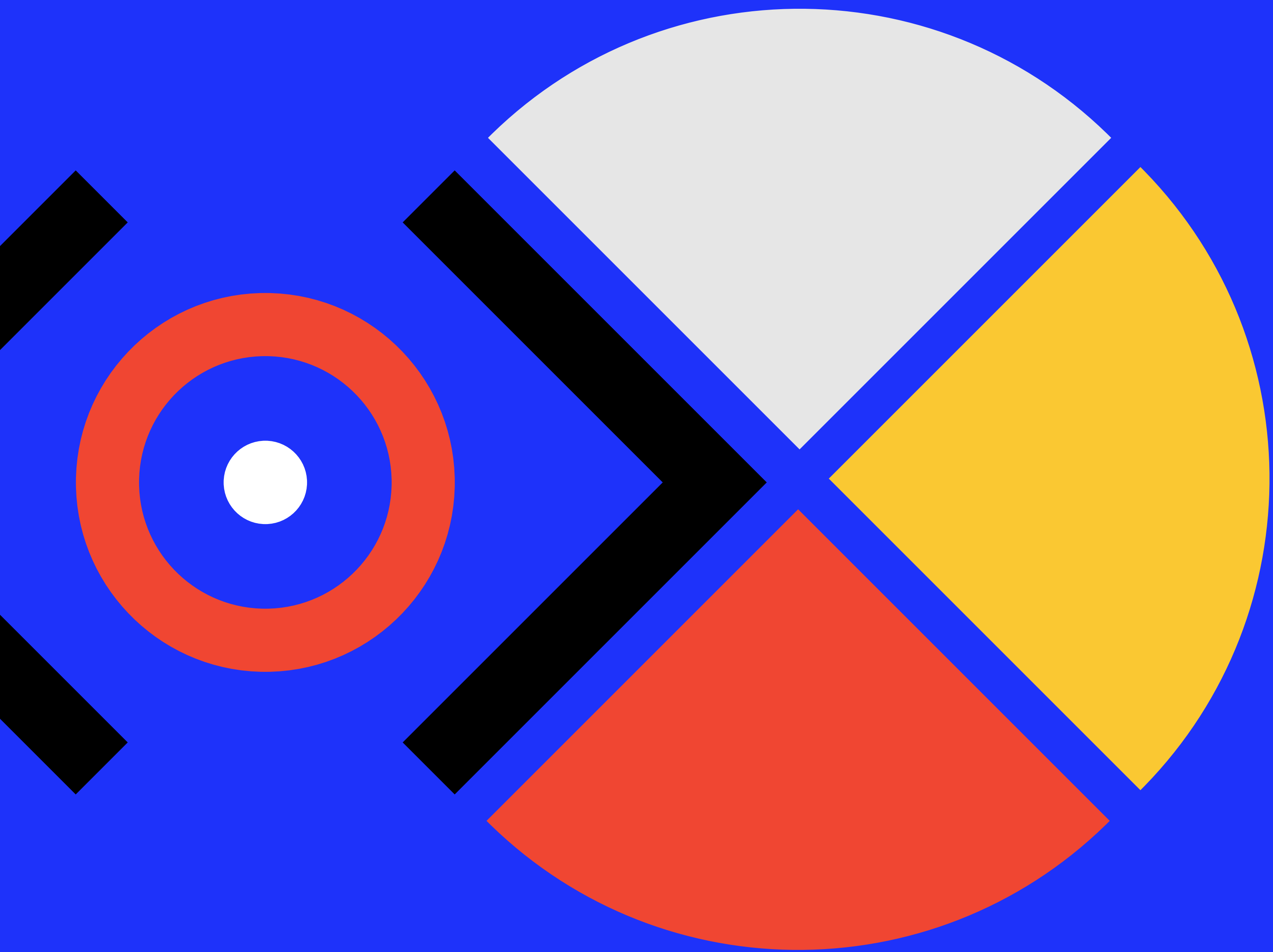
2025 Vision for the Future of Air Cargo Facilities

Reimagining Logistics Through Technology and Innovation



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1. Executive Summary

The air cargo industry is undergoing a major transformation, driven by rising trade volumes, evolving customer expectations, regulatory pressures, and the need for greater resilience and sustainability. Traditional cargo facilities, often constrained by aging infrastructure and manual processes, must adapt to meet growing demands for efficiency, scalability, and compliance. The 2025 Vision for the Future of Air Cargo Facilities white paper addresses these challenges, outlining the technological advancements shaping the next generation of air cargo operations and providing a roadmap for their implementation.

The future cargo facility will be safe, secure, sustainable, automated, connected, and smart. It will enable seamless data exchange, end-to-end visibility, and AI-driven operational optimization. Technologies such as autonomous ground support systems, real-time tracking, and connected infrastructure will improve efficiency, asset utilization, and shipment flow visibility. Sustainability remains a core priority, with electrification, energy-efficient infrastructure, and carbon reduction initiatives playing a key role in aligning air cargo operations with global environmental targets. As automation and AI adoption accelerate, workforce transformation will be critical, requiring upskilling and new collaboration models between human operators and intelligent systems.

This white paper provides airports, cargo operators, and logistics stakeholders with a strategic roadmap for investment, integration, and scalable implementation of these technologies. By leveraging industry-wide innovations and addressing integration challenges, stakeholders can enhance operational resilience, optimize resource allocation, and ensure long-term competitiveness. The document aims to serve as a practical guide to future-proofing air cargo facilities, ensuring they remain efficient, sustainable, and ready to meet the evolving demands of global trade.

> As the world navigates new periods of instability, air cargo remains critical for airline profitability and global trade continuity.

2. Revisiting the Cargo Facility of the Future

In 2018, IATA published the Cargo Facility of the Future white paper (pdf), a visionary document outlining air cargo facilities' transformation through automation, digitalization, and sustainability. The air cargo industry has undergone significant changes since then, influenced by global economic trends, technological advancements.

The COVID-19 pandemic highlighted the critical role of air cargo in maintaining global supply chains, especially for time-sensitive shipments such as vaccines, medical equipment, and e-commerce deliveries. Throughout this period, cargo emerged as a key revenue driver for airlines, at times representing up to 35% of total airline revenues—double its pre-pandemic share. Although passenger traffic has since rebounded, cargo remains vital to airline profitability, enabling strategic investments in infrastructure, technology, and process optimization.

As of January 2025, the air cargo industry has seen 18 consecutive months of growth, with global Cargo Tonne-Kilometers (CTK) rising by 3.2% year-over-year. While this signifies a moderation from the double-digit peaks observed in 2024, IATA predicts that air cargo volumes will increase by 5.8% in 2025, reaching 72.5 million tonnes. This growth is anticipated to be driven by booming e-commerce and geopolitical factors influencing sea shipments. The industry's long-term growth outlook remains positive, with forecasts of an average annual growth of 3.1% from 2027 to 2043.[1]

A critical sector for global connectivity

However, air cargo's operational environment continues to be complex, shaped by an increasingly volatile, uncertain, complex, and ambiguous (VUCA) world. The industry encounters challenges such as geopolitical tensions and potential trade policy shifts affecting global commerce flows, disruptions in key trade lanes, sustainability imperatives, and the accelerating shift toward e-commerce.

E-commerce continues to be a significant driver of air cargo demand, with projections indicating a 14% annual growth rate through 2026.[2] This surge necessitates advancements in air cargo facilities to handle increased volumes efficiently.

As the world navigates new periods of instability, air cargo remains critical for airline profitability and global trade continuity. Airlines and airports are increasingly investing in air cargo infrastructure to capitalize on growth opportunities. Simultaneously, shippers, freight forwarders, and logistics providers are demanding excellence, simplicity, traceability, sustainability, transparency, and speed in air cargo services.

Moving towards the facility of the future

The vision outlined in IATA's 2018 Cargo Facility of the Future white paper has been progressively realized. Over the past years, technologies anticipated in the vision have been adopted by air cargo stakeholders at different levels. The e-commerce boom has significantly contributed to developing new technological solutions for air cargo, as e-retailers focus on optimizing processes along their supply chains and increasing visibility and digitalization.

> **The cargo facility of the future is envisioned to be safe and secure, sustainable, automated, connected, and smart.** This evolution ensures that cargo facilities are fit for purpose in size, location, and for the people who use them, aligning with the industry's commitment to efficiency and sustainability.

1 Airbus. (2024). Global market forecast.
2 U-Freight Group. (2025). Flying start to 2025 for airfreight, but will the market cool?.

3. Challenges and opportunities to evolve

Air cargo facilities act as critical connection points between land and air transportation. They play a vital role in ensuring that shipments are accepted, handled, and prepared for air transport while adhering to strict safety, security, and quality standards, all within tight schedules.

