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Can We Make Airside Training More Effective?

Reimagining how airports train their teams—from simulators to microlearning—to ensure safety, consistency, and peak performance on the airfield.

ACT Airside Training Task Force | Insight Report 2026

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FOREWORD

There is a moment, in the stillness before first light, when every airport comes alive. Airfield and Ground crews move across the pavements beneath a sky not yet day but no longer night. Equipment begins to roll. The first aircraft of the day pushes back from the gate. And in that choreography of motion, light, and sound, something extraordinary takes place - hundreds of people performing complex, high-stakes work in one of the most unforgiving environments ever created by human ambition.

They do it every day. Across the United States alone, more than 45,000 flights take off and land each day, carrying over 1.1 billion passengers every year. But the system sustaining that rhythm is under growing strain. The operational buffers that once allowed airports to absorb disruption - to catch a mistake, recover from a delay, adapt to the unexpected - are steadily disappearing. Today, even a relatively minor disturbance can cascade across an entire network within minutes. The margins are thinner. The expectations are higher. The industry is being asked to prepare more people, faster, and with fewer resources than the system was ever designed to handle.

Behind every one of those flights is a team of airside professionals whose skills, judgment, and readiness determine whether operations run safely and smoothly, or whether they don't. And yet, the systems designed to prepare those professionals have not kept pace with the world they are being asked to operate in.

Here is the uncomfortable truth: we are still training for an airport that no longer exists. The training frameworks used across much of the industry were built in a different era, when traffic volumes were a fraction of today's levels, when cargo flows were smaller, before globalized supply chains reshaped the meaning of time pressure, and before low-cost carriers and mass tourism compressed turnaround dynamics to their current intensity. Yet the core of training has remained largely the same: classroom sessions, annual theory reviews, and limited practical exposure.

We modernized fleets. We modernized terminals and IT systems. We invested heavily in the physical infrastructure of aviation. But we did not modernize how we prepare the people operating within it. What makes this harder to address is how training has traditionally been measured. Attendance logged. Hours completed. Certificates issued. These metrics are easy to track - and that, in part, is why they persist. They tell us whether training was delivered, not whether it was absorbed. They confirm that someone completed a course, but say nothing about whether that person is genuinely prepared to make sound decisions under stress and



pressure, in low visibility, with time running out, and multiple priorities competing for attention. In a high-risk environment, what people do not truly know will eventually show - and safety is the first to pay the cost.

And it connects to something deeper - something the industry understands intuitively, even if it is rarely stated plainly. Aviation is rich with procedures, manuals, layers of defense, audits, and safety frameworks. But in real operations, all of that coexists with something that rarely appears in formal documentation: pressure, tight turnarounds, incomplete information, fatigue, and long working hours. The system relies on human adaptability to absorb what its design cannot. And for most of the time, on most days, it does. People rise to meet the demands placed on them; they adjust, and perform - often without recognition, and sometimes without the preparation they deserve.

But this is where the conversation about safety must become more honest. When an incident occurs, the instinct is to locate the cause in the final action - the decision made, the step missed, the moment of inattention. Aviation has a name for this: human error. It is a label that provides closure. It is also, in most cases, a label that closes the conversation exactly where it should begin.

Because incidents rarely emerge from a single isolated act. They are the visible outcome of accumulated pressure: of tighter schedules and leaner teams, of training that qualified without fully preparing, of growing optimization. The person at the center of an incident is rarely the origin of the problem. They are, far more often, the point at which a series of unfavorable conditions finally became visible. The estimated cost of airside incidents across the industry exceeds ten billion dollars annually.

But the number, striking as it is, is not the point. The point is what it reveals: the gap between the demands of today's airport operations and the systems designed to support human performance within them.

The ACT Airside Training Task Force was established to address that mismatch - by bringing together airport professionals and industry partners in an honest conversation about where training stands today, and where it must go.

What that conversation revealed was not a failure of commitment. The people responsible for airside training across America are dedicated, experienced, and acutely aware of what is at stake. The investigations and findings showed a structural tension between the complexity of airside operations and the capacity of traditional training models to meet them. The encouraging reality is that the solutions exist - and they are far more accessible than many assume. Training technology has undergone the same progressive transformation as personal technology: what was once available only to well-resourced organizations is now within reach for airports of all sizes, ground handling companies, and GSE providers.

