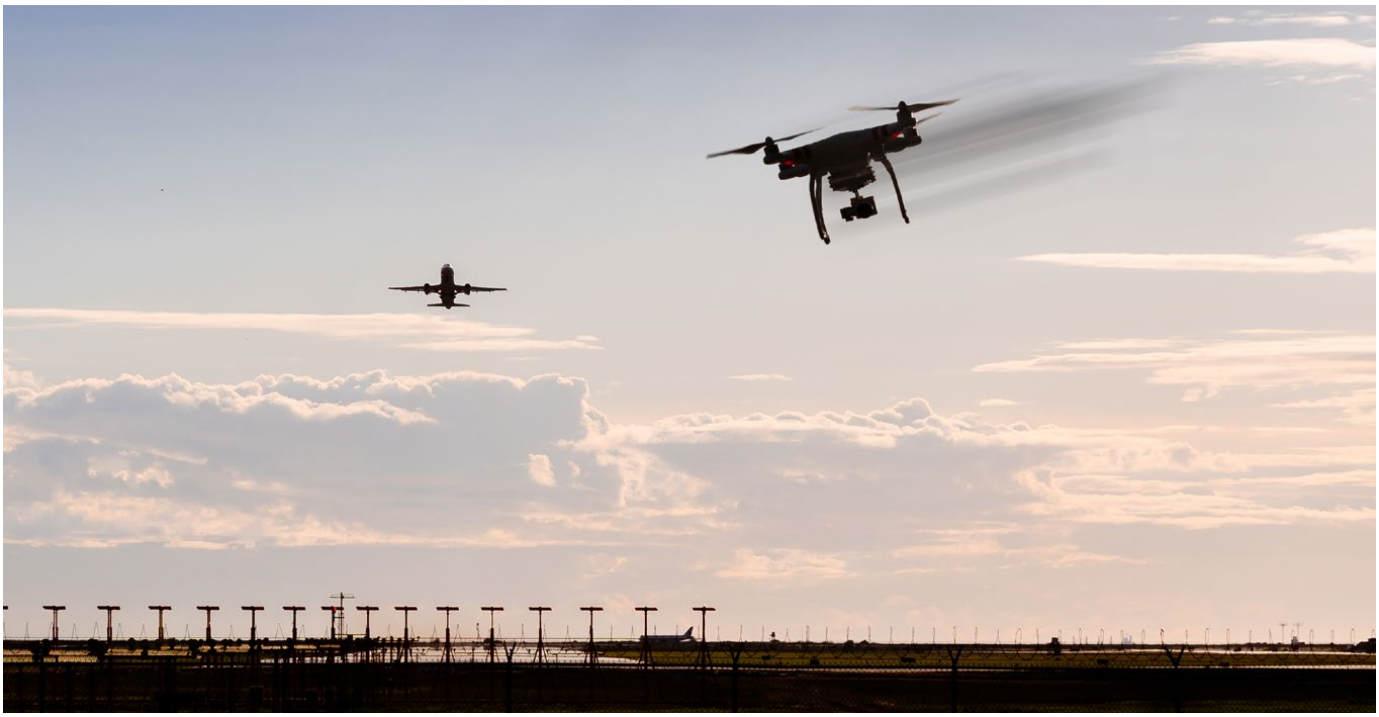
Often, even this low-lying airspace has restrictions that hamper innovation. In London, for instance, helicopters are subject to an Air Traffic Control (ATC) clearance and are required to fly along designated routes – restrictions that would make the development of, say, an air taxi service, difficult.

To address the limitations of existing airspace infrastructure, the industry needs to move towards either making the entire airspace controlled or to encourage the use of navigation instruments for each vehicle. These changes would facilitate the transition to beyond visual line of sight (BVLOS) operations.

New aviation concepts bring new risks

Emerging aviation concepts have a completely different risk profile than the incumbent industry, from system based risk based in a familiar setting, to collective and distributed involving new concepts, closer to the public.