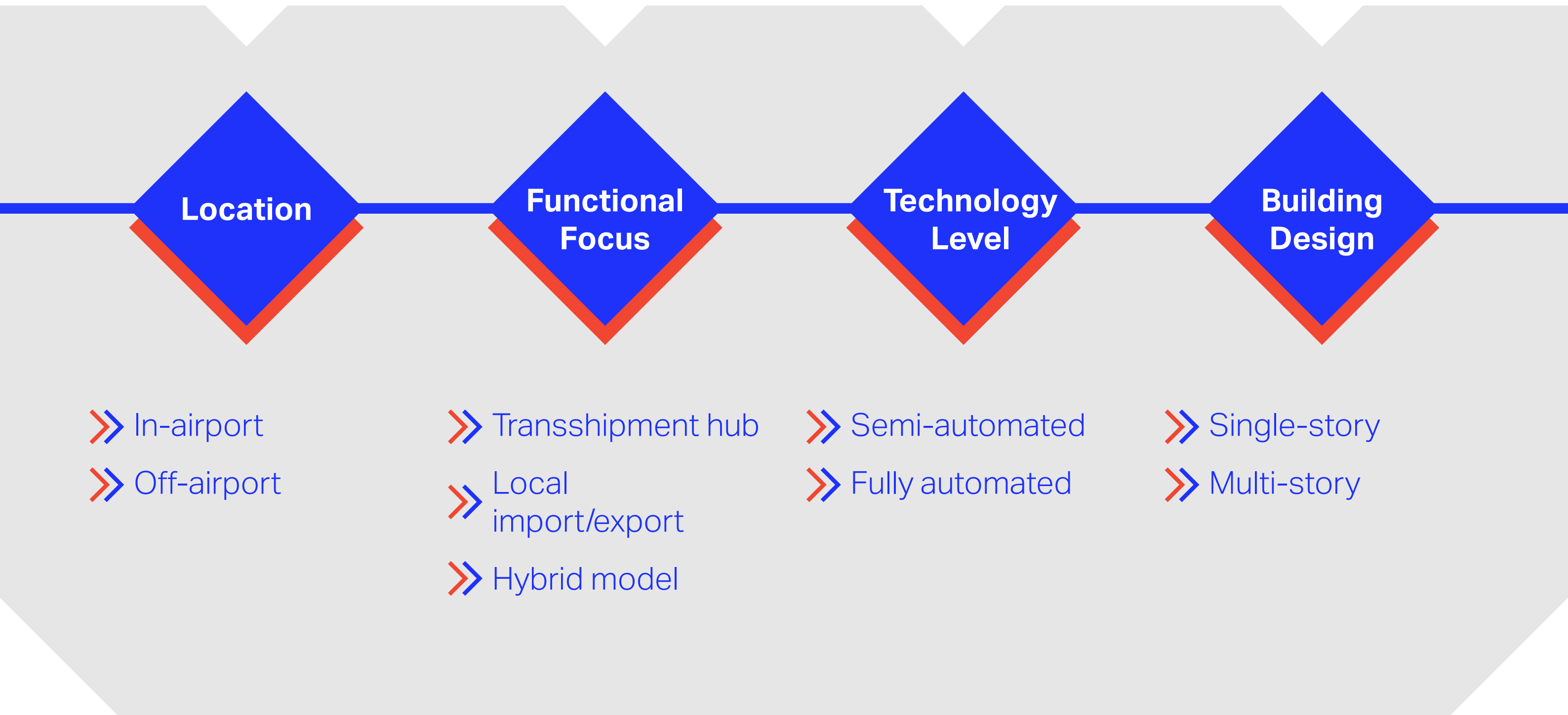
> Ensuring that these facilities are suitable for their intended purpose and easily accessible by other transportation modes is essential for the efficiency of the air cargo industry.

Adapting cargo facility models to different needs

Air cargo facilities worldwide follow different models based on location and functional focus. In-airport cargo facilities tend to be more complex than off-airport counterparts. Besides the essential requirement of adequate infrastructure (including cargo buildings, staging and storage areas, landside and airside access) they must also accommodate various stakeholders, such as airline personnel, freight forwarders, truckers, government agencies, and customs authorities.

In terms of functionality, in-airport facilities may be designed for transshipment, supporting hub operations for home-based carriers, or they may focus more on local import and export activities. They can have single or multi-story designs depending on spatial constraints and throughput needs. High turnover throughput, rather than staging or storage, is often the primary focus of in-airport facilities, as they are expected to facilitate rapid cargo movement. Conversely, off-airport facilities typically emphasize storage and distribution processes, allowing operators to manage logistics in a more extended timeframe. The level of technology in a facility can range from semi-automated to fully automated, depending on the interaction between infrastructure, equipment, and personnel.

Figure 1: Types of Facilities



The impact of legacy infrastructure

Cargo facility design has traditionally centered on infrastructure readiness to accommodate growing cargo volumes and increasing automation to enhance operational efficiency and safety. However, shifts in customer expectations and evolving regulatory requirements have consistently imposed significant challenges on cargo facility operators. Legacy infrastructure and outdated technology can constrict the need for rapid operational adjustments, making it difficult to keep pace with industry changes.

Decades of underinvestment in some locations have resulted in outdated cargo facilities that no longer meet modern operational demands. Some still rely on obsolete technology and polluting energy sources, lack the capacity to handle special commodities, or fail to implement modern safety and environmental measures. Without upgrades, these facilities risk becoming bottlenecks in the supply chain, reducing overall efficiency and sustainability.

Air cargo facilities must be a core component of airport master planning. Their location should ensure easy access, minimize road congestion, and be designed to accommodate future growth forecasts. Therefore, it is imperative to design and construct facilities **with flexibility and sustainability in mind**, ensuring they remain adaptable to industry shifts and technological advancements.

> The current state of air cargo facilities reflects both progress and persistent challenges.

Sustainability challenges

Staffing issues are one of the most pressing concerns for cargo facility operators. The 2022 IATA Global Skills Survey revealed that 57% of cargo operations stakeholders felt they lacked sufficient staffing for smooth operations.[3] The primary challenges identified were the shortage of experienced personnel, a lower-than-usual number of applicants post-pandemic, and high turnover due to working conditions. Furthermore, 40% of respondents in the cargo operations sector anticipated continued difficulties in recruiting and retaining employees, with this trend being particularly pronounced in Europe and the Americas. Low technology adoption is also a factor for staffing challenges. Young professionals are eager to work in environments that leverage cutting-edge technology; therefore, it is crucial for the air cargo industry to accelerate its modernization efforts to attract and retain young talent.[4]

As sustainability becomes a top priority for aviation, air cargo facilities must align with industry-wide efforts to reduce environmental impact. This requires transitioning away from polluting energy sources, modernizing inefficient infrastructure, optimizing equipment and operations, and minimizing waste generation. Regulators also enforce stricter sustainability standards in some regions, requiring cargo facilities to comply with more rigorous environmental regulations. Financial investors increasingly demand sustainability reporting from facility owners as part of their funding considerations.

Beyond operational sustainability, cargo facilities must also prepare for the effects of climate change. Rising temperatures and extreme weather events can disrupt operations, making climate resilience a crucial aspect of facility planning. Operators must proactively assess climate-related risks and implement mitigation strategies to ensure long-term operational stability.

The current state of air cargo facilities reflects both progress and persistent challenges. While advancements in technology and infrastructure have improved efficiency, many facilities remain outdated and need modernization. Ensuring that cargo facilities are well-integrated into airport planning, adaptable to evolving demands, and committed to sustainability will be crucial for the industry's future. Addressing workforce shortages and preparing for climate-related disruptions will ensure that air cargo facilities remain resilient, efficient, and competitive in a rapidly changing logistics landscape.

3 International Air Transport Association (IATA). (2022). Aviation global skills survey.
4 International Air Transport Association (IATA). (2023). Making air cargo appealing to young talent.

4. New transformation approaches for more efficient operations

Who is driving cargo facility transformation? In many cases, government authorities managing airports take a strategic view, considering cargo catchment areas, airspace capacity, and international or domestic flight operating demands when planning facility transformations. However, airlines and ground handling agents also seek to modernize their infrastructure to enhance efficiency and cost-effectiveness without compromising safety and security.

Trucking companies and freight forwarders also play a role in shaping cargo facilities, particularly when their operations contribute significantly to cargo volume, product diversity, and frequent utilization of in-airport or off-airport infrastructure.

A 2023 IATA survey of 26 cargo facility operators revealed that while the average facility was at least 20 years old, most respondents had renovated or upgraded their facilities in the last five years or were doing so regularly. Digitalization and process automation were key drivers of these upgrades, with documentation and acceptance/release processes showing the highest level of technological advancement, while apron interactions remained the least developed.

Focus on high-growth cargo segments

The rapid expansion of e-commerce has fundamentally changed the requirements for cargo facilities worldwide, with rising consumer demand for fast deliveries driving investment in automated sorting, tracking, and processing capabilities. Some airports in Europe have expanded their express cargo facilities to accommodate the surge in online retail shipments and developed integrated advanced sorting systems, digital tracking, and strategic partnerships with leading e-commerce logistics providers to ensure a streamlined, high-speed cargo operation.[5] Similar developments are seen in North America, where some airports have scaled up operations to meet the demands of major e-commerce players.

Beyond e-commerce, other high-growth cargo segments are also shaping the industry's future. Pharmaceutical and healthcare logistics have gained prominence, with major hubs investing in temperature-controlled storage and regulatory-compliant handling solutions to support the expanding global pharmaceutical trade. Cold chain logistics for perishable goods, including fresh produce and seafood, drive investment, particularly in Latin America, Africa, and Southeast Asia, where agricultural exports rely on robust refrigeration infrastructure to maintain product integrity.

