



International Civil Aviation Organization

WORKING PAPER

A41-WP/360

EX/158

2/8/22

(Information paper)

English only

ASSEMBLY — 41ST SESSION

EXECUTIVE COMMITTEE

Agenda Item 23: Innovation in Aviation

INDUSTRY CONSENSUS ON A FUTURE SKY VISION

(Presented by the Civil Air Navigation Services Organization (CANSO), the Airports Council International (ACI), the International Air Transport Association (IATA), the International Business Aviation Council (IBAC), the International Coordinating Council of Aerospace Industries Associations (ICCAIA) and the International Federation of Air Line Pilots' Associations (IFALPA))

EXECUTIVE SUMMARY

In October 2021 the Complete Air Traffic System (CATS) Global Council, an independent industry innovation forum representing a broad cross section of aviation service and technology providers, and airspace users – both traditional and new entrants – released a collaborative vision of the future skies of 2045. The CATS Global Council vision is designed to drive the next era of aviation and forge a more adaptable, resilient industry. The industry has now developed a detailed roadmap to its vision, identifying key milestones and activities that must be actioned between now and 2045 to ensure progress is kept on track. The CATS vision roadmap does not only include technological and regulatory developments but it also encompasses political, economic, social and environmental aspects.

While the future sky vision is aligned with the Global Air Navigation Plan, it goes further in many respects in envisaging a future sky that is more integrated, highly automated and fully digitized.

Having built consensus on the vision, the industry is committed to taking the action necessary to drive progress towards it.

<i>Strategic Objectives:</i>	This working paper relates to Strategic Objectives: Safety; Air Navigation Capacity and Efficiency; Security and Facilitation; Economic Development of Air Transport; and Environmental Protection.
<i>Financial implications:</i>	The activities referred to in this paper will be subject to the resources available in the Regular Programme Budget and/or from extra budgetary contributions. The financial implication to ICAO can be reduced through the advancements of studies and draft provisions prepared by the industry.
<i>References:</i>	futureskyvision.com

1. INTRODUCTION

1.1 The next few decades will see significant transformation of the aviation industry. Increasing demand from traditional passengers and new vehicle types which will drive new service offerings, the unprecedented acceleration of technologies and digitization and the imperative to achieve sustainability are among the many factors forcing air transport to reinvent itself.

1.2 In early 2021 CANSO convened industry leaders from a variety of different disciplines to form the Complete Air Traffic System (CATS) Global Council for the purpose of building a common vision of our future skies, developing the roadmap to achieve it and driving the needed changes in the industry. The Council was a unique opportunity to drive consensus amongst diverse stakeholders and to force collaboration on the issues on which interests converge and diverge.

1.3 In October 2021 the Council delivered its first task, a consensus vision of what our future skies will look like in 2045. [The CATS Global Council 2045 Vision](#) is to create global airspace that is safe, fair, intelligent and interoperable, leveraging revolutionized design, technology and services to power sustainable global mobility and prosperity. Achieving this will necessitate:

- harmonized, integrated and highly automated airspace;
- advancements in hybrid technology, cleaner fuels, electrification, carbon capture and flight path optimization;
- the prioritization of digitization and technological advancement;
- a common regulatory framework, underpinned by global safety standards, including at stratosphere and space levels; and
- an approach to aviation talent that embraces diversity and attracts and engages advanced skills.

1.4 The CATS future skies vision is built on seven building blocks that are essential to success and global progress: services and service delivery; technology and digitization; safety and regulation; environmental sustainability and social impact; airspace design and classification; data and security; and people, organization and talent. Managing change effectively in each of these components is essential.

1.5 All parties recognize that service delivery will take new forms in 2045. Services will need to be more dynamic, agile, adaptable and yet consistent. The organisation and management of airspace need to be harmonised, cost-effective, interoperable, data-centric, secure, optimised, sustainable, demand-driven, performance-based and should promote competition, unlocking new business models and revenue streams that generate value for all stakeholders. This will contribute greatly to system resilience and scalability.

1.6 If we are to meet future needs, airspace needs to transform into a unified environment that integrates a diverse mix of airborne vehicles, equipment and services in an operationally flexible, dynamic and cross border way while enabling States to retain legal, security, administrative and judicial powers within their national airspace.

1.7 Intermodality will be a crucial development. Advanced interconnected transport networks will allow air transport to deliver clean, seamless door-to-door experiences for passengers. But enhancing global mobility, public convenience and meeting the needs of economies will be insufficient to our future success. We must embrace sustainability, not just in our approach to reducing carbon emissions, but at multiple levels and across the entire system as we seek to operate in respect for the planet and the communities we serve.

1.8 Safety will remain aviation's top priority in the future. As we move towards higher levels of automation, it will be essential to ensure services are designed to maximise their contribution to delivering safe operations and that the industry's strong culture of safety is extended to those involved in software and technology design. Safety service performance will be based on a predictive approach to risk using

advanced insight into total system performance (normal and abnormal) gathered by advanced data analytics in real or near-real time.

1.9 In order to foster a global culture of innovation, we must look for ways to balance strong safety leadership with speed of innovation by re-examining our regulatory and certification processes.

1.10 Automation has enabled productivity gains and efficiencies by allowing technology to take over routine repetitive tasks, enabling people to focus on higher value, more complex tasks. That is expected to change in the future as artificial intelligence and machine learning increasingly enable automation of highly complex systems. Determining how technology can amplify the combined strengths of humans and machines and ensure they interact seamlessly together as high performing teams in all circumstances will require thoughtful research and careful management and it is a transition that is likely to occur in phases.