Risk Element	Traditional Aviation	Emerging Aviation
Concept		
Safety	System safety – people, process, technology	Collective and open network safety technology, AI capabilities, autonomous conflict resolution
Security	Closed system	Distributed open system
Privacy	Upper airspace, airside environment	Lower airspace, close to citizen, diverse customers
Insurance	Historic trend analysis	Live and changing risk profile
Trust	Built over time, familiar and consistent	Unknown and changing concepts



Segment and/or integrate

One thread of the conversation around this topic focuses on how new autonomous drones can be accommodated or better yet 'integrated' into existing airspace regimes safely. Given fundamental differences between traditional aircraft and emerging aviation technologies, some argue that segmenting airspace rather than integrating new platforms into existing airspace regimes may be the best approach. Others argue that the burden for integration should be on the new entrants to comply with existing rules and infrastructure. In other words, new technologies should have to plug into, adopt, and comply within the existing framework. Our team foresees a mix of the two approaches emerging from this revolution in aviation, which is being propelled by technological advancement in design, propulsion, electronics, and connectivity.

Airspace, by its very nature, offers a continuous, 3-dimentional medium. Unlike roads and train tracks, airspace does not necessarily require physical infrastructure to construct travel corridors. Nevertheless, like situations where train tracks cross roads, control measures need to provide measures to prevent or reduce the risk of collision and optimize the flow of traffic through the system. Because the air includes a 3rd dimension, one way to deconflict traffic is through differences in altitude. Because a small proportion of traditional air traffic operates at low altitudes (fixed wing aircraft, for example, are prohibited in the United States from flying less than 1,000 feet above cities), altitude deconfliction offers one way to facilitate and quicken the adoption and introduction of new drone technologies. Other ways could also include instituting procedural methods of separation, similar to instrument flight in non-radar airspace.

Nevertheless, increasingly fragmenting airspace, either vertically or horizontally, goes against the principle of providing more, not less access to a public resource for all users. Certainly, allowing autonomous drones to access lower altitudes, especially while leveraging autonomous deconfliction algorithms, will help encourage and expand drone use cases. Indeed, we can imagine designating discrete airspaces and/or low-level routes for parcel delivery, intra-city taxi, and intercity corridors without markedly increasing mid-air collision and other risks. However, limiting access to airspace necessarily limits use cases. Consequently, we believe an ultimate solution will, in all likelihood, meld the two paradigms, shifting over time from segmenting new platforms to allowing full access. This will occur at a rate commensurate with technological advances to mitigate challenges such as overcoming "see and avoid" requirements that provide the foundation for our current airspace system. Regardless, full integration of these new technologies undoubtedly will require a radical departure from today's business as usual and will take time and energy to achieve.

Many possible paths: the choices ahead for regulators

Regulators in all jurisdictions find themselves under significant pressure to respond to these challenges, and accordingly we see a wide range of activity around the world. Globally, there are vastly different levels of ambition when it comes to new aviation adoption.

The options that regulators have to deal with now are fundamental questions that will shape the viability of the industry. Those finding the optimum mix will be leaders in the industry, being able to export infrastructure abroad (analogous to the standard railway sizes / construction).