The transportation of high-value and time-sensitive goods, such as luxury fashion, automotive parts, and aerospace components, has led airports to enhance their security, handling speed, and processes to facilitate customs procedures. Just-in-time manufacturing has increased reliance on air cargo to quickly deliver critical industrial components, further strengthening demand for efficient cargo processing. Another niche but significant segment includes live animal transport, with facility operators adding specialized handling facilities to cater to the movement of livestock, racehorses, and exotic species under strict regulatory oversight.

These developments highlight the critical role of cargo facility transformation in supporting both current and future supply chain demands.

> With growing demand across these diverse cargo segments, airports and logistics providers are prioritizing automation, digitalization, and sustainable infrastructure to ensure the continued evolution of air cargo operations, aligning with global industry initiatives.

Evolving Market Forces Shaping Facility Transformation

The intersection of market demand, technological advancements, and evolving regulatory requirements drives the transformation of air cargo facilities. The global air cargo market is projected to experience steady growth, with IATA forecasting an increase in freight volumes as trade and e-commerce continue to expand. However, macroeconomic uncertainties and geopolitical instabilities are pushing facility operators and investors to build resilience and flexibility into their infrastructure plans.

5 Swissport. (2024). Swissport adds 3rd air cargo center in Liege, Belgium.

Regional market trends illustrate varying transformation priorities. In Asia-Pacific, air cargo demand remains strong due to high-volume manufacturing and the rapid expansion of e-commerce logistics. North America is investing in modernizing infrastructure to accommodate express freight and integrated multimodal transport solutions. Meanwhile, European markets are focusing on automation, digitalization, and sustainability to streamline operations. In emerging regions, such as Africa and Latin America, investment in cargo infrastructure is increasing to support agricultural exports and expand trade networks.

Technology is playing a central role in shaping the future of air cargo facilities. Digitalization and automation are key priorities, with cargo community systems, data exchange, and artificial intelligence being integrated to enhance efficiency and tracking transparency. Automated cargo handling systems and robotics are also being adopted to reduce processing times and minimize labor-intensive operations. These technological shifts align with industry initiatives to standardize processes and improve supply chain visibility.

Sustainability is becoming a critical factor in cargo facility transformation. Airports and cargo operators are adopting green technologies such as solar-powered warehouses, electric ground support equipment, and more energy-efficient building designs to align with international environmental goals. Sustainable building materials, such as recycled steel, low-carbon concrete, and bio-based insulation, are being increasingly utilized in cargo facility construction to reduce environmental impact. Additionally, end-of-life planning for cargo infrastructure is gaining attention, ensuring that decommissioned facilities are dismantled with minimal waste and components are repurposed or recycled where possible.

An express integrator, in particular, is setting an example by developing dedicated guidance for the sustainable transformation of cargo facilities,[6] focusing on carbon-neutral facilities, increased energy efficiency, and green-certified buildings. Their approach includes retrofitting existing facilities with renewable energy sources, electrifying ground operations, and designing new infrastructure to meet environmental standards. These strategies reflect a broader industry trend toward integrating sustainability into long-term infrastructure planning.

From a financial perspective, cargo facility transformation is attracting significant investment from private equity firms, infrastructure funds, and public-private partnerships. The demand for specialized infrastructure, such as temperature-controlled warehouses for pharmaceuticals and automated high-speed sorting hubs for e-commerce, could result in new investment opportunities. However, factors such as fuel price fluctuations, shifting trade policies, and labor constraints pose challenges that stakeholders must navigate.

Ultimately, the transformation of air cargo facilities is a strategic imperative for the industry. Airports, airlines, and logistics providers must embrace technology, sustainability, and operational efficiency to remain competitive in a rapidly evolving global market. By integrating digital solutions, optimizing infrastructure, and fostering collaboration between industry players, cargo facilities can enhance their ability to meet the growing demands of international trade and logistics.

The Potential of Off-Airport Cargo Facilities

In regions where export operations rely heavily on shipper-built ULDs (Unit Load Devices) to support volume, off-airport cargo facilities are becoming a more viable solution to enhance efficiency. These facilities often operate under different national aviation regulations while maintaining the same security standards as on-airport locations. By shifting some cargo handling functions away from the airport, overall capacity can be increased, congestion reduced, and processing streamlined.

From a strategic perspective, off-airport facilities offer greater flexibility in handling cargo flows and supporting logistics networks. Warehouses located outside the airport perimeter can serve as fulfillment centers, allowing logistics providers to optimize their internal networks without being constrained by airport space limitations. This setup enables faster sorting, enhanced supply chain integration, and more efficient last-mile delivery.

However, moving operations off-airport also presents challenges. Ensuring secure and efficient transport between off-airport warehouses and airside operations is critical to maintaining the integrity of the supply chain. Additional considerations include regulatory compliance, the need for dedicated transport corridors, and potential delays caused by off-site processing. Investments in technology, such as automated cargo tracking and secure transport solutions, can help mitigate these challenges.

For exports, the prevalence of shipper-built ULDs directly impacts the feasibility of off-airport activities. The higher the proportion of pre-built ULDs at an airport, the more opportunities exist for off-airport cargo processing, including security screening and pre-checking of shipments. This also opens the door for more self-service options, where stakeholders can input cargo or truck information before arriving at the cargo facility, further streamlining handling operations.

As demand for air cargo continues to grow, off-airport solutions will play an increasing role in alleviating congestion and optimizing cargo flows. The industry can create a more resilient and scalable air cargo infrastructure by integrating facilities into broader logistics strategies.

Focus on efficiency and excellence in operations

This white paper provides insights into the technologies that enable the industry to carry out safe, secure, sustainable, automated, connected, and smart operations. Meanwhile, the IATA white paper "Cargo Operations: Efficiency & Excellence" focuses on the role of IATA Standards in improving operational efficiency and promoting excellence across the industry.

By following IATA standards, organizations can streamline their processes, minimize inefficiencies, and ensure that safety protocols are strictly adhered to. This results in increased productivity and lower costs, which are essential for operational efficiency. IATA standards cultivate a culture of continuous improvement and excellence, motivating organizations to consistently assess and enhance their operations.

6 DHL. (2024). The anatomy of a carbon-neutral building.

5. What are the new technology enablers?

In 2018, IATA identified six technological trends that were expected to shape the future of air cargo. Nowadays, many of these technologies have made their way into cargo facilities, significantly transforming how operations are conducted. Some have become essential enablers of efficiency and automation, while others remain in an early adoption phase, offering glimpses of their future impact.

Despite limited large-scale deployment, we now have greater clarity on how and when these technologies will begin playing a transformative role in the industry. At the same time, new technological advancements have emerged, disrupting the logistics and air cargo landscape in ways previously unanticipated.

One notable example is Artificial Intelligence (AI), which has rapidly proven its potential to impact cargo operations in the past few years, revolutionizing predictive analytics, automation, and decision-making. This underscores how quickly the technological landscape can evolve, forcing industry leaders to continuously reassess and adapt their strategies.

The evolution of these six technologies has accelerated the transformation of cargo facilities into hyper-efficient, data-driven, and sustainable environments.

The Six Technologies Identified in 2018 and Their Evolution

1. Augmented Reality (AR) and Wearables

In 2018, AR and wearable devices were in the early stages of adoption, primarily explored for hands-free workflow assistance, training, and warehouse navigation. Smart glasses and exoskeletons were tested for operational support, but full integration remained limited. Today, AR-enabled smart glasses enhance accuracy in cargo handling, while AI-powered exoskeletons reduce worker fatigue and improve safety. Augmented reality is now integrated with real-time visibility platforms, improving operational transparency and efficiency.

2. Drones and Autonomous Vehicles

At the time of the publication of the first white paper, drones and autonomous vehicles were experimental, with limited real-world applications in inventory management and yard logistics. Concerns over regulation and operational complexity slowed their deployment. Drones are nowadays more widely used for automated inventory checks and security monitoring, while autonomous vehicles can manage cargo movement with improved efficiency. Advances in regulatory frameworks have enabled controlled deployments, reducing delays and manual intervention.

3. Robotics and Automated Systems

Automation was largely limited to conveyor systems and robotic sorting in 2018, with early experiments in collaborative robots (cobots) assisting warehouse workflows. Full automation remained a long-term vision. Today, AI-powered robotic arms perform complex sorting, loading, and unloading tasks. Mobile robots transport cargo autonomously, dynamically adapting to shifting workflows. Automation has reduced manual handling, increased throughput, and optimized space utilization.

4. Big Data, Predictive AI, and Deep Learning

Back in 2018, data-driven solutions focused on demand forecasting and route optimization, with AI in its early stages being used for anomaly detection and workflow efficiency. Deep learning applications were still developing. We are now seeing the potential for AI-driven analytics to optimize cargo flow, minimize bottlenecks, and enhance predictive maintenance. Other examples are the possibilities of using advanced deep learning models to anticipate disruptions before they occur, improving operational resilience and decision-making, and AI-driven scheduling and real-time analytics to enhance facility performance further.

5. IoT, Connected Cargo, and Smart Devices

IoT adoption in 2018 focused on sensor-based cargo tracking, but data integration challenges limited real-time visibility and industry-wide connectivity. In 2025, IoT networks provide comprehensive cargo monitoring, real-time tracking, and predictive analytics for proactive decision-making. Smart sensors automate compliance tracking, while data exchange enhances supply chain transparency. Connected cargo and real-time visibility platforms are reshaping logistics by creating transparent and data-driven ecosystems.