1.11 The CATS Global Council is committed to leading the dialogue and work, necessary to ensure that technology developments proceed in a logical and safe way and that the airspace management community thrives with a new generation of highly-skilled talent and is seen as an appealing sector in which to work. Aviation industry competency models will have to be updated to deliver performance-based training programmes, providing opportunities for continuous monitoring and evaluation and reflect new diverse roles and skills critical to operation within high-capacity and advanced technologies environments.

1.12 The CATS Global Council has developed and released a roadmap that illuminates the key milestones that will need to be achieved in the years between now and 2045 to keep aviation on the path towards the future we have set for ourselves. Critical enablers and evolutionary steps have been identified in ambitious but achievable timelines. Actions have been identified for the achievement of each milestone and we are committed to driving progress wherever we are able to independently, and to working collaboratively with ICAO, standards organizations and regional and national regulators in other instances.

2. CONCLUSION

2.1 The global vision for future skies represents a broad consensus on the needs and services required in 2045. Having achieved widespread industry consensus on a shared blueprint for future, the members of the CATS Global Council are driven by a belief that our job is not just to build consensus on a vision, but to put in place the means to make it happen. Industry accepts its responsibilities in this regard and will continue to advance actions identified in the roadmap to ensure the building blocks are in place to enable our future skies vision. We will look to ICAO and other State and international bodies to support where needed with timely regulatory and certification action, but will not wait for someone else to deliver our future.

APPENDIX



Complete Air Traffic System (CATS) Global Council

Our Shared Vision for 2045

1ST EDITION
OCTOBER 2021

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The time for change is now

The interconnected aviation skyscape we are aspiring to is just over two decades away. That's not very long. As a sector, we need to collectively and immediately act in order to step closer towards this. That's why this Vision provides a snapshot of our future and acts as a rallying call to mobilise all the players in the aviation community to help build the future complete air transport system together.

What got us here won't get us there

We are currently facing a new era for aviation, and the speed of change and rate of innovation will be faster in the years leading up to 2045 than they have been in the last decades. To safely accommodate all airspace users in our sky without congestion or increased delay will require new ways of thinking and increased collaboration.

As we look towards this new future, we can clearly see many opportunities in front of us, but standing in our way are multiple barriers, key challenges that stretch wide across our sector, and extend deep into traditional characteristics that are the by-product of legacy systems and the industry's prestigious history. We will need to have addressed these for our Vision to be a success.



The challenges in our way

This Vision is written as an aspirational ideal. We recognise there are many challenges in achieving this and acknowledge the work that needs to be done. For the purposes of our Vision, the following challenges have either been addressed and solved, or are in the process of being resolved:

Risk-sensitive, legacy mindsets

For an industry with such a strong safety record, aversion to risk is understandable. Attitudes towards innovation and change must shift if we are to accelerate advancements across the system which should improve safety, security and efficiency.

A fragmented sky

There's a lack of consistency and harmonisation of equipment, infrastructure and technology. Such differences pose a significant challenge to sector-wide technological advancement, digitisation readiness and the adoption of data-powered operations.

Price tag of change

The cost of new technologies and digital infrastructure, and their implementation, is extremely high. States and service providers lack the resources to modernise their systems, without passing on modernisation costs to airspace users.

Lack of cooperation and integration

Contrasting business models, different regulatory frameworks and regionally or nationally managed airspace makes it difficult for the airspace management community to collaborate. This slows innovation and affects efficiency as different approaches cannot be scaled. Such a system is not sustainable in the long term.

Future talent gap

A new generation of talent is needed to power and underpin the airspace system of the future. New skillsets are needed for a more technological, data-driven sector. In order to attract the right talent in the future, we must revolutionise training capabilities, reduce certification timelines and invest in change management processes.

Inconsistent approach to sustainability

Despite sector-wide pledges for the future achievement of zero emissions and reduced environmental impact, the current view over-emphasises individual flight carbon emissions, when greener, cleaner skies can be achieved by reducing environmental impact at a system level.

Balancing safety leadership with speed of innovation

Aviation's safety management and safety innovation is world-class and will only improve in the future. Yet the processes linked to safety, regulation, certification and qualification are time-intensive, fragmented and based on traditional rulesets that need updating, which in turn slows innovation and affects the ability of new entrants to access the industry.

Lack of trust in technology

Adopting automated technology, programmes and behaviours is critical for the future system, yet there's an inherent distrust of new technology, especially that which takes control out of a human's hands. This distrust stretches beyond the sector and is a sentiment that the global public also shares. There's a need to make a deliberate effort to build sector-wide confidence in advanced technology and gain a 'social licence' to operate and innovate now in order not to stymie progress.

Carving out a role for humans Automation and operator-to-operator technology will improve many characteristics of aviation, from safety to user experience. But one of the blockers to adopting this technology is the need to determine what role humans will play in total airspace management. Blended human-machine functions will potentially produce the sub-optimal performance of both, threatening the safety and efficiency of the entire system.

What success looks like

It's the year 2045 and our skyscape is one of variety, efficiency and vitality. Airspace is an integrated, harmonised, flexible system. We're experiencing physical and digital connectivity like we've never known before, generating prosperity and social and economic welfare, and sustainable mobility.

Seamless point-to-point flight experiences, interoperability and scalability are powered by advanced technologies and enabled by global safety standards that have been adopted system-wide.

Global airspace is a unified environment that can accommodate a diverse mix of airborne vehicles, equipment and services that meet the equally varied needs of all users. It is an accessible, efficient resource maximised through flexible and dynamic airspace design.

Optimised airspace is a secure, sustainable driver of prosperity and growth for states, nations and the global economy. The ability to maximise capacity is designed into the system, and balanced with ever-growing and diverse user demand, public acceptance and environmental sustainability. The aviation and space industries are thriving, as are convergent sectors such as agritech, construction, urban mobility and logistics that have leveraged the sector's technology and services.