Six key questions

Question	Examples
1. Public or privately-owned? Is there a publicly-owned institution which provides the new automated air traffic control service, or should it be left to the private sector? ■ Public: more control, greater ability for public-centric design and choice, harmonization, single approach. Vs. ■ Private: potentially faster to achieve, more dynamic, responsive to demand.	India has adopted a 'cooperative federalist' approach[1], announcing a drone ecosystem policy roadmap in 2019, as well as drone rules in 2021. There are also active trials in specific sectors at both state and federal level, bringing together private and public entities. China's civil aviation authority has issued guidance on unmanned aerial vehicle (UAV) airworthiness. National bodies in the US and Europe are being challenged by private sector interests looking to develop proprietary ATC solutions, including Amazon, Altitude Angel.
2. Centralized or distributed / franchised network? Is there one monopoly service or are there several distinct environments depending on different operational environments? ■ Centralized: extension of current national airspace model, simpler institutional arrangements, easier to regulate Vs. ■ Distributed: enhance operational efficiency and specificity, allow local ownership (e.g. within the UK, Transport for London)	USA: Federal Aviation Authority (FAA) and NASA have published Concepts of Operation for AAM. The model sees the FAA define AAM corridors and attendant performance requirements and restrictions, but leaves industry stakeholders to govern the corridors on a community-based-rulemaking basis[2]. Europe: draft U-space regulation has been published by EASA; large-scale demonstrations are also being funded by SESAR, the Single European Sky's ATM research project. The UK Air Mobility Consortium, part of the Civil Aviation Authority's Future Air Mobility Regulatory Sandbox, published a full Concept of Operations for London in 2022, setting out the likely phases of AAM operations, how existing technologies can be leveraged to support initial operations, and what regulatory challenges need to be overcome. The UK Air Mobility Consortium includes Eve, NATS, Heathrow Airport, London City Airport, Skyports, Atech, Volocopter, and Vertical Aerospace. Work on AAM traffic management is ongoing in China, Singapore, Brazil and Australia.

[1] https://www.weforum.org/agenda/2021/07/drones-in-india-a-model-for-cooperative-federalism/
[2] https://www.aviationtoday.com/2020/07/13/breaking-faas-v1-0-conops-urban-air-mobility/

3. Existing or new regulatory functions? Does the National Aviation Authority act as the regulator for the new environment or does some other entity get created? ■ Existing: Already has the processes set up to regulate existing aviation Vs. ■ New: Can design the regulatory function around the new industry instead of adapting existing functions - more agile/adaptable to the new markets	In practice, many will opt for a blended approach. In the USA, NASA's 'Sky for All' convenes multiple stakeholders from the aviation community with a view to defining the future of air travel, including AAM, out to 2050. In the UK, the CAA has opened an 'innovation sandbox', offering innovators the opportunity to trial emerging concepts safely and efficiently, including AI-based airspace management software, whilst individual airports have run their own programmes focused on the same issues. Israel's Innovation Authority together with CAAI and other stakeholders have embarked on a multi-year national drone initiative (INDI) to test drone operations and technology in very large demonstrations.
4. Integrated or segregated airspace? To what extent do you extend rules and regulations to the emerging aviation environment, vs setting up totally new and separate operating environments? ■ Integrated: harmonization and simplification of overall system, less fragmentation, more understanding and interoperability between aviation environments, same safety standards Vs. ■ Segregated: faster development pathways, bespoke environments fit for purpose	Versions of airspace segregation have been floated by a number of industry players, including Amazon, whilst real-world trials have been conducted in segregated airspace (e.g. Barcelona TSA 31 drone centre, with 50 km^2 and a ceiling of 4,500 ft). Boeing and Airbus have spearheaded calls for a fully integrated approach to airspace and traffic management, with an advisory group collaborating under the International Civil Aviation Organization (ICAO) to develop a vision. Israel's CAA is defining U-space service providers (USSP) areas together with other stakeholders. In these areas, multiple USSPs will be allowed to operate simultaneously with coordination between them and linked to a central information system (CIS).
5. Heavily or lightly regulated? To what extent should national or local rules be set to govern the development of the industry? ■ Heavy: greater control over operational and safety standards Vs. ■ Light: greater autonomy and scope for innovation	Mature regulators such as the CAA, FAA and EASA are already elaborating regulation after consultation with industry stakeholders. Singapore's Transport Ministry issued a call for proposals to develop drone management systems for the urban environment, with multiple consortia trialling unique approaches[3].
6. Level of national investment? What level of loan / grant giving should national governments put forward? ■ High: ability to accelerate development of the industry (if well allocated) and address market failures Vs. ■ Low: organic growth of the industry based on market principles.	Singapore awarded selected participants in its drone management system development trials up to 50% funding. In the UK, the Department for Transport's Drone Pathfinder Catalyst programme has funded SMEs engaged in R&D for integrating drones into the airspace. In the US, federal and state funding has been earmarked for large research trials by both private sector actors and universities.[4,5] Israel's Innovation Authority is supporting drone developers and operators with up to 50% funding within its National Drone Initiative (INDI).

