SASI WORLD

THE LATEST DEVELOPMENTS

IN AIR CARGO AND AIRPORT SECURITY

2023

By Doug Brittin, Vice President, SASI World

Doug Brittin is a Vice President with SASI World specializing in air cargo security, based in Denver, Colorado. He has nearly four decades of senior management experience in air cargo and security, including having served as Vice President of Marketing at Emery Worldwide and Panalpina. He was appointed as Secretary General of the International Air Cargo Association (TIACA) from 2013-2017, Prior to that he was Director of the Air Cargo Division of the US Transportation Security Administration (TSA), where he was responsible for TSA's global air cargo security programs, and worked closely with international regulatory bodies such as the European Union and ICAO member states on harmonization

SYNOPSIS
Overview

The purpose of this white paper is to provide a comprehensive overview of the latest developments in air cargo security at airports, covering evolving regulatory requirements, security processes and technologies: It is meant for an audience of airport practitioners, but can serve as a reference for other air cargo stakeholders as well, including airlines, cargo handlers, forwarders and other enterprises involved in the end-to-end air cargo supply chain.

While the focus of this paper is primarily on US airports, it also references international approaches and initiatives to harmonize cargo security practices across borders.

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Why it is Important

Air cargo may have an impact on virtually any area of airport operations: Even though cargo is primarily handled in a specific "secured" area, cargo may actually be found on many other operational areas. Since most passenger air carriers carry some cargo or mail in their belly compartments irrespective of aircraft size, this means that cargo to be flown can be found on ramp areas between the cargo handing facility and passenger gates, and in various configurations surrounding an aircraft in preparation for loading at the gates. Since many other non-cargo operations also take place at these locations (e.g. catering, maintenance, fuelling, baggage), there is an opportunity for access to secured/screened cargo by individuals who are not specifically trained in the unique security requirements for cargo and mail.

Thus, it is important for airport management and operations personnel to be aware of possible vulnerabilities at any of these operational locations: It is imperative that no opportunity exists for potential tampering with cargo and mail, such as the insertion of contraband, or potential explosive devices. Although there is a proper Chain-of-Custody (CofC) from the cargo acceptance and screening facility, which is the responsibility of the carrier/operator, airport personnel must participate in the overall process to ensure there are no weaknesses in the process, given the wide range of non-cargo personnel with possible access to cargo. As with baggage, fuelling and other planeside operations, cargo on the ramp moves in a rapid-paced environment, and a watchful eye and awareness can help mitigate or prevent a possible insider

threat to aviation.

It should be noted that not all cargo is alike: Depending on the size of the aircraft involved in transport, or the type of airport (domestic feeder vs. international hub), cargo may comprise items such as: Diplomatic Pouches, Human Remains, Hazardous Materials, Disaster Relief Materials, US Mail or other items that may require special handling. Airport personnel need to be aware of how these items must be handled, and understand who to contact (fire, police, FBI, etc.) in case of an unwanted or suspicious incident.

On and off-airport, there are many participants in the air cargo supply chain, each with a separate set of regulatory responsibilities, yet many of those responsibilities overlap.
Shippers/Consignors (or those that actually originate an air cargo shipment, such as an e-retail distributor, manufacturer or warehouse operator) typically have little if any responsibility or awareness of air cargo security requirements, other than properly describing and labelling Dangerous Goods/HazMat shipments. Most shippers therefore utilize the services of an intermediate provider, such as a Freight Forwarder ("Indirect Air Carrier" or "IAC" in TSA language, or "Regulated Agent" in most other countries) or a 3rd Party Logistics (3PL) provider to perform pickup of the shipment, transport to the airport, customs requirements, or other services. These forwarders or 3PLs will then select and tender cargo to an air operator (passenger or all-cargo) for transport. Some larger companies, such as

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e-retailers, may however work directly with an all-cargo small package carrier (e. g. an integrator) that performs all of the above-listed functions, including air transport.

While IACs are also regulated by the TSA for a wide range of security-related functions, typically, only a small number of them are actually engaged in providing air cargo screening services prior to tendering shipments to carriers. Most will leave that responsibility to the ultimately required party, which is the air carrier itself. However, as many air operators have opted to outsource these functions to a ground handing Agent (GHA), as noted earlier, the GHA must then follow each carrier's TSA functions for screening and security, either on or off-airport.

The US Transportation Security Administration (TSA) regulates the various carrier segments, as well as the IACs, separately, and they cannot share their security programs with each other. Recently the TSA issued a new program purely for screening procedures. This now standardizes the language, processes, training and documentation for screening utilizing: physical search, ETD, EMD and X-ray across all of the air carrier, freight forwarder and certified shipper security programs. This program is referred to as the SSPAC (Standard Security Program for Air Cargo).

Therefore, the airport operator should be aware of these distinctions, and become familiar with the security personnel for any and all carriers, GHAs, freight forwarders, and 3PLs located on and adjacent to the airport facility and maintain a current list of contacts readily available in case if an incident.

It is also important for airport personnel to be aware of the general air cargo environment so that they can prepare for and be flexible enough to facilitate change: As an example, when TSA mandated 100% screening of cargo, carriers and GHAs had to install new technology (X-ray, etc.), which can require a larger footprint than baggage screening equipment, and needed more space within facilities to accommodate this, or more space on the ramp to hold screened cargo separately as required. A strong awareness of the air cargo environment and its requirements also enable an airport to property plan for future growth, or the ability to attract new business opportunities.

It is also essential for airport personnel to have all of the proper TSA contact information, starting with the local Federal Security Director (FSD), so that emergencies or other incidents can be addressed quickly and effectively, minimizing any impact on airport operations.

I. INTRODUCTION
A. DEFINITION AND BACKGROUND

Air cargo is a key element in airport operations and is also an important revenue (and profit) driver for passenger carriers as well as for all-cargo (freighter) operators. Along with increasing regulatory demands for the security and screening of air cargo, technology and other measures with which to accomplish this task continue to evolve. So too do the physical and record-keeping requirements to ensure compliance with ever-changing global and federal regulations related to air cargo.

Airports, along with their air carriers (passenger as well as freighter) and airport cargo ground handling companies all bear responsibility for various aspects of cargo security and must have a clear set of standard guidelines and protocols to be effective as well as efficient in this area.

Airport security practices for cargo follow the International Civil Aviation Organization's (ICAO) Standards and Recommended Practices (SARPs), which are recommendation, not direct regulations. Each ICAO member state will establish its own specific sets of airport and air carrier security regulations based on its individual requirements, aligning as closely to the SARPs as possible. As a result, not all states' security programs align with those created by others, which can lead to duplication of effort, and operational complications.

While this paper primarily focuses on airport security measures within the United States (US), it is important to note that global regulatory bodies, such as the TSA in the US, work closely with their counterparts in other countries (such as Transport Canada, The UK Department for Transport, the European Union, and many others), to harmonize their respective programs to the greatest degree possible. As a result, security approaches from one country to another are well-coordinated with each other. Therefore, while there may be some differences in detail, the security approaches, technologies and requirements set forth in this paper are largely applicable to non-US operations as well.

Furthermore, many of the developments in air cargo security processes, procedures and technologies that are noted in this paper have international implications. An example: the recent development of digital corridors to enhance the flow of air cargo documentation cross-border, and enhance the reliability of information about consignments and their chain-of-custody.

In 2005 the United Nations' Centre for Trade Facilitation and Electronic Business (UN/CEFACT) issued UN Recommendation 33 which focused on the creation of single windows for entry of air cargo information, and the digitalization of cross-border multimodal freight flows. The majority of member countries of the United Nations have adopted this recommendation. Since then, UN/CEFACT has sponsored research to assist in the achievement of this goal.

It is also essential for airport personnel to have all of the proper TSA contact information, starting with the local Federal Security Director (FSD), so that emergencies or other incidents can be addressed quickly and effectively, minimizing any impact on airport operations.

The volume of air cargo required to be screened must be considered: While all US domestic and export cargo shipments transported on passenger aircraft have been required to be screened since 2010, as of July 2021 the TSA requires 100% of all export cargo transported on all-cargo (freighter) aircraft to be screened to the same standards as those mandated for cargo transported on passenger aircraft.

Regulations, requirements, and guidelines: For operations and cargo security purposes, airports and air carriers are directly regulated by the TSA. Ground handlers are not directly regulated, but rather operate as the Authorized Representatives or Agents of Air Carriers. They must follow the provisions of the Air Carrier security programs issued by the TSA. These Standard Security Programs (SSPs) are considered to be Sensitive Security Information (SSI) and must be properly protected and are not shared with any other regulated or unregulated party. These measures refer strictly to air cargo security and screening.