The sky is also cleaner and quieter. Environmental sustainability and social impact are integrated into the entire airspace system.

As a sector we actively collaborate with nations, governments and organisations to collectively combat climate change and achieve global environmental goals while serving the world's growing needs. Such efforts have helped us to gain a 'social licence' to implement and operate such an advanced system.

The organisation, administration and total management of all airspace is harmonised, decentralised and highly automated. Technological advancement enables the safest and most efficient flying conditions for all craft, manned and unmanned. De-risking and deconflicting are proactive, automated activities made possible because of the multi-layered, real-time data shared between all airspace users.

Aviation talent has expanded to reflect new opportunities, diverse roles and advanced skills critical to the active management of automated systems, complex data-sets and greater capacity characteristics. Our culture has evolved too. Without compromising on safety or standards, we have adopted a more proactive approach to risk management and deconfliction in parallel with technological innovation. We have developed dedicated resources for testing new technology and possible scenarios to allow for more rapid innovation, and we've invested in learning and development facilities to foster a growing generation of highly skilled industry talent.

2045 Vision Statement

To create global airspace that is safe, fair, intelligent and interoperable, leveraging revolutionised design, technology and services to power sustainable global mobility and prosperity.



2045 Vision Narrative

In 2045, a wide range of airborne vehicles share our skies.

We all operate in a fair, intelligent, interoperable global airspace that is user-centric, technology-agnostic and performance-based.

Similar to user demand; technology, digitisation and data have fuelled the rise of new and improved services, which are provided to a larger than ever number of manned and unmanned aircraft with more efficient levels of performance. A network of real-time data, machine-to-machine communications and automated technology are dramatically shifting the competitive environment and business models, with service providers capitalising on opportunities in information management and technology, data-based services and connectivity with other transport modes, for example, air taxis and autonomous vehicles in urban environments.

Automated, digitised and data-powered, we're each a node in a smart, connected network that's resilient and scalable in the face of disruption.

Seamless point-to-point travel is facilitated by a harmonised, integrated system; permitted by common regulatory frameworks and underpinned by global safety standards.

Airspace is maximised to its fullest potential as a global resource, powering growth and prosperity. Airspace design and allocation is system-centric, mission-led and performance-based.

The aviation sector is a healthy, competitive marketplace, its culture is one of agility and innovation, and the airspace management community is thriving with a new generation of highly-skilled talent.

Operating Principles

The 2045 Global Vision has been crafted with a collection of operating principles at its core.

These principles speak to the future-facing features, behaviours and practices that are critical to achieve the fully integrated airspace system we aspire to.

Scalability

Scalability and resilience are key in our future state. Digitisation, location-independent operators and automated airspace management will ensure the entire sector can scale up or down operations according to user needs, hazardous events and user demand.

Interoperability

Though we're promoting aviation as a competitive marketplace this level of competition drives commercial opportunities for all. The cooperation and interconnectedness of diverse operators is essential for a fully integrated, harmonised sky.

Adaptability

The entire airspace system, from design to operation, is dynamic in nature. Such flexibility needs to be built-in to enable airspace infrastructure, management and users to adapt to diverse vehicle performance and growth of traffic.

Sustainability

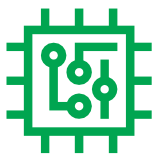
Aviation will take a leading role in reducing emissions across the global transport network, but sustainability is not only linked to the environment. The future airspace system will also require longevity to ensure that innovations are efficient, resourceful and future-proof.

2045 Vision

Building Blocks



Services and Service Delivery **13**



Technology and Digitisation **15**



Safety and Regulation **17**



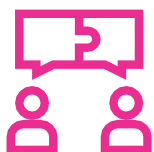
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and Social Impact** **19**



Airspace Design and Classification **21**



Data and Security **23**



People, Organisation and Talent **25**



2045 Vision Building Blocks

Services and Service Delivery

As aviation systems, technology and performance characteristics have evolved, so too have the services airspace users require. An ever-growing mix of emerging business and operating models, strategies, and service propositions reflect the diversity of stakeholders.

With such a varied and densely populated sky, airspace management and services play a critical role in the full integration and interoperability of all airborne vehicles without reductions in capacity or performance constraints, while still maintaining the highest levels of safety. These services are provided by a range of stakeholders, some of which are competitive yet interoperable service providers. Competitive service providers can best adapt their services to meet the needs of diverse and evolving users subject to robust regulatory oversight.

The design and delivery of services are truly user-centric. While facilitating safe and efficient access to airspace is still fundamental, emerging and shifting demands also mean that services need to be equitable, agile, adaptable and consistent. Such dynamism and flexibility are essential to achieving the optimal configuration of airspace and air traffic for all users, which enables the delivery of point-to-point trajectories that are seamless with minimal undue restriction or delay.

Similar to user demand; technology, digitisation and data have fuelled the rise of new and improved services. A network of real-time data, operator-to-operator communications and automated technology are dramatically shifting the competitive environment, with service providers capitalising on opportunities in information management and technology, data-based services and connectivity with other transport modes – like air taxis in airport environments, or autonomous road vehicles in urban environments for example.

Equally, due to this technological advancement, the role of humans is shifting. With automation and cloud-based data exchange, the tracking, identification and registration of airborne vehicles is instant. Risk management, deconfliction and emergency services are proactive or mitigated in real-time. Strategic and tactical traffic management and airspace allocation is automated and dynamic, with human intervention being by exception only. With such capabilities and characteristics the role and nature of service providers continues to evolve, with technology, digitisation and data providing new growth opportunities.