Progress requires someone to go first. It requires leadership that does not wait for a regulatory mandate or a serious incident to justify action. That kind of leadership has always defined American aviation at its best. It was the refusal to accept the limits of existing systems - the willingness to invest in new methods, embrace emerging tools, and build for the future rather than defend the past - that made U.S. aviation so powerful and innovative. This is an opportunity to lead still.

This report represents the first structured step in that direction. It is not a final prescription, as airports are too different from one another for a single model to serve all. What this report offers instead is a shared diagnosis: an honest account of where the industry stands, grounded in the voices of those living these challenges every day, and an invitation to move forward TOGETHER. Importantly, this initiative does not position technology as a replacement for operational experience or instructor expertise. Technology is a means. The measure of this Task Force will always be the person standing on the airfield - better prepared, safer, and better supported than before.

We are grateful to every airport, every operational leader, and every individual contributor whose candor and commitment made this work possible. This report belongs to them. And so does the future it points toward.

Carlton Braley Jr A.A.E.
Chair, ACT Airside Training Task Force, AAAE



As the lead industry partner for ACT's Airside Training Task Force, Fortbrand Services LLC has played an important role in bringing together airports and industry stakeholders to explore opportunities to improve airside training effectiveness. Led by Carlton Braley, A.A.E., Chief Operating Officer and Executive Vice President of the Airport Maintenance Equipment (AME) Division, Fortbrand's involvement reflects a commitment to helping airports address evolving training challenges, explore emerging technologies, and identify practical approaches to strengthening airside safety and workforce readiness. Through this collaborative effort, Fortbrand has helped advance the Task Force's report, Can We Make Airside Training More Effective?, which examines current industry practices and identifies opportunities for improvement.

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EXECUTIVE SUMMARY

Airports in the United States operate within one of the most complex and demanding environments in global aviation. Traffic volumes continue to grow, operations become more time-critical, and expectations around safety, reliability, and efficiency continue to rise. At the same time, the system is being asked to prepare more people, faster, and under tighter constraints than it was ever designed for.

This report is grounded in direct input from airport professionals responsible for training and operations. Their perspectives offer a clear and consistent message. The challenge is not a lack of effort, but a growing mismatch between what the operating environment requires and what current training models are able to deliver. As ATL noted, "too many to train and not enough people to do the training." Several described a system where training is "handled as a collateral duty," competing with day-to-day priorities. Effectiveness is an equally pressing concern. Training is often delivered, but not always absorbed. As FSD observed, "it's a lot of information thrown at people all at once. The retention is not great." In a high-risk environment, this gap between exposure and competence becomes dangerous. Taken together, the findings point to a structural tension. Airside operations have evolved rapidly, while training models have remained largely unchanged. The result is a widening gap between operational complexity and the system's ability to build and sustain workforce readiness at scale.

At the same time, the path forward is becoming clearer. Technology-enabled training is no longer a future concept. Simulation, immersive environments, and microlearning already offer practical ways to expand training capacity, improve retention, and create safe exposure to complex and non-routine situations. They are proven approaches, increasingly adopted across safety-critical industries.

The challenge, however, is not technological; it is structural. Airports are asking for clarity: how to integrate these solutions into existing training systems, how to measure their impact, and how to build programs that go beyond compliance toward demonstrable competence. This points to a necessary shift in perspective. In an environment defined by operational pressure and human performance, training cannot remain a periodic requirement. It must become a continuous, measurable process of capability development - aligned with real-world conditions and designed to support decision-making under pressure.

The potential impact is significant. More effective training strengthens safety, improves operational performance, and increases resilience across the airfield. It enables more consistent standards, and better use of limited resources. Over time, it contributes not only to safer operations but to more efficient and economically sustainable ones.

The industry is ready for this transition. The next step is to provide the structure, guidance, and collaboration needed to turn available solutions into scalable, future-proof training systems.

SECTION 1

The Evolving Operational Environment Reshaping Airport Training Needs



Growing Operational Complexity

The United States is part of one of the largest and most mature airport systems globally, with North America representing a highly developed, high-throughput aviation market.

