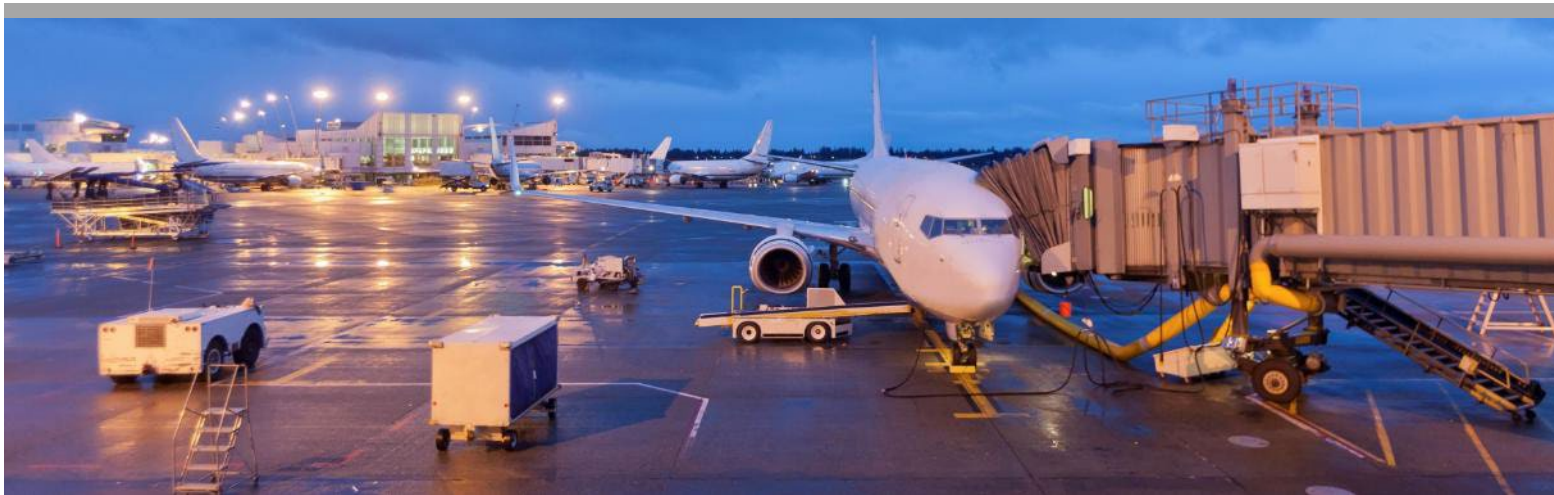




PARAS

PROGRAM FOR APPLIED
RESEARCH IN AIRPORT SECURITY



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Optimizing Security-Related Training for Aviation Workers

National Safe Skies Alliance, Inc.

Sponsored by the Federal Aviation Administration

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SUMMARY

This report examines current practices in airport security-related training, with a focus on how training content is developed, delivered, reinforced, and continuously improved to support effective comprehension and long-term knowledge retention. Through interviews with US commercial service airports, industry business partners, and subject matter experts, the research identifies how training programs are implemented across varied operational environments and highlights approaches that support both regulatory compliance and real-world application.

Findings indicate that while regulatory requirements establish a consistent baseline for training, the effectiveness of training programs is largely influenced by how content is structured and aligned with operational roles and risks. Airports and business partners reported using a combination of required and supplemental training to address both compliance obligations and local operational needs. Approaches that organize content into role-based modules and prioritize higher-risk responsibilities were associated with higher relevance and reduced information overload.

The report also highlights the importance of how training is delivered and reinforced over time. Airports described a range of delivery methods, including classroom- and computer-based instruction and on-the-job training. Effective programs were characterized by the use of recurrent and targeted remedial training, along with active involvement from supervisors to reinforce expected behaviors in the operational environment.

Findings emphasize that training effectiveness also depends on ongoing program management and adaptation. While most airports track training completion and assessment performance, stronger programs incorporate operational data, audit findings, and feedback from the field to evaluate whether training is being applied consistently. Structured processes for reviewing and updating training content, combined with clear program ownership and coordination, support alignment with evolving risks and operational conditions.

Overall, the research underscores that effective airport security training is defined by the integration of content design, delivery practices, and continuous improvement processes. Programs that align these elements are better positioned to support consistent performance, reinforce compliance, and adapt to the dynamic nature of airport operations.

PARAS ACRONYMS

ACRP	Airport Cooperative Research Program
AIP	Airport Improvement Program
AOA	Air Operations Area
ARFF	Aircraft Rescue & Firefighting
CCTV	Closed Circuit Television
CFR	Code of Federal Regulations
DHS	Department of Homeland Security
DOT	Department of Transportation
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FSD	Federal Security Director
GPS	Global Positioning System
IED	Improvised Explosive Device
IT	Information Technology
MOU	Memorandum of Understanding
RFP	Request for Proposals
ROI	Return on Investment
SIDA	Security Identification Display Area
SOP	Standard Operating Procedure
SSI	Sensitive Security Information
TSA	Transportation Security Administration

ABBREVIATIONS, ACRONYMS, INITIALISMS, AND SYMBOLS

ASP	Airport Security Program
BNA	Nashville International Airport
BWI	Baltimore/Washington International Thurgood Marshall Airport
CAA	Civil Aviation Authority
CBT	Computer-Based Training
ICAO	International Civil Aviation Organization
ID	Identification
IDMS	Identity Management System
LMS	Learning Management System
MAT	Movement Area Driver Training
NMAT	Non-movement Area Driver Training
ONT	Ontario International Airport
SME	Subject Matter Expert
VMS	Video Management System

SECTION 1: INTRODUCTION

Training is a foundational component of airport security programs and plays a critical role in preparing aviation workers to identify, prevent, and respond to evolving threats while supporting regulatory compliance and operational effectiveness. As airport operations grow more complex, training programs must address workforce turnover, diverse job functions, varying experience levels, and evolving regulatory and operational requirements.

The objective of this project was to develop a consolidated resource to assist airports in optimizing security-related training, including strategies related to content development, delivery methods, learner comprehension, and long-term knowledge retention. The research also examines the frequency of content review and updates, recurrent and remedial training approaches, and considerations associated with aviation workers who support multiple employers at one airport.

The PARAS 0069 research examined practices used by airports, business partners, and subject-matter experts (SME) from Embry-Riddle Aeronautical University and the United Kingdom Civil Aviation Authority (CAA). The resulting guidance is intended to serve as a practical resource for airport professionals responsible for developing, delivering, and overseeing security-related training programs. It is designed to be broadly applicable to airports of varying sizes and operational complexities.

Recognizing that training programs must be adaptable to local operational environments, the guidance is intended to be flexible and scalable, allowing airports to apply strategies based on their specific needs, workforce characteristics, regulatory requirements, and available resources.

1.1 Definition of Security-Related Training

For the purposes of this research, security-related training refers to training provided to aviation workers to support the knowledge, awareness, and responsibilities necessary to protect the airport environment, maintain secure operations, and respond appropriately to security-related risks, threats, and incidents. This includes both training required by regulation or airport security programs (ASP) as well as additional training implemented to reinforce security awareness, support local operational needs, or address emerging threats.

In this report, security-related training is discussed in two broad categories: regulatory and supplemental. This distinction is intended to clarify which topics are required as part of baseline airport security compliance and which are implemented to address local risks, operational needs, or broader security awareness. It also helps distinguish security-related training from other forms of airport training that support operations but are not primarily security-focused. These categories are discussed further in Section 2.1.

REGULATORY SECURITY-RELATED TRAINING

Regulatory security-related training refers to training required by TSA and ASPs. This training establishes the baseline knowledge and responsibilities necessary for individuals who are granted unescorted access privileges or assigned security-related duties within the airport environment. Regulatory security-related training may also include requirements established by other applicable regulatory agencies, such as the FAA, where training is tied to access privileges or operational responsibilities within the airport environment.

Examples of regulatory security-related training include training associated with unescorted access authority, escort and challenge procedures, identification (ID) media display and control, protection of SSI, and Authorized Signatory responsibilities.

SUPPLEMENTAL SECURITY-RELATED TRAINING

In addition to regulatory training, many airports and aviation stakeholders reported providing supplemental security-related training to address local risks, reinforce expected behaviors and role-based assignments, and strengthen overall security awareness. While this training is not explicitly required by regulation, it is often implemented to support airport-specific operations, emerging threat environments, or organizational security priorities.

Examples of supplemental security-related training identified through interviews included insider threat awareness, active shooter or active threat response, cybersecurity awareness, human trafficking awareness, and locally developed content intended to reinforce vigilance and support a broader culture of security.

1.2 Research Methodology

This research was based on two complementary components: structured stakeholder interviews and a targeted literature review. The methodology was designed to capture a range of perspectives across airport operators, business partners, academia, and an international regulatory authority to identify approaches that may support improved comprehension, retention, and application of security-related training across different operational environments.

Findings presented in this report reflect observed practices and themes across participating organizations. The research was not intended to evaluate or rank individual training programs or prescribe a single training model. Figure 1 provides an overview of the methodology used in the research.

Figure 1. Research Methodology



STAKEHOLDER INTERVIEWS

The research team conducted structured interviews with representatives from 24 US commercial service airports and five business partners. An academic SME from Embry-Riddle Aeronautical University with experience in aviation training and curriculum development was also interviewed. In addition, the research team interviewed an SME from the United Kingdom CAA who oversees aviation training programs from a regulatory compliance perspective.

These interviews were intended to identify approaches and strategies that airports may use to optimize the development, delivery, reinforcement, evaluation, and operational application of security-related training across varied operational environments. The participating organizations are listed in Figure 2.

Figure 2. Participating Organizations and Partners in Research



AIRPORT REPRESENTATION

Airport participants were selected to provide representation across a range of airport sizes, operational environments, and workforce compositions. The airport sample included seven Category X, seven Category I, seven Category II, and three Category III airports. Reported airport populations ranged from approximately 500 to more than 40,000 badge holders.

The interviews were structured to identify practices related to training content development, delivery approaches, learner comprehension, and long-term knowledge retention. The range of participating airports also allowed the research team to consider how training practices may be influenced by workforce size, badging volume, available training space, staffing resources, technology, and operational complexity.

BUSINESS PARTNER REPRESENTATION

For the purposes of this research, business partners refers to private-sector organizations that provide aviation support services to airports, airlines, cargo operators, and other aviation organizations. These organizations represent a range of functions supporting both airport and airline operations, including above-wing and below-wing services for a variety of commercial airlines.

Representative airline-support services included passenger services, aircraft security and cabin search, catering, cargo and warehouse operations, ramp services, and cabin services. The participating organizations also provide airport-facing services such as aviation worker screening, security guard services, traffic control, vehicle inspections, security patrols, and response to door alarms and other access control-related events.

These business partners operate across numerous airports and employ large, geographically dispersed workforces performing role-based duties in varied operational environments. Reported employee populations ranged from approximately 1,000 to 19,000.

Unlike airport operators, these organizations deliver training across multiple client environments, employer structures, and operating locations while maintaining consistent corporate training expectations. Their programs must therefore balance standardized company content with airport-specific procedures, client requirements, local operating conditions, and applicable regulatory obligations. This operating model provided insight into how security-related training is implemented and reinforced across distributed aviation workforces.

SUBJECT-MATTER EXPERT PERSPECTIVES

The SME from Embry-Riddle Aeronautical University contributed perspectives related to aviation training, curriculum development, adult learning, instructional design, learner comprehension, and long-term knowledge retention.

The CAA SME contributed an international regulatory perspective related to aviation security training oversight, competency expectations, structured training models, quality assurance, program evaluation, and regulatory compliance.

The CAA is an independent aviation regulator and public corporation of the United Kingdom's Department for Transport that responsible for oversight of more than 50 airports, 600 cargo sites, and 314 airlines operating within the United Kingdom. The CAA oversees aviation activities ranging from pilot licensing to the regulation of security standards.

INTERVIEW PROTOCOL AND FOCUS

Interview questions focused on how airports, business partners, and SMEs develop, deliver, reinforce, evaluate, and update security-related training, and how those practices differ across operating environments. Interview questions used during the research process are included in Appendix A.

Topics included airport and organizational characteristics; workforce composition; types of training programs in place; required and supplemental training subjects; delivery methods, locations, scheduling practices, and session duration; frequency of content review and updates; methods used to reinforce learning and evaluate retention; recurrent and remedial training approaches; and considerations related to aviation workers employed by multiple companies at a single airport or holding ID media at multiple airports.

Interviews also examined how training programs are adapted to local constraints such as staffing resources, available training space, language or accessibility needs, after-hours training requirements, and the availability of technology to support remote or computer-based instruction. Where applicable, participants described operational challenges, lessons learned, and metrics used to evaluate training effectiveness.

REVIEW OF INTERVIEW FINDINGS

Airport interview responses were reviewed collectively to identify shared practices, distinctions in approach, and recurring themes. The review was not intended to evaluate or rank individual airport programs. Rather, it was intended to understand how different approaches are implemented in practice and how airports assess their effectiveness in supporting knowledge retention, employee engagement, regulatory compliance, and operational application.

Business partner responses were reviewed to identify common delivery approaches, operational challenges, and patterns associated with providing security-related training across multiple employers, clients, and work environments. These findings were considered alongside airport responses to examine areas of alignment and variation in training content, delivery formats, role-based assignments, reinforcement practices, and methods used to support knowledge retention.

Input from the academic and CAA SMEs provided additional perspective on instructional design, adult learning, structured training models, competency development, program evaluation, and regulatory oversight.

Collectively, these perspectives contributed to the identification of practical approaches and strategies that airports may evaluate based on their regulatory requirements, operating environments, workforce needs, available resources, and local risks. The findings informed the report sections addressing training topics and content; training delivery, structure, and application; program management, oversight, and continuous improvement; and the path forward.

TARGETED LITERATURE REVIEW

The research team conducted a targeted literature review to provide research-informed context for the key findings associated with each project objective. In total, 31 sources were examined, including peer-reviewed studies, applied industry research, aviation-specific reports, PARAS reports, and publications from comparable safety-critical industries.

Sources were selected based on their relevance to airport training environments and their examination of adult learning, instructional design, content development, training delivery, learner comprehension, knowledge retention, reinforcement, performance feedback, operational application, and overall training effectiveness.

The literature review helped interpret patterns observed across participating organizations and identify research-informed practices related to delivery methods, content design, reinforcement over time, operational application, and performance evaluation. It also provided context for examining how practices described by participating airports and business partners aligned with or differed from findings in broader training research.

The literature review provided additional context for evaluating current practices and identifying potential areas for improvement. An annotated bibliography of the sources reviewed during the research process is included in Appendix B.

SECTION 2: TRAINING TOPICS AND CONTENT

Findings from interviews and the literature review indicate that airport security-related training content is shaped by a combination of regulatory requirements, operational responsibilities, local risks, and broader industry guidance. While required regulatory topics establish a largely consistent baseline across airports, differences emerge in how training content is supplemented, structured, prioritized, and aligned with specific operational roles and environments.

This section examines how airports and aviation stakeholders define, organize, and apply security-related training content. It explores the relationship between regulatory and supplemental training topics, the impact of training volume and information overload, and the ways training programs incorporate standardized content, local customization, and risk-based considerations to support more effective operational application.

2.1 Overview of Topics

Security-related training topics across participating airports generally consisted of required regulatory training supplemented by additional operational, role-based, and awareness-based content.

REGULATORY TRAINING

Regulatory security-related training forms the foundation of airport security training programs and was largely consistent across participating airports. Interviewees frequently referenced 49 CFR § 1542 requirements, ASPs, and TSA-issued National Amendments as primary drivers of required security-related training content, with local procedures incorporated to reflect airport-specific implementation.

Core topics commonly identified through airport interviews included unescorted access authority, escort and challenge procedures, ID media display and control, protection of SSI, and Authorized Signatory responsibilities.

These topics were consistently described as essential and are required prior to granting access privileges or assigning security-related duties. As such, regulatory security-related training forms the core of airport security training programs and serves as the baseline from which additional training may be developed.

Although the required subject areas were broadly consistent, airports varied in the amount of airport-specific detail, local procedures, and operational examples included in the training.

SUPPLEMENTAL TRAINING

In addition to required regulatory training, participating airports and business partners reported incorporating a wide range of supplemental security-related training topics intended to reinforce awareness, address locally identified risks, and support overall operational effectiveness.

Common supplemental topics included insider threat awareness, active threat or active shooter response, cybersecurity awareness, emergency preparedness, and human trafficking awareness programs such as the Blue Lightning Initiative, an aviation-focused component of DHS's Blue Campaign led by the US Department of Transportation and US Customs and Border Protection. These topics were often influenced by national emphasis areas, airport-specific operational needs, and locally observed compliance trends.

Variation in supplemental training was more pronounced than in regulatory training. Some airports reported limited expansion beyond required topics due to operational pressures, staffing constraints,

available infrastructure, or training platform limitations. Others described more targeted approaches, developing supplemental modules tied to specific operational roles, recurring compliance concerns, or observed gaps in performance.