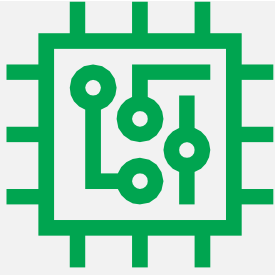
A performance-based approach to airspace management and updated risk-based safety

and regulatory frameworks helps facilitate a fully integrated system and enable service providers to carve-out more commercially-driven opportunities. Such a system makes aviation a positively competitive industry, where market competition and corporatisation strategies do not disrupt system-wide interoperability. The commercialisation of airspace – so that it remains accessible to as many users safely – continues in parallel to adding new competitive services to address evolving user demand. Though technology-centric, it is technology-agnostic too. There is a healthy spread of competitive service, technology and data providers across the world and no one monopoly. For day-to-day operations, traditional

Success factors

- Full integration, harmonisation and interoperability is possible due to safe, competitive and evolving services that are not restricted to any one aircraft type, nor constrained by traditional geographical boundaries.
- Service providers enable skies that are safer, cleaner and quieter while still servicing a busier, more diverse airspace and stakeholder base.
- Dynamic, flexible services are critical to system resilience and scalability.
- Air Traffic Service Providers (ATSP) - incl. UTM - have carved out new revenue streams and generated value off the back of advancements in technology, digital and data.
- Personnel have a clear, legitimate role that adds value to the system and its users, versus a forced or inflexible role that threatens safety culture, efficiency and productivity.





2045 Vision Building Blocks

Technology and Digitisation

Advancements in technology and digitisation have been the key driver of increased productivity, interoperability and innovative growth for our industry. They have enabled fully scalable, sustainable and resilient services, that meet demand while further enhancing safety through higher levels of automation and virtualisation.

Public interest and acceptance have been a critical topic and remain key measures of success. Industry, government and regulatory bodies have invested significant resources to get to where we are today by successfully demonstrating and validating how a fully automated and digitised airspace system is a safe with predictive de-risking; smarter with instant communication and efficient demand-capacity management; and both quieter and more sustainable. The global public is a key stakeholder in the aviation sector, and we continue to ensure any emergent technology does not negatively impact societies and communities.

The design and types of flight vehicles and flight equipment are diverse. Our sky hosts aircraft that are piloted differently (e.g. traditional, UAS, RPAS), powered differently (e.g. electric propulsion and hybrid mobility), operate differently (e.g. eVOTL, ultra-long haul, supersonic) and occupy different altitudes, including transitory paths in and out of space. New entrants share and obtain data through a range of technologies, including operator-to-operator, vehicle-to-vehicle, and operator-to-service provider. It has been the sector-wide adoption of such advanced technology, that is safe, secure and standardised, which has enabled the integrated, harmonised system we have in 2045.

Digitisation of aviation brings a much-needed upgrade that benefits the entire industry and generates opportunities for growth. Radio telephony has been replaced by an advanced digital communication capability. Craft-to-craft communications and commands allow for instant, efficient and safe flying operations at every level of airspace. All information is digitally transferred between ground and air, or air to air as needed and this extends beyond the realm of aviation. As we continue to build a sophisticated digital ecosystem, some airborne vehicles are able to communicate with other autonomous vehicles and digitised infrastructure, for example in urban environments with other forms of mobility.

Automation continues to revolutionise the industry, not only in the cockpit and on-board aircraft, but for ground-based technology and the total management of airspace as well. Such technology enables proactive and predictive activities; strategically deconflicting flight

paths prior to take-off and sense-and-avoid capability facilitating self-separation and collision avoidance.

Consequently, the role of service providers has evolved. Automation and advanced technology manage point-to-point flight paths and trajectories, traffic flow and deconfliction. As risks emerge, decision making is first owned by automated systems and software and only addressed by personnel in non-nominal instances. The role of air traffic management, administration and navigation has advanced to strategically managing the overall health of the integrated airspace system, including the technology, data and software that underpins it. Human intervention is minimal, and a key indicator of our system's safety and resilience.

Virtualised technologies and platforms mean the management of airspace and its related services are independent of any physical location or geography and flexes more effectively with traffic volumes. An integrated system relies less on traditional borders and control centres, enabling dynamic airspace management and system operation by technology and teams that are virtual, and best suited for the users' needs. Such remote operation provides the airspace system and community with greater flexibility, and in the case of any disruption to demand or capacity, greater scalability and resilience.

In order to implement new safe and secure emerging technology we need a consistent and confidence-inspiring way to test it. Simulation, virtual platforms, scalable demonstrations and dedicated test environments enable hardware and software to be trialled and validated rapidly. Such testing capabilities moderate suitability and help technology infrastructures proactively prepare for innovations that are emerging. Advanced simulation such as digital twins also allow for cost-effective advanced modelling of new system designs, architectures, infrastructures and capabilities, giving us a realistic view of how operations and performance can be optimised.

Success factors

- A system-wide upgrade of both technological and digital capabilities facilitates interoperability, scalability and resilience.
- Automation and digitisation are critical for the growth of aviation and adjacent transport sectors such as commercial space travel.
- Safety is continuously improved due to the implementation of this technology and a more sensitive, anticipative, harmonised and intelligent approach.
- New business and operating models, growth opportunities and value creation are generated by a fully automated, scalable and digitised airspace system.
- Digitisation of all information and communication is vital to the aviation and ATM communities becoming a secure, intelligent global data network.
- An improved, seamless passenger experience is better enabled by automation and digitisation, from reduced capacity and congestion issues in airports to personalised interfaces at different touchpoints of their journey.
- Public understanding, acceptance and comfort with automation are needed for the adoption of automated and digital technology and software. Demonstrating the benefits is critical.



2045 Vision Building Blocks

Safety and Regulation

At the heart of aviation, the safety of all passengers and flights remains our highest priority. Rather than waiting for increasingly rare incidents from which to learn and mitigate, our approach to safety has evolved to become more sensitive, anticipative, harmonised and intelligent.