According to Airports Council International, airports in North America generated approximately USD 48.0 billion in total revenues in 2024, reflecting a 6.2% year-on-year increase and continued post-pandemic recovery. The region accounts for approximately 25% of global airport revenues, underlining its economic significance and scale.

Within this, aeronautical revenues reached USD 23.4 billion (+8.6%), while non-aeronautical revenues accounted for USD 15.9 billion (+5.5%), confirming a diversified and traffic-dependent revenue structure typical of large airport systems. At the same time, operating costs reached USD 20.9 billion (+5.8%), with total costs at USD 36.6 billion (+4.1%), indicating sustained investment alongside rising operational intensity. Cost structure data further highlights the labour-intensive nature of airport operations, with personnel expenses representing approximately 33% of total operating costs.

The volume of global air traffic continues to grow, with long-term forecasts indicating a sustained upward trend in both passenger numbers and flight operations. Looking at total system activity, including general aviation and cargo operations, the FAA reports that the U.S. airspace system handles over 45,000 flights per day on average, making it one of the most operationally dense aviation environments globally (FAA Aerospace Forecast 2024-2044). According to the Bureau of Transportation Statistics (BTS), monthly passenger volumes remained steady at approximately 81 to 85 million. Furthermore, the FAA Aerospace Forecast indicates that total systemwide enplanements for fiscal year 2024/2025 surpassed the 1.1 billion threshold, representing a 6.5% increase over pre-pandemic averages.

The growth rate is expected to stabilize at approximately 2.3% over the long-term forecast period through 2044 (FAA Aerospace Forecast 2024-2044). Meanwhile, both the FAA and Boeing predict that air cargo volumes will increase at an annual rate of between 3.3% and 4.1% (FAA Aerospace Forecast; Boeing Commercial Market Outlook).

At the same time, ICAO forecasts indicate a sharp increase in demand for skilled aviation professionals, with over 2.5 million new personnel required by 2043 to maintain safe and efficient operations (ICAO Next Generation of Aviation Professionals Programme, Working Paper). Skills shortages are predicted across a wide range of occupations within aerospace and aviation, including but not limited to maintenance personnel, airport operations, airline crew and ground staff, ground handlers and cargo personnel, security staff and in government.

All of these areas must be addressed to ensure continuity of operations, license to grow and maintenance of safety and security. However, for example, ground workforce numbers have not fully recovered, remaining at approximately 88% of pre-pandemic levels, which translates into an estimated 21-30% increase in per-capita operational workload for ground teams. This creates a structural imbalance between operational demand and available human resources in an environment where multiple operations take place simultaneously under constant time pressure.

As a consequence, airport schedules have become significantly more fragile. What was once a manageable disruption has become systemic sensitivity. Data from 2024 in the U.S. shows that while flight volumes grew by just under 6%, en-route delay minutes in specific control centers - such as Florida and the New York metropolitan area - surged by more than 45-50%. This stems from the fact that the system has exhausted its 'buffer capacity,' leaving no room for operational recovery (FAA Air Traffic Organization (ATO) Performance Report; FAA OPSNET).

In 2019, the aviation system maintained larger staffing and equipment reserves. Currently, due to critical workforce shortages, a single technical failure or a brief weather event now triggers a systemic 'cascade effect'. The Airlines for America (A4A) 2025 report indicates that the average duration of secondary delays has increased by approximately 25% compared to pre-pandemic levels. The system has become structurally 'rigid,' losing its ability to absorb minor disruptions (Airlines for America Industry Review 2025).

Shifting Risk Profile

Despite continuous improvements in equipment, enhanced GSE capabilities, and increasing levels of technology embedded in airport operations, the nature of operational risk is changing. The industry has reached a point where technological safety has advanced significantly, yet incident rates, particularly on the ground, are no longer decreasing at the same pace.

According to the EASA, ground handling-related occurrences across EASA Member States reached approximately 135,780 cases over the period 2019-2025, with a sharp acceleration in recent years, including a 50% increase between 2023 and 2024. While many of these events are non-catastrophic, they signal a growing instability in day-to-day operations. This trend is mirrored globally, with IATA identifying ground damage as a top accident category, driven by operational pressure and workforce experience gaps (IATA Annual Safety Report 2025).