Airport interview responses included multiple examples of supplemental training developed in response to operational needs and vulnerabilities:

- Fuel handler training module to address recurring compliance issues related to safety and security requirements
- CCTV user training for personnel with access to the airport's video management system (VMS) to reinforce appropriate system use and protection of SSI
- Vehicle inspection training for personnel responsible for access point screening
- Blue Lightning Initiative to provide human trafficking awareness training to airport stakeholders
- Supplemental or role-based training for functions such as security guard responsibilities, passenger boarding bridge operation, concession inspections, emergency response, volunteer ambassadors, and access point operations

These examples illustrate how supplemental training can be used to address operational vulnerabilities, reinforce role-based responsibilities, and provide additional depth in areas not fully addressed through baseline regulatory training.

Business partners described a similar range of supplemental topics but generally emphasized a more structured approach to assigning content based on job function, operational exposure, and observed performance trends. Rather than delivering supplemental topics as broad awareness content for all employees, business partners reported linking training to specific tasks, post orders, incident reviews, audit findings, client requirements, and local airport procedures. These topics were often incorporated into role-based training plans and reinforced through operational application.

Supplemental training serves as a primary mechanism for tailoring training content to operational needs, particularly when it is aligned with job responsibilities, supported by real-world examples, and integrated into broader training programs rather than delivered as disconnected standalone content. The matrix in Figure 3 provides an example of how an airport may align role-based training with different employee groups.

Figure 3. Sample Role-Based Training Matrix

Training Requirements by Employee Group								
Employee Group	Airport - All, Shift & Admin	Airport Ops	Airport Ambassador	Airport Security Contractor	Airline - Above the Wing	Airline - Below the Wing	Fuel Handler	Concessions
Training Type								
SIDA		✓		✓	✓	✓	✓	
Sterile Area Security								✓
Security Awareness	✓							
Customer Service	✓	✓	✓	✓				✓
Cybersecurity	✓	✓						
Vehicle Escorts		✓		✓		✓		
Human Trafficking	✓	✓	✓	✓	✓			✓
Volunteer Ambassador			✓					
Fuel Handler							✓	
Non Movement Area Driver		✓				✓	✓	
Emergency Preparedness	✓	✓		✓	✓	✓		
Insider Threat Awareness	✓	✓		✓	✓	✓	✓	✓

 Required training

2.2 International Framework and Alignment

At the international level, aviation security training is guided by standards established by the International Civil Aviation Organization (ICAO), Annex 17 and supporting guidance such as Document 10207, the Aviation Security Training Manual. These frameworks establish broad expectations for aviation security training programs, including initial and recurrent training, role-based competencies, and national oversight responsibilities. Supporting ICAO guidance documents, including the Aviation Security Training Manual (Doc 10207) and Training Development Guide (Doc 9941), further emphasize competency-based training principles, instructional design considerations, and structured approaches for developing aviation security training programs. Interviewees with international aviation security experience noted that ICAO guidance is often viewed as establishing overarching principles and best practices that are later translated into country-specific regulatory requirements and operational implementation approaches.

National authorities, including TSA in the United States and the CAA in the United Kingdom, translate these broader standards into country-specific regulatory requirements and oversight structures. Airports are then responsible for implementing those requirements through locally developed training programs that reflect their individual operating environments, workforce structures, and operational risks.

The CAA SME described a more formalized risk-based and competency-focused approach in which training programs are expected to demonstrate alignment between identified risks, operational responsibilities, and assigned training content. This includes the use of quality assurance processes, performance metrics, periodic reviews, recurrent evaluation methods, and operational demonstration of competency intended to support continued program effectiveness.

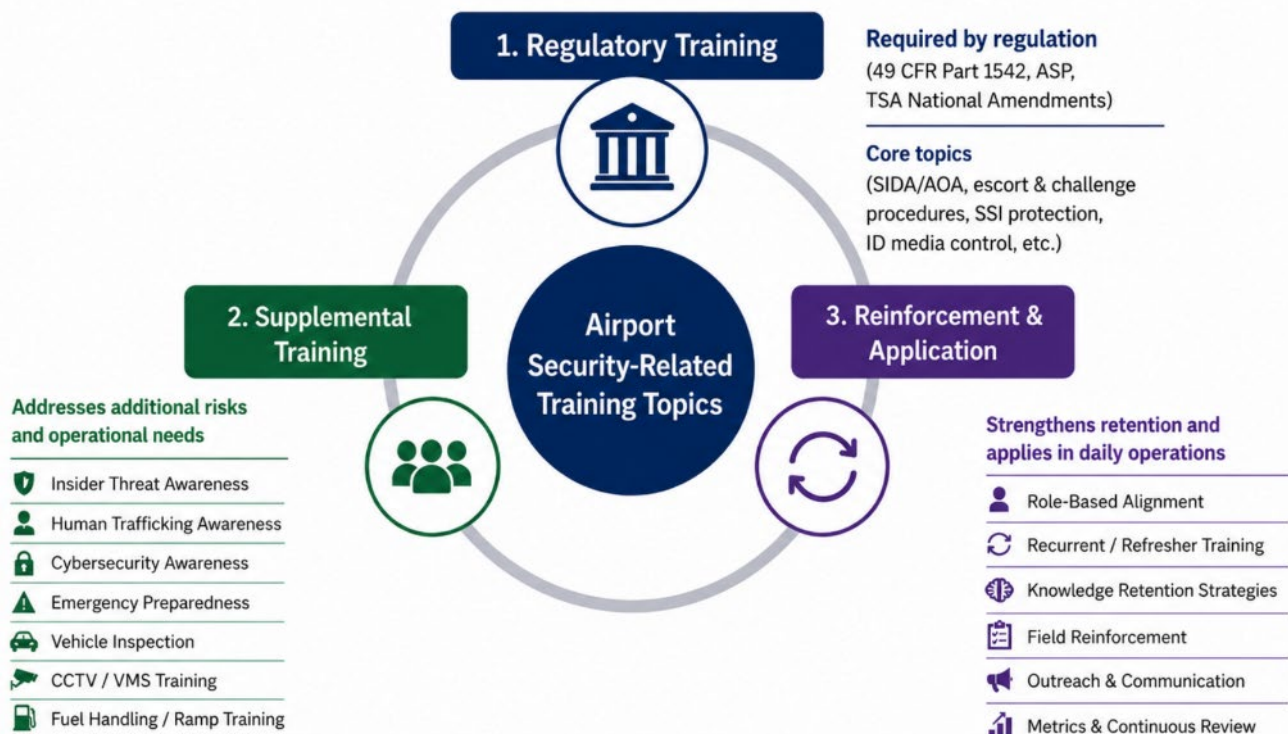
Although ICAO guidance is not directly implemented as a regulatory framework at US airports, interview findings indicated that several concepts emphasized within ICAO guidance may support enhanced and operationally focused training programs. These concepts include:

- Aligning training with operational responsibilities
- Incorporating competency-based principles
- Reinforcing recurrent learning
- Validating the practical application of training within the operational environment

From a practical standpoint, the international perspective was most valuable in reinforcing themes also identified through interviews with participating airports and business partners. Across both domestic and international perspectives, interview findings and literature consistently emphasized the importance of aligning training content with operational roles, identified risks, competency expectations, review processes, and practical application within the operational environment. Figure 4 illustrates the major categories of security-related training topics identified through stakeholder interviews, including regulatory training, supplemental training, and reinforcement and application activities.

Figure 4. Components of Airport Security-Related Training Topics

Components of Airport Security-Related Training Topics



2.3 Volume of Content and Mitigating Information Overload

Interviews with participating airports and business partners identified training content volume as a consistent challenge across airport security training programs. While required regulatory topics are largely uniform, the amount of training program content often expands as additional regulatory detail, supplemental topics, and airport-specific requirements are incorporated, which may result in training programs that contain a high volume of information relative to the time available for comprehension and retention.

Required regulatory topics are often presented alongside additional security-related and operational content, including emergency preparedness, insider threat awareness, cybersecurity awareness, and other airport-specific requirements. In some cases, non-security-related topics, such as customer service expectations or operational procedures, are incorporated into the same training curriculum. The cumulative effect is training programs that contain a large volume of information that learners must absorb and apply within operational environments.

This content is typically delivered through structured modules that combine the training topics with supporting explanations and procedural detail. Modules often include definitions, required behaviors, and scenario-based examples, along with knowledge checks intended to confirm understanding. While this level of detail is necessary to support compliance and operational awareness, combining multiple detailed modules into a single training sequence can make it more difficult for learners to distinguish between critical requirements and supporting information.

Several airports described efforts to better manage content volume by refining the scope of required training material and distinguishing between essential regulatory content and additional or supplemental topics. These efforts included reviewing existing training modules to identify overlap, consolidating duplicative material, and removing content that was not directly relevant to security responsibilities. In some cases, airports reported restructuring content to emphasize key regulatory requirements while relocating less critical material to supplemental training or other communication channels.

Examples from participating airports also demonstrated how training content can be refined to better align with operational responsibilities and reduce unnecessary training burden without removing required material. One Cat I airport with approximately 6,000 badge holders established a dedicated Training Coordinator position within the security office responsible for reviewing and managing training content across the airport community. This role included identifying redundant or unnecessary material, aligning training topics with job-specific responsibilities, and developing targeted training modules where needed. As part of this effort, the airport developed role-based content for certain operational groups, including an in-person vehicle inspection course focused on required procedures and regulatory expectations. This approach allowed the airport to maintain required content while improving clarity and relevance. Interview findings also suggested that assigning dedicated personnel to oversee security training program management may support greater consistency, improved coordination, and stronger alignment between training content and operational responsibilities.

This approach also aligned with input from the CAA SME, who emphasized the importance of having qualified personnel responsible for managing and maintaining aviation security training programs.

**KEY OPERATIONAL INSIGHT**

Assigning **dedicated staff** to oversee training content, coordination, and updates can **help airports better align training** with operational responsibilities and reduce unnecessary or duplicative material.

Business partners described a similar challenge related to content volume, but they frequently addressed it through structured organization of training material. Training content was typically grouped by job function and operational responsibility, allowing employees to focus on the material most relevant to their role. Rather than expanding general awareness content across all employees, business partners reported assigning specific modules based on task requirements, performance trends, and operational risk, which helped limit unnecessary exposure to unrelated content. For example, rather than requiring all personnel to complete a single, comprehensive training module covering access control, escort procedures, vehicle operations, and emergency response, business partners described structuring content into shorter, role-based modules, as illustrated in Figure 3.

Under this approach, a tenant employee with unescorted access but no operational responsibilities would complete core regulatory training and a focused module on ID media and challenge procedures, while personnel assigned to vehicle gate operations would complete additional modules specific to vehicle inspection protocols, access point procedures, and escalation requirements. This structure allowed employees to receive only the training directly relevant to their responsibilities while ensuring that higher-risk roles received more detailed, task-specific instruction.

**KEY OPERATIONAL INSIGHT**

Role-based training assignment approaches may **improve operational relevance** while reducing unnecessary training burden and information overload for employees whose duties do not involve higher-risk operational responsibilities.

The academic SME similarly noted that training programs often attempt to include too much information within a single curriculum, particularly when additional topics are layered onto existing requirements over time. This accumulation can result in content that is technically complete but difficult for learners to absorb or apply effectively. Supporting research similarly indicates that when large volumes of information are presented without clear prioritization or segmentation, learners are less likely to retain and apply key concepts in operational settings (Sweller et al., 2011; Bjork & Bjork, 1992).

Interview findings also consistently suggested that approaches focused on prioritization, removal of redundant content, alignment with job function, and clearer separation of supplemental material may improve clarity while maintaining compliance with regulatory requirements. Managing content volume

is not simply a matter of reducing material, but of structuring content in a way that clearly distinguishes between required regulatory knowledge, supplemental awareness topics, and role-based responsibilities.

These observations also reinforce that content volume should be considered alongside how training programs are designed and organized. When content is structured to emphasize critical requirements, supported by relevant operational examples and aligned with employee responsibilities, training programs are more likely to support comprehension, retention, and practical application within the airport environment.

2.4 Standardized vs. Customized Training Programs

Interview findings identified notable differences across participating airports in how required security-related training content is structured, particularly in the balance between standardized training programs and locally developed or customized content. While regulatory requirements establish a consistent baseline of required topics, airports varied in the extent to which training content was tailored to reflect local operating environments, procedures, and risks.

STANDARDIZED TRAINING

Standardized training programs, often delivered through vendor-supported platforms, were widely used to provide consistent coverage of regulatory requirements. These programs offer a structured, efficient, and cost-effective way to deliver baseline content aligned with federal regulations and industry expectations. Standardized programs were particularly valuable for ensuring consistency across large populations of badge holders and for maintaining alignment with evolving regulatory requirements. In many cases, these programs served as the primary method for delivering core training such as SIDA and Authorized Signatory content.

However, standardized programs may not fully capture airport-specific procedures, local enforcement practices, or unique operational conditions without additional customization. Several airports noted that vendor-provided content is often generalized and may require supplemental material or clarification to ensure that employees understand how requirements are applied within their specific airport environment. In some cases, vendor platform costs, system constraints, or restricted editing capabilities limited the extent to which airports could modify or tailor content beyond basic additions. Vendor-supported programs often incorporate structured quality assurance processes that limit direct airport modification of regulated training content, requiring airports to coordinate updates and customization through the training provider.

CUSTOMIZED TRAINING

In contrast, customized training programs allow airports to develop content directly aligned with their specific operating environment. These programs often incorporate airport-specific procedures, facility layouts, local policies, and operational expectations. Examples provided in interviews included developing targeted modules for specific functions, such as CCTV system use and access control or inspection procedures. These modules typically included detailed, task-specific content reflecting how procedures are carried out within the airport environment rather than presenting requirements in a generalized format.

Customized modules often provided greater specificity than standardized content by incorporating step-by-step procedural expectations, real-world examples, and scenario-based situations tied to actual job responsibilities. For example, training developed for fuel handlers may address specific requirements for vehicle positioning, bonding and grounding procedures, coordination with airport operations, and emergency response expectations associated with fuel spills or safety incidents. Access control or

inspection-related training may include credential verification procedures, recognition of prohibited items, challenge and escalation protocols, and inspection procedures associated with vehicle gates or access points. CCTV or VMS training may include instruction on system navigation, camera usage protocols, monitoring responsibilities, incident documentation, and protection of SSI. One participating airport described delivering this training annually through a computer-based training (CBT) module that typically requires approximately 30 minutes to complete.

Additional interview examples included customized training modules developed for security guard responsibilities, Sterile Area and public area badge procedures, concession inspections, emergency response coordination, passenger boarding procedures, and access point operations. Some airports also described developing targeted refresher modules or supplemental awareness training tied to recurring operational issues, audit findings, or observed compliance trends. These modules were typically designed to reinforce operational expectations and provide employees with clearer guidance regarding how security-related procedures apply within their specific work environment. This level of detail allows training content to more closely align with operational tasks and responsibilities while reinforcing how regulatory requirements are applied in practice within the airport environment.

Airport Example: Targeted Role-Based Training

Nashville International Airport (BNA) described developing a custom Fuel Handler training module specifically for employees responsible for fuel handling operations at the airport. The training is delivered through the airport's CBT platform and may be completed either remotely or within the airport badging office/training room based on operational scheduling needs and training space availability.

According to BNA, the course was developed at the request of the airport's Aviation Fuel Safety Inspector and Fire Training Coordinator to provide an additional layer of fuel safety training for personnel performing these responsibilities. The module includes airport-specific operational expectations associated with fuel handling activities and is required only for employees performing fuel handling functions.

BNA also described developing targeted CBT modules for security guard personnel and passenger boarding responsibilities requiring jet bridge access. These modules are assigned only to personnel performing those operational functions and are intended to provide additional role-based reinforcement beyond baseline regulatory training requirements.

Many airports described using a blended approach, combining standardized core content with locally developed modules to address airport-specific needs. In this model, standardized programs provide a consistent regulatory foundation, while customized content is used to reinforce local procedures and address operational considerations not fully captured in vendor-based training. The extent to which this approach is implemented varied based on factors such as airport size, available resources, technical capability, and control over the training platform.

Business partners described a similar model but with greater consistency in how content is structured across locations. Standardized corporate training modules were typically used to establish a baseline aligned with regulatory and international requirements, while location-specific procedures, post orders, and operational expectations were incorporated at the local level. Unlike many airports, business partners reported updating location-specific content more frequently in response to client requirements, audit findings, and operational changes while maintaining a stable core curriculum.

The CAA SME described a comparable framework in which nationally defined training syllabi establish required subject areas while airports retain responsibility for implementing and adapting those

requirements within their operating environment. The SME also noted that trainers are audited and evaluated for their ability to deliver the material effectively, reinforcing the importance of assigning training responsibilities to individuals with demonstrated instructional capability. This model supports a consistent baseline while allowing flexibility for local application and maintaining attention to the quality of training delivery.

Standardized training programs provide consistency and regulatory alignment, while customized training enhances operational relevance, role specificity, and applicability within the airport environment. Interview findings and literature consistently suggested that blended approaches integrating standardized baseline content with locally tailored modules may provide the greatest flexibility for balancing regulatory compliance with airport-specific operational needs.

2.5 Reactive vs. Risk-Based Content Development

Interview findings identified notable differences in how participating airports develop, expand, and maintain security-related training content. While all airports incorporate required regulatory topics, the process used to determine additional content, level of detail, and training emphasis varied significantly across organizations. Interviews revealed a distinction between more reactive approaches driven by operational events or compliance concerns and more structured, risk-based approaches that align training content with operational risk, role responsibilities, and identified vulnerabilities.