Other local or Federal programs may be in force, such as those issued for US Customs and Border Protection (CBP), US Drug Enforcement Agency (DEA), Bureau of Alcohol, Tobacco, and Firearms (ATF), or specific provisions for the handling of Dangerous Goods/Hazardous Materials, or for Mail. While US Mail is considered to be cargo for screening purposes, separate guidelines and requirements for its handling are under the auspices of the US Postal Service (USPS) and US Postal Inspection Service (USPIS).

Each regulated airport is issued an Airport Security Program (ASP), which is unique to the physical layout and properties of that airport. Thus, an ASP for Chicago O'Hare (ORD) will have many similar, standard provisions to the ASP for

Pueblo, Colorado (PUB), but each will also have its own individualized measures.

The carriers operating at any airport also have separate security programs. These are as follows:

- US based passenger air carriers: Aircraft Cargo Operator Standard Security Program (AOSSP)
- US based all-cargo carriers: Full All Cargo Aircraft Operator Standard Security Program (FACAOSSP)
- Foreign based passenger air carriers: Model Security Program (MSP)
- Foreign based all-cargo carriers: Air Carrier International Security Program (ACISP)
- 12/5 Standard Security Program

B. PRIMARY AREAS OF CONSIDERATION FOR AIR CARGO SECURITY AT AIRPORTS

For air cargo security at airports, there are four primary areas of consideration. These include airport perimeter security, aircraft protection and security, air cargo screening and security, and personnel access/security. Of these, it is the responsibility of the airport to provide perimeter security and certain elements of aircraft and personnel security. The aircraft operator is responsible for air cargo screening and security, and certain elements of aircraft and personnel security.

Airport Perimeter Security
Details of the requirements for airport perimeter security are to be found within the ASP. These may include, but are not limited to, areas such as; fencing type/height; gate access controls/checkpoints; CCTV; personnel access, patrols, or other topics. For the airport, all property inside of the perimeter is considered to within the Aircraft Operating Area (AOA) and therefore must be secured at a higher

level than any airport property which might exist outside of the perimeter. Airport property outside of the secured perimeter is considered to be the "public" or "landside" area. Cargo facilities located on airport property therefore may have both AOA and public facing access, and thus must be secured accordingly. These provisions are also set forth in the ASP.

Personnel Security
Airports have the responsibility to conduct employee background checks and issue the appropriate badges for any airport or private persons/individuals who will have access to the AOA. This badge is known as a Secured Identification Display Area (SIDA) badge. A SIDA badge allows its wearer to access secure parts of the airport, including cargo areas within the AOA.   The screening process is thorough and includes fingerprinting. The airport performs this task in accordance with the procedures listed within the AOS, and typically coordinates with the TSA, and charges a fee to the individual or company making the request for such access or provides this action for its own employees with ramp access. SIDA badges are specific to each airport, and not transferrable.

   Industry (e.g., non-airport personnel) who will have access to the AOA must first have a SIDA badge. They must also have a Security Threat Assessment (STA) background check, which is performed by the TSA via the individual's employer, which allows them access to the public side of any on-airport cargo facility. In addition, their actual access to the AOA is also tightly controlled. However, these latter two personnel security functions are the responsibility of the company or operator, under the appropriate SSP. It should be noted here that in certain airports, freight forwarders, that are also regulated by the TSA (known as Indirect

Air Carriers, or IACs), may have an on-airport facility with both a public and AOA side. The same provisions noted here are contained within their SSP, which remains separate from the carrier SSPs listed above.

   Ground handlers (GHAs) that perform various functions for carriers (including but not limited to: cargo acceptance, documentation, cargo screening and containerization, etc.) may also have similar facilities. The distinction here is that GHAs are NOT directly regulated by the TSA, but instead, acting as Authorized Representatives (AR) or Agents of the carriers, must comply with the carrier's SSPs as a subcontractor. It should be noted that there may be multiple GHAs performing tasks for any given carrier (e.g., one GHA may accept and screen cargo, while another acts as a ramp agent, transporting the screened cargo from the public/AOA GHA facility directly to the aircraft for loading).

   Although the carrier security programs under which a GHA operates are essentially the same, each carrier may require its own unique procedures, and typically provides its own training. Therefore, it is not unusual for a GHA handling multiple carriers within a single facility to apply different procedures for each carrier, which can add to complication and cost.

Aircraft Security
   General provisions and requirements for the security of an all-cargo aircraft, or a passenger aircraft which also transports cargo (typically in the belly compartments) are listed within the ASP. However, both all-cargo and passenger aircraft operators have specific provisions within their SSPs for securing inactive/parked aircraft, and for proper inspections prior to loading any cargo onboard.

   Because cargo transported on passenger

aircraft is physically loaded at passenger gates, while shipments loaded onto freighter aircraft are loaded at other AOA ramp areas, there are typically separate operating and security procedures for each mode. These may vary by airport and the size of operations dedicated to cargo.

Air Cargo Screening

The airport itself is not required to screen air cargo. The specific provisions for screening cargo, both for passenger and all-cargo operators, resides with them, contained within their respective SSPs. In some smaller airports, where Over-the Counter (OTC) or other small cargo shipments are accepted, the screening may be performed by the TSA at the baggage screening area.

a. How Things are Changing in Air Cargo Security

The Role and Nature of Air Cargo

Air cargo has played an essential role in regional commerce since the earliest days of aviation. With the advent of the jet age volumes have grown dramatically, and while never approaching the volume of surface transport (land or ocean), air cargo has played an increasingly important role in the global supply chain.

As reported by the International Air Transport Association (IATA), airlines transport over 52 million metric tons of goods a year, representing more than 35% of global trade by value but less than 1% of world trade by volume. That is equivalent to $6.8 trillion worth of goods annually, or $18.6 billion worth of goods every day.

Air Cargo transports virtually all commodities, with the exception of bulk products. The highest value goods make up the vast majority of shipments. These include products such as: high-technology items, pharmaceuticals,

perishable food products, oil and gas equipment, automotive and machine parts, emergency supplies and artwork, as well as animals and athletic equipment. Historically, mail (letters/documents as well as parcels and packages) was a base commodity, with the latter increasing as the former decreases. This is in large part due to the rapid increase in individual shipments moving in the "e-commerce" area. In remote areas, more mundane products such as household goods and supplies now rely on air cargo.

IATA notes that most personal electronic devices are were built using a global supply chain linked by air. E-commerce websites rely on the express delivery services made possible by aviation to get those devices, and so much more, to their customers. Almost 340 billion letters and 6.7 billion postal parcels are sent every year, and air transport plays an essential role in their delivery."

While most products are of an inert nature, a fair percentage is deemed to be Dangerous Goods. These goods have either major restrictions limiting them to freighter aircraft only, or the requirement of special handling procedures.

Air Cargo Transportation Models

Air cargo is transported in a variety of different models that present various security challenges. These three basic models include:

- Passenger aircraft in both single aisle and wide-bodied aircraft, where cargo is handled only below the passenger cabin (the "belly") similar to passenger baggage.
- Freighter aircraft.
   o Express carriers that operate large networks primarily dedicated to door-to-door small packages.
   o Cargo Operators that operate regularly scheduled service essentially as a wholesaler, doe larger shipments on an

airport-to airport.
• Freighter aircraft operators that operate primarily on a non-scheduled charter basis.

ULDs and pallets: In all of these models, cargo shipments are typically "containerized", but a significant number of larger shipments do not lend themselves to that configuration and are shipped "loose". On narrow body passenger aircraft, very few containerization opportunities exist. Within the industry, a wide range of cargo containers, known as Unit Load Devices (ULDs) are utilized, and are often specific to an aircraft type. These ULDs are further segregated into two types: solid wall containers, and flat metal units. The former, commonly referred to as "cans" or "pods", easily allow numerous smaller skids or pieces to be stacked within, while the latter, which are typically referred to as "pallets" or even "cookie sheets", require specific and proper civil aviation authority approved netting in order to secure the cargo configuration to the ULD.

In all cases, the ULD is rolled onto the aircraft, and then secured to the frame with locking pins to prevent moving and shifting during flight. Some ULDs can be used on multiple aircraft types, while others are only for specific aircraft types. For example, a ULD with a load capacity of 1,500 kilograms will fit within the belly of most wide-body aircraft, passenger, or freighter, but ULD pallets with a gross maximum weight   of up to 11,000 kilograms, designed for "upper deck" usage on a freighter, cannot be utilized in an aircraft belly, due both to the load bearing capacity of the airframe and the contour of the aircraft body.