We strongly encourage challenge in organisations to guard against complacency and to support us in striving for better, safer, more efficient levels of performance throughout the sector. Across a community of leaders, experts and organisations we adopt a global learning culture, sharing the success stories and the lessons learned for each of us to be smarter, safer and more responsible.

Technological advancement, automation and digitisation has not only reinforced aviation's safety record, but improved it with fewer conflicts, disruptions and incidents. Safety is fully integrated into how we do business. We continuously collaborate with other industries who seek to learn best practices in high-risk environments and safety management from our sector. We are at the forefront of safety management and safety innovation in total airspace management, and this provides space for growth and progress.

Underpinning and enabling our safe skies is a clear, robust and performance-based regulatory framework that governs all airspace, including stratosphere and space. This global regulatory rule-set is consistently adhered to by every airspace user and service provider. This rule-set is fit for purpose and outcome-based to ensure it can quickly adapt as needed. As new entrants and emerging technologies surface, this rule-set can flex to allow exceptions or 'special' cases or local exceptions, providing these are transitory cases that do not disrupt the full integration of the system.

Our regulatory framework is performance-based and technology-agnostic, providing the agility, openness and flexibility for new entrants and technological innovations in aviation vehicles, as well as safety, efficiency, capacity, security and environmental sustainability. The regulatory framework acknowledges new and evolving approaches to mitigating safety risks and other challenges, such as security, privacy and public opinion. Risk assessments are transparent and safety qualification is harmonised at the regional and global level and completed once.

We have revised, common standards and specifications to facilitate safety, interoperability

and integration, especially where technology is concerned, for example including provisions for UAS and RPAS technologies, automated concepts and AI algorithms.

Inclusivity is a critical principle by which we regulate, certify and operate. Both the aviation sector and global airspace are resources that any qualified operator can access, whether an incumbent or new entrant.

Success factors

- A holistic and harmonised approach to safety is critical for a fully integrated aviation system.
- Processes are simpler, clearer and universal to aid with equitable access for all users and to fuel the continued growth of the industry.
- Innovation is enabled by performance-based, risk-based and adaptable safety standards, specifications and regulatory frameworks, not stifled or slowed by prescriptive requirements.
- Transparency around risk and accountability is essential to uphold the industry's safety record.
- The highest level of safety is maintained for all airspace users and aviation remains the safest form of transport.





2045 Vision Building Blocks

Environmental Sustainability and Social Impact

The sky of 2045 is cleaner, quieter and more efficient. Just as aviation powers global prosperity, economy and trade, it also has a critical role in minimising its impact on the planet. Aviation continues to improve the environmental sustainability of the global transportation system as a whole, driving improvements in operational efficiency and reductions in emissions, pollution and fuel consumption.

The aviation community also plays a significant role in helping nations achieve their climate targets. By actively partnering with states and governments worldwide we are able to develop win-win outcomes where our partners move closer to their targets for climate and environmental sustainability while, as a sector, we collectively push forward on innovation and technology agendas as many advancements can contribute to cleaner and more efficient skies.

The sector has successfully built a positive relationship with the global public as they have witnessed our intent and investment in sustainability which has led to successfully addressing the environmental and climate implications of air travel.

Such efforts have helped us to gain a 'social licence' to implement and operate such an advanced system.

Even though our skies are busier than ever before, with hybrid technology, cleaner fuels, electrification, carbon capture and flight path optimisation, the aviation sector continues to limit its impact on the environment. The entire community actively goes beyond offsetting initiatives, mitigating environmental damage with a significant reduction in carbon emissions, noise and air pollution.

Technology facilitates optimised flight paths and therefore less output that negatively impacts the environment. Smarter, user-centric airspace design has optimised airport traffic flows and capacity, and reduced the congestion and noise for communities surrounding airports.

For cities specifically, technology, digitisation and services continue to evolve entire transport systems. With more cities electrifying their infrastructure, airborne operators and

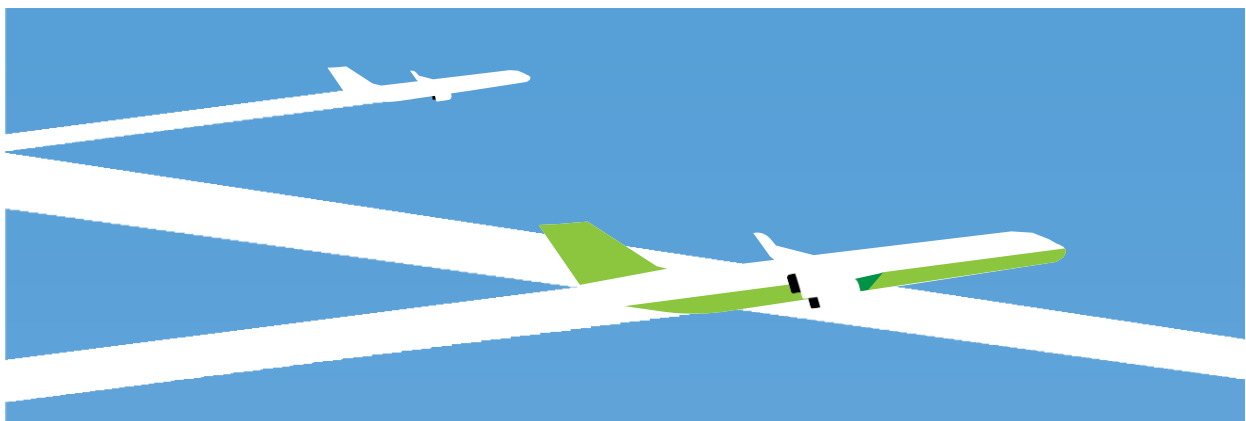
ground-based transport modalities can sync-up creating advanced interconnected transport networks. Aviation is also playing a significant, demonstrable role in tackling pollution, fuel consumption and congestion. With electric UAS and mobility services such as drone-based last-mile deliveries and airtaxis, aviation has replaced a substantial number of road vehicle logistics and as a result, has cut city emissions dramatically.