6. Sustainable, Net-Zero Buildings

Sustainability efforts were in their early stages when the first white paper focused on energy-efficient infrastructure, solar power, and waste reduction. The goal was to align with aviation's carbon-neutral growth targets. Nowadays, we see more cargo facilities integrate net-zero principles, incorporating renewable energy, energy optimization, and sustainable materials. Smart grids, battery storage, and circular economy initiatives have made sustainable facilities a financial and environmental priority. The adoption of electric and hydrogen-powered ground equipment further reduces carbon footprints in operations.

Digitalization and optimization: Closing the innovation gap

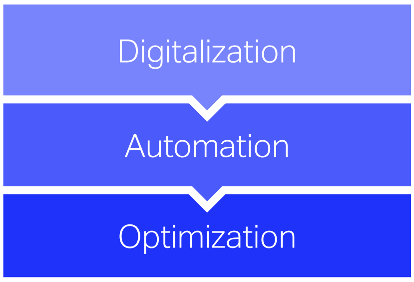
The air cargo industry has long struggled with a significant innovation gap, lagging other sectors in digitalization and optimization. Many cargo operations still rely on incomplete or inaccurate data, limiting operational efficiency and hampering optimization efforts. Underutilized cargo capacity remains a persistent challenge due to outdated processes and the absence of comprehensive data integration, leading to inefficient load planning and revenue loss. Additionally, manual workflow slows cargo handling, making automation an essential requirement for the industry's future.

The industry has recognized that transitioning from manual operations to a fully digital and optimized ecosystem is key to this transformation.

Technologies such as RFID, data loggers, and IoT-based tracking are increasingly integrated into air cargo operations, providing greater visibility and planning capabilities.

The modular nature of digitalization allows for a gradual transition. Organizations can first digitalize cargo, introduce efficiency tools, and progressively implement automation solutions to achieve optimized cargo processes. This phased approach ensures that facilities can enhance efficiency without causing significant operational disruptions.

Figure 2: Phased approach



Recent proof-of-concept studies have demonstrated that digitalizing cargo handling at the piece level leads to more accurate flight planning and significant capacity optimization. One study analyzing 262 AWBs across nine flights revealed that only 27.5% had an accurate declared cargo volume, with 72.5% showing discrepancies beyond ±10%. Correcting these discrepancies resulted in improved planning, ensuring that available space was utilized more effectively. In another study, using a digital planning tool over three months reduced build-up operation times by 33.75% per flight while optimizing load capacity, creating an additional 23.6% usable space for cargo.

In a separate case study, retrospective analyses of 1,000 global cargo flights demonstrated that, on average, 24.8% of space per flight was underutilized, with 16.4% being viable for additional cargo.

The findings underscore the importance of real-time digital visibility and accurate volumetric data in addressing inefficiencies. By integrating digitalization into Cargo Management Systems (CMS) and airline booking platforms, cargo handlers and airlines can streamline planning, reduce inefficiencies, and optimize revenue potential.

With the industry pushing for greater adoption of digital standards such as ONE Record and Interactive Cargo, the air cargo industry is moving toward a future where digitalization, automation, and real-time optimization will define the next generation of air cargo operations.

Use Case 1

Digitalization at the Origin of 262 AWBs from 9 flights.

- Variance between declared cargo volume against what was received at the cargo handler showed that only 27.5% of AWBs were accurate and that 72.5% of AWBs had a variance beyond +/- 10%.
- Digitalization of the cargo build-up process unveiled 22% of free space on each flight, equivalent to 18.25 m^3, with 14% (equivalent to 11.75 m^3) of it being usable space.

Use Case 2

Digitalization tool used in live operations for over 3 months by cargo handler staff on four passenger flights.

- The use of a planning tool resulted in 33.75% timesaving in cargo build-up operations per flight.
- Capacity was optimized by providing 23.6% usable free space for loading additional cargo.

Use Case 3

Flights were replanned in retrospect to examine the potential for capacity optimization and to understand how much additional cargo could be loaded on them. Data from around 1000 flights (pax + freighters) operating on crucial global cargo routes was used.

- The study showed that 24.8% of free space was detected on every flight, equivalent to 38.9 m^3.
- Out of this, 16.4% was usable space, equivalent to 27.05 m^3.

6. The Cargo Facilities Technology Trends Radar

As air cargo facilities continue to evolve, the technologies driving transformation must be continuously reassessed to reflect emerging trends, new operational challenges, and advancements in automation, digitalization, and sustainability. In this edition, IATA has refined and expanded the original six key technology areas, ensuring they align with the latest developments shaping cargo operations. This evolution reflects technological advancements and industry needs, such as greater efficiency, transparency, sustainability, and resilience in cargo handling and logistics.

To bring a data-driven perspective to this analysis, IATA has developed the first Technology Trend Radar for Cargo Facility Operations, providing a structured evaluation of innovation adoption in air cargo. Based on insights from 90 industry experts, this radar assesses each technology's impact on cargo facility operations and estimates its timeline for mainstream adoption. By combining expert perspectives with an objective evaluation of technology maturity, this edition offers a comprehensive roadmap for the industry's digital and operational evolution.

This refined approach highlights the technologies shaping the future of air cargo and provides a practical guide for industry stakeholders as they seek to create smarter, automated, and more sustainable cargo facilities.

The Six Updated Technology Trends

Based on the outcomes of the industry-wide survey and extensive research into emerging technology trends in air cargo facilities, IATA has updated the original six technology trends first defined in 2018.

This revision captures significant developments and reflects current industry priorities, including increased digitalization, automation, sustainability, and real-time operational visibility. By integrating expert insights and recent innovations, the updated framework offers a clearer, more comprehensive perspective on the technologies poised to shape the future of cargo operations.

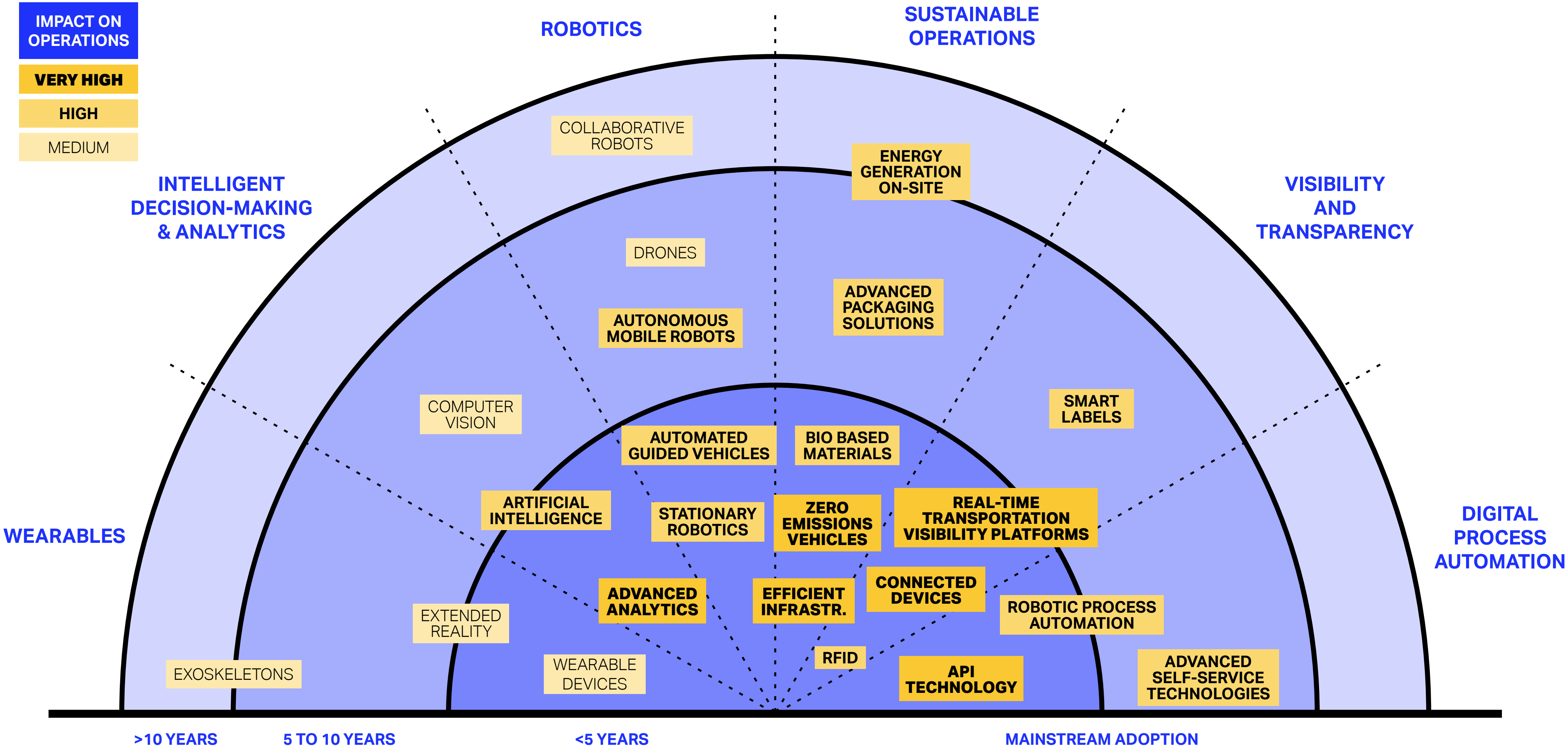
Figure 3: 2025 Technology Trends

Technology Trend Radar for Cargo Facility Operations

To support the creation of the radar, a comprehensive industry survey was conducted, collecting insights from **90 participants** representing various stakeholder groups within the air cargo ecosystem. Participants assessed each technology according to two dimensions:

- **Impact in Operations** (the expected operational effect, categorized as Very High, High, Medium, or Low)
- **Range of Adoption** (expected timeframe for widespread acceptance and use of a new technology: already adopted, within 5 years, 5-10 years, or beyond 10 years)

The respondents represented diverse stakeholder groups, including **Airlines (31%)**, **IT Providers (16%)**, **Cargo Terminal Operators (12%)**, **Freight Forwarders (15%)**, **Ground Handlers (13%)**, and **Shippers (4%)**, ensuring a comprehensive understanding of industry needs and perspectives.