At the same time, runway incursions and ground safety-related events now account for approximately 40% of fatal aviation accidents (ICAO Safety Reports), highlighting the critical role of ground operations in overall flight safety.

This shift reflects a deeper structural reality. The majority of operational risk is no longer driven by equipment limitations, but by human performance within complex systems, and of course, staff shortage. Human factors are estimated to contribute to 70-80% of aviation incidents and accidents (FAA). In high-density environments, small deviations (miscommunication, distraction, or procedural shortcuts) can escalate quickly. The issue is not only error frequency, but error amplification. A single misjudgment can trigger a chain of operational consequences affecting multiple aircraft, teams, and timelines.

A stark illustration of this systemic sensitivity occurred on October 17, 2025, at Chicago O'Hare International Airport, where a wing-tip collision occurred due to a spatial awareness failure by a ground tug operator during a high-pressure pushback operation. While the physical damage was non-catastrophic, the incident instantly neutralized two gates during a peak arrival period, triggering a cascade of taxiway congestion and secondary delays that affected dozens of flights across the national network.



Furthermore, regulatory expectations are evolving. Aviation authorities are increasingly shifting from reactive safety models toward proactive and predictive safety frameworks, requiring organizations to identify and mitigate risk before incidents occur. This creates a more demanding safety landscape, where operational performance and safety performance are inseparable.

Workforce Transformation

Parallel to these operational changes, the structure and characteristics of the airport workforce are also evolving rapidly. The pandemic period has resulted in a significant loss of experienced personnel. Approximately 57% of ground handlers exited the profession between 2019 and 2021, creating a substantial experience gap across the industry. As a result, workforce experience levels have shifted dramatically. It's estimated that today, around 60% of ground handling personnel have less than two years of industry experience (Airport Services Association (ASA). In many cases, team leaders with limited tenure are supervising employees with only a few months of operational exposure.

The COVID-19 pandemic left an unprecedented mark on the aviation industry. The combination of revenue loss, recruitment freezes, and epidemiological safety measures resulted in a radical reduction of traditional forms of education. Analysis of data from the IATA "Workforce skills & training to fuel the revitalization of the aviation industry" reveals an alarming scale of competency development restrictions in 2020-2021. As many as 70% of aviation organizations eliminated training budgets or cut them by at least half; 75% of companies canceled or indefinitely postponed all on-site training; only 36% of companies shifted priorities to remote learning solutions.

Retention is also a critical challenge. Around 50% of new hires leave within the first three months (A4A), forcing organizations into a continuous cycle of recruitment and onboarding. This has direct implications for training because organizations must repeatedly train new personnel while maintaining operational continuity, often with limited experienced staff available to support the process. ICAO's Strategic Plan 2026-2050 recognizes that ensuring the availability of talented professionals in a wide range of occupations is a key enabler for the future of aviation.

At the same time, the workforce itself is changing. Many experienced technical workers are approaching retirement age, and there is a lack of successors with comparable competencies. In Europe, up to 44% of the aerospace workforce is expected to retire by 2030. Although this estimate is region-specific, similar workforce pressures are observed across mature aviation markets worldwide (ICAO Next Generation of Aviation Professionals Programme, Working Paper). Work on the airport apron is perceived as poorly paid and unattractive in terms of image and salary, so attracting and retaining employees in "below the wing" positions poses a challenge.

A growing proportion of employees are digital-native, with different expectations toward learning, information



access, and engagement. Traditional training formats may not align with these behaviors, particularly in environments where attention, retention, and speed of learning are critical.

The result is a system where the need for faster onboarding, higher consistency, and continuous competence development is increasing, while the underlying workforce stability required to support it is decreasing.

Conclusion

These structural shifts: growing operational complexity, an evolving risk landscape, staff shortages, and a transforming workforce, are redefining what operational readiness means in an airport environment. The system is becoming more demanding, more interconnected, and less tolerant of variability. At the same time, the workforce responsible for operating within this system is less experienced and under greater pressure. This creates a critical "readiness gap" that traditional training models can no longer bridge. Airports today operate in an environment that is fundamentally different from the one in which most current training models were designed.