REACTIVE CONTENT DEVELOPMENT

Across interviews, many participating airports and business partners described training content development as largely reactive in nature. Under this approach, training content is expanded incrementally over time in response to specific triggers such as regulatory updates, audit findings, security incidents, observed compliance deficiencies, operational concerns, or stakeholder requests. When a new issue emerges, additional material is often added to existing training programs to address the identified concern, reinforce expected procedures, or reduce the likelihood of recurrence.

Some airports described adding targeted awareness content or refresher modules following repeated badge violations, escort failures, challenge procedure deficiencies, or operational concerns identified during inspections, audits, or field observations. Others noted that additional training topics are often introduced following TSA findings, local incidents, recurring compliance trends, or requests from operational departments, tenants, security personnel, or other airport stakeholders seeking to reinforce specific procedures or address identified vulnerabilities. This process can result in training programs that continue to expand as additional requirements, awareness topics, and operational procedures are layered onto existing modules.

Supplemental training can provide significant operational value when content is intentionally aligned with specific job functions, access privileges, operational responsibilities, or identified risks. Several airports described using targeted supplemental modules to reinforce higher-risk procedures, address operationally sensitive responsibilities, or provide role-based instruction not fully captured within baseline regulatory training. Interviewees generally distinguished between structured, role-based supplemental training and the continued accumulation of unrelated awareness topics within broad baseline onboarding programs.

While reactive approaches allow airports to remain responsive to evolving operational needs and emerging security concerns, interview findings indicated that this model can also contribute to gradual expansion of training content without a structured process for prioritization, reassessment, or integration. New material is not always accompanied by a review of existing content,

resulting in overlapping information, inconsistent depth across topics, and limited differentiation between critical regulatory requirements and supplemental awareness material.

This incremental growth in training content directly aligns with broader concerns identified in earlier sections regarding content volume and information overload. As additional material is added over time, training programs may become increasingly difficult for employees to navigate, absorb, and apply effectively within operational settings.

RISK-BASED CONTENT DEVELOPMENT

Some business partners and the CAA SME described more structured approaches in which training content is developed and maintained using defined risk considerations and operational exposure as primary decision-making factors. Under this model, training topics, level of detail, and reinforcement priorities are aligned with the likelihood and potential impact of security-related risks associated with specific roles, tasks, environments, or access privileges.

Rather than broadly expanding content across all personnel, these approaches prioritize training depth based on operational relevance and employee responsibilities. Interviewees described assigning more detailed, task-specific content to personnel performing higher-risk or security-sensitive functions while limiting lower-risk roles to more focused awareness-based training aligned with their responsibilities.

This approach also influenced the structure and specificity of individual training modules. Personnel responsible for vehicle screening, access control, inspections, escort responsibilities, or other security-sensitive functions often received more detailed procedural training incorporating step-by-step expectations, escalation protocols, operational decision-making guidance, and examples of both compliant and non-compliant behavior. Interview findings also identified airports developing specialized modules for vehicle gate operations, fuel handling activities, CCTV responsibilities, and public area or Sterile Area access procedures where operational errors or non-compliance could create elevated security concerns.

Airport Example: Risk-Specific Content

Ontario International Airport (ONT) described a similar role-based approach through its Vehicle Gate Operator course, which is assigned to personnel responsible for operating or responding to incidents at airport vehicle gates, including Airport Security, Airport Police, Airfield Operations personnel, and other designated operators. ONT described the course as targeted to personnel with direct gate operation responsibilities rather than the broader badge-holder population, allowing more detailed instruction to be focused on employees performing higher-risk access control functions.

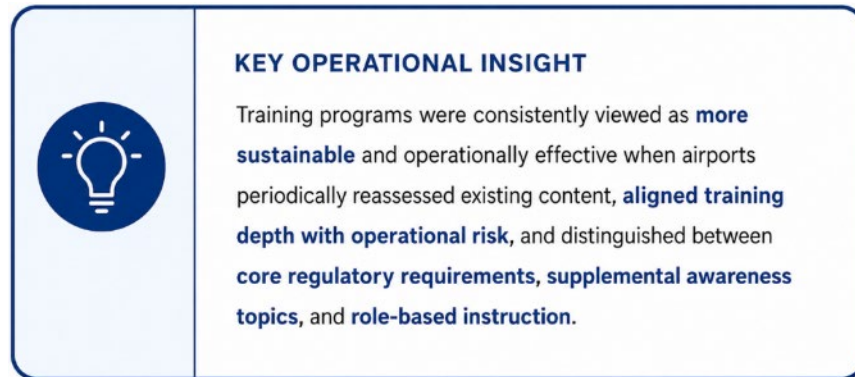
Several interviewees described efforts to better align training assignments with operational exposure by separating generalized awareness content from role-based procedural instruction. In practice, this included assigning targeted modules only to personnel responsible for specific operational tasks rather than requiring all employees to complete the same expanded curriculum. Business partners described a particularly structured application of this model, linking training assignments directly to job function, operational exposure, audit findings, incident trends, and client-specific requirements. This approach helped reduce unnecessary content exposure while ensuring that higher-risk personnel received more detailed and operationally relevant instruction.

INTEGRATION OF RISK AND CONTENT DESIGN

Input from the CAA SME reinforced the importance of aligning training content with identified operational risks and competency expectations rather than continuously expanding training requirements

without reassessment. Within this framework, training effectiveness is influenced not only by the amount of content included, but by how clearly training supports the knowledge, skills, and operational behaviors required for specific roles and environments.

Interview findings similarly suggested that more sustainable training programs are developed when airports periodically reassess existing content, evaluate whether training depth aligns with operational risk, and distinguish between core regulatory requirements, supplemental awareness topics, and role-based operational instruction. Several interviewees noted that training programs become increasingly difficult to manage when additional content is continuously added without structured review, prioritization, or refinement of existing material.



Interview findings consistently indicated that **aligning training content with operational risk may help improve relevance, reduce unnecessary complexity, and support more effective operational application of security-related procedures**. Rather than relying solely on expansion of existing curricula, more structured approaches emphasized prioritization, targeted depth, periodic reassessment, and clearer alignment between training content and operational responsibilities.

While reactive content development remains common across airport environments, more structured, risk-based approaches may provide a more sustainable framework for managing training content over time. Aligning training topics and level of detail with operational risk allows airports to maintain required regulatory coverage while improving relevance, clarity, and applicability within the operational environment.

The findings support a structured approach in which training content is periodically reassessed, aligned with operational exposure, and reinforced through targeted operational application and recurring reinforcement activities. Figure 6 summarizes an approach to organizing airport security training content based on regulatory foundations, operational risk alignment, targeted supplemental instruction, and continuous review processes. Practical steps for applying these findings are provided in Section 5.

Figure 5. Structured Approach for Organizing Airport Security Training



SECTION 3: TRAINING DELIVERY, STRUCTURE AND APPLICATION

Findings from interviews indicate that the effectiveness of airport security training programs is influenced not only by the content that is delivered, but also by how training is structured, sequenced, delivered, reinforced, and applied within the operational environment.

Supporting literature reinforces these observations, indicating that training retention and operational performance are influenced not only by the amount of information delivered but by how training is sequenced, reinforced, and applied over time. Research related to cognitive load, spaced reinforcement, and contextual learning suggests that employees are more likely to retain and apply information when training is delivered in manageable segments, reinforced through repetition and application, and aligned with real-world operational tasks (Sweller et al., 2011; Bjork & Bjork, 1992).

This section examines how training programs are delivered in practice, including the methods used to present content, the environments in which training occurs, and the timing and sequencing of training events. It also explores how airports and business partners structure recurrent and remedial training, reinforce key concepts over time, and adapt training delivery approaches to support long-term knowledge retention and operational application within the airport environment.

3.1 Training Delivery Methods

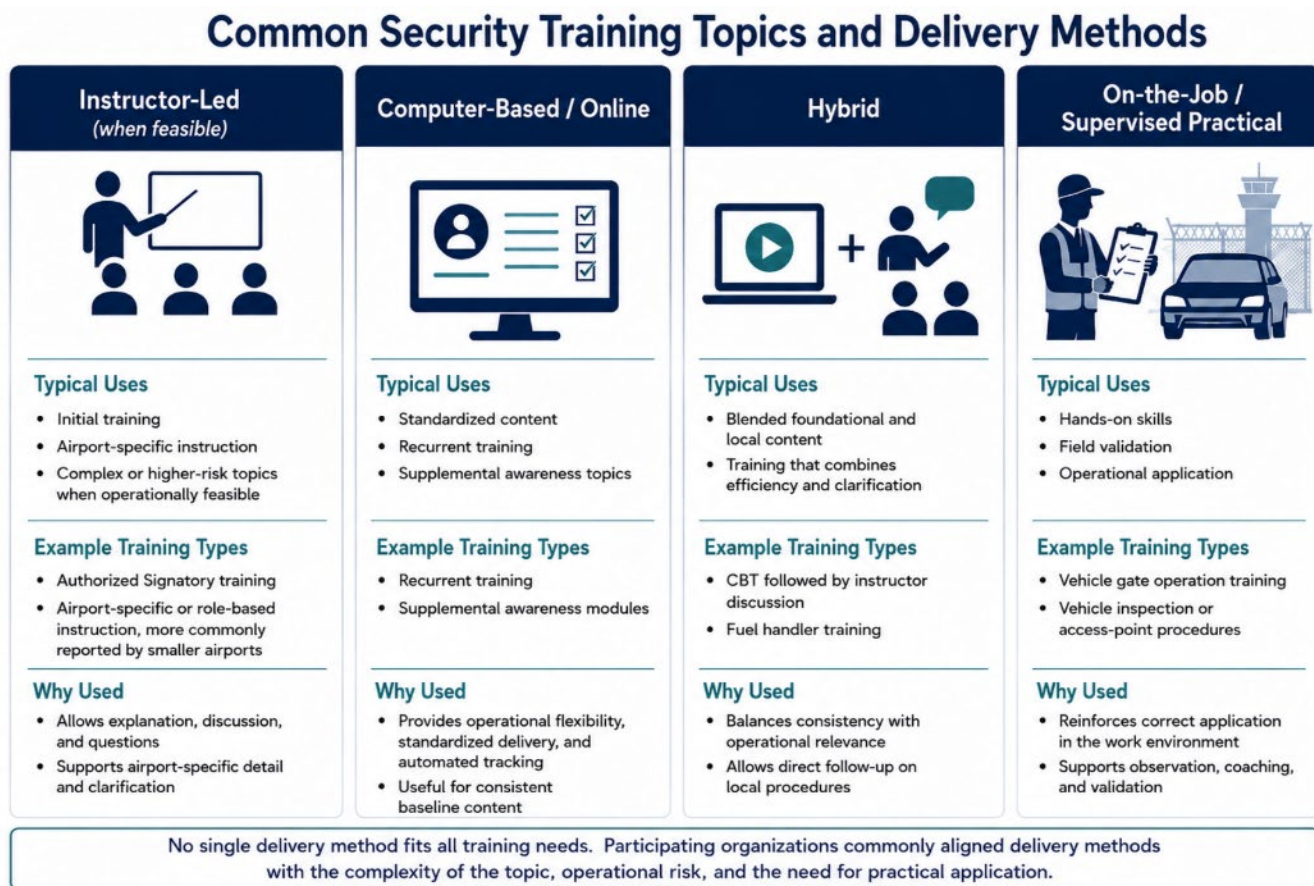
Interview findings identified a wide range of approaches used to deliver airport security-related training, with variation influenced by workforce size, operational tempo, badging throughput demands, available infrastructure, and airport-specific operational requirements. While all participating airports are required to provide training that satisfies regulatory requirements, the methods used to present and reinforce that training differed significantly across organizations and were consistently identified as influencing how effectively information is understood, retained, and applied within the operational environment.

Initial airport security training was frequently conducted on-site, either through proctored computer-based training, instructor-led training, or a combination of both. Most participating airports described using multiple delivery methods simultaneously rather than relying on a single approach, with delivery decisions often shaped by the complexity of the topic, operational risk, workforce accessibility, and the need to balance efficiency with practical application.

Across all delivery methods, no single training approach was universally viewed as most effective for all training needs. **Training effectiveness is generally strengthened when delivery methods are intentionally aligned with the type of content being delivered, the complexity of the operational task, and the level of reinforcement required for successful application within the airport environment.** Standardized awareness content and recurrent topics may be effectively delivered through CBT or online platforms. Training on operationally sensitive tasks, including vehicle inspections, access control procedures, challenge and escort responsibilities, and certain Authorized Signatory functions, often benefit from instructor involvement, hands-on demonstration, operational discussion, or field validation to reinforce correct application within the operational environment.

As shown in Figure 7, participating airports and business partners used different delivery methods based on the type of content, the complexity of the task, and the level of practical application required. The examples illustrate commonly identified patterns rather than a single prescribed approach. Each of the training types is further discussed in the subsections below.

Figure 6. Alignment of Common Security Training Topics and Delivery Methods



INSTRUCTOR-LED TRAINING

Instructor-led sessions were frequently incorporated into initial security training, particularly for Authorized Signatory training and operational topics requiring greater interaction, discussion, or practical engagement, such as vehicle gate operations. In-person instruction allowed instructors or badging-office staff to answer questions in real time, reinforce airport-specific expectations, clarify misunderstandings, and incorporate practical examples tied to local operating conditions. Several airports emphasized that direct interaction provided greater opportunity for discussion, engagement, and immediate clarification regarding challenge procedures, escort requirements, ID media responsibilities, and other critical security concepts.

At the same time, interview findings indicated that maintaining fully instructor-led training programs can be operationally challenging, particularly at larger airports with high volumes of badging activity. Several Cat X and Cat I airports with badge populations ranging from approximately 12,000 to more than 40,000 badge holders described difficulties associated with classroom scheduling, staffing limitations, classroom availability, and the need to process large numbers of employees, tenants, contractors, and vendors through badging requirements within compressed onboarding timelines. These airports frequently noted that fully in-person training models can create operational bottlenecks during peak badging periods or major tenant onboarding events.

In contrast, several smaller airports, generally those with approximately 4,000 ID media holders or fewer, described greater flexibility in maintaining classroom-based approaches due to lower training volumes and smaller badging populations. In these environments, training personnel were often able to

provide more individualized instruction and direct interaction with trainees throughout the onboarding process.

COMPUTER-BASED TRAINING AND ONLINE DELIVERY

CBT and online delivery platforms were widely used across participating airports to support both initial and recurrent training requirements. Interviewees noted that online systems provide operational flexibility, standardized delivery, automated tracking, and the ability for employees to complete training remotely or asynchronously. These systems were commonly used for recurrent training, supplemental awareness modules, and situations where classroom instruction was impractical due to scheduling or staffing constraints.

Interviewees and training developers described a structured implementation process for CBT programs that typically begins with standardized course templates aligned with current regulatory requirements. Airports then work collaboratively with training providers to customize content to reflect airport-specific procedures, access control methods, local terminology, and security program requirements. This process often includes scripting, content review, airport approval, recording, editing, and Learning Management System (LMS) configuration prior to deployment.

Interview findings also highlighted operational and administrative considerations associated with online delivery platforms. Configuration elements may include assessment thresholds, pass/fail criteria, automated notifications, user access controls, course assignment logic, and retake restrictions within the LMS environment. Standardized training solutions can often be deployed relatively quickly while highly customized airport programs may require substantially longer implementation timelines due to coordination and approval requirements involving airport operators, tenants, training providers, and regulatory stakeholders. Highly customized SIDA training programs often require substantially more development time than standardized baseline modules due to scripting, airport review cycles, coordination with stakeholders, and approval requirements associated with airport-specific operational content. In cases where Authorized Signatory training was delivered through CBT or online platforms, interviewees generally described the content as more standardized across airports and less frequently customized beyond local procedural references. However, many airports also described maintaining some level of instructor interaction, on-site participation, or operational review as part of the Authorized Signatory training process.

Interview findings identified significant variation in how airports configure assessment and retake requirements within CBT platforms. Several airports reported minimum passing thresholds in the range of approximately 80 to 90 percent for most required training modules, while others described requiring 100 percent passing scores for certain security-sensitive courses prior to badge issuance. Retake policies also varied, with some airports permitting unlimited retest attempts and others limiting employees to a defined number of attempts before requiring instructor intervention or reassignment of the training module. Interviewees noted that retake limitations are often intended to discourage repeated guessing or memorization of assessment answers without sufficient comprehension of the underlying material. Several stakeholders indicated that requiring delayed retesting, instructor involvement, or partial retraining following repeated failures is intended to reinforce understanding of operational responsibilities rather than allowing employees to progress through training solely by repetition.

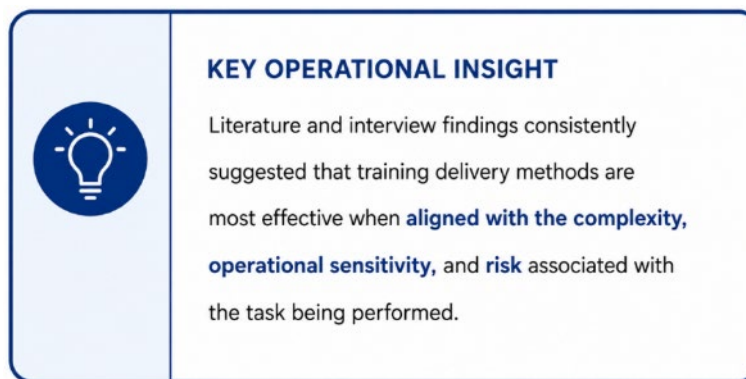
Examples described by interviewees included airports limiting employees to three testing attempts within a defined period before requiring instructor intervention, delaying retesting until the following day, or requiring employees to repeat portions of training prior to additional test attempts. Other airports reported using automated proctor notifications or supervisory review following repeated assessment failures. Some interviewees also described incorporating knowledge checks throughout training modules

rather than relying solely on a final assessment to evaluate comprehension and reinforce critical concepts during course progression.