6.1 Intelligent Decision-Making & Analytics

As air cargo operations become increasingly complex, data-driven decision-making is essential to improve efficiency, reducing costs, and ensuring smooth workflows. Intelligent decision-making and analytics technologies harness artificial intelligence (AI), machine learning (ML) and predictive analytics to optimize cargo handling, security, resource planning, and demand forecasting. By processing vast amounts of real-time and historical data, these technologies enable smarter, faster, and more strategic decision-making, helping air cargo stakeholders move from reactive to proactive operations.

Technologies such as AI-powered automation, advanced analytics, and cloud computing provide real-time insights that support operational resilience, data-driven planning, and seamless collaboration across the supply chain. By integrating these technologies, air cargo operators can enhance efficiency, optimize costs, and improve service levels.

Artificial Intelligence

Artificial Intelligence is the simulation of human intelligence in machines that can learn, reason, and self-correct and perform tasks such as visual perception, speech recognition, decision-making, and translation between languages.	**High Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
AI enhances efficiency in air cargo by enabling predictive maintenance, optimizing cargo space, and automating workforce and equipment scheduling. AI-powered robotics streamline cargo handling, while anomaly detection strengthens security screening. Advanced analytics improve inventory management, demand forecasting, and route planning, ensuring better load planning and ULD build-up automation. Real-time monitoring of cargo conditions helps maintain quality, while natural language processing (NLP) enhances customer service through automated support and elimination of manual tasks. AI simplifies compliance with industry standards, creating a more intelligent and efficient cargo ecosystem.	Despite its high operational impact, AI adoption faces challenges such as high initial costs, integration complexities with legacy systems, and workforce resistance. Successful implementation requires skilled personnel, data standardization and quality, and regulatory collaboration. While AI requires significant investment and ongoing maintenance, its ability to enhance speed, accuracy, and decision-making gives businesses a competitive edge. As AI adoption expands, it will continue to disrupt the industry, driving a shift from manual processes to intelligent automation and allowing companies to focus on customer needs and revenue optimization.

Advanced Analytics

Advanced and predictive analytics use AI, machine learning (ML), and statistical models to process historical and real-time data, enabling proactive decision-making and forecasting.	**Very High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
In air cargo, advanced analytics improve operational efficiency, demand planning, and resource allocation by identifying patterns and trends. By leveraging predictive insights, cargo operators can optimize routing and capacity use, automate warehousing and pallet buildup, and enhance overall decision-making, ensuring more efficient and data-driven operations. They can also use advanced analytics to power dynamic pricing, improve scheduling and revenue optimization	Adoption of advanced analytics requires high-quality data, integration with existing systems, and specialized expertise in data science and AI. Implementation costs vary, depending on the complexity of analytics models and system integration requirements. Challenges include data silos, standardization issues, and resistance to AI-driven decision-making, while reliance on cloud computing, IoT, and APIs ensures seamless data access and system interoperability. As more companies recognize its potential, advanced analytics will continue to drive cost reduction, operational efficiency, and service improvements, solidifying its role in the future of air cargo logistics.

Computer Vision

Computer Vision (CV) leverages AI to process and analyze visual data, automating cargo identification, inspection, and workflow monitoring.	**Medium Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
By scanning barcodes, QR codes, and labels, CV enhances real-time tracking, improving efficiency and security in air cargo handling. CV reduces manual processes by measuring the shipment dimensions in transit for improved buildup. It also plays a crucial role to perform damage detection, ensuring cargo integrity during loading, transit, and unloading. Threat detection capabilities allow for enhanced security screening and detection of illegal trade by analyzing X-ray images of shipments, while workflow monitoring optimizes warehouse operations by identifying inefficiencies and bottlenecks. Automated quality control verifies packaging integrity and regulatory compliance, and analyzes shipement discrepancies with AWB data, while safety monitoring helps detect potential risks, improving workplace security.	CV adoption requires specialized infrastructure, advanced sensors, and AI-powered processing, contributing to high implementation costs. Additional challenges include regulatory compliance, worker resistance due to fears of job displacement, and safety concerns related to automated surveillance. Its effectiveness depends on AI, network stability, and seamless data integration. CV is set to enhance efficiency, improve security, and optimize cargo handling processes, making air cargo operations smarter and more reliable.

6.2 Wearables

Industries such as manufacturing, healthcare, and logistics have successfully adopted wearables, extended reality (XR), and exoskeletons to improve workforce performance and reduce physical strain. In air cargo, where operations involve physically demanding tasks, complex coordination, and real-time decision-making, these technologies present a unique opportunity to bridge the gap between human expertise and digital automation.

Extended Reality

Extended Reality (XR) is the umbrella term encompassing Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MX). It blends virtual and real-world environments to enhance interactions, simulations, and data visualization.	**Medium Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
Extended Reality (XR) is transforming air cargo operations by enhancing training, facility planning, cargo handling, and maintenance. AR and VR create immersive training environments, improving workforce readiness for cargo handling, equipment operation, and safety procedures. MR enables warehouse and facility planning, optimizing layouts and cargo space utilization. In day-to-day operations, AR-powered inventory management provides workers with real-time cargo details, while AR-based navigation systems guide personnel directly to cargo locations, streamlining workflows. Maintenance and repair operations also benefit from AR-guided troubleshooting, which improves efficiency and reduces errors.	Despite its potential, XR adoption in air cargo remains limited, requiring significant investment in infrastructure, data management, and skilled personnel. Integration is complex, as XR systems must connect with existing IT platforms, IoT devices, and operational workflows. Regulatory concerns, workforce adoption challenges, and the high cost of implementation remain key barriers.

Wearable Devices

Wearables are devices worn on the body that enhance worker efficiency, productivity, and safety by providing real-time information or assistance.	**Medium Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	**Considerations for implementation**
Wearable devices improve air cargo staff's efficiency, communication, and safety by providing real-time information and hands-free functionalities. Smart wearables such as glasses, headsets, and scanners allow workers to access shipment details, handling instructions, and navigation guidance without interrupting their tasks. Hands-free barcodes and RFID scanners enhance cargo tracking and inventory management, reducing processing time and errors. Health monitoring wearables track worker vitals and fatigue levels, helping optimize workload distribution and improving safety for physically demanding roles.	While wearables offer clear operational benefits, adoption remains moderate due to high initial investment costs, integration challenges, and workforce adaptation concerns. Successful implementation requires seamless connectivity with cargo management systems and IoT networks. Data privacy and security considerations also need to be addressed, particularly for health monitoring applications. Despite these challenges, cargo stakeholders are demonstrating the potential of wearables to enhance performance and reduce physical strain.

Exoskeletons

Exoskeletons are wearable mechanical devices designed to enhance workers' physical capabilities by reducing strain and fatigue.	**Medium Impact**	**More than 10 years for mainstream adoption**

Transformative impact on air cargo	**Considerations for implementation**
These assistive technologies provide lifting support during loading and unloading, help minimize the impact of repetitive movements and offer ergonomic reinforcement for workers required to stand for extended periods. By reducing physical exertion, exoskeletons improve efficiency and productivity in labor-intensive tasks and contribute to workplace safety and injury prevention.	Despite their benefits, adoption in air cargo remains limited due to high costs, workforce adaptation challenges, and integration with existing workflows. Successful implementation requires specialized training, collaboration with occupational safety teams, and alignment with operational processes. Concerns over worker comfort, long-term usability, and maintenance requirements must be addressed, but early suggest that exoskeletons can reduce injuries and enhance efficiency, paving the way for broader adoption as technology improves and costs decrease.

6.3 Robotics

Automation is reshaping air cargo operations, with robotics playing a central role in improving efficiency, precision, and safety. As cargo volumes increase and operational demands grow, robotics help streamline handling, reduce manual labor, and enhance security. From autonomous vehicles transporting cargo to robotic arms sorting and palletizing shipments, these technologies bring greater speed, accuracy, and reliability to logistics processes.