When the cost of a single ground incident exceeds millions and systemic "cascading delays" are triggered by minor errors, airports need to ensure that personnel reach operational proficiency before stepping onto the high-density airfield. However, as our recent industry survey reveals, achieving this proficiency is increasingly difficult under current constraints. DFW reports that the "airfield is too busy for training at times," and Charlotte adds that "as the airfield grows and gets busier, it limits the amount of time on the movement area we can utilize for training"

The data following this section highlights a widespread struggle with resources, where many organizations simply "do not have enough dedicated staff in operations to sufficiently train drivers". This lack of bandwidth often leads to a "lot of information thrown at people all at once" resulting in poor knowledge retention.

Furthermore, with a "diverse workforce in terms of skill levels" and new employees who have "different ways of learning from previous staff", the industry is urgently seeking "modernizing" solutions and "new technologies that streamline and automate the processes". These firsthand insights provide a compelling baseline for the following analysis of current airside training challenges.

SECTION 2

Survey Insights: How Airports Train Today





The purpose of this survey was to understand how airports are training the people who operate on the airfield today, where the gaps lie, and what the industry says it needs next. The survey was also designed to capture how airports collaborate with external partners, how training is staffed and delivered, whether new technologies are being explored or used, and whether airports are measuring training effectiveness in a meaningful way.

This survey reflects 26 responses representing 20 airport organizations across the United States, collected during the period November 2025-June 2026. Respondents include airports with varying traffic volumes, workforce structures, and levels of training maturity, providing a broad view of current practices. This mix offers a representative cross-section of the industry, capturing both common challenges and differences in how airside training is delivered. This group features a powerhouse lineup, including three of the world's top ten busiest airports, sourced from the 2024 Airport Traffic Ranking by Airport's Council International (ACI), representing the absolute pinnacle of global operational density.

Participating Organizations

- Hartsfield-Jackson Atlanta International Airport (ATL)
- Jackson Hole Airport (JAC)
- Sioux Falls Regional Airport (FSD)
- Boise Airport (BOI)
- Charlotte Douglas International Airport (CLT)
- Reagan National Airport (DCA)
- Dulles International Airport (IAD)
- Philadelphia International Airport (PHL)
- Boston Logan International Airport (BOS)
- Kansas City International Airport (MCI)
- Memphis International Airport (MEM)
- Manchester-Boston Regional Airport (MHT)
- Dallas Fort Worth International Airport (DFW)
- Lancaster Airport (LNS)
- Kansas City Downtown Airport (MKC)
- Norfolk International Airport (ORF)
- Portland International Jetport (PWM)
- Detroit Metro/Willow Run (DTW)
- George Bush Intercontinental Airport (IAH)
- Cincinnati/Northern Kentucky International Airport (CVG)

AAAE ACT Pulse Check: Airside Driver Training

The following survey has been completed by airport maintenance and operations leaders.

A special thank you to airport Champions - ATL, PHL, CVG, and DTW for their leadership, feedback, and contributions throughout the process.

QUESTION 1

How would you describe collaboration between your airport and external partners (airlines, tenants, regulators) on staff training?

46% of respondents rated collaboration with external partners as moderate. Another 35% described it as limited, and 4% reported no collaboration at all. Only 15% reported extensive collaboration.

Of all of the respondents, 39% indicated that collaboration with external partners on staff training is limited or nonexistent. That is a significant finding in an operating environment where airlines, tenants, contractors, and other authorized users routinely move equipment and personnel through safety-critical areas.

The issue is not whether those external partners are conducting some form of training. In many cases, they are. The issue is whether that training is being delivered within a coordinated framework that the airport helps define, oversee, and validate.

When collaboration is weak, training becomes fragmented. Standards vary by operator. Expectations are interpreted differently. Practices are passed from one employee to another without a common baseline. In that environment, the airport may be responsible for the safety of the operating environment without having sufficient influence over how its airfield users are being trained to operate within it.

The larger takeaway is that moderate collaboration should not be mistaken for a mature or fully aligned training model. It suggests some coordination, but not complete control, consistency, or shared accountability. One group may be trained directly by the airport while another is trained independently within a tenant space, cargo area, or leasehold. From a safety and operational standpoint, that is not where the industry should stop. If the objective is to improve airfield safety, the standard should be full collaboration with external partners, so that every individual authorized to operate on the airfield is trained within a framework established by the airport and one that the airport can stand behind.