With significant investment in research and development, there are an increasing number of low carbon and zero carbon energy sources. When these airspace operations and services then link-up with other transport modalities, such as electric vehicles, they're able to deliver clean, seamless door-to-door experiences for passengers.

Consequently, the aviation sector is fast becoming an exemplar for environmental sustainability, collaborating with adjacent categories, states and policy makers. Our innovations with electric and hybrid airborne vehicles, flight planning and fuel alternates and efficiency are used as best practice examples for how an entire industry can positively help combat the breakdown of our planet's climate.

Success factors

- Political sponsorship and partnership are critical to achieving environmental goals at scale. We share the same pressures and ambitions as governments and states and so it's a perfect opportunity to tackle these together.
- We need to cater for public sensitivity towards air travel and air mobility to prevent it from developing into negative sentiment. We need to actively work with communities to identify the barriers and develop win-win solutions, so that the public embrace the progress and advancement aviation is making towards global mobility in efficient and sustainable ways.
- This is bigger than carbon emissions. We need a holistic approach to sustainability considering impact at multiple levels and across the entire value chain of the economies and companies we serve.
- There needs to be a significant commitment to, as well as an investment in, R&D alternatives to fossil fuels and production at scale to meet aviation's energy needs.





2045 Vision Building Blocks

Airspace Design and Classification

Airspace is designed and configured to enable the coexistence of all airspace users and services. To sustain the diversity and vitality of our skies it is imperative that airspace is safely shared between a mix of users, missions and machinery.

Therefore, accessibility continues to be a key focus of states, industry, regulatory bodies and the service providers to facilitate a completely integrated and interoperable airspace system.

The skies are managed safely and sustainably, according to traffic flows, user demand and public interest. Over time airspace has been reconfigured with national borders becoming increasingly less evident in low altitude airspace and with partnering states joining-up to merge resources, capabilities and service provision. This reconfiguration has resulted in a more flexible, regional approach to airspace management, with the best-suited players serving the market as users' needs arise.

States exercise sovereignty via a range of service providers, not by functionally running their own service provision. This has enabled more flexible and dynamic cross border service provision while enabling States to retain legal, security, administrative and judicial powers within their national airspace. Airspace sectorisation is therefore organised in line with major traffic flows or divided by upper and lower airspace, or dynamic by time of day, rather than fixed by national boundaries.

Seamless and comprehensive coordination arrangements between military authorities and service providers facilitate the exercise of national security measures through delegation measures, providing assurance of compliance. Civil use of military airspace when not in use by the military is enabled by these coordination arrangements, preserving exclusive military use when needed while greatly improving flight efficiency.

Demand exceeding available airspace capacity is rare. Airspace can accommodate all users, vehicles and missions in nominal operating environments. This configuration is also future-fit; a malleable architecture that allows for adaptability and scalability today and for future users and capacity.

This flexibility extends beyond the aviation and space sectors too. With digitisation, automation and the adoption of data services, systems have extended to include multi-

modal transportation systems and infrastructures.

There is no longer a need for segregation or classification according to specific classes or aircraft types; all airborne vehicles are assessed and operated according to their performance characteristics. Dynamic separation is facilitated by a range of technology and systems, and supported by ground-based capabilities that oversee the integration of information, especially over urban terrains. Therefore, airspace is serviced with a multi-dimensional view and capacity and productivity are maximised, making global airspace, continental and oceanic, an accessible and useable resource for all qualified users.

Airspace design and allocation is system-centric, mission-led and performance-based. Though exceptions are still needed in some instances, these cases are minimised to help enable fair access. The dynamic nature and flexibility for the system enables transitory use-cases, whether due to advanced technological capabilities or environmental or societal provisions, to co-exist in the same skies as traditional craft e.g. the ascent and descent of stratospheric vehicles or craft that are powered by alternative fuels.

The system also delivers safety, efficiency, capacity and high performance under some of the most complex conditions, especially for urban territories and at higher altitudes.

The architecture and management of urban airspace needs to be flexible and resilient enough to handle extremely high levels of traffic 24/7. Advanced ground-based risk management is critical for operations around buildings and built-up areas. Restricted domains facilitate a reduction in noise and emission levels, and respect the privacy and social acceptance of the general public. Airports in and around cities have an ever-increasing range and volume of transport modalities, therefore airspace design should enable operators to optimise all flight paths, protect capacity from restriction or delay, deconflict situations between aircraft, and those between aircraft and ground-based mobility vehicles.

Airspace management also coordinates the ever-increasing volume of space-destined traffic, supersonic aircraft and ultra-long-haul flights. These stratospheric users need to safely enter and exit lower domains in their ascent and descent journeys, without conflicting and disrupting the daily operations of all other airborne vehicles.

Success factors

- Removing traditional airspace segregation and physical geographical borders from airspace design and classification will enable system-wide accessibility.
- Safely and fairly maximising all airspace will ensure demand does not exceed system capacity. With greater capacity, global airspace is a more valuable, productive and resilient resource and a key driver of growth for the aviation industry and beyond.
- Environmental sustainability and societal impact must be incorporated into the design and architecture of global airspace.
- Exceptions made for the benefit of communities or for advanced tech players need to be case-by-case and continuously reviewable.
- Advanced technology, capabilities and protocols are critical to the safe, efficient and secure management of urban and stratospheric airspace



2045 Vision Building Blocks

Data and Security

Airspace management is more intelligent than ever before. Airspace is in fact a data- powered network with millions of nodes based in the air and on the ground.