Airport Example: Testing and Competency

ONT described incorporating both formal testing and operational competency validation within its Vehicle Gate Operator program. The course includes an 80-question assessment requiring a 90 percent passing score in addition to live operational evaluation conducted by Public Safety personnel during onsite gate operations. Trainees are not authorized to independently operate vehicle gates unless they successfully demonstrate operational competency during the practical training portion.

Despite the operational efficiencies associated with CBT delivery, interviewees consistently identified limitations related to interaction, clarification, and practical application. Several airports and business partners indicated that while online delivery is effective for standardized awareness content and recurrent training requirements, it may be less effective for complex procedures, operational decision-making, or task-specific responsibilities without additional reinforcement or field-based application.



Several airports also described incorporating follow-up verification measures for training completed remotely, including in-person questioning during badge pickup, random knowledge-validation checks, or supervisor observation during initial operational activities. Interviewees noted that these measures were intended to confirm employee comprehension, verify that the assigned employee completed the training, and reduce the risk of individuals completing training without fully understanding operational requirements.

A Cat X airport with approximately 46,000 ID media holders described conducting selected in-person verification checks for certain remotely completed training courses. Questions were drawn from the original training material, and verification includes a short proctored CBT-based quiz with badging-office staff upon arrival at the badging office to receive ID media. Applicants requesting new or renewed ID media are randomly selected using the airport appointment scheduler.

Airports considering a similar approach could establish a sampling percentage, determine the number of employees to be verified during a defined period, and use appointment, reservation, or check-in records to identify individuals for follow-up testing. For example, an airport could select 20% of the employees completing a remote course during a particular business day and assign those individuals a brief on-site knowledge check. This process can help confirm training completion and comprehension while reinforcing key airport-specific requirements.

LANGUAGE ACCOMMODATION

Language accommodation also emerged as an important operational consideration across several participating airports. One airport described offering pre-training support in an employee's native language to improve comprehension prior to formal instruction. A business partner similarly reported using bilingual instructors or providing clarification in an employee's primary language during onboarding while maintaining English-language testing to meet local policy.

Several airports reported permitting SIDA-badged stakeholders to provide verbal interpretation for non-English-speaking employees during training when translated course materials were not available. These individuals were limited to interpretation only and were not permitted to assist with answering questions, explain content, or otherwise influence employee test responses. One Cat I airport with approximately 5,000 ID media holders required employees requesting interpretation support to sign a "Request for Translator Assistance" acknowledgment form as part of its language accommodation process, as shown in Figure 8.

Airports could use this form or develop a similar acknowledgment to document the request for interpretation assistance, identify the translator, define the translator's limited role, and obtain the appropriate signatures. If desired, the form could also be provided in the primary language of both the employee and the translator to support clear understanding of the process and its requirements.

These approaches reflect efforts to balance regulatory compliance with practical comprehension needs in linguistically diverse workforce environments. Interview findings also suggested that business partners may have greater flexibility in implementing language-support strategies because of differences in workforce composition, onboarding practices, and operational structure.

Figure 7. Example Airport Translation Assistance Request Form for Security Training

Request for Translators Assistance Airport Badge Security Training	
Name: _____	Badge # _____
Phone Number: _____	
Email Address: _____	
Language for Translation: _____	
Organization/Company Name: _____	
<u>Translator's information</u>	
Name: _____	Badge # _____
Phone Number _____	
Email _____	
Organization/Company Name: _____	
By submitting this form, I acknowledge that I am requesting translation assistance for the Airport Badge Security Training. I understand that the accuracy and quality of the translation may impact the effectiveness of the training program. I also understand that I must complete the work for myself and the translator can not do the work for me. If it is discovered that the translator is doing the work for me, a notice of violation will be issued to both of us, and both badges could be revoked.	
Badge Holder Signature	Date
Translator	Date
Trusted Agent	Date

Source: Provided by participating airport interviewee

ON-THE-JOB TRAINING AND OPERATIONAL VALIDATION

On-the-job training was consistently identified as an important component of effective training delivery, particularly for operationally sensitive roles involving access control, vehicle inspections, CCTV/VMS responsibilities, escort procedures, or security-sensitive system use. **Certain operational tasks cannot be fully reinforced through classroom or online instruction alone and require supervised practical application within the operational environment.**

Examples from participating airports included observed vehicle gate training in which employees were required to demonstrate competency before independently conducting inspections or screening procedures, as well as supervised system-specific training for personnel granted access to VMSs or access control tools. Several airports described field validation processes in which supervisors or trainers observe personnel performing operational tasks and provide immediate correction or reinforcement where needed.

Business partners described similar delivery methods but often with more structured integration between classroom instruction, CBT delivery, and supervised operational training. Interviewees noted that training delivery methods are frequently selected based on task complexity, operational exposure, regulatory sensitivity, and client-specific requirements. Several business partners also described cohort-based onboarding models in which employees complete foundational security awareness training first, followed by role-based instruction and supervised operational application aligned with assigned responsibilities.

HYBRID DELIVERY APPROACHES

Many participating airports described using hybrid delivery approaches that combine online modules with instructor-led sessions, practical demonstrations, or field-based validation. In these models, foundational awareness content is often delivered through CBT platforms, while classroom sessions or operational training are used to reinforce airport-specific procedures, answer questions, conduct assessments, or validate operational competency. This blended approach provides a balance between operational efficiency and practical reinforcement.

Airport Example: Blended Vehicle Gate Operator Training

The Vehicle Gate Operator training program at ONT combines approximately one hour of classroom instruction with an additional two to three hours of in-person practical training conducted onsite at an operational vehicle gate with a Public Safety representative. The classroom component uses PowerPoint-based materials and focuses on rules and regulations related to airport searches, vehicle inspection procedures, computer systems, and Vehicle-Borne Improvised Explosive Device awareness. The practical portion then moves trainees to an operational vehicle gate, where the Public Safety representative guides them through gate operation procedures and vehicle inspection expectations. Although ONT does not administer a separate written test for the onsite portion, trainees are evaluated throughout the practical exercise and are not authorized to independently operate the gate unless they demonstrate full competency in the required procedures. ONT reported that this training has contributed to improved compliance, and that vehicle gates are now among the areas where the airport experiences fewer operational issues.

3.2 Training Duration, Scheduling, and Volume Constraints

Interview findings identified training duration, scheduling, and onboarding throughput demands as significant factors influencing how airport security training is experienced in practice. Airports must often deliver required training within compressed onboarding timelines shaped by workforce availability, classroom capacity, operational continuity, and badging throughput requirements.

Across participating airports, employees frequently complete multiple required training elements before receiving credentials or beginning operational duties. Interviewees described onboarding processes that commonly combine SIDA training, challenge and escort procedures, ID media requirements, driver training, airport-specific policies, and role-based operational instruction within limited timeframes. Several Cat X and Cat I airports specifically noted that maintaining efficient onboarding processes while processing large numbers of employees, tenants, contractors, and vendors creates significant pressure to streamline training delivery and minimize operational delays.

Interview findings also indicated that onboarding complexity is influenced not only by required regulatory training, but by the accumulation of operational, system-specific, and administrative requirements assigned during the same onboarding period. Several airports described employees completing multiple LMS assignments simultaneously, including security training, operational

procedures, airport orientation material, and non-security administrative coursework before beginning work responsibilities.

Business partners providing training development and implementation services described relatively consistent duration patterns for core regulatory programs across airports, although total onboarding time frequently varies based on customization, assessments, supplemental modules, and airport-specific operational requirements. Based on aggregated implementation data, customized SIDA training programs generally average approximately 50 to 55 minutes in duration, including instructional content and examinations. Authorized Signatory training was consistently described as shorter and more standardized, typically averaging approximately 15 to 20 minutes. Standardized CBT modules commonly range from approximately 30 to 60 minutes depending on course structure and customization levels. Examples of training duration patterns reported by participating airports and business partners are summarized in Figure 9.

Figure 8. Initial Airport Security Training Durations Reported by Participating Organizations

INITIAL SECURITY TRAINING DURATIONS

Examples Reported by Participating Airports and Business Partners

	AUTHORIZED SIGNATORY (AS) TRAINING Standardized program focused on regulatory responsibilities.	 15–20 MINUTES
	STANDARDIZED CBT MODULES Typical duration for standardized security awareness, challenge/escort, and recurrent CBT modules.	 30–60 MINUTES
	CUSTOMIZED SIDA TRAINING Includes instructional content, examinations, airport specific requirements and information.	 50–55 MINUTES AVERAGE
	ADDITIONAL AIRPORT-SPECIFIC MODULES Includes operational procedures, system training, role-based instruction, and other supplemental requirements.	 VARIES BY AIRPORT AND OPERATIONAL ROLE



Interview findings indicated that total onboarding duration often extends significantly once airport-specific operational requirements, supplemental modules, and role-based instruction are incorporated into the training process.

Interview findings indicated that total onboarding duration often extends significantly once airport-specific operational requirements, supplemental modules, and role-based instruction are incorporated into the training process.

Several interviewees emphasized that training challenges are often driven less by the existence of required security topics and more by how training is scheduled, combined, and sequenced during compressed onboarding timelines or periods of high-volume hiring. Airports and business partners described situations in which multiple unrelated training requirements are consolidated into a single onboarding sequence for efficiency. Interviewees frequently noted that these compressed and highly

consolidated onboarding environments can make it more difficult for employees to distinguish between critical security procedures, supplemental awareness information, and administrative requirements, potentially reducing comprehension, retention, and consistent operational application of higher-risk responsibilities.

Supporting literature reinforces these observations. Research related to cognitive load and memory retention indicates that comprehension and long-term retention decline when large volumes of information are delivered within compressed training sessions without opportunities for reinforcement or staged application (Sweller et al., 2011). Research also suggests that front-loaded training models contribute to faster knowledge decay when learning is not reinforced through repetition and operational application over time.

Participating airports described several approaches intended to improve training usability and reduce onboarding fatigue without eliminating required content. Several airports reported separating non-security material from required security training programs, allowing SIDA and other regulatory courses to remain focused on critical security concepts while assigning airport orientation, administrative policies, or customer service expectations separately through LMS platforms or follow-on onboarding sessions.

Other airports described restructuring recurring training into shorter, more focused refresher modules emphasizing challenge procedures, escort responsibilities, ID media compliance, and other higher-risk operational expectations rather than repeating full-length initial courses. Several airports also described implementing or piloting “test-out” pathways for experienced personnel who successfully demonstrate proficiency through assessments rather than completing full recurring modules. These approaches optimize training usability by allowing employees to focus more directly on critical operational responsibilities, reinforcing higher-risk procedures more frequently, and reducing unnecessary repetition of information that may be less relevant to an employee’s assigned role or operational exposure.

Business partners frequently described more structured sequencing approaches in which foundational security awareness training is completed first, followed by role-based instruction and supervised operational application aligned with assigned responsibilities. Distributing training over multiple onboarding stages allows employees to apply training more immediately within operational settings.

Several airports described field-based reinforcement and operational observation as important strategies to optimize training outcomes by reducing reliance on increasingly lengthy classroom or online instruction. Supervisors and trainers conduct operational observations, reinforce key procedures during daily work activities, and provide corrective feedback in real time rather than attempting to address every operational scenario during initial onboarding.

3.3 Training Structure and Sequencing

Interview and literature findings consistently indicated that how training is structured and sequenced plays a significant role in how effectively information is understood, retained, and applied within the operational environment. While regulatory requirements establish the topics that must be covered, airports retain flexibility in how training is organized across onboarding, recurrent training, and operational qualification processes.

Across interviews, one of the most commonly identified challenges involved heavily front-loaded onboarding models in which large portions of required training are completed at the beginning of the onboarding process before employees receive credentials or begin operational duties. Interviewees noted that this structure is often driven by operational necessity, as airports seek to complete badging

requirements efficiently while minimizing delays to onboarding, staffing, tenant access, and operational continuity. Several Cat X and Cat I airports specifically described pressure to process large numbers of employees, contractors, vendors, and tenant personnel within compressed onboarding timelines, particularly during peak hiring periods or major operational expansions.

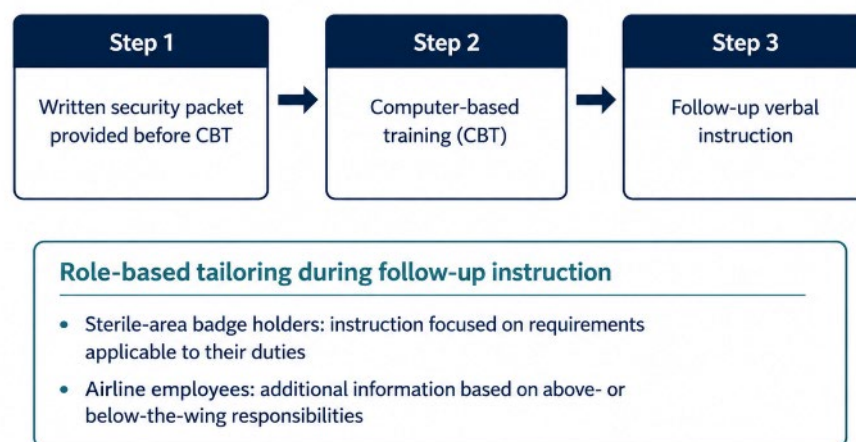
Interviewees described onboarding environments in which employees complete SIDA training, airport driver training, emergency preparedness modules, system-specific instruction, airport orientation requirements, and additional LMS assignments within the same onboarding period before beginning work responsibilities. Interviewees consistently indicated that these heavily front-loaded onboarding models can reduce comprehension and retention, particularly when foundational security concepts are presented simultaneously with detailed operational procedures, supplemental awareness topics, and role-based instruction.

Several participating airports described efforts to restructure training into more deliberate and progressive sequences separating foundational awareness content from task-specific operational instruction. Under these approaches, employees first complete baseline security awareness and regulatory training before receiving additional modules aligned with operational responsibilities, access privileges, or assigned duties. This sequencing allows employees to establish familiarity with core security expectations before progressing into more detailed operational procedures.

A Cat II airport with approximately 1,200 badge holders described using a three-part SIDA training process that combines CBT, a written security packet provided before the CBT, and follow-up verbal instruction. The airport also tailors portions of the verbal training to specific employee groups. For example, Sterile Area badge holders receive instruction focused on requirements applicable to their duties, while airline employees receive additional information based on above- or below-the-wing responsibilities. This approach maintains a consistent security baseline while allowing the airport to reinforce role-based information where needed. Figure 10 illustrates the three-part structure described by this participating airport, including the role-based tailoring provided during follow-up instruction.

Figure 9. Structured and Sequenced SIDA Training Approach

Example of a Structured and Sequenced SIDA Training Approach



Business partners described this staged approach more consistently, particularly within cohort-based onboarding environments. Employees frequently complete foundational security awareness training during initial onboarding phases, followed by role-based instruction, supervised operational training, and practical application aligned with assigned job functions. Distributing training across multiple stages

reduces onboarding fatigue and allows employees to apply concepts more immediately within operational settings rather than attempting to retain all information simultaneously.

Training effectiveness is influenced by how modules are grouped and assigned within onboarding workflows and LMSs. Several airports described situations in which training modules are bundled together primarily for administrative convenience or system limitations rather than operational relevance. This can result in employees completing unrelated modules within a single training session or receiving fragmented instruction sequences that do not align with actual workflows or job responsibilities.

To address these concerns, several participating airports and business partners described aligning training sequences more closely with operational workflows and field responsibilities. This included grouping related training topics together, sequencing instruction to mirror operational tasks, and incorporating operational validation following classroom or computer-based instruction. Examples included personnel completing foundational security awareness training prior to receiving access control instruction, followed by supervised credential verification procedures and field-based operational observation before independently performing assigned duties.

Several airports also described incorporating operational milestones into training progression. Under these approaches, employees receive additional operational responsibilities only after completing earlier training stages or demonstrating competency through assessments, supervised observation, or operational validation. This structure helps reinforce learning progressively over time and reduces reliance on one-time onboarding events as the sole method of preparing employees for operational responsibilities.

Interviewees highlighted the importance of sequencing training in ways that align with how employees actually encounter responsibilities in the field. Employees are more likely to retain and apply information when instruction is tied directly to operational context and reinforced shortly before performing related duties.

Supporting literature reinforces these observations. Research related to staged learning, cognitive scaffolding, and contextual reinforcement suggests that training retention and operational performance improve when learning is introduced progressively, reinforced over time, and connected directly to real-world application rather than delivered as isolated information transfer (Salas et al., 2012). Research on memory retention similarly indicates that learners are more likely to retain and apply information effectively when foundational concepts are established before introducing more complex or task-specific responsibilities.