Elsewhere in the survey, respondents reinforced this point by emphasizing the need for greater consistency among stakeholders. As ATL noted, "Consistency across the board with all stakeholders would be nice to ensure everyone has a similar background and basic knowledge." BOS wrote that "having everyone training on the same platform and to the same standards would be beneficial to all parties involved."

QUESTION 2

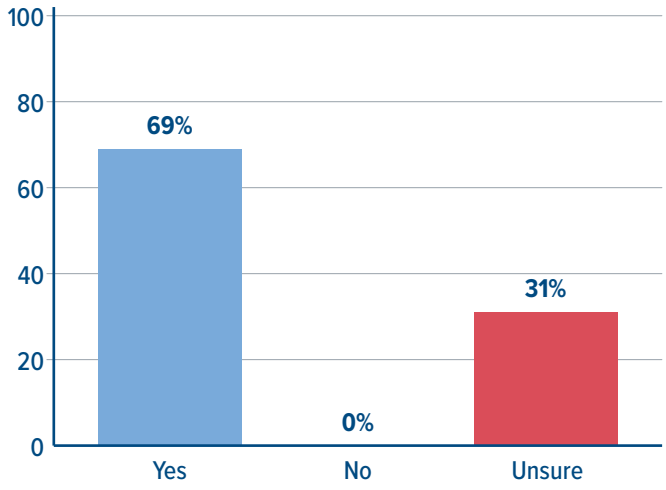
Would an industry-wide training guideline or framework be valuable to your airport?

The response to this question is one of the clearest findings in the survey. No respondent said no. Two-thirds of respondents (69%) said yes, and the remaining 31% said they were not sure.

That result is important because "not sure" should not be read as opposition. It reflects a need for more information, more definition, and a better understanding of what such a framework would require in practice. Taken together, the responses indicate that 100% of respondents are open to the value of an industry-wide training guideline, and none rejected the concept outright.

That matters because it shows the industry is not resisting the idea of stronger alignment. Respondents understand that a more consistent framework could help establish a common baseline for training, improve coordination across operating environments, and reduce the variability that exists from one airport or operator to the next. At the same time, they are cautious for a very practical reason: they do not want an unfunded mandate.

Would an industry-wide training guideline or framework be valuable to your airport?



Respondents want to know what the framework would look like, how flexible it would be across different sizes and types of operations, and whether implementation would be supported by realistic resources. Their hesitation is not about whether improvement is needed. It is about whether improvement can be achieved in a workable way.

The takeaway is that the industry is ready for leadership on this issue. Respondents are signaling that a structured training framework would be valuable, provided it is practical, scalable, and grounded in operational reality. In other words, the question is no longer whether the industry sees value in a common approach. The question is what that approach should look like, how it should be delivered, and how to build it in a way that improves safety and performance without creating a burden airports cannot support.

The open-ended responses reinforce the strength of support for an industry-wide framework. PHL pointed to "regulatory alignment, workforce readiness, and cost savings," while ATL stated that "industry-wide guidelines would provide a great baseline for airports to build off of." Taken together, these comments show that respondents are looking not only for consistency, but for a practical foundation they can scale and defend operationally.

QUESTION 3

If yes, why would industry-wide training guidelines be valuable to your airport?

Respondents are seeking a common training baseline that improves consistency, supports regulatory alignment, and provides operators across the industry with a more uniform foundation for performance.

Among the 20 respondents who provided narrative feedback, the same themes surfaced repeatedly: consistency, standardization, scalability, workforce readiness, and practical support for local program development. As one respondent from Atlanta put it, "consistency across the board with all stakeholders would be nice to ensure everyone has a similar background and basic knowledge." Another noted that industry-wide guidelines would "provide a great baseline for airports to build off of." That is the central message in this section of the survey: respondents do not want more ambiguity; they want a clearer, more defensible starting point.

The responses also show that respondents are not looking for a rigid, one-size-fits-all requirement. They are looking for a framework that establishes common expectations while allowing for differences in airport size, complexity, tenant mix, and operating environment.



Several respondents tied that value directly to regulatory alignment, especially in areas where local interpretation can vary. A response from IAH highlighted the need for "regulatory alignment, workforce readiness and cost savings," while another emphasized that widely accepted guidance would help departments justify training initiatives internally and provide a stronger basis for decision-making. In other words, the value lies not only in consistency for its own sake, but also in providing airports with a practical structure they can implement, defend, and scale.