[3] https://www.urbanairmobilitynews.com/utm/singapore-foundation-for-specialist-air-traffic-control-tower-for-drones-in-situ-after-successful-trials/
[4] https://www.faa.gov/newsroom/us-department-transportation-announces-58-million-33-unmanned-aircraft-system-research
[5] https://www.unmannedairspace.info/latest-news-and-information/state-and-government-will-fund-large-uas-research-at-houma-airport/

What incremental steps would lead the industry to a completely autonomous ATMS?

Moving from a human centred ATM system to a completely autonomous ATM system is a long leap, taking multiple years, perhaps decades, for this transition to complete. We therefore advocate for a crawl-walk-run approach, meaning small incremental steps are needed to move from the existing ATM an autonomous ATM. These incremental steps would facilitate a harmonious change, ensuring existing pilots absorb these changes as and when they occur, and the current infrastructure is progressively upgraded to support this shift.

Broadly, these incremental changes can be bucketed into two categories – regulatory and technology. While regulatory changes pertain to **modifying the existing airspace classification,** technology changes pertain to **adopting advanced technology for navigation** purposes. To an extent, these changes complement each other. It is not possible for one facet to significantly change without causing the other to.

Modifying the airspace classification refers to changing the existing airspace classification to establish a higher set of rules for AAM. This modification is needed as the airspace must accommodate a higher number of vehicles while ensuring the highest level of safety. For example, the airspace above global cities, such as London, is both controlled and uncontrolled. Allowing uncontrolled flying while a new category of aerial vehicles, such as drones and eVTOLs, proliferate the skies poses a safety risk. Perhaps, one approach to modify the airspace classification is by introducing a new category of airspace called **semi-controlled airspace.** The rules for semi-controlled airspace would be a step higher than uncontrolled but a step lower than controlled airspace, meaning, aerial vehicles need to specify their heading and altitude but would not need ATC clearance. Uncontrolled airspaces above global cities could potentially be migrated to semi-controlled, facilitating regulated flying of aerial vehicles in these airspaces.

> “AAM offers a great opportunity to enhance the efficiency and effectiveness of safety critical operations amongst other services, while reducing the overall operation cost. However, the regulatory and cybersecurity framework as well as the standard for air mobility urgently need updated to unlock the full potential and benefits of AAM.
>
> The diversity of AAM introduces the industry to a new, complex web of cyber threats and risks, which can endanger the safety of drone operations. Traditionally, approaches to secure cyber physical systems such as AAM systems are not fit for purpose, with the potential for operations and systems to be hindered or jeopardized if connectivity with an external or untrusted network is required to enable device protection.
>
> Digital safety standards and regulations need to adopt a fresh view for AAM, progressing from traditional security and aviation standards. There is an essential need for the new security and regulatory frameworks to adapt futuristic principles such as zero trust and distributed security management through enhanced security by design and privacy by default throughout AAM operations and systems like drone, UTM, USS, crowd control stations and communication links.”
>
> Shadi Razak, Chief Technology Officer at ANGOKA

Another approach could be implementing **dynamic airspace** – airspaces that change their category based on the intensity of traffic in the skies. Such airspaces would alter its rules based on the intensity of aerial vehicles in the skies. For example, Heathrow airport has significantly reduced to nil operations post-midnight. Can the airspace above Heathrow be modified in the night to allow air taxis to fly above it during reduced traffic hours? Here, we need to acknowledge that U-space airspaces are an advanced version of dynamic airspaces using digitalized and automated functions to allow any type of operation in any class of airspace and any environment. A third approach could setting-up zones in the skies that either mandate the use navigation instruments or establish highways for dedicated movement of aerial vehicles.