Single packages vs. forwarder consolidations: While the configuration of air cargo is often commonly thought of as simply single packages, which are certainly prevalent in the business-to-consumer as well as the consumer-to-consumer shipping environment, the vast majority of shipments by weight that are transported globally are of the more traditional model. In this business-to-business model, it is not unusual for shipments to move via multiple ground handling partners prior to flight.

Shippers, such as manufacturing or distribution companies, will typically rely on the expertise of a freight forwarder to handle the door-to-door logistics for them. This is both for expedience and also due to the fact that, other than express carriers, most passenger and freighter operators prefer to handle cargo in a simple "airport-to-airport" manner, since air cargo is only an adjunct (but generally profitable) to their core business, and they strive to minimize operating costs. The freight forwarder in turn will "consolidate" shipments from its multiple customers, thereby benefiting from reduced bulk rates from the carriers they select.

Freight forwarders include major global, while many smaller niche companies offer specific solutions to their customers and serve unique products or markets. Globally there are thousands of such companies, including more than 6,000 in the USA alone. Adding to the complexity of air cargo security, most forwarders outsource various handling portions of their business, including containerization and ground transport used for shipment pickup, as well as transport to the carrier locations. As a result, it is far from a "closed loop" process, making security a difficult issue to manage.

Tracking and air waybills: For tracking as well as other purposes, express operators typically issue a shipment number to each individual shipment, irrespective of the number of pieces. Freight forwarders

will normally assign each shipment a House Air Waybill Number (HAWB), for consolidation onto the carrier's Master Air Waybill (MAWB). The MAWB is essentially a transport bill of lading showing all of the HAWBs but only certain details of the actual shipment contents. A MAWB may comprise a single or multiple HAWBs.

History of Air Cargo Security

Security of air cargo has always been a factor within the industry, given the historic value of cargo shipped and the relatively open environment in which it was transported. As evidenced by the theft of a major shipment of cash and jewellery from the Lufthansa cargo terminal at New York City's Lufthansa facility in 1978, the relatively simple security measures then in place were easily circumvented by insider knowledge. This event was related to security of the product itself, not a threat to aviation special protections and limitations of the transport of certain dangerous goods were in the domain of the various civil aviation authorities. Considering the current state of global security, it is hard to imagine an individual being able to walk up to a passenger airline cargo counter and tender a shipment, paying by cash, check or credit card, and showing identification only primarily as a means to validate the payment. This was fairly common throughout much of the world even into the 1990s.

In 1988, Pan Am flight 103 enroute from London to Detroit was destroyed over Lockerbie Scotland by the detonation of a bomb secreted in luggage, timed for detonation once the aircraft was in flight. In the aftermath aviation security from a regulatory perspective increased but was still primarily cantered on passengers and passenger aircraft, and understandably so. This targeted focus resulted in stronger security measures for airports and airlines, but as these changes were largely confined to the airport environment, the full air cargo supply chain was not significantly affected.

Industry recognized the need for enhanced measures to protect cargo, especially with the increased volumes of high value products moving globally in support of the technology boom. As a result, new security processes were developed and introduced with partners in the ground handling, cartage and forwarding sectors, but there was not great degree of commonality. Companies across the board also began conducting background checks on certain personnel, especially on employees with physical access to the cargo. These background checks, which in some cases included criminal as well as credit checks, varied in depth and scope, but were also limited by privacy and employment laws in some countries. Overall, the safety and security of the cargo itself remained mostly the responsibility of industry rather than any centralized national regulations. Not many followed Israel's El Al airlines early lead of placing transport holds on shipments or utilizing detailed physical inspections.

By the mid-to-late 1990s, especially in the wake of the TWA flight 800 disaster after its departure from New York City's JFK airport, where a baggage or possibly cargo -related explosion was at first suspected, the security of cargo from potential outside threats became a greater concern. Mindsets, even among regulators (who primarily remained under civil aviation directorates such as the Federal Aviation Administration (FAA) in the United States), were still focused mostly on protection of passengers and passenger aircraft. All-cargo/freighter operations remained largely in the background. The threat to either mode was still considered to be hijacking, but

more thought and emphasis was given to mitigating risk of explosive devices hidden in cargo.

Industry did begin to see a ramping upward of concerns about the shipping community itself. Regulators started paying more attention to this area and, in some countries, carriers (sometimes through their agents or even forwarders), were asked to begin identifying, physically visiting, validating and listing their shippers, through various types of programs. In many countries, more severe restrictions were placed on "over the counter" type shipments. At the same time industry began to receive more requirements to at least "inspect" shipments upon receipt by the carrier, requiring them to look for any suspicious or obvious evidence of tampering.

However, this "inspection" terminology was used and interpreted quite loosely, as actual cargo "screening" itself was not yet in the forefront of collective vocabularies. In fact, there was a high degree of conflicting language in many regulatory programs surrounding the proper definition of screening, ranging from simple data and manifest checks, to physically opening and searching shipments. Again, this was primarily focused on cargo moving in passenger bellies, not on freighters or express carriers. Mail shipments essentially remained just another commodity, with the widespread assumption that the Postal regulations in force took care of security for that particular stream.

Securing and Screening Air Cargo Issues regarding shipper identification: With global threats to aviation continuing to emerge, especially in the wake of 9/11, an increasing awareness grew from global regulators regarding the potential vulnerabilities in air cargo. This was mostly focused on the risks

of transporting air cargo on passenger aircraft, and less so for freighters. As noted earlier, one of the most basic challenges identified in the mid-1990s was the true identification of shippers, and the relative security (or lack thereof) during the transport of shipments prior to flight. Some states developed lists of acceptable shippers for transport on passenger aircraft only. Other states allowed airlines or forwarders to categorize and validate shipper locations.

The ICAO definitions of Known Consignor were modified and adapted to allow only shipments from this group of shippers to move via passenger aircraft. Other definitions such as Account Consignors were given to shippers in general, only allowing their cargo to be transported on cargo aircraft. The latter was especially useful with the millions of individual shippers that utilized the express networks, and also for parcel mail shipments. This distinction has led to further complications when Account Consignor shipments are later transferred to a passenger carrier for operational expedience, which happens frequently.

Securing cargo while in transport on the ground, and when handed off from one party to another in the air cargo supply chain: Further attention was given to developing methods to secure cargo while in transport on the ground; from shipper to forwarder; forwarder to ground handler; and handler to air carrier. This was designed to protect this vulnerability from outside interference. Secure methods of logging, inspecting and segregating cargo were developed and implemented into security programs, again increasing the involvement and role of freight forwarders as they became IACs or Regulated Agents. Additional concern also arose from regulators about potential "insider threats", and

measures were further put in place to require background checks, including criminal history and the use of terrorist watch lists available to governments, for all employees operating in the air cargo supply chain.

Air cargo screening: Until the early 2000s, screening of air cargo was minimal at best. While some carriers implemented extensive measures due to their own security needs, most only followed the basic requirement to "inspect" shipments and look for obvious signs of tampering. By some estimates, in the United States, up until the passage of the "Implementing the Recommendations of the 9/11 Commission Act in 2007", less than 10 percent of the cargo transported on passenger aircraft, domestically as well as export, was actually screened at all. The passage of that law required screening of 100 percent of cargo on passenger aircraft, to be implemented by 2010.

Actual cargo screening proved to be an even greater challenge. Many regulators unfamiliar with the industry were of the view that all cargo shipments looked like the express package they sent or received and could be relatively easily screened in a process similar to that used for baggage. While this was of course true for the majority of such express shipments, it was far from the reality of cargo transported in the bellies of passenger aircraft, or on freighters or charter operations. These shipments were typically much larger, comprised multiple pieces per individual shipment, and were typically already shrink-wrapped on skids or pallets, or fully containerized, prior to being tendered to the airline. Further complicating the equation was the multitude of odd or oddly-shaped commodities, such as drums of chemicals, pharmaceuticals, large machinery and other high value products, some of

which could not have any packaging compromised due to other health, safety or technical reasons.

Screening this cargo with processes akin to the measures applied to passenger baggage, was extremely impractical. Baggage moving on a conveyor belt, and of typically common size, is much more conducive to X-ray or other technologies. New regulations required cargo screening only on a level deemed commensurate with baggage screening, which of course meant at the individual piece level. More importantly, while all baggage is for the most part screened by Civil Aviation authorities, on airport property, cargo screening was mostly deemed to be the responsibility of the aviation industry itself.