3.4 Recurrent and Remedial Training

Recurrent and remedial training emerged as critical components of airport security training programs, particularly in how knowledge is reinforced, operational expectations are maintained, and deficiencies are corrected over time. While initial training establishes a baseline for regulatory compliance and operational awareness, interview findings and literature consistently indicated that long-term effectiveness depends heavily on how training is revisited, reinforced, monitored, and applied within the operational environment.

RECURRENT TRAINING

Across participating airports, recurrent training is typically required at defined intervals to maintain access privileges and ensure continued compliance with airport security program requirements. Interviewees described recurrent programs as serving multiple operational functions, including

reinforcing critical procedures, communicating policy or regulatory changes, addressing recurring compliance concerns, and maintaining awareness of employee responsibilities over time.

Interview findings indicated significant variation in how recurrent training is structured, assigned, and administered across participating airports and business partners. Several airports continue to use recurrent programs closely resembling initial onboarding courses, requiring employees to complete full-length refresher modules regardless of experience level, operational role, or prior performance history. While interviewees acknowledged that this approach provides standardized coverage of required topics, several also noted that **broad repetition of familiar material can reduce engagement and contribute to a more transactional approach to training completion.**

Several interviewees described situations in which experienced badge holders complete nearly identical recurrent training annually despite years of demonstrated operational familiarity with core concepts such as challenge procedures, escort responsibilities, and ID media requirements. Interviewees indicated that when recurrent training is perceived as repetitive or disconnected from current operational responsibilities, employees are more likely to focus on completing requirements rather than reinforcing operational understanding.

In response, several participating airports described restructuring recurrent training to focus on higher-risk operational procedures, recurring audit findings, TSA inspection trends, and compliance deficiencies observed within the operational environment. Rather than repeating full onboarding programs, these recurrent modules emphasize:

- Challenge procedures
- Escort responsibilities
- Suspicious activity reporting
- Access media compliance
- Recurring operational deficiencies identified through audits, inspections, or field observations.

Several airports also described separating supplemental awareness topics from recurrent security training and reinforcing those subjects independently through operational briefings, stand-downs, targeted bulletins, LMS assignments, or departmental communications. Interviewees indicated that this allows recurrent security training to focus on critical operational procedures while reducing unnecessary repetition of unrelated material.

A Cat I airport with approximately 6,000 ID media holders described offering a test-out option for recurrent SIDA, Authorized Signatory, and Non-movement Area training. Eligible employees may demonstrate proficiency through a knowledge assessment rather than completing the full-length refresher course. The airport identified limited classroom and lobby seating, constrained parking, and the large number of experienced employees who had successfully completed the training previously as operational reasons for offering the option. Eligibility is limited to employees with established compliance histories, successful prior training completion, and no recent operational violations or audit concerns.

Business partners described more formalized implementations of these models. Several interviewees reported using shortened refresher modules combined with scenario-based assessments, allowing experienced personnel to demonstrate competency operationally rather than repeating full-length training. In some environments, abbreviated recurrent modules were described as lasting approximately 10 to 15 minutes when employees successfully demonstrated proficiency through assessments.

Personnel failing to meet required thresholds were automatically reassigned to complete the full-length training program.

Interviewees also described variation in how recurrent training assignments and corrective interventions are triggered operationally. Some recurrent requirements are generated automatically through badge expiration cycles or LMS scheduling functions, while others incorporate additional supervisory review, audit trends, or operational observations when assigning supplemental recurrent instruction.

Some airports described using recurring field observations, random compliance checks, or operational spot inspections to evaluate whether personnel continue applying required procedures following completion of formal training. Examples included observing challenge compliance, escort procedures, credential display practices, and vehicle inspection activities within operational environments. Interviewees indicated that these observations are sometimes used to identify trends requiring broader recurrent reinforcement across departments or tenant groups.

Variation was also identified in assessment and retake policies associated with recurrent programs. Most participating airports require successful completion of examinations or knowledge assessments to demonstrate comprehension; however, interviewees described substantial differences in permitted retake attempts and escalation procedures following repeated failures. Several airports reported limiting employees to a defined number of attempts—commonly three—before requiring instructor-led intervention, supervisory involvement, or in-person retraining. Other airports permitted repeated attempts until a passing score was achieved, particularly when operational scheduling or workforce accessibility constraints limited classroom availability.

These approaches are often shaped by operational practicality, staffing limitations, workforce accessibility concerns, administrative burden, and differing organizational philosophies regarding accountability and compliance assurance.

REMEDIAL TRAINING

Remedial training was consistently described as an important mechanism for addressing operational deficiencies, compliance concerns, observed behavioral issues, and recurring performance gaps within the airport environment. Unlike recurrent training, which is generally scheduled at defined intervals, remedial training is typically triggered by specific incidents, audit findings, operational observations, security violations, or supervisor-identified deficiencies.

Interviewees described remedial training as more targeted and operationally focused than broad recurrent programs. Rather than requiring employees to repeat entire training courses, airports frequently assign corrective instruction tied directly to the observed issue or operational concern. Examples included assigning focused retraining following escort violations, repeated badge-display noncompliance, challenge procedure failures, recurring Authorized Signatory documentation errors, improper vehicle inspection procedures, and misuse of access control systems or VMSs. In some cases, remedial instruction was paired with supervisory observation, operational spot checks, or field validation prior to restoring independent operational responsibilities. Several airports described assigning targeted LMS modules or instructor-led refreshers addressing the specific procedure associated with the observed deficiency. Instructor involvement, supervisory observation, and field-based remediation can provide opportunities for immediate clarification, correction, and reinforcement that may be more effective than simply requiring employees to repeat standardized training modules independently.

Several interviewees also described escalation processes tied to repeated deficiencies or recurring operational concerns. At some airports, employees demonstrating repeated noncompliance may receive progressively more formal interventions, including additional retraining, instructor-led remediation,

supervisory counseling, temporary suspension of operational privileges, or referral back through portions of the badging process, depending on the severity of the issue.

Operational observations and field-based correction were also consistently identified as important forms of ongoing remedial reinforcement. Supervisors, trainers, and operational personnel frequently reinforce expectations in real time by correcting employee behavior during daily activities, observing performance in the field, and providing immediate feedback within operational settings. Interviewees indicated that these approaches often allow deficiencies to be corrected more effectively than relying solely on periodic classroom retraining.

Business partners described more formalized integration between recurrent training, remedial interventions, operational observations, and supervisory oversight processes. Interviewees indicated that remedial assignments are frequently informed by audit findings, incident trends, operational deficiencies, client requirements, and quality assurance reviews. For example, when an audit, incident, or operational observation reveals a recurring procedural deficiency, the organization may assign targeted retraining addressing the specific issue, followed by supervisory observation or field validation to confirm that the employee is correctly applying the procedure.

Supporting literature reinforces these observations. Research related to reinforcement learning, contextual feedback, and memory retention suggests that knowledge is more likely to be retained and operationally applied when training is reinforced through targeted feedback, repetition, and contextual application rather than relying solely on periodic repetition of broad course material. Studies related to adult learning and performance reinforcement similarly indicate that shorter, targeted retraining tied directly to observed deficiencies is generally more effective at influencing operational behavior than generalized retraining alone.

3.5 Reinforcement and Knowledge Retention

Literature and interview findings consistently indicated that the effectiveness of airport security training programs depends not only on how training is delivered, but on how effectively key concepts are reinforced, retained, and operationally applied over time. While initial and recurrent training establish baseline awareness and regulatory compliance, participating airports and business partners emphasized that long-term retention is heavily influenced by what occurs after formal training concludes within the operational environment.

Across participating airports, reinforcement methods varied based on operational complexity, staffing levels, available resources, and organizational culture. Common approaches included recurrent and refresher training, field observations, challenge testing, operational briefings, awareness campaigns, bulletins, tabletop exercises, incident reviews, and targeted follow-up training tied to compliance concerns or operational trends. Airports and business partners also emphasized that reinforcement is more effective when it is aligned with employee responsibilities, access privileges, observed risks, and recurring operational issues rather than applied uniformly across the workforce.



KEY OPERATIONAL INSIGHT

Long-term retention was more consistently associated with **reinforcement, operational application, recurring engagement, and field validation** than with increasing training volume alone.

OPERATIONAL REINFORCEMENT

Reinforcement practices ranged from informal supervisor-driven activities to more structured operational oversight and competency validation processes. In many environments, reinforcement occurred through operational observation, real-time correction, supervisory feedback, and repeated exposure to procedures during daily activities.

Interviewees consistently emphasized the importance of field-based reinforcement for operationally sensitive tasks requiring procedural accuracy, judgment, and consistent decision-making. Frequently cited examples included:

- Access control procedures
- Challenge and escort responsibilities
- Credential verification
- Vehicle inspections
- Operational reporting expectations

Several interviewees noted that while these topics are covered during formal training, **correct long-term application depends heavily on repeated operational reinforcement and supervisory oversight within the field environment.**

Several airports described situations in which employees gradually drift away from expected procedures when reinforcement is inconsistent or operational shortcuts become normalized over time. Interviewees indicated that infrequently performed tasks, particularly challenge procedures and suspicious activity reporting expectations, may degrade operationally when employees do not regularly apply or reinforce those responsibilities following initial onboarding. The academic SME similarly emphasized that training concepts are more likely to be retained when employees regularly apply or reinforce those responsibilities within the operational environment rather than relying solely on periodic classroom instruction.

Operational supervisors, trainers, and experienced personnel were consistently identified as playing a central role in reinforcing security expectations. Interviewees described supervisors and auditors conducting informal operational observations, correcting procedural errors in real time, reinforcing badge display and escort requirements during daily operations, and using routine interactions to remind employees of expected security practices. Several airports described this type of operational reinforcement as more influential to long-term behavior than formal classroom instruction alone.

Airport Example: Teach To Learn

Baltimore/Washington International Thurgood Marshall Airport (BWI) described a “Teach to Learn” approach used as a second layer of education and accountability within the badge community. Under this concept, the Compliance team reviews relevant violation footage with the individual and supervisor to reinforce what occurred, clarify expected responsibilities, and strengthen awareness of the employee’s role in maintaining airport security. As part of this process, the individual involved may subsequently provide briefings or peer discussions within their work group or organization regarding the violation, contributing factors, and proper procedures. BWI explained that this approach supports proactive reinforcement for other employees within the organization while also strengthening the individual’s own understanding and retention of the training content through the act of teaching others. The approach may be used in connection with certain violations, including some driving violations, and is intended to engage employees, supervisors, and operational stakeholders as active participants in the corrective learning process rather than treating training solely as a periodic compliance requirement or punitive response.

COMMUNICATION AND REINFORCEMENT

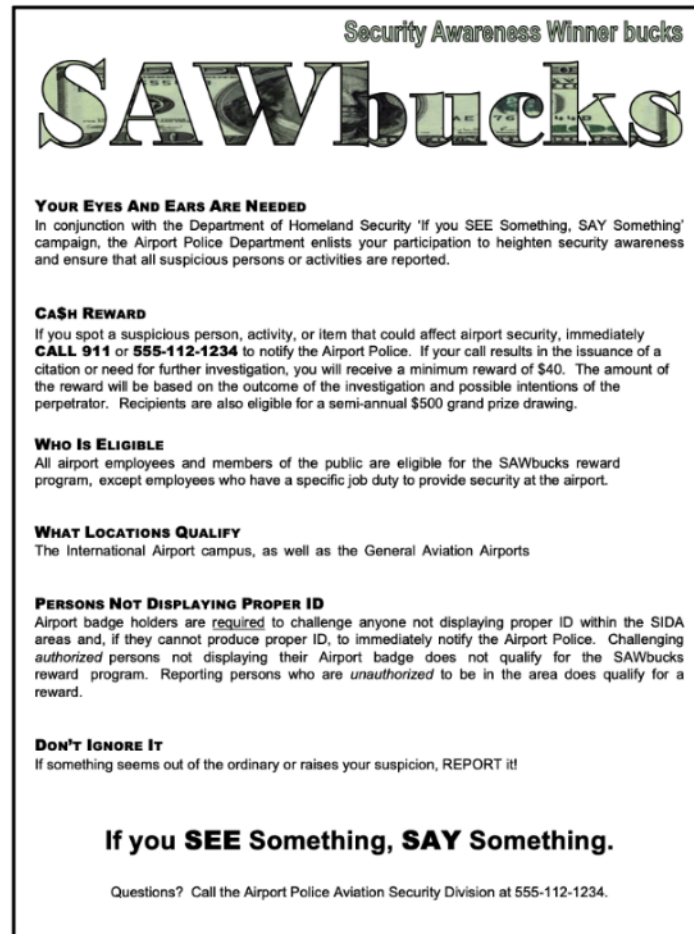
Several participating airports described using recurring communications and operational messaging to reinforce training concepts between formal training cycles. Examples included security bulletins, email reminders, recurring “security tip” campaigns, stand-down discussions, incident summaries, and targeted notifications tied to recurring compliance concerns or operational observations.

Interviewees indicated that these communications are frequently used to reinforce challenge procedures, escort responsibilities, access media compliance, and suspicious activity reporting expectations without requiring full retraining assignments. Some airports described distributing targeted reminders following TSA inspections, operational incidents, or observed trends involving repeated noncompliance within specific departments or tenant groups.

Several airports also described more structured recurring reinforcement efforts aligned with seasonal operational changes, audit findings, or airport-specific concerns. These included recurring security briefings, focused operational discussions, and department-level reminders intended to maintain awareness of critical procedures throughout the year rather than relying solely on annual recurrent training cycles. One airport also described using recurring “Security Topic of the Month” campaigns focused on specific operational concerns such as challenge procedures, escort responsibilities, suspicious activity reporting, or access media compliance. Interviewees indicated that these were reinforced through recurring bulletins, awareness flyers, stakeholder meetings, and operational reminders tied to observed trends, compliance concerns, or emerging operational issues. These focused reminders were intended to reinforce key concepts between formal training cycles without requiring full retraining assignments.

Several airports also described incorporating recognition-based reinforcement strategies intended to encourage employee engagement and sustain security awareness over time. One Cat X airport with approximately 22,000 ID media holders described a “SAWbucks” recognition initiative tied to its See Something, Say Something campaign, in which employees demonstrating positive security behaviors or reporting security concerns could receive small incentives or recognition items. Interviewees noted that these approaches were intended to reinforce vigilance, encourage participation, and support a broader culture of shared security responsibility within the operational environment. Figure 11 provides an example of a security awareness and recognition campaign used to reinforce employee vigilance and reporting expectations between formal training cycles.

Figure 10. Awareness Recognition and Reporting Reinforcement Campaign



Source: Adapted from participating airport internal memo

These findings are consistent with PARAS 0049 *Creating and Maintaining a Strong Security Culture at Airports*, which identified frequent, clear, and consistent communication, security awareness programs, and employee recognition as practical strategies for building and sustaining security culture across the airport community.

STRUCTURED REINFORCEMENT AND PERFORMANCE OVERSIGHT

Business partners described more formalized integration between reinforcement practices, supervisory oversight, and operational performance management processes. Several interviewees reported using documented operational observations, job-specific checklists, periodic competency validations, and supervisory evaluations to identify areas requiring additional reinforcement or corrective intervention.

In some environments, supervisors conduct recurring field observations tied directly to employee operational responsibilities and document deficiencies requiring follow-up coaching or retraining. Several interviewees described reinforcement processes that incorporate operational metrics, audit findings, incident trends, and quality assurance reviews to identify recurring performance gaps or emerging training concerns requiring targeted intervention.

Reinforcement is most effective when training concepts are introduced shortly before operational application or revisited during real-world operational scenarios. Airports using staged onboarding or progressive operational qualification models described stronger reinforcement outcomes when

employees were able to immediately apply procedures within their assigned operational environments following instruction.

Supporting literature reinforces these observations. Research related to spaced repetition, contextual learning, reinforcement theory, and feedback-based instruction indicates that knowledge retention improves when learning is reinforced over time, connected directly to operational context, and repeatedly applied through real-world practice rather than relying solely on periodic classroom instruction. Studies related to adult learning and operational performance similarly indicate that repeated contextual reinforcement and immediate feedback are associated with stronger retention and more consistent behavioral application than one-time information transfer alone.

Collectively, these findings indicate that reinforcement is not a separate component of airport security training, but an ongoing operational process occurring through supervision, communication, observation, feedback, and repeated application within the airport environment. Programs that actively reinforce key concepts through operational integration, supervisory involvement, targeted communications, and contextual application are more effective in supporting long-term retention, procedural consistency, and operational performance.

3.6 Multi-Employer Badge Holder Considerations

Interview findings identified significant variation in how participating airports manage employees who hold ID media for multiple employers in a single airport. Stakeholders described differing approaches related to badge issuance, training repetition, recurrent training cycles, reciprocity, and operational accountability. These variations were often influenced by airport-specific operational requirements, access privileges, administrative capacity, and expectations established in coordination with the airport's local TSA office.

BADGE ISSUANCE AND TRAINING REQUIREMENTS

Participating airports described a range of approaches for issuing ID media to employees working for multiple employers. Most airports reported issuing separate badges for each employer, requiring employees to display the badge associated with the company they are working for at a given time. A smaller number of airports described issuing a single badge tied to a primary employer or listing multiple employers on one badge, with access privileges aligned with the employee's authorized duties.