Aviation's shared focus is to continue to build a smart, dynamic, optimised system that delivers efficient, seamless and safe point-to-point travel.

Data is the lifeblood of this system. The amount of information being captured, processed and shared is huge and will continue to grow as aviation and its user- base expand. A cloud-based data network enables secure flows of high-volume information between trusted users and robust data exchange between all infrastructure and aircraft. As aircraft and ground-based capabilities continue to digitise and modernise the airspace system grows, enabling broader integration, harmonisation and interoperability of all users.

Airspace users increasingly depend on the provision of accurate, secure, timely data that's quality-assured and situationally relevant. As airspace management is largely an automated process, open information exchange facilitates operational excellence, decision-making and risk management.

In this intelligent, cloud-based, data-powered network each operator participates in a safe, secure, open, and scalable framework for exchanging information. As certain craft become web-connected devices they're increasingly becoming part of the broader IoT, especially in urban environments with multi-modal transport infrastructure. The combination of data and digitisation facilitates communications that are secure, instant and operator-to-operator to aid with navigation, traffic management and deconfliction.

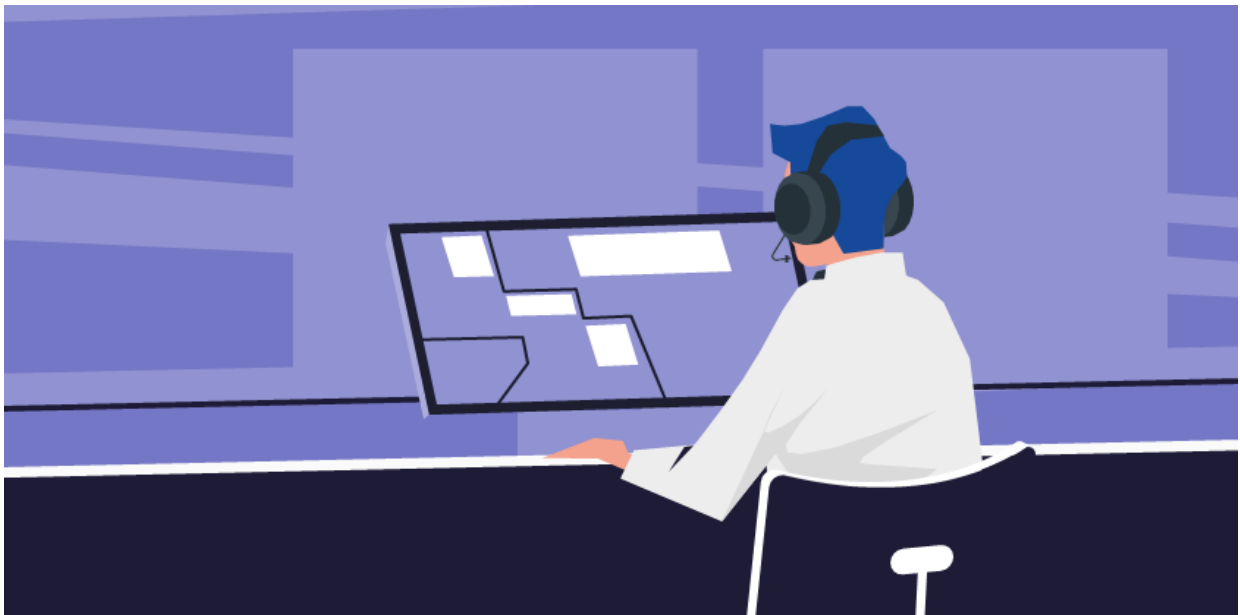
With data comes opportunity but also responsibility. IT is a significant risk to the safe and secure management of our skies. Network volatility, cybercrime and cyber failure are constant, real threats to the entire system. And with the cross-domain nature of airspace and third parties accessing its intelligent systems, maintaining safety and integrity is critical.

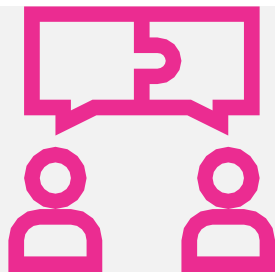
Therefore, cyber security and cyber resilience are system-wide priorities, with global quality standards that every user must comply to. A global, interoperable framework has been adopted by all users which allows for trusted ground-air, air-air and ground-ground exchanges for digital identity and user authentication. Strict privacy policies are in place that respect sovereignty and protect user privacy. States, regulators and organisations

continue to collaborate on all matters relating to cyber security and cyber resilience to protect our global skies.

Success factors

- Data capabilities and systems need to be adopted by all users in order to achieve interoperability and a harmonised airspace.
- Thought leadership and intelligence across the sector must stay ahead of cyber threats to maintain the safety, security and integrity of the aviation system, while policy and regulation remain solid foundations. The threat of cybercrime and cyber-related risks must be taken seriously. Carelessness could cost the whole system. Investment in technology, protocols, policies and personnel is critical.
- Evolution in technology, digitisation and data go hand-in-hand. A data- powered network and cloud-based services are only possible if technological and digital advancements happen in parallel.
- Cross-domain and cross-sector collaboration is key to ensure aviation can integrate with IoT and other web-connected infrastructure, especially in cities and in and around airports.





2045 Vision Building Blocks

People, Organisation and Talent

In a digitised, automated environment the roles and responsibilities of those in the global airspace community continue to evolve, still remain essential. To deliver the strategic and total management of airspace today's workforce is more sophisticated with complementary talent profiles, skills and competencies in different areas such as IT, data and communications. Traditional ANSP models have migrated from people-oriented service provision to technology organisations, provide greater scalability, resilience and support to an advanced, intelligent airspace system.