Screening of cargo by industry at airports alone was not a supportable model for air cargo since it would entail airlines either refusing to accept consolidated cargo shipments and configurations, or charging fees to forwarders to break such configurations apart. Either option would add both cost and time (in addition to any actual fees to screen the shipments) and it became quickly apparent that the desires and goals of legislators and regulators were not readily transferrable to the operational and practical reality of the air cargo industry. Convincing regulators that baggage and cargo were more dissimilar than similar was not an easy task. Although industry fully understood the reasons and underlying need behind the new regulations, implementation was not easy.

As a result of these challenges, some states began to expand their regulatory authority to enable screening cargo further "upstream" from the airlines or airport. Forwarders and Regulated Agents, based on additional measures put in place, on a strictly voluntary basis, have been allowed to actually screen the cargo

prior to its consolidation and tender to the airline. In even more limited cases, shippers too have become voluntarily regulated, so that they can screen cargo within the packing and shipping process, thus avoiding damage to products and packaging later on. However, this is a very limited subset of the shipping community. In the US for example, fewer than 1,400 shipper locations are certified for this capability, out of millions of air cargo shippers. All of this also entailed additional, more secure methods of transport prior to air transport, and additional detailed regulations were put in place to cover acceptance and verification procedures.

The wide variety of programs and procedures, coupled with wide variations in the approval of screening technology, adds operational as well as capital cost to industry. A carrier (or forwarder for that matter) that operates globally must be compliant with the wide range of security programs for each country in which they operate and must train its employees for all of them. Recent initiatives among some State regulators to more effectively recognize and harmonize their respective programs have been helpful, but still remain a challenge.

Cargo Screening Technology and Procedures

As the requirements to screen cargo increased, regulators and industry also began to learn more about the capabilities as well as the limitations of technology, and what might be useful or even effective for the various types of cargo configurations and commodities. New technologies have emerged, moving well beyond the primitive decompression chambers which could not detect, but could likely detonate, any pressure sensitive/altimeter based explosive devices. The somewhat common earlier

conception of any explosive device (improvised or not) was along the lines of a TNT-based or plastic explosive, which might have anomalous wiring exposed, and/or a somewhat primitive timing or pressure sensitive detonation device. The process of "holding" cargo was also determined to be ineffective, and was eliminated in most security programs, as were compression chambers.

X-ray: X-ray equipment originally designed for baggage began to be used, but was primarily used for smaller packages and boxes, due to the limited aperture size of the units themselves. Of course, the units themselves were relatively primitive, single view, monochromatic technologies, and were not particularly fast. Training on the usage of the equipment, as well as image interpretation and resolution by the operators of the equipment, was a long process, with continual retraining required as well.

Physical search: Physical search of shipments was further expanded into the cargo environment, with procedures similar to those used to screen checked baggage. However, this was not only extremely labor intensive, but it was also particularly disruptive to product packaging and led to damage and claims issues from shippers and consignees. To date, while still considered valid and effective, it is seldom used except in locations with extremely small cargo volumes where equipment is not considered to be cost effective.

Limitations: As a result of these new and increasing screening requirements, technology began to improve, with new technologies introduced, such as multi-view , multi-color x-ray units, many of them with increased power to better penetrate dense cargo, and also with

bigger apertures through which larger shipments could fit. Even these newer technologies are limited however, as a ULD filled with multiple commodities is extremely difficult to view effectively and receive a clear image of the contents. Even X-ray screening of single commodities such as melons, or seafood packed in shaved ice cannot always be effectively cleared, due to the physical density. Screening larger configurations using x-ray, such as those on skids or in and ULDs is still prohibited in most security programs.

Explosive trace detection (ETD): Other technologies, such as explosive trace detection (ETD) units began to gain broad acceptance and were fairly widely adopted due to lower initial cost. ETD units are hand-held wands which can detect trace particle residue amounts of explosives. To be fully effective, the wand must be inserted into the actual detection unit after each "swipe". While also a time consuming method, requiring multiple swipes of boxes, (and appropriate supplies of swipe pads) they still provide a lower cost and more efficient method than physical inspection, even though some security programs require opening the boxes and obtaining internal samples.

Metal detectors: A more recent technology has been the use of powerful new metal detectors, which are effective since virtually all explosive devices will have some metal component, even if only in the triggering mechanism. They have been proven capable of detecting minuscule amounts of metal even in large cargo configurations, such as multiple boxes packed onto skids. These have been especially efficient in the effective screening of perishable products, such as fruits and vegetables, as well as pharmaceuticals. This has

led to the design of special packaging, including skids, to eliminate any metal content. They are in fact so sensitive to trace metals that many seemingly straightforward commodities such as printed materials, which are typically too dense to produce a clean X-ray image, cannot be screened using this technology, simply due to the minuscule amounts of metal in the ink.

Canines: The use of canines has also increased on a global basis, as they are the most effective method with which to screen pre-configured/consolidated cargo, as well as odd-shaped commodities such as machine parts, automotive engines or transmissions, and oil field equipment banded to skids. Canines are operated by trained and regulated handlers, either by government /Law Enforcement Officer (LEO) entities, or by private approved and TSA-regulated companies. Similar to drug-sniffing dogs, they are specifically trained to detect trace residuals from a wide range of known explosives. They are however limited by the number of hours they can be on duty and remain effective, and both the animals and their trainers require continual recurrent training.

   As with other forms of screening, this intense activity also comes with an operating cost. The private canine screening companies are regulated separately under the Certified Cargo Screening Program-Canine (CCSP-K9), which was implemented in 2018. Carriers, freight forwarders and (certified/regulated) shippers that wish to use canine screening, must first file for and receive an Amendment to their SSPs from the TSA in order to do so.

Testing and validating the effectiveness of screening equipment: The need to test and validate the effectiveness

of screening equipment is an ongoing issue. In most states that research is directed by the regulatory agencies and is a costly and time-consuming process for technology providers. The latter are often asked to design and develop prototype units, with no guarantee that it will be accepted by the regulators. Industry cannot utilize any equipment which has not met this approval process. Further complicating the issue is that, while some technology providers are global in scope, not all regulators accept the same types of equipment. Even if they do, they may require variations of the algorithms used within the software, negating the efficiencies of any larger scale production that might help reduce cost.

Screening Procedures and Technology in the United States

While technology for screening air cargo is widespread (in the United States comprising only TSA-approved: X-Ray; AT X-Ray; Explosive Trace Detection (ETD) and Electromagnetic Detection (ETD) equipment), canine (K-9) usage has now become increasingly common. In 2018 TSA authorized the usage of privately operated and trained K9 teams to screen cargo, both for passenger as well as freighter cargo configurations. TSA continues to evaluate new technologies, with input from air carriers, freight forwarders, ground handlers, airports and shippers as well as through Broad Agency Announcements (BAAs) seeking new concepts. Physical search, while not a primary screening method, must still be factored in as it is a required default screening method for certain commodities, or when "alarms" are detected using other methods. Each method dictates different space as well as time requirements.

The procedures for each of these screening methods are SSI, and are contained in the respective operator's SSP.

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II. GUIDANCE: EVOLVING STANDARDS AND REQUIREMENTS, NEW DEVELOPMENTS, TECHNOLOGIES, AND APPROACHES

Screening and Technology
While passenger baggage is screened by TSA personnel, air cargo screening remains the regulatory responsibility of the air carrier or its agent, or even its supply chain partners. The methods of screening are currently limited to:

- Physical search
- Explosive Trace Detection (ETD)
- Electromagnetic Detection (EMD)
- X Ray (and Advanced Technology, or AT x-ray)
- Canine (K9)

Each of these methods has its unique advantages, as well as some disadvantages. The details for each procedure are SSI and is contained in the respective SSPs. The objective of screening is the detection of any explosive device contained or hidden within the cargo. Cargo therefore must be screened to the same exacting standards as passenger carry on or checked baggage.

Physical search: This remains the most labour intensive and time consuming. Each carton or package within a cargo shipment must be opened, items removed and searched, and re-packaged. Thus, it is little used, but can be used to resolve any anomalies detected by other methods of screening. Space must be set aside to perform this function.

Explosive trace detection (ETD): This is still labour intensive, but less so than actual physical search. The screener uses a wand with disposable pads that can detect trace amounts of explosive residue and must wipe multiple areas of each package or box in a prescribed manner,

then insert the pads into the detection unit. In some environments, such as high heat or especially high humidity, this method may produce incorrect readings, resulting in items needing to be re-screened by other approved methods. Space must be set aside to perform this function. From a cost perspective, ETD units are the least expensive of the technological methods of cargo screening.