Technology can help overcome these regulatory complexities - but the debate on who should pay for such technology is already contentious. One example could be the use of **interactive radar screens** fitted inside each manned vehicle allowing pilots to see the direction, speed, and altitude of each vehicle, both manned and unmanned, in the skies. Of course, a precursor to this technology would be to ensure each aerial vehicle is fitted with a GPS device/A-type transponder indicating its position in 3-D space. Another potential navigation technology could be the use of **dynamic flight plan systems** - an AI based software that allows each aerial vehicle to submit its flight plan on a central, automated system that spontaneously validates the flight path submitted and promptly suggests alternate routes in case of a potential collision.

In the end, what matters is aerial vehicles should be conspicuous in the skies and should not intersect the path of any other vehicle, ensuring safety of air operations. While the path will differ by country, we see a series of small, incremental changes as the most likely path to eventual autonomous ATM.

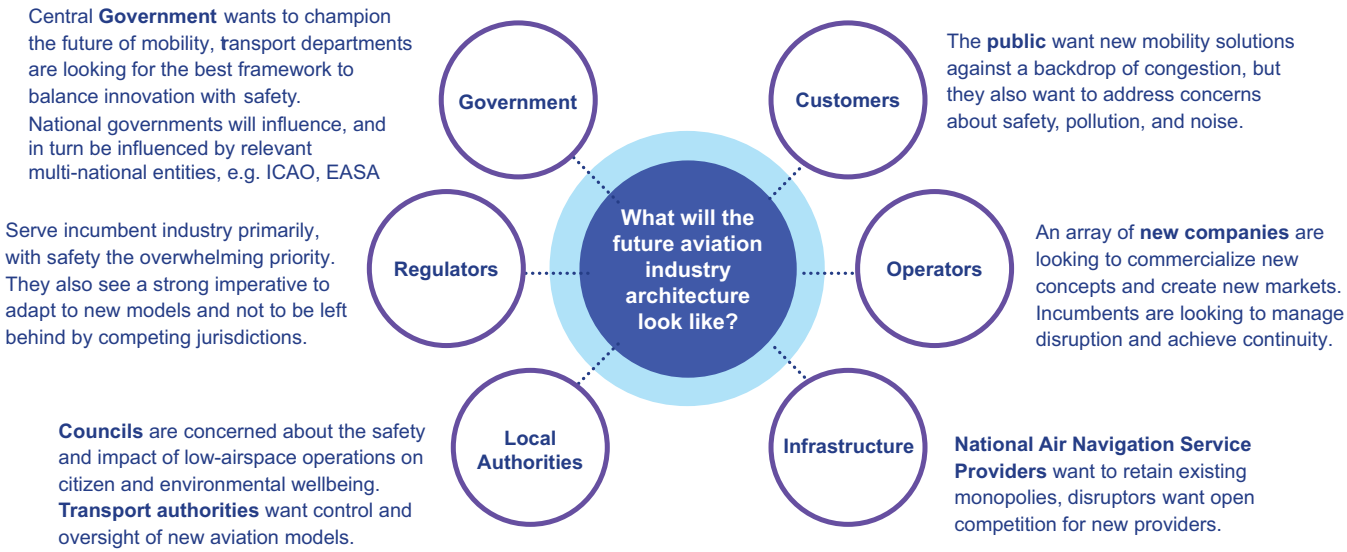
From Human Centred ATM to Autonomous ATM