The global culture of safety and quality remains as robust and as important as ever, and has extended to include data security and privacy. As regulatory frameworks, qualification processes and technology have globalised, so too has talent management. Common job specifications, recruitment procedures and training exist worldwide, aiding system integration and interoperability. This has helped to build a global, connected community.

The evolution of the aviation sector has made it an appealing, promising career path. Improving airspace accessibility has also helped aviation become more accessible to a more diverse range of talent. More diverse, transient skills are both required for newer roles and desired by a new generation of talent. The sector has invested considerably in learning and development, with shorter, faster training and certification programmes.

Humans do that which automation cannot. And human intervention is the exception, not the norm. The adoption of automation and automated systems continues to extend and expand the human capability of the airspace community. Even now the sector continues to learn how humans and machines collaborate best in complex environments where trust and compatibility are crucial.

Automation and predictive algorithms manage point-to-point flight paths and trajectories, traffic flow and deconfliction. As risks emerge, decision making is first owned by automated

systems and software and only addressed by personnel in non-nominal instances.

The role of service providers has advanced to strategically managing the overall health of the integrated airspace system, including the technology, data and software that underpins it. Human intervention is minimal, and a key indicator of our system's safety and stability.

New business and operating models, value creation and growth opportunities have meant a more diversified workforce. Fluency in the language of automation and data literacy are top priorities. For example, Data science, analytics and information management are critical skills for modern day airspace management personnel, as are expertise in algorithm design, machine learning and other automated concepts. New safety and security protocols have also created job opportunities in spaces such as data security, cyber protection and digital identity in order to uphold the quality and integrity of the airspace system.

The rise in virtual technologies has seen the parallel rise of virtual teams. No longer confined to any traditional or physical geographic boundary, these virtual teams manage airspace dynamically, based on user needs and the services best equipped to serve them. Personnel and operations are independent of location and provide the airspace system and community with greater flexibility, and with any cases of disruption to demand or capacity, greater cost-effectiveness, scalability and resilience.

Remote working, or hybrid models, have enabled the industry to become more agile and adaptable. Such companies are increasingly becoming agile organisations with high-performance cultures, flexible management practices and resources, and organisational structures supporting collaborative rapid decision making and execution.

Success factors

- Human intervention and coordination is the exception, not the norm. Automation will support a high level of safety, security, capacity, and scalability, while extending the capabilities of people. Establishing new, desirable and legitimate roles for personnel that complements an automated, intelligent, data-powered system is key to the evolution of the aviation sector and its talent.
- The globalisation of aviation's approach to talent, skills and learning and development will aid with the accessibility and interoperability of the system as a whole.
- Digitisation and virtualisation will hugely impact organisations and their talent. Such shifts will result in greater adaptability and scalability across the airspace system and community.
- The innovation and growth of the sector will be critical to making it an attractive career prospect for younger, sought-after talent.

About the Complete Air Traffic System (CATS) Global Council

The CATS Global Council exists to drive the next era of aviation and forge a more adaptable, resilient industry; to explore, imagine and shape a shared vision for how our global skies can innovate and interoperate safely in the future. To show the way and go the way, enabling all aviation and aerospace players to learn, evolve and advance so that they are fit for this exciting future.

The CATS Global Council is an independent innovation forum, initiated by CANSO (the Civil Air Navigation Services Organisation), to facilitate collaboration among leaders across the aviation and aerospace industries: ANSPs, UTM service providers, aircraft manufacturers, drone operators and manufacturers, high- tech companies, airlines, airports, regulatory authorities, space agencies and research bodies.

CATS Global Council Membership is founded on the principles of cooperation and leadership. All Council Members share a concern for the future of aviation and hold a senior leadership position within their organisation.

Next steps following our Vision and the 'What', moving into the 'How' part of our journey

The CATS Global Council will continue work on developing a roadmap to achieve our shared vision that everyone can rally around. We look forward to extend the Council Membership with parties that will support us further in the 'how' of turning the Vision into reality. We aim to finalise a first version of the roadmap by Summer 2022. The CATS Global Council initiated and led by CANSO.

The logo for CANSO (Civil Air Navigation Services Organisation) features the word "CANSO" in a bold, black, sans-serif font. A green swoosh underline is positioned beneath the letters "A", "N", and "S".

The roles we play

- Leaders and collaborators
- Drivers of change
- Strategy setters
- Architects of future frameworks

Our collective responsibilities

- Never compromise the safety the industry is founded on
- Demonstrate active leadership
- Spearhead industry transformation
- Be accountable for the end result
- Authorise action and commit resource
- Cultivate a collaborative culture

Principles for how we work together

Be the change we want to see

We each need to lead by example to foster respect and rally others to follow in our footsteps along both the mental journey of being less risk-averse, and the physical journey of driving change.

Actions speak louder than words

If we only come up with a vision statement then we have failed. Inertia is unacceptable. Forging and actioning our roadmap is critical to realising the future we imagine.

Hold each other to account

Taking ownership and being accountable are critical to making decisions and taking action.

Maintain our safe space

We will always create the right conditions and spaces to share honestly and openly in order to generate and sustain trust.

In it for the long haul

Each member needs to be committed to the group and the process, which means showing up in the right moments and delivering on what we each commit to.

Good enough to move forward

Perfect is the enemy of the good. We won't allow perfectionism to get in the way, but will never compromise safety.

Representative of the global industry

Our membership and content are inclusive of different actors and attitudes across the entire system. We maintain a global mindset and ensure different geographies and economies have a voice and are heard.

For more information and the latest news, please visit www.futureskyvision.com.

Creators of the CATS Global Council



AIRBUS



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