Electromagnetic detection (EMD): This method is relatively fast, as individual cargo pieces can be screened in a "conveyor belt" method. Operator training on this equipment is less extensive than ETD or X-ray, as the units will sound an alarm when any metal is detected in a piece or package. As a result, they are typically only used for certain commodities (such as perishable fresh food products) known to contain zero metal in the contents, or in the packaging itself. They require more space than physical search or ETD, as they must be relatively permanently mounted in the screening area and require an "input" and "output" collection area, as well as a dedicated power source running to the unit. There is a size limitation (portal) of what cargo configurations can be screened, but they can screen configurations containing multiple pieces or boxes, which results in further time savings. While costlier than ETD, they are typically less expensive than X-ray or AT X-ray.

X-ray/Advanced Technology (AT) X-ray: Units used for air cargo have some similarities to those used for baggage screening, but also have some unique features to make them pertinent to the cargo environment. Apertures can range

from small, carry-on baggage size to large openings capable of receiving cargo Unit Load Devices (ULDs) up to 65" in height, making them capable of screening cargo up to the maximum size that will fit in the belly holds of any current passenger aircraft. Operator training on each unit is extensive and costly. Units must be calibrated and tested on a set schedule. A large physical footprint is required, as well as a greater dedicated source of power. While providing a good deal of automation, they still require labour to load and unload, particularly when screening larger cargo configurations. As with EMD units, they can screen configurations containing multiple pieces or boxes. These are the costliest of all screening technologies, with some AT units costing well in excess of $600,000 USD.

K9: Cargo can be screened either by K9s operated by Local Law Enforcement (LEO) teams, or by privately operated 3rd party canine teams (3PK9). In both cases, the teams (handler and K9) are required to be trained to TSA K9 standards and are tested regularly. Many carriers/GHAs and IACs have adopted this method as it allows significant flexibility in screening a wide range of commodities and is the only TSA approved method by which to screen the larger ULD units and cargo configurations carried on the upper decks of freighter aircraft. Space requirements dedicated to this activity are needed but can be more flexible than the rigid needs of EMD and X-ray units.

When LEO teams are used, there is typically not a fee involved, but they are not usually readily available. 3PK9 teams can be contracted by the operator, usually at an hourly rate for set periods of activity, and multiple teams are often employed at any given cargo facility. While start-up and ongoing refresher training for each team can be significant, that is

usually built into the contracted rate. Due to their wide range of capability, especially with the larger cargo configurations, their effectiveness, speed and relatively lower cost than other technologies, they have rapidly become one of the most preferred methods of screening.
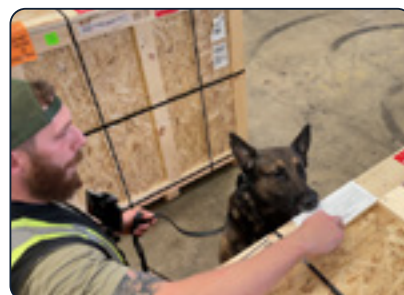

Explosive Trace Detection (ETD) equipment

X-ray screening equipment

Large aperture X-ray screening equipment

Canine cargo screening

Other Technology - Security
Other than for the screening of cargo, technology is often used for other security measures. Within cargo handling facilities, Closed Caption Television (CCTV) is frequently used (and in some instances required) to provide oversight of the cargo handling and screening areas as well as access points. This has evolved from fixed view/tape recording systems to multi/mobile view/digital recording systems. Under the carrier SSPs, records must be kept and made available to the TSA for specified lengths of time.

Similar systems are often a requirement of the airport operator's ASP, for perimeter security as well as at other points within the perimeter where cargo and mail are handled.

Other Technology - Compliance
The TSA sets specific requirements for record keeping on training and screening activity, as well as overall security (such as CCTV, etc.). Record keeping has been an extremely labour intensive requirement, but many operators have purchased or developed in-house programs to better manage this effort. For example, video capture can enable screeners and K9 teams to cross-file and store Air Waybill information for each item screened and be stored digitally. Similarly, some operators have developed centralized HR systems that can capture all employee training records and automate scheduling of recurring training requirements. In addition, some systems can automatically maintain the screening equipment calibration activity, for daily review by the appropriate managers, and send automated alerts when any information is "out of standard."

Other Technology – Airport Cargo Community Systems and Digital Data Corridors

Airport Cargo Community Systems (ACCSs) provide an electronic link between participants in the air cargo supply chain at individual airports – e.g., airlines, handlers, forwarders, beneficial cargo owners, trucking companies, Customs, other regulatory agencies and so forth -- providing increased information transparency as well as faster and more reliable transmittal of air cargo information and documentation. Such systems have been implemented at numerous airports in Asia and Europe and are starting to be launched at airports in North America.

The process of collecting shipment information within each ACCS is based on a 'blockchain' process. As each consignment moves through the supply chain from one partner to the next, the shipment information is updated in real-time. The highly encrypted ACCS platforms are a collection point of shipment information and status; information is entered only once and does not have to be re-entered repeatedly. The one-time entry of data in the ACCS eliminates data-entry errors, leads to a reduction of processing and transit delays, and creates a transparent environment.

Digital data corridors link ACCSs at two or more airports and facilitate the transfer of consignment information and status along the supply chain from the origin to the destination across a given trade lane. Such digital corridors are in place or in development linking airports in North America, India, and Europe.

In a digital corridor, the information of each shipment is collected and assembled at the origin ACCS. That information is available at the destination ACCS as well as transit points which host an ACCS via the digital corridor. Details of each consignment as well as the real-time collection of transfers from one partner

to the next are available to the beneficial cargo owners and the government agencies charged with protecting the safety and security of cross-border trade.

Regulatory agencies, including border agencies, can use the step-by-step consignment information and status reports to assemble a complete picture of the movement of each consignment. From a security perspective, the agencies can use this real time information to flag questionable events which can affect the security of the shipments and organize an appropriate intervention.

Other Security/Screening Issues – US Postal Service (USPS)

In the US, mail shipments, both domestic and international export, are transported by passenger as well as freighter aircraft. Most domestic mail (letters and packages) is transported by all-cargo aircraft and is subject to special security measures. The majority of these types of shipments are pre-sorted and containerized at a USPS facility, most of which are located off-airport. These containerized shipments are then trucked to the contracting freighter/express air carrier's facility in a secured vehicle, for loading onto the aircraft.

Smaller volumes of mail, more typically letters and envelopes, up to a certain (regulated) size, are carried in the bellies of passenger air carriers. These shipments are also pre-sorted at a USPS facility and trucked to the contracting air carrier. The carrier handles these shipments, usually packaged in open/banded "flats", are handled in a secure manner prior to being loaded along with any belly cargo or baggage at a terminal gate.

These USPS shipments are not covered by the carrier's SSPs. However, some passenger carriers, for their own security and safety reasons, require them to be screened by canines. Canine

screening is acceptable within USPS' mail privacy guidelines.

Dangerous Goods/Hazardous Materials

Dangerous Goods (DG)/Hazardous Materials (HazMat) are transported on both passenger and freighter aircraft. However, such shipments are severely restricted on passenger aircraft, based on type of commodity, size, weight and overall percentage of cargo carried on the flight. Larger volumes can be carried on freighter aircraft, and a wider range of commodities are allowed. The handling of all DG/HazMat shipments is regulated separately from the measures outlined in the SSPs for the carriers. Recently, concern has increased regarding the handling and transport by air of lithium batteries, and electronics containing them, due to their high flammability and intense heat when ignited. However, as with mail shipments, some carriers have opted to apply the same measures required in their SSP for other types of shipments to this group.

Operating Practices and Layouts

Cargo handling and screening facilities at most airports are either single or multi-user operations. For carriers with a large operation at the airport, a dedicated facility may be used to handle their own cargo. However, it should be noted that, in many of these instances, a portion of the actual staff may actually be contractors, and not actual employees of the carrier. However, these workers must still follow the carrier's SSP requirements.

For other carriers, it is not unusual to share a single GHA facility. In this instance, the GHA hires and trains its own personnel but must train them to each carrier's specific instructions and requirements, which include the TSA measures, as well as individual operational and business practice training. Thus, for a GHA in these circumstances, a shipment

for carrier "A" may be handled differently than one for carrier "B".

In either case, a cargo facility will have a "landside" access, for personnel as well as dock doors for the receipt of cargo. These access points are secured in some measure, so that outside personnel do not have ready access to dock floors or office areas. Personnel working for the carrier/GHA will have the appropriate badges and/or key/keypad access as discussed earlier in this chapter. Many operations require a "cage" area so that drivers bringing in cargo cannot actually enter the dock area when transferring the appropriate paperwork to the GHA/carrier.

Once accepted, cargo is held in a separate secure area. If it is pre-screened, it may be prepared/containerized for air transport. Otherwise, it will be screened by any of the above-mentioned methods,

and then prepared for transport.