Drones

Drones are aircraft operated without a human pilot onboard. In air cargo, drones can enable fast, flexible, and cost-effective transportation of lightweight and time-sensitive shipments and operational support in other ways.	**Medium Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
Their ability to operate autonomously or remotely makes them a highly flexible tool for cargo transportation, facility monitoring, and security applications. Drones excel in last-mile delivery, providing customers with urgent, high-value, or time-sensitive shipments. They facilitate inter-hub cargo transport, minimizing dependency on ground transport for small deliveries. In addition to delivery. UAVs are increasingly utilized for infrastructure inspections, inventory oversight, and security. They utilize cameras and sensors to track cargo, assess warehouse inventory, and improve surveillance. Their application includes emergency logistics, enabling rapid delivery to isolated or disaster-stricken regions.	Despite obstacles like airspace rules, range constraints, and integration with current logistics systems, UAVs have the potential to be a game-changing technology.

Automated Guided Vehicles

Automated Guided Vehicles (AGVs) are self-driving vehicles that follow predefined paths using magnetic strips, tracks, or sensors to transport goods efficiently within air cargo facilities.	**High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
Unlike Autonomous Mobile Robots (AMRs), which dynamically navigate environments, AGVs operate on fixed routes, making them ideal for structured, high-volume cargo movement where predictability is key. AGVs automate the transport of ULDs, pallets, and containers between loading docks, storage areas, and aircraft, reducing manual handling and increasing efficiency. They play a critical role in warehouse automation, streamlining material transport, cargo sorting, and stacking while optimizing space utilization. AGVs also support inter-terminal cargo movement, dock-to-aircraft delivery, and controlled-temperature transport, ensuring seamless cargo handling.	In air cargo, While AGVs significantly enhance efficiency and accuracy, they require dedicated infrastructure, and their fixed-path nature limits adaptability compared to AMRs.

Autonomous Mobile Robots

Autonomous Mobile Robots (AMRs) are self-navigating robots that transport cargo within warehouses and cargo hubs without requiring fixed routes.	**High Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	**Considerations for implementation**
Unlike Automated Guided Vehicles (AGVs), which follow predefined paths, AMRs move dynamically, adapting to changing environments using sensors, AI, and real-time mapping. This flexibility makes them ideal for complex cargo facilities where layouts frequently change. AMRs automate cargo movement, sorting, and inventory management, helping reduce reliance on manual labor. They improve efficiency in warehouse automation, cargo staging, and picking tasks, ensuring better resource utilization. AMRs also support cold chain logistics by handling temperature-sensitive cargo with precision.	Challenges such as high initial costs, integration complexity, and the need for reliable wireless connectivity remain. As IoT, AI, and cloud computing continue to advance, AMRs will play an increasing role in making air cargo facilities more autonomous, adaptive, and efficient.

Stationary Robotics

Stationary robotics refers to fixed robotic systems for automated cargo handling, sorting, and inspection in air cargo facilities.	**High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	**Considerations for implementation**
Unlike AMRs or AGVs, stationary robots operate in dedicated workstations and perform repetitive tasks with high precision and speed. These robots play a key role in automating cargo sorting, palletizing, and scanning, ensuring faster processing times and improved accuracy. They are also integrated into security screening, using AI-powered X-ray and image recognition systems to detect shipment anomalies. Stationary robotics improve cold chain logistics by providing consistent, climate-controlled handling of temperature-sensitive goods.	Despite their high efficiency and accuracy, challenges such as high setup costs, integration with existing systems, and lack of flexibility remain. AI, IoT, and advanced sensors are key enabling technologies that enhance the capabilities of stationary robotics. As adoption increases, these robots will become critical in high-volume cargo operations, reducing processing times and minimizing errors.

Collaborative Robots

Collaborative robots, or cobots, are designed to work alongside human operators using advanced sensors, AI, and safety features. They allow them to perform physically demanding and repetitive tasks while ensuring seamless human-robot interaction.	**Medium Impact**	**More than 10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
In air cargo, cobots assist with cargo sorting, stacking, and packaging, reducing strain on workers and improving accuracy in barcode scanning and quality control. They help handle delicate or irregularly shaped shipments and can be used in training and onboarding, demonstrating workflows to new employees. Cobots provide greater flexibility than fully autonomous systems, making them a practical solution for automating repetitive tasks while maintaining human oversight.	Integration challenges, workforce training, and initial investment costs can slow adoption despite their advantages. Successful implementation depends on AI-driven decision-making, IoT connectivity, and system compatibility with cargo workflows. As logistics automation advances, cobots are expected to play an increasing role in streamlining air cargo handling, reducing workplace injuries, and enhancing overall operational efficiency.

6.4 Sustainable operations

As the air cargo industry prioritizes efficiency and environmental responsibility, facility design is evolving to reduce energy consumption, emissions, and waste. Cargo hubs and warehouses integrate energy-efficient systems, on-site renewable energy, and sustainable materials to minimize carbon footprint while maintaining operational performance. While challenges such as high upfront costs and retrofitting complexities exist, these innovations are key to future-proofing air cargo operations, improving efficiency, and aligning with global sustainability goals.

Bio-based Materials

Bio-based materials, derived from renewable biological resources such as plant fibers, biopolymers, and agricultural waste, are becoming a sustainable alternative to conventional materials in air cargo.	**High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
These materials are used in packaging, cargo handling accessories (such as skids and straps), and facility infrastructure, reducing dependence on plastics and other non-renewable resources. Insulated bio-based packaging protects temperature-sensitive cargo, while bio-concrete, engineered wood, and bamboo are emerging as alternatives for warehouse construction, reducing the environmental impact of infrastructure projects.	While bio-based materials contribute to waste reduction and sustainability, challenges such as higher costs, material durability, and availability at scale remain. Their adoption depends on advancements in material science, regulatory acceptance, and integration with existing cargo handling systems. Companies already trialing bio-packaging for special cargo and exploring alternative materials for skids and ULD construction are paving the way for broader implementation.

Energy-efficient Infrastructure

Energy-efficient building design incorporates materials, technologies, and practices to minimize facility energy consumption. This includes insulation, optimized layouts, energy-efficient HVAC systems, and natural light.	**Very High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
Energy-efficient infrastructure is critical to reducing operational costs and environmental impact in air cargo facilities. By integrating advanced insulation, passive solar design, and high-efficiency HVAC systems, warehouses and cargo terminals can minimize energy consumption while maintaining optimal operating conditions. IoT-enabled smart building controls enhance efficiency by monitoring and adjusting lighting, heating, and cooling based on real-time demand.	Despite the benefits, retrofitting existing facilities can be costly, and long ROI periods may slow adoption. The success of energy-efficient infrastructure depends on the availability of green building materials, alignment with sustainability regulations, and industry-wide investment in climate-friendly initiatives. As more cargo operators commit to carbon reduction goals, energy-efficient building design is expected to become standard practice, making cargo hubs more sustainable, cost-effective, and environmentally responsible.

Energy Generation On-site

On-site energy generation refers to the local power production at air cargo facilities, mainly utilizing renewable sources like solar panels, wind turbines, or combined heat and power (CHP) systems.	**High Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
On-site energy generation allows cargo facilities to produce their own power, reducing dependence on external grids and increasing energy resilience. Solar panels, wind turbines, and combined heat and power (CHP) systems can supply energy for lighting, HVAC, and cargo-handling operations, lowering long-term energy costs and emissions. Energy storage systems ensure surplus energy is captured and used when needed, while electric vehicle (EV) charging stations support the transition to zero-emission ground operations.	Despite the promise of energy independence and sustainability, upfront costs, land availability, and infrastructure compatibility are key barriers. Local energy regulations and incentives influence the feasibility of these projects. However, as the industry moves toward carbon-neutral cargo operations, on-site energy generation will become integral to sustainable air cargo hubs, helping reduce operational emissions and energy costs over the long term

Advanced Packaging Solutions

Next-generation packaging uses innovative materials, designs, and technologies to improve cargo protection, sustainability, and efficiency.	**High Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
Reusable containers and biodegradable packaging reduce single-use waste. Smart packaging with embedded sensors provides real-time condition monitoring for temperature-sensitive shipments. Lightweight materials further reduce fuel consumption by reducing cargo weight, enhancing both cost-efficiency and environmental impact.	While sustainable packaging solutions offer clear benefits, higher costs, supply chain readiness, and regulatory acceptance remain challenges. Widespread adoption depends on standardization efforts, collaboration with material suppliers, and investments in circular economy practices. As customer demand for eco-friendly logistics grows, cargo operators that embrace smart, lightweight, and reusable packaging will gain a competitive edge.

Zero Emission Vehicles

Zero-emission vehicles (ZEVs) generate no tailpipe emissions, lessening transportation's environmental impact. Usually, these vehicles run on electric batteries or hydrogen fuel cells.	**Very High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
ZEVs are replacing diesel-powered ground support equipment (GSE), forklifts, pallet movers, and last-mile delivery trucks, contributing to a lower-emission logistics ecosystem. Electrified refrigerated vehicles also provide a sustainable solution for cold chain transport, ensuring temperature-sensitive cargo remains protected while reducing carbon footprints.	Despite their potential, ZEV adoption faces challenges such as charging infrastructure, vehicle range limitations, and higher upfront costs. Government incentives and industry commitments to carbon-neutral operations are accelerating investment, but full-scale deployment requires improved battery technology, hydrogen fuel infrastructure, and integration with smart energy grids. ZEVs will play a major role in decarbonizing ground operations, making air cargo logistics cleaner, quieter, and more sustainable.