	Modifying the airspace classification				Adopting advanced technology for navigation	
	Semi-controlled Airspace	**Dynamic Airspaces**	**Instrument Mandatory Zones (IMZ)**	**Dedicated Flying Corridors (DFC)**	**Dynamic Flight plan systems (DFS)**	**Interactive Radar Screens (IRS)**
The change	Changing uncontrolled airspaces above major cities (e.g., London) to semi-controlled	Airspace category in the sky would dynamically change based on the intensity of air traffic	Creating certain zones in the sky that mandate the use of specific navigation instruments or software	Establishing sky highways to allow air taxis and UAVs to fly along a specific corridor only	Using an AI based tool that allows each aerial vehicle to submit its flight plan to a cloud-based server that validates the plan and promptly suggests changes	Installing advanced radar screens inside each vehicle, thus allowing each vehicle to see the position and path of other aerial vehicles and communicate with them
Relevance	Large cities have certain pockets of airspace that are uncontrolled leading to unregulated flying. Semi-controlled airspace would mandate vehicles to specify their heading and altitude, but vehicles would not need ATC clearance.	Certain commercial airports do not operate post mid-night or have hours of reduced traffic. However, low noise drone cargo services could be operational 24x7. Airspaces can be modified as per the intensity of traffic to facilitate quicker movement.	Not all aircraft are equipped with navigation equipment to identity traffic in the vicinity, leaving room for safety risks. IMZs would require all aircrafts flying in this zone to be equipped with specific navigation instruments or software.	Allowing aerial vehicles to fly along any direction in 3D space is hard to regulate. DFCs would operate like road highways, allowing movement along a specific direction and specific altitude only.	With proliferation of aerial vehicles, getting route clearance will be cumbersome. DFS will allow you to up-load your flight plan on a cloud server that would validate your plan against each prior plan filed, suggesting changes if there is a possible intersection	Each flying vehicle needs be aware of the position of other flying vehicles in the airspace. There should be the ability for each vehicle to communicate with other vehicles in case paths are intersecting.
Advantages	- Aerial vehicles in the vicinity are aware of each other's intentions - Reduced load on ATCs - Lesser chance of deviating from planned route	- Rules of the air would be based on the number of vehicles in the sky – a pragmatic approach - Reduced travel times - Will pave way for U-space airspace	- Each vehicle will be aware of the position and heading of other vehicles - Reduced chances of collision - Reduced load on ATCs	- Helps create the social acceptance and legitimacy required for larger changes in ATM - High level of safety	- Reduced human errors - Can autonomously give priority to a certain category of traffic - Faster clearance	- Can swiftly communicate with other aircrafts by selecting the air-craft on the radar screen - High level of safety - Reduced human error
Timeline for implementation	Shorter Longer	S L	S L	S L	S L	S L
Training for existing pilots	Moderate Extensive	M E	M E	M E	M E	M E
Upgrading aircraft	Not required	Yes - vehicles need to be equipped with instruments that provide information on the changing airspace	Yes – vehicles need to be equipped with navigation instrument	Not required	Yes – vehicles need to be equipped with navigation instru-ments and com-munication system connected to a cloud server	Yes – vehicles need to be installed with IRS devices
Key players involved	- ICAO - Local government - ANSPs and regulators	- ICAO - National policy makers - Air regulators - Instrument OEM - Navigation software providers	- National policy makers - Air regulators - Instrument OEM	- Local government - ANSPs and regulators - UAV Operators	- Manufacturers - UAV Operators - Instrument OEM - Navigation software providers - ANSPs and regulators	- Manufacturers - UAV Operators - Instrument OEM - Navigation software providers - ANSPs and regulators

What should industry do to get there?

Building the governance and control frameworks for the aerial mobility of this century will be a collaborative enterprise, requiring the input of multiple stakeholders, each with overlapping interests:

Stakeholders have differing drivers and concerns



National regulatory bodies still occupy a crucial convening role, but will need to adapt quickly if they are to keep abreast of the breakneck pace of change. Regardless of national choices about the direction they want to take the industry, there are a number of things that can be done:

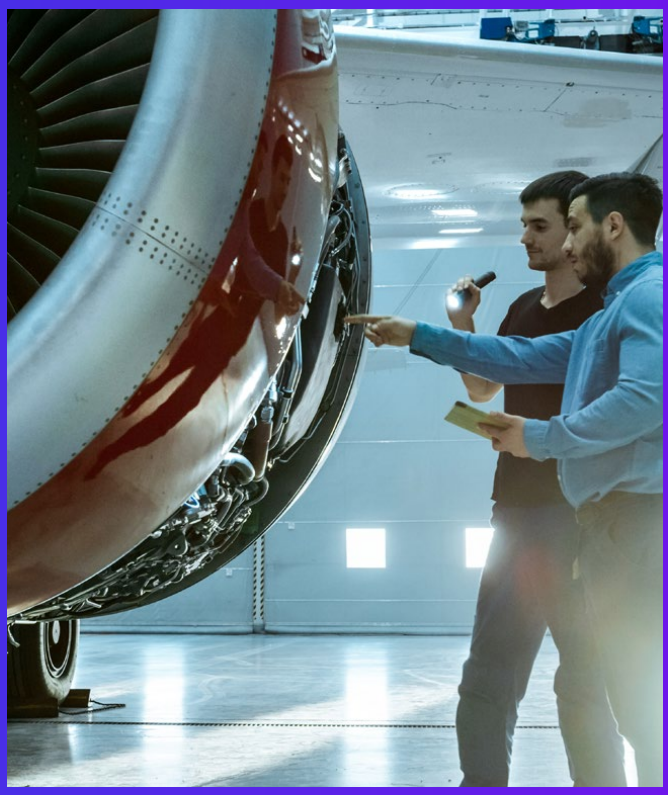
- **Speed:** under the traditional model, regulation develops iteratively and under heavy collective scrutiny. Entirely new concepts are now being developed, with far less consultation, and the pace of concept development needs to increase exponentially. Tried and tested tools from other sectors such as innovation hubs and sandboxes can help.
- **Technology:** regulators need to move away from paper-based, stand-alone safety cases towards live, dynamic processes using open aviation data, to match the dynamic nature of new concept development.
- **Inclusion:** with the number of stakeholders hugely increased, the responsibility for risk is more diverse and today's monopoly environment needs to open up. To elaborate the next generation of regulation, debate that has typically taken place between institutions should be opened up to local authorities, the public and new small businesses. Relationships should be pursued proactively with new investors in the industry to influence the debate around future concepts early on.
- **Function plurality:** as a greater range of discrete airspaces comes into play, regulators need to allow for a new flexibility of approach towards specific needs. As urban airspace needs a different approach to rural, so regulators will need to foster different functions dedicated to specific operating environments.
- **Devolution:** with more environments to maintain oversight over, and a much more direct impact on the public, there is a case to be made for devolution of certain regulatory responsibilities (licensing, noise, etc) to local authorities or new / devolved regulatory bodies.

At the same time, the creation of a safe operating environment for aviation may not any longer be the sole responsibility of national monopoly bodies. Emerging industry actors will play a critical role. We suggest:

- Appreciation that they are joining a safety critical and mature industry, and are not just tech start ups. Success relies on getting the existing industry on board.
- Support the design of new safety processes hand in hand with regulators – mirror new concept development methodologies and expertise.
- Design safety and security into the process from the start (for instance using digital geofences to protect sensitive infrastructure environments, and technical standardization of physical and digital infrastructure to promote interoperability).
- On all sides, airspace should no longer be considered as one harmonious block, but as a multitude of real estates that can be leveraged for a multitude of transport purposes, as on land. Embracing new technologies in the context of this conceptual evolution will unlock huge potential, waving in the next revolution in air transport.

Conclusion

The future of aviation promises to be radically different from its recent past, and the regulatory software that will control it must be incubated today, on the same frenetic timeline as the much-hyped hardware of vertiports, drivetrains and vehicles. This will require unprecedented collaboration between the industry's many competing interests, as well as rapid evolution at the organizational and conceptual levels. There are also major decisions to be made about the shape and structure of the emerging aviation ecosystem, and the level of public / private involvement in achieving it. To conclude, we outline the main implications by player type:



ANSPs and Regulators

- Enact broad reviews of capability, innovation and skills to ensure these are fit for purpose in an era of rapidly changing technology and business models.
- Review existing processes and procedures, compared against the rate of technology development. Consider the consequences of maintaining the status quo and develop a roadmap for improvement.
- With potential new air traffic control services in busy uncontrolled airspace, consider how the market for control over segmented airspace will be created and regulated, and whether this could translate to enroute.
- Review the different new emerging aviation concepts, considering the stakeholders affected and how the regulator could innovate to include other institutions in regulation development.
- Consider development of separate subsidiaries focused on different airspaces, to encourage increased competence and appreciation of emerging technologies.
- Bolster technical competence through recruitment to improve organizational understanding of and communication with tech background aviation startups.
- Prepare for more powerful vested interests and market forces in the sector, which may not always align with local public interest and will require careful balancing.
- Prepare for major change in the 'customer' base, from legacy/incumbent players to disruptive innovators.
- Lobby funders for necessary resources now to enhance and split capabilities to deal with expanded / segregated airspace.
- Develop relationships now with key market entrants - the earlier involved the better.
- Appreciate the wider group of stakeholders, from institutions to small businesses and wider public, widen the attitude to risk accordingly.
- Begin conversations around which responsibilities can be devolved to local levels.
- Encourage technical standardization (vehicles, vertiports, data models, operations, safety, etc.)
- Non-traditional airspace actors represent a potential source of new revenue streams for national incumbent aviation authorities.

Local government

- Consider what devolved aviation responsibilities may be appropriate for the local authority level.
- Begin conversations now with aviation market entrants to understand how future aviation plans will impact the local level.
- Consider implications for local infrastructure investment plans and regulation, as well as integration of future aviation into existing public transport and MaaS plans.
- Consider the role of publicly-subsidized transport today and whether some of its lower volume and/or slower ground routes relying on poor infrastructure could be pivoted towards early AAM use-cases.
- Consult locally to understand limits of public tolerance and how their buy-in is best sought.

Investors

- Do your jurisdictional homework: some geographies will do much better than others at developing the regulatory infrastructure for new aviation.
- Don't ignore the software of the new aviation – huge opportunities exist for companies that bring durable solutions to next gen air traffic control

OEMs and Supply chain

- Ensure resilience of business models as the aviation landscape changes, and adapt to serve new customers with new operational concepts.
- Need to ensure realism on mission design compatibility with airspace constraints.
- Engage now for influence over and foresight of next generation air traffic control.
- Seek diversification and reduce exposure to disruption through partnership with new aviation startups; existing relationships with ANSPs and other established industry bodies provide leverage.

National policy makers

- Champion investment and innovation by allowing geographic access to new entrants to commercialize concepts, separate the differing infrastructures as they mature, align and bolster regulatory functions to match changes accordingly, and then allow competition for markets to incentivize improvement.
- Lead overall strategy for airspace modernization, setting parameters for passenger growth and vehicle numbers, as well as environmental and other impacts. Consider a comprehensive aviation mobility roadmap.
- Lead public consultation on aviation strategy at the national level.
- Champion development of the future of air mobility – future business model impact analyses, focussed investment strategies, support industry consultation.
- Convene wide stakeholder engagement.

Startups / Emerging industry

- Use the expertise in new technology to inform the development of new control processes and procedures.
- Seek a leading role in suggesting new safety and risk approval processes, to mirror new concept development methodologies like rapid software simulations and AI-based learning techniques.
- Learn from the legacy of the aviation industry, understanding that they are not just tech start-ups, but joining a highly public and safety-critical industry. The weight of accountability and responsibility that comes in providing a public service is incumbent on all new industry partners.

Lessors

- Existing fleets will increasingly have to adapt themselves to operate in a new and evolving air traffic control environment, shared with a host of new aircraft. Understanding this environment will be critical to identifying market opportunities as well as the most viable new models in each segment.
- New business models will proliferate as more airspace is opened up to commercial operations. Don't be left behind – understand now where your new aviation customers are and what hardware best suits their needs.

Operators

- Need to keep abreast of a dynamic regulatory environment to ensure available hardware compatibility and viability as the new aviation control ecosystem is developed.
- Understand new business opportunities arising from next-gen aviation and the regulatory unlocking of new airspaces and new customer segments.
- New operators need to inform themselves on the existing constraints, rules and regulations of aviation.

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