Preparation and containerization of cargo for transport by air may be done within the walls of a facility, or on the AOA outside area dedicated to the GHA/carrier. Once prepared, the cargo is then transported by tugs and dollies or other vehicles to the planeside loading area. This is either at the designated passenger gate (PAX operations) or the tarmac pad assigned to an operator of freighter aircraft.

Within these facilities, there may be areas segregated and separately secured areas for certain activities and/or commodities. For example, HAZMAT and DG will have a specific, properly labelled area. Similar areas may exist for Human Remains, Diplomatic Pouches, pets, live animals, or for commodities requiring refrigeration or other special handling, established by regulation on business practice.

Lower deck cargo container

Upper deck cargo container

Upper deck cargo container

Lower deck containers loading into passenger aircraft belly

Upper deck containers nose-loading onto freighter aircraft.

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III. BEST PRACTICES

As regulatory requirements continue to evolve, so too have the measures which have been developed to ensure not only compliance with these regulations, but also to ensure the most advanced and effective means of providing the highest level of security: These measures include physical solutions as well as electronic (with ensuing cyber protection) security systems. While some of these measures fall within the sole regulatory responsibility of airports, they can be, and often are, developed conjunction with air cargo partners such as: ground handlers, freighter and passenger air carriers, forwarders, and 3rd party technology providers.

Physical security measures (airport perimeter and access controls) are one area which ultimately remains the responsibility of the airport itself: For cargo facilities located on airport, this is the case whether the airport actually owns or leases/manages these facilities. Where the airport owns as well as operates cargo facilities, this is regulated through its ASP. However, there are many other models for operating these facilities.

   In some cases, the airport may not actually own the building(s), which are owned by a 3rd party. In this instance, the airport will typically then control the tenant leases, in order to manage their activities in compliance with the ASP. Such leases are most commonly made with ground handlers (handling one of multiple air carrier's cargo operations), with air carriers directly, or in some cases, with forwarders. Lease operations can also include activities such as ramp access and parking. In some situations, these latter activities can also be managed by the building owner, who may then further

sub-lease ramp access and/or parking to companies noted above.

With all of these variations however, it is important to note that, for every facility within the airport property as well as the perimeter itself, the airport holds the ultimate regulatory responsibility and must be compliant with its ASP: It should be noted that activities within these facilities occupied by handlers, carriers or forwarders must comply with their own, separate TSA regulatory programs, This includes activities such as: cargo screening, employee background checks and security clearances (separate from SIDA), company badging, access controls, training and other areas. These issues can become quite complex, and airports should have a full understanding of them as they plan to add or expand cargo activity.

For building and/or ramp access control, a wide variety of models also exists: Some airports provide access control devices to approved users, as well as escort logging programs. These programs are auditable for compliance purposes by the airport operating authority and the TSA. Many airports are also using, or are developing, capabilities such as: automated appointment systems; and QR code systems for linkage to automated escort logs. These solutions can be provided to carriers/handlers/forwarders at no cost, or may be provided via compensation, typically covered within a lease agreement. However, some airports prefer to leave such types of programs, upon approval, to the tenants themselves, citing possible legal liabilities.

   Airports are also exploring other options. These can include systems such

as cloud-based data sharing platforms. Such programs can enable data to be shared across multiple user platforms used by the carriers, handlers, or forwarders, and can include standard cargo IATA (International Air Cargo Association) messaging formats. These systems are usually not designed by the airport, but by a 3rd party software company. In even more advanced programs, some providers are developing systems, in coordination with the proper regulatory agencies, to capture biometric data, including driver license information and facial recognition capabilities. These programs are also able to provide readily accessible audit trails for compliance purposes.

In addition, some airports and software providers are working on systems that can match other data with SIDA badge information and are placing more robust remote camera systems at key access points and ramp areas, enabling gates and barriers to be operated automatically. These programs must be agreed to by any vendors or tenants and are usually limited in scope of work and/or access.

Airports perform security audits of their air cargo tenants: Since the airport is not directly responsible for cargo screening, these audits typically are focused on access control measures, SIDA badge security, and other procedural requirements established by the airport in accordance with its ASP. These can be performed on a regular, or an unannounced basis, and frequencies will vary by airport. Some airports do not regularly perform any, while others do this as often as weekly.

In all cases, airports as well as the operators must be cognizant of necessary cyber security measures in order to properly protect personal, security and shipment data from outside threats. **Physical perimeter and facility security**

controls can also vary. The ASP for each airport may require more restrictive measures in certain areas than in others.

For perimeter security, it is not unusual for wire mesh fencing, of a specified type and height, topped by barbed/razor wire, to be required. In addition, parallel access roads may be needed where physical vehicle patrols are required or are planned to be utilized. Other recommended types of perimeter fencing can include "anti-climb" materials, and in areas where exterior vehicle proximity or access can pose a potential threat, "post and cable" systems may be recommended, as they add a much more solid deterrent.

At legitimate perimeter access points, barriers will be needed for controlling vehicle access, pedestrian access, or both. Pedestrian access controls can be relatively simple, and can include swing gates, guard huts, turnstile gates, or fully enclosed, single direction rotating gates. These barriers themselves are separate from any badging controls that may be required.

Vehicle barriers can be a bit more complicated and sophisticated, depending on the types of vehicles which will have access. Common methods include: swing arm gates; raised arm gates; roll-back lateral gates; or other similar types. These are usually deployed, as with pedestrian controls, in conjunction with a staffed guard house. Fallback measures, should these barriers be forcefully penetrated, include options such as: retractable wedge barriers; or tire shredding systems (passive systems that can be activated on demand, or proactive systems that must be retracted for each transit). Tire shredding devices can effectively slow a threatening vehicle, but not necessarily stop it completely. Wedge barriers (passive or proactive) are considered to be more effective at stopping vehicles but can also cause major physical damage

to the vehicle involved or serious injury to its occupant(s). Thus, there are some concerns about their usage when vehicles may not be an actual threat, but rather potentially driven by an operator experiencing a severe health issue. Once deployed and used, clean-up time can be extensive and time consuming, causing delays to all operations.

Newer physical barrier systems being deployed now include "less-than-lethal" barriers. These systems have the benefit of quick deployment (instantaneous), high effectiveness, and less damage to vehicles or injury to occupants. Examples include pop-up/deployable "net" barrier systems.
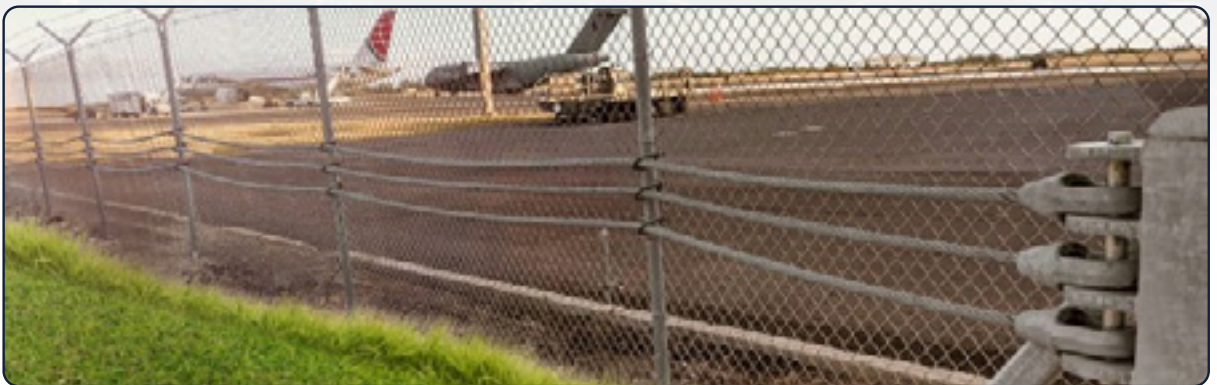
Chain link and barbed wire perimeter fence, with added post and cable strengthening
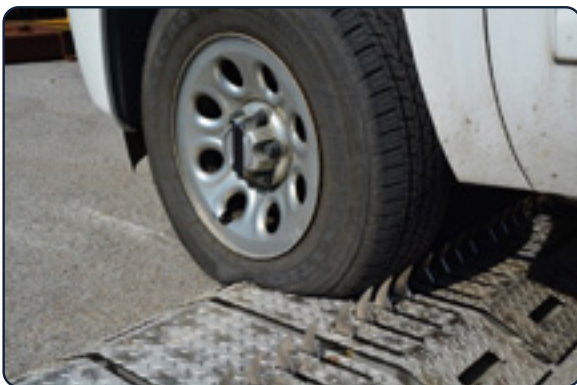
Standard entry barrier, tire puncture system

Retractable solid barricade system

"Ramp" barricade system deployed

Hydraulic less-than-lethal "net" system

How Airports Should Plan and Determine the Best Solution(s) Appropriate to Their Individual Circumstances

Planning for physical space requirements: A key component of planning for the appropriate solution(s) is physical space. This primarily refers to the space for cargo acceptance, screening and consolidation/containerization prior to being transported via tug/dolly to planeside operations at the passenger gates. However, for airports with an existing or planned all-cargo/freighter aircraft operation, the ramp space necessary for large aircraft parking and loading/unloading must also be considered. Not only do cargo planes, typically wide-body models, take up a large footprint, they may sit unused for long periods of time, since many all-cargo operations maximize aircraft utilization at night. In addition, the loading systems for freighter's upper deck loading and handling systems are larger than those necessary for cargo loaded in the bellies of passenger aircraft. In addition, consideration must be given to the space necessary for ULD, as well as numerous tug/dolly and maintenance equipment storage and operations for these larger facilities.