6.5 Visibility & Transparency

Real-time visibility and seamless data exchange are essential for air cargo operations, ensuring that shipments, assets, and infrastructure are constantly monitored and optimized. IoT, RFID, real-time transportation visibility platforms (RTTVPs), and smart labels provide actionable insights that enhance tracking accuracy, operational efficiency, and security. These solutions enable cargo operators to proactively manage disruptions, ensure compliance, and improve customer transparency, reducing delays and enhancing service reliability.

Connected Devices

The Internet of Things (IoT) involves connecting physical devices embedded with sensors and processing abilities to the Internet, enabling them to collect and share data.	**Very High Impact**	**Less than 5 years for mainstream adoption**
Transformative impact on air cargo	**Considerations for implementation**	
IoT is transforming air cargo by enabling real-time tracking, monitoring, and automation through connected sensors and devices. IoT-equipped cargo shipments can transmit temperature, humidity, location, and security status, ensuring greater visibility and compliance for sensitive goods. IoT supports predictive maintenance by identifying potential failures in advance, reducing equipment downtime. It also enhances fleet and asset management, optimizing vehicle routes and warehouse workflows while improving security monitoring through tamper detection and automated alerts. It assists with tool tracking for maintenance and tracks the movement of shipments within the warehouse.	Despite its high potential, IoT adoption requires significant investment in connectivity infrastructure, data integration, and cybersecurity to ensure seamless operation. Successful implementation depends on interoperability with existing tracking systems, cloud computing, and artificial intelligence. In order to address device approval constraints, IATA has developed a validation program to streamline the process. As IoT technology evolves, its role in enhancing transparency, efficiency, and risk management across air cargo operations will continue to grow.	

Radio Frequency Identification (RFID)

RFID employs electromagnetic fields to identify and track tags attached to objects automatically. An RFID system includes small radio transponders known as tags, along with a radio receiver and a transmitter.	**High Impact**	**Less than 5 years for mainstream adoption**
Transformative impact on air cargo	**Considerations for implementation**	
RFID is used in inventory management, asset tracking, and security monitoring, offering a cost-effective solution for automated cargo identification. RFID tags embedded in shipments, ULDs, and equipment allow cargo to be scanned and tracked through facilities without manual intervention, reducing errors and improving efficiency. RFID also enhances security monitoring, detecting shipments' unauthorized movement and ensuring cargo handling compliance.	While RFID excels in controlled environments, its effectiveness is limited once cargo leaves RFID-enabled zones. Successful adoption depends on investment in infrastructure, such as RFID readers and network integration, and ensuring interoperability with broader tracking platforms. As the demand for real-time visibility and automation increases, RFID remains a key tool in modernizing cargo operations, especially when combined with IoT and smart label technologies.	

Real-Time Transportation Visibility Platforms

RTTVPs leverage GPS, IoT sensors, RFID, AI, and cloud-based systems to give stakeholders actionable insights into shipment status, location, and condition and enable them to respond to disruptions and optimize operations within and outside the facility.	**Very High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
RTTVPs provide real-time tracking and predictive insights, helping air cargo operators monitor shipments, cargo conditions, and disruptions. They offer end-to-end visibility by combining GPS, IoT sensors, RFID, AI, and cloud-based systems, enabling proactive issue resolution and real-time risk management. Operators can track cargo movement within facilities, monitor temperature and humidity for sensitive shipments, and respond quickly to delays caused by traffic, weather, or operational disruptions.	Adopting RTTVPs is growing, but challenges remain, including integration with legacy systems, standardization across stakeholders, and ensuring reliable data accuracy. As AI and cloud computing advance, RTTVPs will continue to play a critical role in improving operational efficiency, customer transparency, and regulatory compliance in air cargo logistics.

Smart Labels

Smart labels are technology-enabled tags that combine traditional labeling (text, images, barcodes, QR codes) with embedded sensors, RFID, or IoT features.	**High Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
Smart labels offer a cost-effective, scalable solution for real-time cargo tracking and condition monitoring. Unlike traditional labels, smart labels integrate barcodes, QR codes, RFID, and IoT sensors, transforming them into active tracking devices. These labels provide live updates on shipment location, environmental conditions, and security status, ensuring greater visibility across the supply chain.	Smart labels are gaining traction as a more affordable alternative to RFID and IoT tracking for cargo monitoring. Widespread adoption depends on standardization, durability, and seamless integration with digital tracking platforms. As sensor technology improves, smart labels are expected to play a key role in enhancing shipment visibility, ensuring cargo integrity, and supporting security monitoring.

6.6 Digital Process Automation & Integration

As air cargo operations grow more complex, automation and system integration are essential to improving efficiency, accuracy, and customer experience. Advanced Self-Service Solutions, API Technology, and Robotic Process Automation (RPA) enable cargo operators to streamline administrative processes, enhance real-time data exchange, and reduce manual intervention. These solutions allow faster processing, better resource management, and improved service transparency, helping the industry adapt to increasing demand and regulatory requirements.

Advanced Self-Service Technologies

Advanced self-service technologies are automated systems and tools that allow users to independently perform tasks with minimal or no assistance.	**High Impact**	**5-10 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
Automated kiosks, online portals, and mobile applications provide a more efficient and customer-friendly approach to booking, drop-off and pick-up, document scanning and submission, and payment processing. Self-service solutions improve cargo drop-off and pickup, enable customers to book cargo space and track shipments online and allow drivers to check in, navigate facilities, and receive real-time updates via mobile apps. By automating routine interactions, these technologies reduce waiting times, minimize paperwork, and enhance operational efficiency.	Despite their advantages, challenges include integration with existing systems, cybersecurity concerns, and the need for workforce training. As digitalization accelerates, self-service technologies will continue to improve speed, reduce costs, and enhance user experience.

API Technology

APIs (Application Programming Interfaces) are the backbone of digital integration, enabling different software systems to communicate and share data in real-time.	**Very High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	Considerations for implementation
APIs streamline booking and scheduling, real-time tracking, customs data exchange, and capacity management, ensuring seamless collaboration between freight forwarders, airlines, cargo handlers, and regulatory authorities. APIs link cargo management platforms, IoT sensors, and operational workflows to provide live updates on shipment status, automate documentation processes, and enhance decision-making.	Their effectiveness depends on data standardization, cybersecurity, and compatibility with legacy systems. As air cargo increasingly adopts cloud-based infrastructure and AI-powered analytics, APIs will be crucial in enhancing visibility, automation, and system interoperability across the supply chain.

Robotic Process Automation

Robotic Process Automation (RPA) is a software-based automation technology streamlining air cargo operations' data entry, documentation, and workflow processes.	**High Impact**	**Less than 5 years for mainstream adoption**

Transformative impact on air cargo	**Considerations for implementation**
Unlike physical robots, RPA operates on digital platforms, automating repetitive administrative tasks such as booking management, invoicing, customs declarations, and compliance checks. RPA minimizes errors, speeds up processing times, and enhances operational efficiency by reducing human intervention. It integrates with existing cargo management systems, helping airlines, freight forwarders, and ground handlers optimize workflows. AI-powered RPA enables intelligent decision-making, flagging anomalies in shipment data or optimizing cargo capacity planning.	Despite its benefits, integration complexity, workforce adaptation, and cybersecurity concerns pose challenges to adoption. As cloud computing and AI technologies evolve, RPA is set to become a key driver of digital transformation in air cargo, enhancing back-office efficiency and customer experience.

7. Conclusion

The air cargo industry is entering a new era, fueled by rising trade volumes, uncertainty, evolving customer expectations, and growing demand for efficiency and sustainability. Facilities that once relied on manual processes and outdated infrastructure need now to accelerate their transformation to meet these changing demands.

The emerging technologies outlined in this white paper are key to this evolution. These advancements will improve operational performance, enhance transparency, and reduce the industry's environmental footprint. Yet successful adoption of these technologies requires overcoming significant hurdles, including legacy infrastructure constraints, workforce adaptation, integration complexities, and regulatory compliance.

Cargo stakeholders must strategically address these challenges through proactive investments, workforce training, and collaborative industry-wide standards. By doing so, air cargo facilities will become smarter, more automated, adaptable, and aligned with global sustainability goals. The industry's future resilience and competitiveness depend on making these strategic decisions, ensuring cargo operations are prepared for the future.

8. IATA's Initiatives

Operational Efficiency

ONE Source
IATA ONE Source is the industry platform for validated aviation capability and infrastructure information. Find the right business partner for your needs, from specific infrastructure requirements such as temperature-controlled rooms to IATA certifications (CEIV Pharma, Live Animals, Fresh and Lithium Batteries, SFOC, ISAGO, IEnvA).

Smart Facility Operational Capacity Certification
The Smart Facility Operational Capacity (SFOC) Audit assesses cargo handling facilities' equipment, infrastructure, and procedures against IATA's cargo handling standards. SFOC validates the facility's compliance and creates transparency to business partners and customers, reducing the audit scope and frequency applied by airlines.

Audit Reduction Commitment
The Audit Reduction Commitment (ARC) is a binding airline commitment that specifies the audit reduction in facility handling. The ARC lists the exact audit scope and/or frequency reduction a specific airline applies to all SFOC-certified cargo handling facilities.

Framework for Operational Efficiency
Improving speed on the ground through smart regulations, efficient operations, and modern technologies. The framework aims to reduce unnecessary stationary cargo pre & post flight, and create visibility on the reasons for these temporary events. The IATA Cargo Handling Manual (ICHM) defines cargo handling standards for air cargo stakeholders to ensure that cargo operations are accomplished safely, efficiently, and consistently.