Approaches to training requirements also varied significantly. Some airports require employees to complete SIDA training separately for each employer or badge issued, particularly where this reflects expectations established with the local TSA office or airport-specific policies. Other airports require training only once per employee, regardless of the number of badges issued, provided the employee's access level and operational responsibilities remain substantially the same.

Several airports described hybrid approaches intended to balance accountability with operational efficiency. Under these models, employees may complete baseline SIDA training once, while supplemental training is assigned only when additional access privileges or operational responsibilities are added. Interviewees provided examples in which employees receiving Movement Area driving privileges, escort authority, vehicle gate responsibilities, or access to additional Secured Areas were required to complete only the additional training associated with those new responsibilities rather than repeating the full baseline curriculum.

Interviewees also described time-based acceptance windows in which recently completed training may be accepted for additional badges issued within a defined timeframe. One airport reported that employees receiving a second badge within 60 days of completing initial training were not required to

repeat the training, while badge expiration dates were aligned to ensure recurrent training would occur only once during future renewal cycles. Other airports described establishing a single renewal date across multiple badges or employers to reduce administrative burden and repetitive recurrent training requirements.

ADMINISTRATIVE CONTROLS AND ACCOUNTABILITY

Interview findings also identified several administrative practices intended to maintain accountability while minimizing unnecessary duplication. These practices included aligning badge expiration dates across employers, linking multiple employers to a single employee profile within the Identity Management System (IDMS), assigning a primary employer for administrative purposes, and requiring supplemental training only when new access privileges are added.

Maintaining clear accountability regarding badge usage when employees hold multiple credentials is critical. One airport described requiring employees to sign an attestation acknowledging that they must display and use the correct badge associated with the employer they are actively working for at that time. Other airports described using badge management controls within their IDMS platforms to track associated employers, access levels, and training status across multiple credentials.

These approaches are intended to preserve regulatory defensibility and access accountability while reducing repetitive training burdens for employees who support multiple employers or operational functions within the airport environment.

RECIPROCITY AND SITE-SPECIFIC LIMITATIONS

Despite efforts to reduce duplication, airports generally do not accept training completion from other airports, even when similar vendor-supported training platforms are used. Interviewees consistently cited airport-specific procedures, local operating conditions, ASP requirements, and expectations confirmed with the airport's local TSA office as the primary reasons for requiring airport-specific training completion.

While baseline security principles may be similar across locations, local procedures related to access control, challenge requirements, escort practices, Movement Area operations, and enforcement expectations vary significantly enough to require airport-specific instruction. As a result, full reciprocity between airports was generally uncommon, even when the same training vendor or standardized platform was used.

Airports considering reduced training repetition, acceptance of prior training, or other reciprocity-related practices should coordinate with their local TSA office before implementing those approaches.

3.7 Optimizing Training Delivery and Application

Findings across participating airports and business partners consistently indicated that training effectiveness is shaped less by any single delivery method and more by how training delivery, sequencing, reinforcement, and operational oversight function together over time. While regulatory requirements define the training that must be completed, interviewees emphasized that programs are generally more effective when training is treated as an ongoing operational process rather than a one-time compliance activity. Figure 12 summarizes common elements associated with more effective training delivery and reinforcement approaches identified through stakeholder interviews.

Figure 11. Common Elements of Effective Training Delivery and Reinforcement Approach



Stronger training outcomes occur when delivery methods, sequencing, reinforcement, recurrent processes, and operational oversight function as interconnected components of an ongoing operational system rather than isolated compliance activities.

Participating airports and business partners described more effective training environments as those that align training delivery with operational responsibilities, reinforce key procedures through operational observation and feedback, reduce unnecessary repetition, and continuously adjust training approaches based on operational experience, audit findings, workforce feedback, and evolving risks.

Several interviewees also emphasized that operational reinforcement and supervisory involvement are critical to sustaining long-term retention and procedural consistency. Airports using staged onboarding or progressive operational qualification models, similar to approaches described by several business partners, reported stronger reinforcement outcomes when employees were able to immediately apply procedures within their assigned operational environments following instruction.

Collectively, these findings reflect a broader shift from viewing airport security training primarily as a periodic compliance requirement toward treating training as a continuously reinforced operational capability integrated into daily airport operations. Programs integrating delivery methods, sequencing, reinforcement, recurrent processes, and ongoing operational evaluation are better positioned to support sustained retention, procedural consistency, and effective operational application within the airport environment.

SECTION 4: TRAINING PROGRAM MANAGEMENT, OVERSIGHT, AND CONTINUOUS IMPROVEMENT

Findings from stakeholder interviews and supporting literature indicate that the effectiveness of airport security training programs is influenced not only by the content that is delivered and the methods used to deliver it, but also by how training programs are governed, evaluated, coordinated, and continuously refined over time.

This section examines how airport security training programs are managed and sustained in practice, including how responsibilities are assigned, how effectiveness is evaluated, and how programs are adapted over time. It also explores how airports and business partners use operational feedback, audit findings, performance data, and continuous improvement processes to refine training programs and maintain alignment with both regulatory requirements and real-world operational conditions.

4.1 Program Governance and Responsibility

DECENTRALIZED GOVERNANCE MODELS

Airport security training programs are typically managed through a distributed governance structure that combines centralized oversight with operational implementation across multiple departments and stakeholder groups. Responsibility is often shared among airport security offices, credentialing teams, training administrators, LMS personnel, operational supervisors, tenant organizations, and contractors. While this structure allows airports to manage training across large and operationally diverse populations, it also creates challenges related to coordination, consistency, communication, and accountability.

The airport security office generally serves as the primary authority for establishing training requirements, maintaining alignment with 49 CFR § 1542 and the ASP, approving training content updates, and determining baseline requirements associated with access privileges and operational responsibilities. Security departments are also typically responsible for ensuring that required training is completed prior to credential issuance or access authorization.

Credentialing offices frequently support these responsibilities by administering training assignments, coordinating onboarding activities, managing records, tracking completion status, and controlling operational workflows associated with ID media issuance. Several airports described coordination between security offices and badging operations as particularly important during periods of high onboarding activity, seasonal staffing increases, large contractor projects, or operational expansion efforts where significant numbers of individuals require access within compressed timelines.

Interview findings indicated that the scope of credentialing office responsibilities varies across participating airports. Some offices focused primarily on security-related training associated with 49 CFR § 1542, while others also administer or coordinate Movement and Non-movement Area driver training, airport orientation, customer service, emergency preparedness, and other airport-specific operational or administrative courses. At airports with broader responsibilities, the credentialing office often functions as a centralized training and onboarding hub for the airport community.

Managing training requirements across multiple tenant organizations, contractors, airport departments, and operational groups was consistently identified as a significant governance challenge. Organizations often maintain different onboarding processes, operational priorities, and supervisory structures, making it difficult to ensure consistent application of training requirements across the broader airport community.

Several airports described challenges associated with coordinating training updates across multiple operational stakeholders, particularly when changes are driven by TSA inspections, ASP revisions, audit findings, operational incidents, or revised procedures. Updates often require coordination between security offices, badging personnel, operational managers, tenant representatives, and training administrators to ensure that revised requirements are implemented consistently across the airport environment. It is recommended that airports collaborate with local TSA to clarify expectations.

Decentralized governance structures can create operational difficulties when updates originate from individual departments, tenants, or SMEs without a formalized coordination process. In these environments, airports described issues associated with inconsistent messaging, overlapping training requirements, outdated material remaining in circulation, and variation in how procedures are communicated across different stakeholder groups.

Operational supervisors were consistently identified as critical contributors to effective training governance and implementation. While supervisors are not typically responsible for developing formal training content, they frequently serve as the operational link between formal training requirements and field application. Supervisors are often responsible for validating operational understanding, reinforcing challenge and escort procedures, monitoring compliance behaviors, identifying procedural deficiencies, and communicating operational concerns back to security or training personnel.

Several airports described situations in which supervisors or operational personnel were the first to identify recurring misunderstandings, inconsistent application of procedures, or gaps requiring additional clarification or reinforcement. In decentralized governance structures, operational feedback and field observations function as important inputs into future training updates, supplemental reinforcement efforts, and broader continuous improvement activities.

CENTRALIZED GOVERNANCE STRUCTURES

Business partners described more centralized governance structures, often supported by corporate training departments responsible for establishing standardized training frameworks across multiple locations. These organizations generally define baseline training aligned with regulatory and international requirements while allowing local management teams flexibility to implement site-specific procedures and operational expectations. This model supports consistency across locations while still allowing adaptation to local airport requirements and operating environments.

Clearly defined governance structures also influence how effectively airports respond to regulatory changes, TSA inspections, audit findings, operational incidents, and evolving threats. Training programs are generally more effective when ownership for updates, approvals, communication, and implementation is clearly established. Fragmented oversight or unclear responsibility can delay updates, create conflicting guidance, or reduce confidence in training consistency across operational groups.

Input from the CAA SME reinforced the importance of designated accountability for training development, delivery, oversight, and evaluation. International frameworks similarly emphasize structured coordination processes, recurring program reviews, and clearly assigned responsibilities to ensure that training programs remain current, consistent, and operationally effective over time.

Effective training governance depends on more than regulatory compliance alone. Sustaining effective programs requires clear ownership, centralized coordination, operational communication, and structured collaboration across the airport community to ensure that training requirements remain consistent, current, and aligned with operational realities. Figure 13 summarizes the common roles that support airport security training program governance.

Figure 12. Common Roles in Airport Security Training Program Governance



4.2 Quality Assurance and Evaluation

While most participating airports have established processes to ensure that required training is completed and documented, approaches to evaluating the quality and operational effectiveness of training programs vary significantly. Across participating airports, quality assurance activities are often centered on compliance, with primary emphasis placed on verifying that required training has been assigned, completed, and documented in accordance with regulatory requirements. However, several airports and business partners described more structured approaches that extend beyond completion tracking to evaluate whether training is effectively supporting operational performance and procedural compliance within the field environment.

EVALUATING TRAINING EFFECTIVENESS

Some participating airports described incorporating additional quality assurance mechanisms intended to evaluate how training translates into operational behavior and compliance performance. These approaches include operational observations, periodic audits, supervisory evaluations, trend analysis, and reviews of recurring security violations or operational deficiencies.

Recurring issues related to escort procedures, challenge requirements, ID media display, vehicle inspections, and access control practices were frequently cited as indicators that training content or reinforcement practices may require additional emphasis, clarification, or restructuring. Repeated deficiencies involving the same procedures often trigger focused reviews of how those topics are presented, reinforced, or operationally validated.

Several airports described using TSA inspection findings, internal audit results, security violation reports, and operational incident data as indirect indicators of training effectiveness. By analyzing recurring patterns of non-compliance, airports are better positioned to identify where employees may misunderstand procedures, where reinforcement may be insufficient, or where training content may not align effectively with operational realities.

Some interviewees also described reviewing assessment trends, including recurring test failures or poor performance associated with specific modules, as indicators that training content may be unclear, overly complex, or insufficiently connected to operational responsibilities. In these environments, assessment performance is used not only to validate completion but also to identify opportunities to improve training clarity and usability.

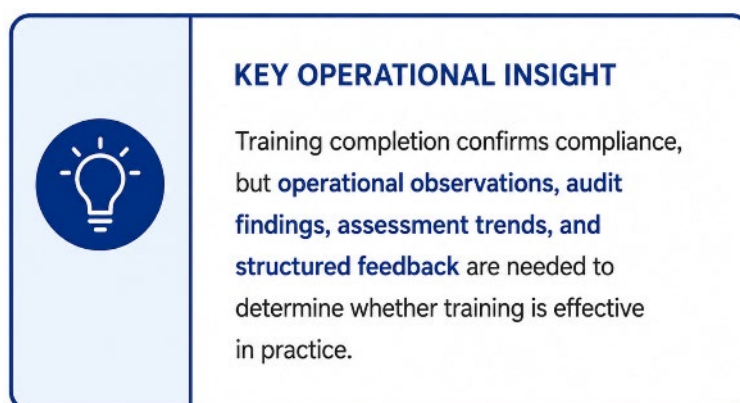
Business partners described more structured quality assurance frameworks that integrate training oversight into broader operational performance management processes. These organizations often combine formal assessments, operational observations, documented performance metrics, competency validations, and supervisory evaluations to assess whether employees are consistently applying training within their assigned operational roles.

In some environments, job-specific checklists, field observations, or operational validations are used to confirm procedural understanding following formal training completion. Several stakeholders described operational observation as one of the most valuable methods for identifying disconnects between classroom instruction and real-world application.

Structured feedback loops also emerged as an important component of effective quality assurance processes. Supervisors, trainers, auditors, operational personnel, and trainees frequently provide insight into where confusion exists, where procedures are inconsistently applied, or where training may not accurately reflect operational conditions. However, the extent to which this feedback is formally captured, documented, and incorporated into future training updates varies significantly across airports.

Feedback collection is often informal and operationally driven, relying heavily on conversations, field observations, or audit discussions rather than structured evaluation mechanisms. Airports with more formalized review processes generally described stronger coordination between operational feedback, training updates, and continuous improvement activities.

Input from the CAA SME reinforced the importance of establishing formal quality assurance processes that evaluate both compliance and operational effectiveness. International frameworks similarly emphasize the importance of periodic program review, operational validation, feedback integration, and risk-based evaluation approaches to ensure that training content and delivery methods remain aligned with operational requirements and evolving threats.



While completion-based tracking provides a necessary foundation for training oversight, effective quality assurance requires a broader evaluation framework that incorporates operational performance, audit findings, supervisory observations, assessment trends, and structured feedback mechanisms. Figure 14 illustrates a structured quality assurance and continuous evaluation approach synthesized from stakeholder interview findings and supporting literature. Programs that integrate these elements are better positioned to identify gaps, refine training approaches, and ensure that training supports consistent and effective operational performance across the airport environment.

Figure 13. Common Elements of Structured Training Quality Assurance Processes



4.3 Data, Metrics, and Performance Monitoring

While most airports collect substantial amounts of data related to training completion, compliance status, and assessment performance, the extent to which that data is actively used to evaluate operational effectiveness and inform training decisions varies significantly. **Across participating airports, data collection systems are generally well established, but the application of data to support performance monitoring, program evaluation, and continuous improvement is less consistent.**

COMPLETION AND ASSESSMENT METRICS

At a foundational level, airports rely heavily on LMS, IDMS, and training databases to capture completion data, maintain records, manage recurring requirements, and support audit readiness. These systems provide visibility into who has completed required training, when it was completed, whether recurring requirements remain current, and whether individuals are eligible to receive or maintain access privileges.

Stakeholders consistently described this type of data tracking as essential for managing large populations of badge holders and ensuring regulatory compliance across complex operational environments. Automated tracking and reporting functions have become increasingly important as onboarding volumes, contractor populations, and tenant coordination requirements have expanded.

In addition to completion tracking, many airports also monitor assessment results associated with required training modules. Common metrics include:

- Test scores
- Failure rates
- Retest frequency
- Completion timelines
- Minimum passing thresholds tied to initial and recurrent training requirements

Interviewees indicated that passing thresholds are commonly established within a defined range, often requiring personnel to achieve scores of approximately 80 to 90 percent prior to credential issuance or renewal.

Assessment metrics are generally used to validate baseline comprehension and document compliance with required training standards. However, stakeholders consistently emphasized that assessment performance alone does not fully reflect training effectiveness or operational readiness. This limitation was frequently identified as one of the primary weaknesses associated with relying too heavily on completion and testing metrics when evaluating training effectiveness. **High completion rates do not necessarily correlate with strong procedural compliance, operational understanding, or consistent field performance.**

OPERATIONAL PERFORMANCE INDICATORS

To address this gap, several participating airports described using operational performance indicators as a more meaningful measure of training effectiveness. These approaches incorporate security violation reports, audit findings, operational observations, incident logs, supervisory feedback, and recurring compliance trends to evaluate whether training is translating into expected operational behaviors.

Recurring issues involving escort procedures, challenge requirements, ID media display, vehicle inspections, access control practices, and restricted area compliance were frequently cited as indicators that training content, reinforcement strategies, or operational communication may require additional attention. Several stakeholders described reviewing recurring deficiencies to identify patterns associated with specific procedures, departments, operational groups, or training topics.

Interviews also highlighted the use of trend analysis to identify persistent problem areas over time. Some airports monitor recurring deficiencies associated with specific training modules and use those trends to adjust training content, reinforce operational expectations, or introduce targeted retraining and supplemental communication efforts.

Several interviewees also described reviewing assessment trends over time rather than relying solely on individual scores. Increased failure rates associated with specific modules, repeated confusion surrounding particular procedures, or unusually high retest frequencies were cited as indicators that training material may be unclear, overly complex, insufficiently reinforced, or poorly aligned with operational responsibilities. Figure 15 summarizes examples of training, assessment, and operational data described by participating organizations as useful for evaluating training effectiveness and informing program review.

Figure 14. Examples of Data Used to Evaluate Airport Security Training Effectiveness

Examples of Data Used to Evaluate Airport Security Training Effectiveness



TECHNOLOGY-ENABLED REINFORCEMENT AND PERFORMANCE TOOLS

Several interviewees discussed the growing use of technology platforms to support ongoing reinforcement, field-based evaluation, and performance visibility beyond traditional classroom or CBT delivery. Examples included mobile applications, dashboard-based reporting tools, gamified learning platforms, digital field-observation tools, and systems capable of tracking reinforcement activities, operational observations, or recurring knowledge gaps over time.