Facility location: Another consideration is the proximity of a cargo acceptance/handling facility to passenger gates. Ideally, the facility should be located so as to facilitate direct, short-distance access for rapid processing. Also important is the need to minimize the number of active runways and/or taxiways, where ground handling equipment might have to wait for aircraft, especially at busy, hub airports.

Surface transport access: Cargo facilities should also have relatively easy access for surface transport to bring in cargo, with enough dock doors and surface area to handle multiple vehicles easily. Along with this, parking access for GHA and carrier employees should be located as close as possible to the facility. Ideally, separate access road for cargo in order to keep trucks out of the flow of passenger vehicles into and out of the airport should be used. Access on a 24/7 basis would be necessary, especially as many cargo operations operate on that basis.

Power requirements: For cargo handing areas where high volumes of cargo may be screened, there may be special power needs, to provide for the screening equipment to be used.

Air Cargo Security Approaches can Vary by Airport Type/Size
   Airports may have a wide variety of tenants/partners, depending on the geographic location and markets served. It should be noted here that, although security of air cargo is primarily focused on outbound shipments, the ground handling of air cargo inbound must be considered for operations planning, even though there are fewer security measures applied. No screening is required for inbound cargo. Inbound cargo transported on freighters will require screening if the shipment has not previously been screened and is for export at the airport.

Domestic hub: Airports with a larger number of carriers, passenger and/or freighter, and a relatively small number of international flights, may still have a fairly significant amount of cargo that is processed.
   Each domestic passenger carrier that operates aircraft larger than narrow body commuter planes will need a GHA for all functions previously covered, although

this may be a shared facility. The space and facility size will be predicated on the number of flights, as well as hours in which flights are operated. In hub operations, flights tend to be bunched at specific times of the day, so cargo operations planeside will ebb and flow accordingly.

If there are freighter operators at the airport, support and handling will typically require a separate facility for their cargo. This is most often a single operator facility and can be a GHA operation or an operator owned facility. If wide body/upper deck aircraft are utilized, space will need to be allocated for the large number of specialized ULDs and upper deck loading equipment, tugs and dollies used to support the operation.

At airports where integrated freighter operations are in place, size and scope of the operation may vary greatly. Integrators (or "express carriers") are defined as air carriers that handle door-to-door shipments for their customers, without utilizing other carriers or ground pickup and delivery service, which is different from the typical forwarder/carrier/ground handler model.

At larger hubs, multiple smaller "feeder" aircraft will be arriving and departing from other regional airports. Their cargo, typically comprising numerous small packages, may be transferred directly on the ramp to larger aircraft for the next leg, or it may be off-loaded and moved into an air-side facility operated by the integrator for consolidation into larger ULD's. In some cases, security screening may also need to be performed within the facility. The variety of these types of models needs to be fully considered.

International hub/gateway: Operations will be similar than those of a domestic hub. However, there will be a higher number of domestic as well as international flights. There will typically be a higher number of domestic wide-body flights, with the attendant higher volume of containerized cargo, either for domestic or international transfer, or outbound to other domestic hubs. Similarly, since most international flights at major hubs will likely be wide body aircraft, there will be a higher volume of outbound and inbound, containerized cargo that will be loaded on the aircraft at the gates. It should be noted also that many international passenger aircraft arrivals and departures also operate in waves, as they are operated primarily for passenger convenience rather than cargo requirements.

International hubs will likely have a larger number of all-cargo operators. These generally fall into two categories: Integrators and heavy all-cargo operators. Integrators handle a high volume of small package business, and many also carry other large shipments. For the most part, their customers/shippers deal directly with them on a "door to door" basis More recently, some e-tail companies have begun operating their own aircraft, similar to an integrator, but handling only their own customer shipments. Heavy all-cargo operators usually act as a "wholesale" carrier, gaining their shipments from the freight forwarding segment of the industry. Thus, they are considered an "airport to airport" operation. In both cases, flights are operated based on cargo shippers' needs, and can occur at any time during the day or week.

For any of these types of carriers and operations, due to the high volume of cargo, GHA operations are much more challenging. Many GHA facilities may be located off-airport, so there will be a high frequency of cargo vehicles, tugs/dollies moving onto and off of the airport perimeter on an almost continual basis. Airport operations must consider how

frequently these movements may need to cross active runways and taxiways. For on-airport GHA locations, significant space is necessary for the handling and storage of ULDs, tugs/dollies and other operations support equipment. Another consideration at large facilities is the need for Customs Bonded facilities to properly handle import shipments. As these may be located on or off-airport, the special handling of this portion of cargo needs to be considered in the operational flow.

All-cargo/freighter airports: Some airports may operate primarily as cargo facilities, with little or no passenger traffic. Many integrators operate in this manner, and the facilities to support them will be similar to the freighter portion of international hubs/gateways. However, in many cases, a single integrator will be the primary carrier, but other heavy all-cargo carriers may also use such airports, either for scheduled or charter operations, both domestic and international.

IV. THE ROLE OF AIRPORT MANAGEMENT

Airport management can play an important role in planning, introducing, implementing, facilitating and/or overseeing these developments.

Financing of any air cargo operations will depend on the general development plan for each airport. Airport management will need to review the operating and growth plans of its airline partners to determine, in advance, what cargo operations and facilities will be necessary to support this. Some US carriers that primarily fly narrow body feeder/commuter aircraft will typically not need much in the way of cargo handling facilities, as they will not need space for consolidation or containerization of cargo due to the nature of the aircraft they operate. Larger carriers that fly aircraft with belly capacity may have a greater need, but this is dependent on the number if fights they plan to operate.

Some airports may consider cargo opportunities as a growth target, and after consulting with potential carrier tenants, commit to either a shared investment in any necessary cargo facility, a direct airport investment to attract such business, or a committed space for a carrier to build and/or lease on a long-term basis.

In any case, the airport management would be prudent to consider the potential costs to uphold its own responsibilities for maintaining a secure perimeter, and other obligations in its

ASP, operating in conjunction with the carrier's SSP.

As noted in an earlier section of this paper, multiple models for airport cargo operations and facility ownership exist. Whether a cargo facility is airport owned, 3rd party owned, or a hybrid model, airport management must consider a wide range of factors to support those operations.

In making a determination as to how cargo facilities will be operated, airport management may need to include its groups responsible for: properties/real estate management; insurance; legal, security or other departments, as well as local fire, police, airport law enforcement. Environmental issues may need to be addressed for de-icing and fuelling operations. Arrangements will likely need to be made to ensure compliance with the handling of dangerous goods that are frequently handled as air cargo.

Permit processes for construction, electrical and power requirements for temperature-controlled shipments, as well as for screening equipment, must be considered in advance, as they may vary by jurisdiction. Consideration should also be made for proper care and rest areas for canine screening companies, as that method of screening becomes increasingly more prevalent.

With prior understanding of and necessary approvals and permits in place, potential delays in operations and/or leases may be avoided.

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V. EXPECTED CHALLENGES AND HOW TO MITIGATE THEM

Airports, as well as all industry participants in the air cargo supply chain, identify challenges in ensuring a high level of security without disrupting the flow of legitimate trade via air. Because their operations and responsibilities vary to a degree, yet overlap in certain areas, there is some commonality, while some are somewhat unique.

Personnel issues: For airports, the most common challenges foreseen relate to ever increasing air cargo volumes, and the ability to handle them with qualified and well-trained personnel. They also point out concerns with the possibility of insider threats, and the risk that complacency among employees who regularly handle cargo can entail.

The most common solution suggested among this group are increased wages; standardized training with regularly re-occurring updates and refresher courses; and a strong engagement with the other parts of the air cargo industry to reinforce the significance of security program compliance and updated threat awareness.