Certifications of Excellence
Delivering certifications through the Center of Excellence for Independent Validators (CEIV) programs in Live Animals, Pharmaceuticals, and Fresh and Lithium Batteries to achieve transportation and handling excellence and meet safety obligations.

LAR Verify
LAR Verify is an automated compliance solution for live animal shipments, streamlining planning, booking, acceptance, and handling. It provides real-time access to IATA Live Animals Regulations (LAR), including state and operator variations, container requirements, and documentation standards.

Digitalization

Interactive Cargo
Interactive Cargo develops and maintains the relevant standards, guidelines, and solutions to standardize and streamline device approvals and distribution of shipment data in the air cargo transport chain.

ONE Record
ONE Record develops the relevant standards and guidelines for using data sharing technology (with a standard API, industry data model, and common security solutions) for digitalizing all transport and logistics by air and providing end-to-end data access and visibility to all stakeholders in the air cargo supply chain.

Modernizing Cargo Distribution
The Modernizing Cargo Distribution working group, in collaboration with the ONE Record initiative, has brought together over 30 different stakeholders, all working towards a unified goal. The primary objective of this collaboration is to establish a common and standardized approach to cargo distribution within the industry. These efforts are designed to streamline operations and enhance efficiency across the cargo distribution industry. Please refer to the Air Cargo Distribution, Current Trends and Prospects White Paper to learn more.

Data

WCO Measurement and Analysis
Big data, analysis of work currently undertaken by international bodies, research, and analysis of various e-commerce business models, measuring e-commerce flows and economic benefits, capacity building, awareness, and education.

Cargo iQ
Cargo iQ supports the planning, recording service promise, monitoring execution and measurement of each AWB. The Cargo iQ Routemap is generated based on the process steps contained in the Master Operating Plan. This Routemap data provides the possibility to monitor shipments proactively and intervene to avoid delays or process deviations. Airlines, Ground Handlers, and Forwarders use the Routemap information to demonstrate data quality and performance towards their customers, ultimately leading up to the shipper. This data is also used to optimize station performance and drive network optimizations.

IATA Innovation Hub
Stay ahead with the latest data, technology, and cybersecurity developments, and explore how you can drive meaningful change in the aviation industry through the IATA Innovation Hub. Discover advancements in digital identity, AI-driven analytics, multi-cloud strategies, and cutting-edge cybersecurity innovations that enhance efficiency, resilience, and trust.

Safety & Security

Mail Safety Guidelines
Implementing Mail Safety Guidelines developed by IATA and the Universal Postal Union for airlines and posts to ensure that dangerous goods and prohibited items are not accepted in airmail, except as permitted by the Regulations.

Secure Supply Chain Programs
Supporting the adoption and implementation of secure supply chain programs across the globe (e.g., Known Consignor, Regulated Agent, and AEO validation programs) to facilitate and simplify the acceptance, carriage, and delivery of air cargo shipments, aligning security and safety risk assessment requirements, ensuring a secure, safe and efficient transport of goods.

Border Procedures

Advanced Cargo and Mail Information
Developing and implementing flexible solutions for pre-departure and pre-arrival risk assessments by customs for cargo and mail to facilitate compliance with regulatory requirements, support security and safety, and reduce delivery times.

Border Efficiency
Lobbying governments and national customs to collaborate in border efficiency to allow for faster clearance and delivery of air cargo, including e-commerce goods.

Sustainability

Waste Reduction
IATA is actively collaborating with the industry to minimize cargo loss and waste through various initiatives. The Guidance on Perishable Loss Reduction in Air Cargo outlines strategies to address challenges such as damages and delays, thereby enhancing transit operations. IATA's Single-Use Plastic Products Reduction in Air Cargo guidance highlights the importance of minimizing plastic sheeting and stretch wrap in cargo operations. Finally, their Guidance on Sustainable Management of IoT Cargo Devices offers detailed information on the proper end-of-life management of these devices, aiming to support manufacturers and stakeholders in implementing sustainable practices.

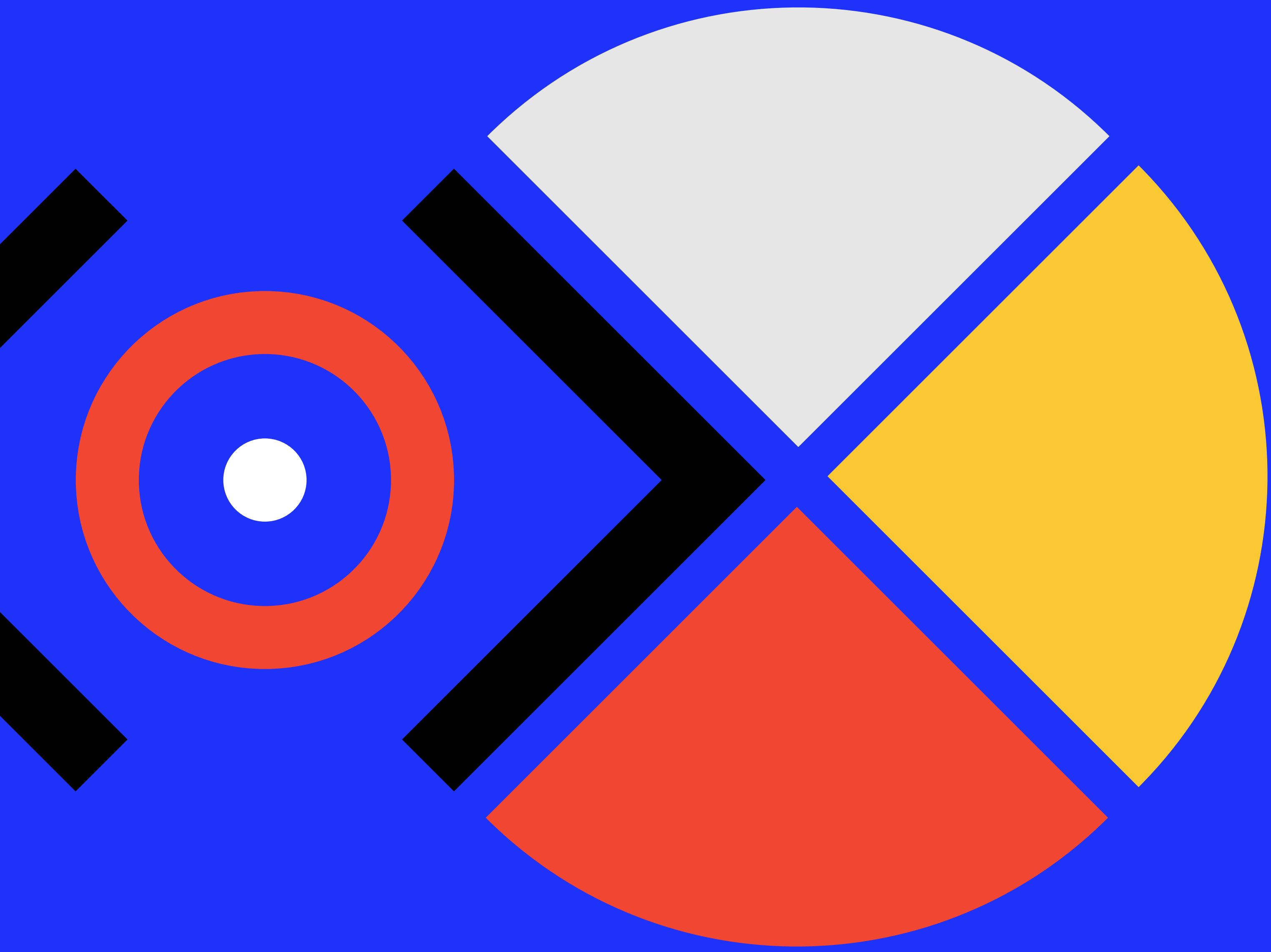
Integrated Sustainability Programs (ISP)
The IATA Integrated Sustainability Programs (ISP) are a set of four certification programs developed to support organizations at varying points in their sustainability journeys to address & improve their products, services, and operations: ISP Environmental Assessment (IEnvA), ISP Sustainable Procurement, ISP Social Responsibility, and ISP Sustainability Performance. ISP independently assesses the commitment of aviation stakeholders to continuously improve their sustainability performance in these topics.

IATA CO2 Connect for Cargo
As critical stakeholders in the industry's effort to achieve net zero carbon emissions by 2050, shippers, freight forwarders, and solution providers across the air cargo industry need accurate CO2 emissions data to ensure better decision-making and reporting compliance. IATA CO2 Connect for Cargo calculates per-shipment CO2 emissions using primary data from airlines and is based on industry-approved recommended practices. The solution provides a highly accurate value of per-shipment CO2 emissions by airline and aircraft type.

Other IATA programs

Consulting Activities
IATA Consulting can help you optimize safety and security, improve customer service, reduce costs, increase profitability, plan better, and give employees the training they need. Our tailor-made solutions can benefit the entire supply chain.

Cargo and Logistics Training
IATA offers the industry's most dynamic and innovative training solutions for every aspect of the supply chain, including strategy, business planning and development, management and optimization, business intelligence, operations and handling. IATA Cargo and Logistics training has an unparalleled track record in helping thousands of air cargo professionals stay at the top of their game.



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