One business partner described using a commercial mobile compliance and field-observation platform to standardize field training and reduce reliance on informal employee-to-employee instruction. Qualified field training personnel use a mobile device that can access checklists and standardized procedures to conduct spot checks, document on-the-job training and performance evaluations, and provide immediate feedback. The platform can track results for individual employees and across larger groups, identify repeated failures or knowledge gaps, and display findings through dashboards and analytics. The organization also uses the system to support audits, investigations, metrics, and key performance indicators. Although primarily used as a compliance and field-observation tool, the platform can also be used to create, assign, and deliver training content.

Other participants described using digital tools in more limited ways. Examples included supervisor checklists completed through an app, centralized systems used to review audit and incident trends, simple game-based activities to improve engagement, and use of a course-development platform with gamification features to create more interactive training as an alternative to traditional presentation-based instruction and more complex scenario-based training.

These tools may be particularly useful for large or geographically distributed workforces, recurring awareness topics, structured field observations, and operational behaviors that require reinforcement between formal training cycles. Mobile platforms may support brief knowledge checks, standardized observations, and immediate feedback, while dashboards and centralized reporting tools may help managers identify recurring deficiencies, compare performance trends, and prioritize targeted recurrent or remedial training.

Technology-enabled tools should complement rather than replace instructor-led explanation, supervised on-the-job training, or field validation for complex or higher-risk responsibilities. Airports and business partners considering these tools should evaluate cost, workforce access to devices and connectivity, integration with existing training and identity management systems, data quality, supervisory follow-up, and the protection of SSI or other controlled information. The value of these platforms depends on the information collected as well as on whether the results are consistently reviewed and used to guide reinforcement, corrective action, and future training decisions.

Business partners described more structured performance monitoring frameworks that integrate training data with broader operational and organizational metrics. These organizations often track trends related to incident rates, assessment performance, compliance observations, audit findings, operational deficiencies, and supervisory evaluations to assess how training is influencing employee behavior and operational performance over time.

Some business partners described using dashboards, reporting tools, or centralized data systems that allow managers to monitor trends across locations, identify recurring deficiencies, and prioritize areas requiring additional oversight or reinforcement. These approaches provide greater visibility into operational performance and allow organizations to identify patterns that may not be apparent through completion tracking alone.

The value of data depends less on how much information is collected and more on how consistently it is reviewed, interpreted, and incorporated into operational decision-making. While many airports collect substantial amounts of compliance and assessment data, fewer described formalized processes for systematically analyzing that information and incorporating findings into training updates, delivery adjustments, or reinforcement strategies.

Airports that actively integrated operational data, assessment trends, audit findings, and supervisory feedback into training program management generally described stronger alignment between training content, operational expectations, and real-world compliance concerns. In these environments, data functions not only as a compliance tool but also as an operational feedback mechanism supporting ongoing program refinement.

The CAA SME reinforced the importance of using performance metrics, audit findings, operational feedback, and trend analysis to support continuous improvement and ensure that training programs remain aligned with evolving operational risks and regulatory expectations. International frameworks similarly emphasize the importance of integrating data-driven evaluation processes into broader training governance and oversight activities.

Data and performance metrics are critical components of effective training program management, but their value depends on how they are operationalized. Programs that integrate completion tracking, assessment performance, operational observations, audit findings, and recurring trend analysis are better positioned to identify gaps, prioritize improvements, and ensure that training supports consistent and effective operational performance across the airport environment.

4.4 Continuous Improvement and Program Adaptation

Airport security training programs require ongoing adaptation to remain effective within dynamic operational, regulatory, and threat environments. While training requirements are initially established based on regulatory standards, ASP requirements, and baseline operational needs, effective programs evolve over time.

Many participating airports described a primarily reactive approach to updating training programs. Under this model, training changes are often implemented following a specific event, audit finding, compliance concern, or operational issue requiring corrective action. While this approach helps ensure that training remains responsive to emerging conditions, stakeholders also identified operational limitations associated with heavily reactive update models. Training content often expands incrementally over time as new material is added without a corresponding review of existing content, redundancy, or overall training volume. Additionally, reactive update processes can create version control and communication challenges, particularly in decentralized environments involving multiple tenants, contractors, departments, and training administrators.

A smaller number of airports described more structured continuous improvement processes that incorporate recurring program reviews, operational trend analysis, and coordinated evaluation mechanisms intended to assess both training content and delivery effectiveness over time. These approaches generally integrate multiple data sources, including audit findings, operational observations, assessment trends, supervisory feedback, incident data, security violations, and workforce input to evaluate where training programs may require refinement or adjustment. Rather than relying solely on isolated corrective actions, these environments incorporate broader review processes intended to maintain alignment between training requirements, operational risk, and workforce responsibilities.

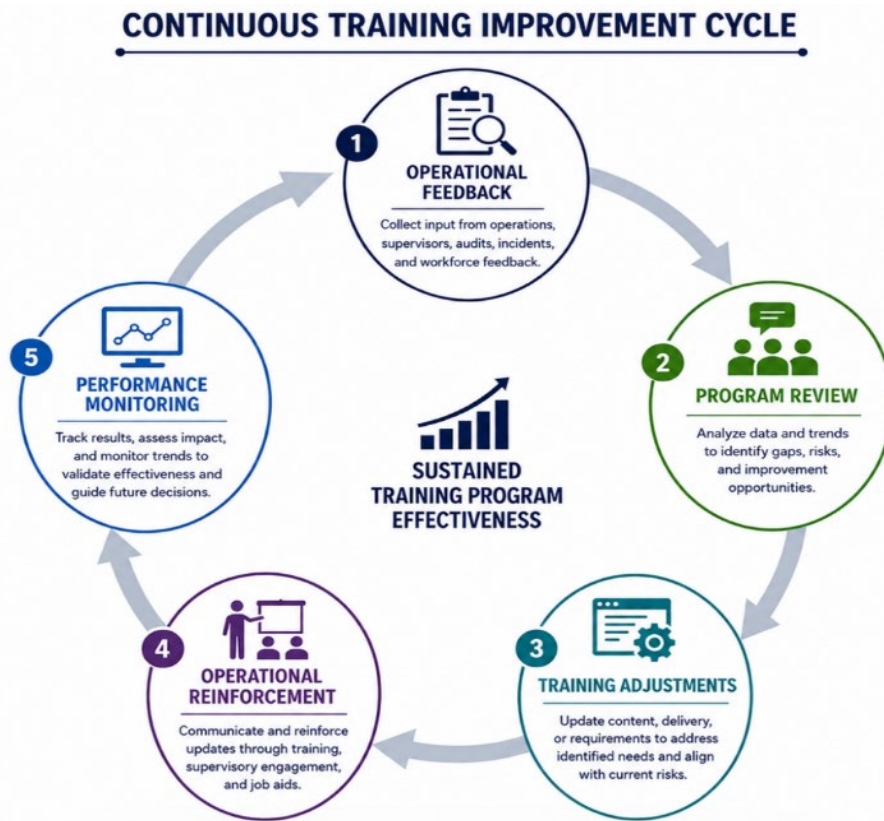
Effective continuous improvement processes require airports to evaluate not only whether updates are needed but also whether additional content, procedural detail, or reinforcement activities meaningfully improve operational understanding or simply increase training complexity. Programs relying solely on reactive updates may remain compliant but risk becoming increasingly fragmented, duplicative, or misaligned with operational priorities over time. In contrast, programs incorporating structured review processes, coordinated governance, operational feedback, and recurring evaluation mechanisms are generally better positioned to maintain clarity, relevance, and operational effectiveness within complex airport environments.

4.5 Optimizing Sustained Training Program Effectiveness

Findings across participating airports and business partners indicate that long-term training effectiveness depends not only on compliance with regulatory requirements but on how effectively training programs are governed, evaluated, refined, and operationally sustained over time. Programs viewed as more effective consistently demonstrated stronger alignment between governance structures, operational feedback, performance monitoring, and continuous improvement activities.

As illustrated in Figure 16, more effective training programs generally incorporate continuous operational feedback, program review, training adjustments, reinforcement activities, and ongoing performance monitoring.

Figure 15. Continuous Training Improvement Cycle Identified Through Stakeholder Interviews



Sustained program effectiveness is strengthened when training governance, quality assurance, performance monitoring, operational feedback, and program adaptation function as interconnected components of an ongoing operational system rather than isolated administrative activities.

Participating airports and business partners described stronger outcomes when operational observations, audit findings, supervisory feedback, assessment trends, and recurring compliance concerns were actively incorporated into training review and update processes. Airports using more coordinated governance and evaluation approaches generally reported stronger alignment between training content, operational expectations, and field application.

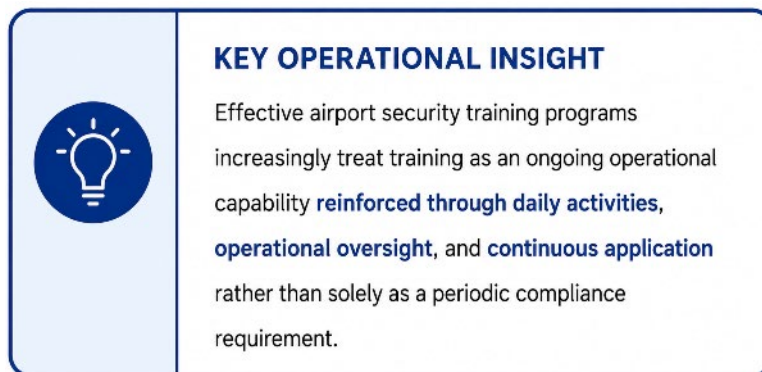
Effective programs balance responsiveness to emerging risks and regulatory changes with deliberate efforts to maintain clarity, reduce redundancy, and prioritize operational relevance. Programs that continuously expand training content without structured review processes are viewed as more difficult to manage, reinforce, and operationalize effectively over time.

SECTION 5: PATH FORWARD: EFFECTIVE TRAINING PROGRAMS

Findings from stakeholder interviews, supplemental airport responses, and supporting literature consistently indicated that effective airport security training programs depend not on any single training element but on how training content, delivery, reinforcement, governance, and continuous improvement function together within the operational environment.

Across participating airports and business partners, programs perceived as more effective generally aligned training requirements with operational responsibilities, reinforced critical procedures over time, and incorporated audit results, supervisory input, and operational observations into ongoing program updates. While regulatory requirements establish a necessary baseline, the findings throughout this report demonstrate that long-term effectiveness is shaped by how training programs are structured, operationalized, evaluated, and adapted within the realities of airport operations.

The findings also indicate that training effectiveness is strengthened when airports move beyond completion-focused approaches to incorporate operational performance indicators, supervisory reinforcement, audit findings, recurring trend analysis, and structured review processes into broader training oversight activities. Airports and business partners that integrated these elements generally described stronger alignment between training requirements, operational expectations, and real-world application.



At the same time, stakeholders also emphasized the operational challenges associated with sustaining effective programs across large and diverse airport communities. Coordination across tenants, contractors, departments, and operational groups requires ongoing communication, clear governance structures, and the ability to adapt training in response to evolving risks, workforce dynamics, regulatory changes, and operational feedback without creating unnecessary complexity or training overload.

5.1 Review and Prioritize Training Topics and Content

Airports should periodically review the full training curriculum to distinguish required regulatory content from supplemental awareness topics and role-based operational instruction. This review should focus not only on whether required subjects are present but also on whether the volume, depth, and organization of the material support comprehension and operational application. Recommended actions include:

1. Develop an inventory of all training modules, topics, and assignments currently provided to each employee group.
2. Classify each topic as regulatory, supplemental awareness, or role-based operational training.

3. Identify duplicative, outdated, or unrelated material that may be consolidated, relocated, or removed.
4. Map role-based training assignments to access privileges, operational responsibilities, and identified risks.
5. Confirm that employees performing higher-risk or security-sensitive functions receive sufficient procedural detail and operational reinforcement.
6. Establish a documented approval process before new topics are added to baseline training programs.

5.2 Align Delivery Methods with Operational Need

Training delivery methods should reflect the complexity, level of skill required, and risk associated with the task being performed. Standardized awareness topics and recurrent content may be effectively delivered through CBT or online platforms, while tasks requiring practical application or demonstrated proficiency may require instructor involvement, supervised practice, or field validation. Recommended actions include:

1. Identify which topics can be effectively delivered through standardized CBT or online instruction.
2. Identify tasks requiring instructor-led explanation, hands-on demonstration, operational discussion, or supervised application.
3. Use hybrid delivery when foundational content can be completed online but airport-specific procedures require direct interaction or clarification.
4. Evaluate training accessibility, including language support, literacy needs, after-hours availability, technology access, and accommodation requirements.
5. Establish identity-verification and follow-up assessment procedures when training is completed remotely.
6. Monitor classroom capacity, computer availability, instructor staffing, and scheduling demands as part of the broader badging and onboarding process.

5.3 Establish a Recurring Content Review Process

Training programs should be reviewed on a defined schedule and when operational or regulatory changes occur. Reviews should assess whether the content remains current, relevant, clearly organized, and aligned with airport procedures and workforce responsibilities. Recommended actions include:

1. Assign clear ownership for coordinating training reviews, content updates, and stakeholder input.
2. Establish a recurring review schedule for required and supplemental training content.
3. Define triggers for interim review, including ASP revisions, TSA findings, audit results, security incidents, technology changes, procedural updates, and recurring operational deficiencies.
4. Consult operational supervisors, trainers, badging personnel, tenants, and SMEs during the review process.
5. Evaluate existing content before adding new material to determine whether updates can be incorporated without increasing unnecessary volume or duplication.
6. Maintain version control and communicate approved changes consistently across affected stakeholder groups.

5.4 Reinforce and Validate Knowledge Retention

Formal training should be supported by recurring reinforcement and opportunities for operational application. Completion records and assessment scores provide necessary compliance documentation but should not be treated as the sole measures of training effectiveness. Recommended actions include:

1. Identify critical procedures requiring reinforcement between formal training cycles.
2. Use operational briefings, security bulletins, supervisor discussions, awareness campaigns, incident reviews, and targeted reminders to reinforce key expectations.
3. Incorporate field observations, knowledge-validation checks, scenario-based assessments, or supervised demonstrations for higher-risk responsibilities.
4. Encourage supervisors to provide immediate clarification and corrective feedback during daily operations.
5. Review recurring violations, audit findings, assessment trends, and operational observations to identify topics requiring additional reinforcement.
6. Document how reinforcement activities and operational feedback are incorporated into future training updates.

5.5 Differentiate Recurrent and Remedial Training

Recurrent and remedial training serve different purposes and should be structured accordingly. Recurrent training should maintain awareness, communicate changes, and reinforce critical procedures. Remedial training should respond directly to identified deficiencies, violations, or performance concerns. Recommended actions include:

Recurrent Training:

1. Focus recurrent training on regulatory changes, higher-risk responsibilities, recurring compliance concerns, and procedures susceptible to knowledge decay.
2. Establish clear eligibility criteria before implementing test-out or abbreviated recurrent-training pathways.
3. Coordinate proposed test-out approaches with the airport's local TSA office to confirm regulatory expectations.

Remedial Training:

1. Focus remedial training on observed deficiencies, violations and performance concerns.
2. Define escalation steps for repeated deficiencies, including instructor-led remediation, supervisory involvement, field validation, temporary restriction of privileges, or additional corrective action.

5.6 Address Multi-Employer Badge Holder Requirements

Airports should identify employees working for multiple employers at one airport to address training. While some duplication may be reduced, airport-specific procedures, local operating conditions, access privileges, and TSA expectations must remain clearly addressed. Recommended actions include:

1. Coordinate with the local TSA office to clarify training expectations for multiple badges, employers, and access privileges.
2. Determine whether an employee who works for multiple employers at the same airport may complete baseline SIDA training only once to limit redundancy and administrative burden, and

assign supplemental training when additional access privileges, employer responsibilities, or operational duties require it.

3. Link multiple employers, badges, access levels, and training records within the IDMS when system capabilities allow.
4. Align expiration dates and recurrent training dates where practical to reduce administrative duplication.
5. Require employees to understand and acknowledge in writing which badge and access privileges apply while working for each employer.

5.7 Program Review Checklist

The actions outlined in Sections 5.1 through 5.6 are intended to help airports evaluate their training programs within the context of local regulatory requirements, operational risks, workforce needs, and available resources. The checklist in Figure 17, consolidates those actions into a practical starting point for identifying current strengths, potential gaps, and areas that may warrant further review or improvement.

Figure 16. Suggested Airport Security Training Review Checklist



AIRPORT SECURITY TRAINING PROGRAM REVIEW CHECKLIST

- ☐ Are regulatory, supplemental, and role-based training topics clearly distinguished?
- ☐ Is each training assignment connected to an employee's duties, access privileges, or level of skill required?
- ☐ Are delivery methods appropriate for the complexity and sensitivity of the task?
- ☐ Is training content reviewed on a defined schedule and when operational changes occur?
- ☐ Are redundant or outdated topics removed before new content is added?
- ☐ Are supervisors involved in reinforcing and validating training in the field?
- ☐ Are recurrent and remedial training programs clearly differentiated?
- ☐ Are assessment results, audit findings, violations, and operational observations used to evaluate training effectiveness?
- ☐ Are responsibilities for training ownership, approval, updates, and communication clearly assigned?
- ☐ Are training changes documented, approved, communicated, and incorporated into continuous improvement activities?