Freighter operations: All-cargo (freighter) operators typically express a different set of concerns, some of which are related to regulations, while others are focused on operations and capacity. More specifically, with increasing volumes, they are concerned with the infrastructure capacity at airports, citing congestion and improving and streamlining access as a key issue. Regarding regulatory concerns and challenges, freighter operators stress that increasingly prescriptive cargo security programs, rather than more risk-based programs, may cause delays and backlogs at airports, especially if more

cargo is required to be screened than is mandated in current security programs.

Working to resolve these concerns, freighter operators feel that it is critical that airports recognize the challenges that exist within the often-limited footprint at airports where cargo can be handled, screened, secured, consolidated, and uplifted. An awareness of all these issues, which can be identified by a close working relationship, may require an airport's further investment in improved infrastructure and facilities. These carriers recognize that they must also continue to work closely with regulatory bodies to create effective security measures that are based on how industry works.

Passenger aircraft operations: Passenger air carriers share many of the same challenges and concerns faced by freighter operators. The often-limited number of, or space for, ground handlers at many airports creates a pinch point that can inhibit the smooth flow of cargo. This limited space makes it more difficult to properly segregate screened and unscreened cargo, as well as DG/HazMat shipments, in accordance with the requirements of their security programs. Similar concerns as those outlined by freighter operators include the cost of screening and securing cargo, with the need for new and improved screening technologies being highly ranked. Outdated or life cycle expiring equipment can be costly to maintain and can add to the overall cost of performing this important function. In addition, more digitization of all aspects of the air cargo function must be a goal, to cut down on burdensome paperwork, enable more efficient compliance.

As with freighter operators, passenger carriers believe that airports and all carriers must work together to identify the best solutions to modernize and/or expand existing facilities, as well as airport operating procedures. This also includes modernization of information processing that have an impact on access controls and procedures. They also recognize that they must work closely with regulatory bodies to ensure that the differing procedures required by multiple carriers are standardized and enabled, from a regulatory perspective, to be utilized for multiple carriers.

Freight forwarders: Freight forwarders (IACs or Regulated Agents) echo the same concerns as other participants in the air cargo community. While only a small minority have their own on-airport facilities, they recognize the physical and space limitation challenges at airports and ground handlers. As they are the segments which has the greatest customer interface, they also are increasingly concerned with cyber security. Training and maintaining a strong workforce, and regulatory issues, are also of high importance to this group. The latter is of high importance since the TSA required that export shipments carried on freighters be screened to the same level as those moving on passenger aircraft beginning in 2021. Because this often entails items which can only be carried on freighters, such as drums of chemicals or other items, screening these shipments, and the space to do so at ground handlers, has had a major impact on operations.

As with other segments, IACs point to the importance of focusing on improving

digital linkage across the supply chain, for efficiency, security and auditability. Standardizing training materials across all segments rank highly in importance. They also continue to work with TSA in improving screening capabilities and procedures, while at the same time advocating for more shippers, especially those with difficult to screen cargo, to participate in the Certified Cargo Screening Standard Security Program, in a joint outreach effort with the TSA and the shipper community at large.

GHAs: Ground handlers are often the key interface between IACs and carriers. They point out that, as air cargo procedures and regulatory requirements have changed significantly, many on-airport cargo facilities have become outdated, as they were designed more in line with a typical warehouse, rather than one built to accommodate newer security measures, and the increasing flow of e-commerce shipments, which are typically smaller, but more numerous. As an example, with the increasing usage of canine screening teams for cargo, there often are not sufficient facilities to rest and refresh the canine teams on the property. Standardized security training, accepted by TSA, which can be utilized for all carriers and IACs, is also of high importance.

For this group, the importance of working jointly with airport operating authorities, carriers and IACs is paramount. This helps facilitate any design changes or on-airport handling and ramp procedures that may be beneficial to all parties, while still maintaining the necessary levels of security. Regular meetings to discuss these challenges are an important part of that effort.

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VI. LESSONS LEARNED AND KEY SUCCESS FACTORS

As air cargo demands evolve, the members of the air cargo supply chain must continue to evolve with them. Airports remain a key factor in ensuring that air cargo moves safely, and in a secure manner, while at the same time moving efficiently. Airports that can adapt and remain open to changes will continue to attract new business in this important sector.

While airports may only have a somewhat limited role in air cargo security overall, it remains a significant one. Perimeter security has become increasingly important as threat factors have changed. This has led to a heightened awareness of these threats, and the need to effectively counter them. Solutions, such as stronger fencing, and physical barriers or methods at access points, have been improved in recent years. In addition to physical barriers, better and newer technology has enabled airports to improve information flow at access points where air cargo vehicles and personnel enter the AOA. This makes access more secure, as well as more efficient, but requires a close cooperation between the airport operating authority and industry in order to be most effective.

Airport operators are encouraged to meet regularly with existing and potential air cargo tenants to stay abreast of issues affecting operations. These meetings can be held with individual tenants, but for broader issues, general meetings held with multiple/all cargo tenants can be very beneficial. As with security audits, the frequency of such meetings can vary. It has proven beneficial to also include the surrounding, off-airport IAC community in some of these sessions, so that broader issues can be addressed, such as backlogs at entry points, infrastructure plans, contraband, driver access and badging procedures which can affect all partners. Air cargo supply chain members also suggest that airports pay particular attention to catering and other vendor suppliers since those materials can have an AOA interface with cargo at gate locations. Successful airports, especially where cargo operations are greater, schedule more frequent meetings, at least on a quarterly basis.

VII. CONCLUSIONS AND RECOMMENDATIONS

Air cargo security regulatory requirements, as we have seen over the past 20+ years, continue to increase: As new threats are identified, regulators such as the TSA will likely modify and/or add to existing security programs, both for airports and the industry partners that operate at them. Thus far, these security programs have grown in size, scope, and complexity, and have become increasingly prescriptive and detailed. Airport security programs will likely be modified as part of this ongoing effort. As with any operational change of modification, costs will be expected. These costs must be weighed in full consideration of the potential economic consequences should a serious incident occur on airport property. Even if an incident is limited to air cargo operations, it may have a cascading effect on other airport operations overall.

Airports should understand the importance of air cargo revenue as an economic contributor to passenger air carriers: While it comprises 100% of the revenue for freighter and express cargo operators, it can still contribute well over 30% of revenue for passenger air carriers and can be a factor in their determination of flight schedules or frequency. It is therefore essential for airports to have a solid understanding of these carrier's needs, as well as the cargo-related regulatory issues they face. With this understanding, and by working closely with industry, air cargo volumes can grow and remain a major contributor to an

airports economic bottom line.

Cyber security is and will remain a priority topic of concern for all participants in the air cargo supply chain: Data breaches can cause significant disruptions to operations. With more data being exchanged through multiple partners and systems, the security of this data is paramount.

Aging airport facilities and limited automation of processes on-airport can inhibit the success and growth of air cargo: As more cargo is required to be screened, much of which will occur at the airport cargo facility, more space, and more efficient use of space (both in buildings and ramp areas) will be necessary. Older facilities may also pose a challenge at some access points in avoiding potential insider threats to cargo security.

Security audits can be very beneficial in ensuring all partners are aware of key security issues: Successful airports actively perform such audits, announced or unannounced, as often as weekly at larger operations. Regardless of frequency, they have proven to be a valuable tool in ensuring awareness of the importance of securing the air cargo supply chain.

Attracting, training, and keeping personnel at airports, and in the air cargo supply chain overall, will remain an issue: This can be due to challenging

working conditions, challenging work hours (since cargo can be a 24/7 operation), as well as wages. In tighter labour markets, cargo wages are at time not competitive with the surrounding market. Considering the high cost to train, and to also provide recurring training on multiple regulations, employee turnover can prove to be a costly issue having an impact on both operations and operating margins.

Airport operations and security personnel should be encouraged to engage closely and regularly with their air cargo tenants: By doing so, airports can gain a better understanding not only of all the security factors involved, but also the evolving business practices that may lie ahead, as we have seen in recent years with the dramatic increase in e-commerce air cargo volumes.

Airports are also encouraged to focus all of their personnel on awareness of the potential security threats that can come from the air cargo segment of operations: Ongoing training is highly recommended as an effective means of maintaining proper diligence.

Air cargo operations and resulting revenue can be an important contributor to any airport. Volumes have grown steadily, and are expected to continue to do so, especially with the solid growth of e-commerce business globally. **Because cargo is subject to many more operational and security measures than those required for passengers, a full understanding of these measures and procedures can make them not only safe, but also a major contributor to an airport's economic growth and success.**

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