REFERENCES

- International Civil Aviation Organization (ICAO). (2022). *Annex 17 to the Convention on International Civil Aviation: Security — Safeguarding International Civil Aviation Against Acts of Unlawful Interference*. ICAO.
- International Civil Aviation Organization (ICAO). (2025). *Aviation Security Training Manual (Doc 10207)*. ICAO.
- National Safe Skies Alliance. (2017). *PARAS 0009: Guidance for Security Management Systems (SeMS)*. Program for Applied Research in Airport Security (PARAS).
- National Safe Skies Alliance. (2019). *PARAS 0027: Guidance for Root Cause Analysis in Aviation Security*. Program for Applied Research in Airport Security (PARAS).
- National Safe Skies Alliance. (2021). *PARAS 0049: Creating and Maintaining a Strong Security Culture at Airports*. Program for Applied Research in Airport Security (PARAS).
- National Safe Skies Alliance. (2021). *PARAS 0054: Optimizing Compliance with Airport Security Rules and Regulations*. Program for Applied Research in Airport Security (PARAS).
- Transportation Security Administration. (2024). *Security Training Requirements for Airport Employees and Contractors*. U.S. Department of Homeland Security.
- United Kingdom Civil Aviation Authority. (2024). *Aviation Security Training Requirements and Guidance*. Civil Aviation Authority.

APPENDIX A: STAKEHOLDER INTERVIEW QUESTIONS

AIRPORT INTERVIEW QUESTIONS

Airport Details:

U.S. or Non-U.S. Airport?

Airport Category, i.e., CAT X, CAT I, CAT II, etc.?

Number of ID Media Holders (Badge Holders)?

Tenant Mix, i.e., Full air cargo carrier, Fixed-Based Operator, (FBO), military on-site, etc.?

Size of office responsible for managing the training, i.e., how many staff?

Type of Training Program:

Do you use a standard training program or have a modified specific training program, i.e., airport specific?

Training Topics and Content (Required and Optional)

What training do you require for all Security Identification Display Area (SIDA) or Non-SIDA badge holders? (i.e., training required by Transportation Security Administration (TSA) or Federal Aviation Administration (FAA), i.e., SIDA, Movement Area Training (MAT), Escort, Challenge, etc.?

What, if any training, do you require for all Public Area ID Media holders and/or those working on airport property but not required to apply for ID Media? If yes, can you describe the training program (initial only, recurrent)?

What, if any training, do you require for temporary ID Media holders? If yes, can you describe the training program (initial only, recurrent)?

Do you offer, or require, other training that is not “mandated” by a governing agency and what is that training? Some examples may be, Non-Movement Area training (NMAT), Human Trafficking, Cybersecurity, Emergency Response, etc.

Have you identified any training gaps or lessons learned in your current training program?

Delivery Methods, Location, Scheduling, and Duration

How do you deliver training, specifically:

Do you conduct your training on-site only?

If your training is conducted on-site with a proctor, is “role-playing” part of the training course?

If you use Computer Based Training (CBT), do you allow employees to receive the training remotely or require them to complete the training in your office?

Do you deliver your training with some form of blended delivery method?

Whatever your method, do you have any metrics to substantiate training method success?

If you believe a different method should be used, what method is that and why?

How do you accommodate language, literacy, or after-hours access needs, i.e., English Second Language (ESL) modules, closed captioning, 24/7 CBT access?

If remote delivery is permitted:

What platforms are used (e.g., web portals, mobile apps, video conferencing), and how do you verify completion and identity?

For which modules do you permit remote delivery (SIDA, AST, other)?

What accountability measures are used (learner acknowledgment/attestation before start, supervisor sign-off, unique credentials)?

What accountability measures are used (learner acknowledgment/attestation before start, supervisor sign-off, unique credentials)?

What safeguards prevent unauthorized aids being used (e.g., webcam/proctoring, lockdown browser, randomized items, time limits, IP/location controls)?

Which training or assessments are marked SSI? Do you allow SSI-marked material to be completed remotely? If yes, what protections are in place (role-based access, no-download/print, watermarking, encryption, purge/retention rules)?

What challenges or lessons learned have you encountered with remote delivery/testing, and how did you address them?

What challenges or lessons learned have you experienced with remote training delivery (i.e., technical issues, engagement, knowledge retention), and how have you addressed them?

How long are your typical training sessions or anticipated completion times for:

SIDA?

Authorized Signatory (AST)?

MAT?

NMAT?

Other training? (Name the training and anticipated completion time)

Do you utilize an online scheduler or do signatories/applicants contact badging via phone or email to schedule training?

Do you track the appointment no-show and/or cancellation percent?

Frequency of Content Review and Updates

What training do you require for all Security Identification Display Area (SIDA) or Non-SIDA badge holders? (i.e., training required by Transportation Security Administration (TSA) or Federal Aviation Administration (FAA), i.e., SIDA, Movement Area Training (MAT), Escort, Challenge, etc.?)

What, if any training, do you require for all Public Area ID Media holders and/or those working on airport property but not required to apply for ID Media? If yes, can you describe the training program (initial only, recurrent)?

What, if any training, do you require for temporary ID Media holders? If yes, can you describe the training program (initial only, recurrent)?

Who, or what department, reviews the training programs?

How often do you review and update your training content?

Who reviews the training programs?

Is this frequency the same for SIDA, AST, MAT, or other training?

Do you have any statistics or metrics to show if your review is adequate? (i.e., audit outcomes, security violation or incident trends, etc.)

What triggers updates, i.e., regulatory changes, new threats, incident reviews, etc.?

If you do not require recurrent training, when your training is updated/revised, do you require all ID Media holders to complete the new training?

Maximizing Knowledge Retention

What methods do you use to assess employee's knowledge retention?

Quizzes throughout the training?

Full testing at the end of training?

If you test at the end, do you require a minimum score and what is that minimum score?

Do you have a maximum number of times an employee can take the test?

Is there a specified timeframe for the testing must take place within, i.e., 24/48 hours?

What methods or techniques do you use to reinforce learning and improve knowledge retention?

Do you conduct aviation worker testing in the field? If yes, who or what department conducts the testing?

Do you utilize a dashboard (airport website or platform) to communicate training reminders?

Do you issue bulletins or send emails to stakeholders to communicate training reminders?

Do you host meetings with stakeholders to provide reminders of security training information, i.e., weekly, monthly, or quarterly meetings?

For training methods currently in use, do you have metrics or evaluation tools in place to measure the effectiveness in reinforcing knowledge retention? If yes, do these tools substantiate the effectiveness of your methods?

How does your airport measure the overall effectiveness of its training?

What metrics or Key Performance Indicators (KPIs) do you track, i.e., test-pass rates, audit findings, incident trends, and trainee feedback?

Recurrent and Refresher Training Strategies

Do you conduct recurrent training and if you do, what topics do you require, i.e., SIDA, MAT, etc.?
(Note: we already know AST is required annually)

How often is recurrent training required for each topic (SIDA, MAT, etc.), and is the content identical or modified from the initial course?

Do you offer a “test out” option; meaning, do you allow an applicant to go directly to the test without going through the formal recurrent training?

Do you require refresher training? If yes, what topics do you offer as refresher training?

What drives the requirement for refresher training, do you have specific criteria like an employee violating security or safety requirements?

Is refresher training the same, or modified, from the initial training?

Do you offer a “test out” option; meaning, do you allow an applicant to go directly to the test without going through the formal refresher training?

Do you tailor training to address individual performance gaps? If yes, what is your method?

Considerations for Multi-Airport Badge Holders

Do you provide different, or modified, training to individuals who hold ID Media at another airport, i.e., possibly provide a shortened refresher training?

Do you accept training completion from another airport?

Do you accept training from another airport if they had the same Federal Security Director (FSD)?

If an individual already holds a badge from another airport that uses the same training program as yours, do you accept that training as meeting your airport's training requirement, i.e., both airports use non-airport specific training, usually provided by American Association of Airport Executives Interactive Employee Training (AAAE-IET) or Safety Security Instruction (SSi)?

If an individual at your airport is issued multiple badges for different companies, are they required to complete separate training for each company, or is one training course sufficient to cover all associated ID Media? Do you issue one badge for individuals working for multiple companies?

BUSINESS PARTNER INTERVIEW QUESTIONS**Company Details:**

Location?

Company Name?

Points of Contact?

Number of employees?

Describe the scope of services you provide at US airports

Company Training Program:

Can you tell us the training courses that are required for every employee?

Do you have a designated office for managing your training, or is it handled at each location?

What is the size of the office responsible for managing the training, i.e., how many staff?

Recurrent and Refresher Training Strategies

Please describe all recurrent training requirements.

Can you tell us the frequency of recurrent training for each course?

Are there test-out options?

What events would trigger an employee to take refresher training?

Does refresher content differ from initial training?

Delivery Methods, Location, and Duration

Identify the training delivery formats supported (on-site, remote, CBT, instructor-led).

What courses do you allow to be taken remotely, if any?

Describe challenges encountered in remote delivery, if offered.

What are your average completion times for your training modules or classroom instruction?

How do you accommodate language, literacy, after-hours needs, i.e., English Second Language (ESL) modules, closed captioning, and 24/7 CBT access?

How do you track the employees' completion success?

Frequency of Content Review and Updates

Who within your company reviews the training programs?

How often do you review and update your training content?

What triggers updates, i.e., regulatory changes, new threats, incident reviews, etc.?

If you do not require recurrent training, when your training is updated/revised, do you need all employees to complete the new training?

Maximizing Knowledge Retention and Evaluation

What methods do you use to assess an employee's knowledge retention?

Quizzes throughout the training?

Full testing at the end of training?

If you test at the end, do you require a minimum score, and what is that minimum score?

Do you have a maximum number of times an employee can take the test to pass?

Is there a specified time frame that the testing must take place within, i.e., 24/48 hours?

Do you track trends in maximizing/measuring successful retention?

Do you conduct testing in the field to reinforce their learning? If yes, who conducts the testing?

APPENDIX B: ANNOTATED BIBLIOGRAPHY

As part of the project, the team performed an in-depth literature review to identify strategies for content development, delivery, comprehension, and knowledge retention in safety-critical training environments. The purpose of this review was to examine research and best practices that strengthen the effectiveness and sustainability of workforce training programs, particularly within aviation and airport security operations. Findings from the literature inform the development of practical, evidence-based recommendations that enhance how training is structured, delivered, and reinforced over time. The following annotated bibliography summarizes the sources reviewed and their relevance to this research effort.

BIBLIOGRAPHY

Andreisová, L. (2015). Building and maintaining an effective compliance program. *International Journal of Organizational Leadership*, 5(2016), 24–39.

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3331825

This paper outlines strategies for building and sustaining effective compliance programs through leadership engagement, continuous communication, and recurrent training. Andreisová emphasizes moving beyond binary completion metrics toward continuous proficiency evaluation that integrates feedback, performance monitoring, and organizational accountability. Although centered on corporate compliance, the framework is directly applicable to aviation security training, supporting data-driven oversight and sustained workforce competence.

Bjork, R. A., & Bjork, E. L. (1992). A new theory of disuse and an old theory of stimulus fluctuation. In A. Healy, S. Kosslyn, & R. Shiffrin (Eds.), *From learning processes to cognitive processes* (Vol. 2, pp. 35–67). Erlbaum.

This theoretical paper presents the New Theory of Disuse, distinguishing between retrieval strength and storage strength. It demonstrates that long-term retention improves when training includes spaced practice and retrieval exercises that make recall effortful. The study supports distributed reinforcement and low-stakes testing to sustain retention over time.

Bloom, B. S. (1968). Learning for mastery. *Evaluation Comment*, 1(2), 1–12.

Bloom's mastery learning model emphasizes that most learners can achieve high competence when instruction includes formative feedback, targeted remediation, and individualized pacing. The approach supports recurrent assessments and structured feedback loops to ensure consistent comprehension.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32–42.

This foundational article introduces situated cognition, proposing that learning occurs most effectively within authentic contexts that mirror real-world application. The framework supports embedding aviation security instruction within realistic environments and guided practice.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245–281.

This seminal paper connects feedback with self-regulated learning, showing that learners improve when given timely, specific input. The model supports structured reflection and review processes following training sessions.

DeRouin, R. E., Fritzsche, B. A., & Salas, E. (2005). E-learning in organizations. *Journal of Management*, 31(6), 920–940. <https://doi.org/10.1177/0149206305279815>

This conceptual review presents a framework for designing and evaluating e-learning in workplace settings. It emphasizes alignment with organizational goals and integration of digital instruction with instructor oversight to enhance engagement and retention.

Dickinson, M. T. (2021). *A comparison of safety management systems training methods* (Master's thesis). Embry-Riddle Aeronautical University Digital Commons.

This study compares classroom, online, blended, and scenario-based approaches to SMS training in aviation. Results show blended and interactive methods produce higher retention and practical transfer than lecture-only formats.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques. *Psychological Science in the Public Interest*, 14(1), 4–58. <https://doi.org/10.1177/1529100612453266>

This comprehensive review identifies retrieval practice and spaced learning as the most effective strategies for long-term retention. The findings directly support structured review cycles and low-stakes testing in security training.

Fraulini, N. W., Marraffino, M. D., Garibaldi, A. E., Johnson, C. I., & Whitmer, D. E. (2024). Adaptive training instructional interventions: A meta-analysis. *Military Psychology*. <https://doi.org/10.1080/08995605.2024.2377884>

This meta-analysis shows that dynamically adjusting difficulty, pacing, and feedback enhances engagement and long-term retention in high-stakes environments.

Gómez-Cambronero, Á., Miralles, I., Tonda, A., & Remolar, I. (2023). Immersive virtual-reality system for aircraft maintenance education. *Applied Sciences*, 13(8), 5043. <https://doi.org/10.3390/app13085043>

This case study highlights the use of gamified virtual reality for procedural learning and reinforcement in safety-critical environments.

Haughton, J. (2023). *Exploring knowledge-retention strategies to prevent knowledge loss in project-based organizations* (Doctoral dissertation, Walden University). <https://scholarworks.waldenu.edu/dissertations/10338/>

This qualitative study emphasizes mentorship, documentation, and cross-training as strategies to preserve institutional knowledge.

Khalafi, A., Fallah, Z., & Sharif-Nia, H. (2024). The effect of spaced learning on retention of nurse-anesthesia students. *BMC Medical Education*, 24(1), 322. <https://doi.org/10.1186/s12909-024-05290-9>

This randomized study demonstrates that spaced learning improves immediate and long-term retention compared to continuous lecture formats.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Kolb's experiential learning cycle supports scenario-based and hands-on training approaches.

Landsberg, C. R., Astwood, R. S., Van Buskirk, W. L., Townsend, L. N., Steinhauer, N. B., & Mercado, A. D. (2012). Review of adaptive training system techniques. *Military Psychology*, 24(2), 96–113. <https://doi.org/10.1080/08995605.2012.672903>

This review highlights adaptive feedback systems that improve efficiency and retention.

Latimier, A., Peyre, H., & Ramus, F. (2021). A meta-analytic review of the benefit of spacing out retrieval practice episodes on retention. *Educational Psychology Review*, 33(3), 959–987. <https://doi.org/10.1007/s10648-020-09572-8>

This review demonstrates that spacing retrieval practice enhances long-term retention across learner types and domains.

Lohre, R., Bois, A. J., Pollock, J. W., Lapner, P., McIlquham, K., Athwal, G. S., & Goel, D. P. (2020). Effectiveness of immersive virtual reality on orthopedic surgical skills. *JAMA Network Open*, 3(12), e2031217. <https://doi.org/10.1001/jamanetworkopen.2020.31217>

This randomized trial shows virtual reality improves procedural accuracy and skill transfer compared to traditional instruction.

Makombe, J. R., & Rutenge, M. (2025). Evaluation of common employee training methods in enhancing performance at Tanzania Commercial Bank. *African Journal of Empirical Research*.

This case study finds experiential methods produce stronger engagement and performance outcomes than digital learning alone.

Metzler-Baddeley, C., & Baddeley, R. J. (2009). Does adaptive training work? *Applied Cognitive Psychology*, 23(2), 254–266. <https://doi.org/10.1002/acp.1454>

This study shows adaptive repetition spacing improves recall compared to fixed schedules.

Murray, J. S., Baghdadi, A., Dannenberg, W., Crews, P., & DeZellar Walsh, N. (2024). The role of high reliability organization foundational practices in building a culture of safety. *Federal Practitioner*, 41(7). <https://doi.org/10.12788/fp.0486>

This article connects structured reinforcement and culture-building to safety performance.

National Safe Skies Alliance. (2018–2025). PARAS 0018, 0035, 0044, 0046, 0049, 0051, 0054. National Safe Skies Alliance.

These applied aviation security reports emphasize standardized, scenario-based, and recurrent training practices to strengthen compliance and operational readiness.

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. Springer.

This synthesis explains how managing intrinsic and extraneous load improves learning efficiency and retention.

Vygotsky, L. S. (1978). *Mind in society*. Harvard University Press.

This foundational work supports scaffolding and guided practice in complex learning environments.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts et al. (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press.

This chapter outlines the self-regulated learning cycle and supports building learner autonomy in training system