There is also a strong operational message in these responses. Respondents are telling us that developing and maintaining training programs from scratch is resource-intensive, especially when internal staffing is already limited. One response from MCI stated plainly that industry guidance would be valuable because it is "one less thing for Ops to create and manage." ATL observed and reported that "the hardest part of developing a training program is figuring out where to start." That is an important point. The industry is not asking for more ideas in the abstract. It is seeking a usable framework that reduces duplication of effort, improves consistency among stakeholders, and helps airports build training programs that are more credible, current, and effective.

QUESTION 4

Does your airport have dedicated training staff?

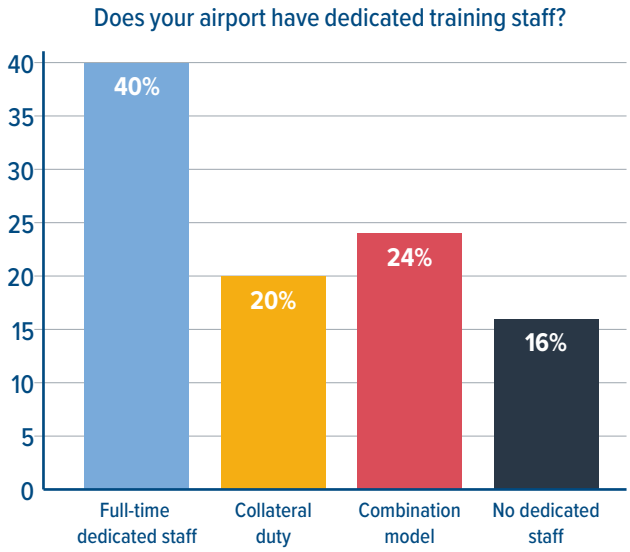
Of the 25 respondents who answered this question, 40% reported having full-time dedicated training staff. Another 20% said training is handled as a collateral duty, 24% reported a combination model, and 16% said they have no dedicated training staff at all.

A clear majority of respondents are not relying on a fully dedicated training structure. They are relying on some mix of shared responsibility, partial assignment, or no formal training staff whatsoever.

Training in a safety-critical environment cannot be treated as something that happens only when time allows. When training is assigned as a collateral duty, it competes directly with day-to-day operational demands. When handled through a combination model, the airport may have some structure in place, but not enough dedicated capacity to fully own the program. When there is no dedicated training staff, the airport is left trying to meet a complex training requirement without a clear operational anchor.

Elsewhere in the survey, respondents described that reality plainly. One respondent from IAD noted that "Most is handled as a collateral duty that rotates from individual to individual." ATL stated that the challenge is "too many to train and not enough people to do the training."

The takeaway from this question is that the industry is trying to support increasingly complex training requirements without a consistently sufficient training workforce. Even among respondents who do have some training capability, many lack the personnel depth needed to deliver recurrent, hands-on, and performance-based training at the level the operating environment demands. As one ATL respondent noted, there is "not enough staff to optimize training to maximize its potential."



At a high level, this finding helps explain several of the themes that follow in the survey. If airports do not have enough dedicated people to train, evaluate, update, and reinforce performance, it is not surprising that respondents are looking for stronger frameworks, more scalable delivery models, and new technologies that can extend training capability beyond what current staffing alone can support.

QUESTION 5

What is the approximate number of individuals requiring training: movement area drivers, non-movement area drivers, and full-time trainers?

This question is important because it begins to show the scale of the training burden respondents are carrying. While the responses were submitted in open-text format and vary in level of detail, the overall pattern is clear: the number of individuals requiring training is substantial and, in many cases, far exceeds the number of personnel available to deliver it.

Several respondents reported movement-area populations in the hundreds, non-movement area populations in the thousands, and training staff ranging from a few individuals to none in some cases. The relationship between the number of people requiring training and the number of people available to provide it is one of the most consequential findings in the survey.

This shows that airside training is not a small-scale internal function. At larger airports, the training obligation can involve hundreds of movement-area drivers and thousands of non-movement-area personnel. This creates a continuous training demand. The challenge is not only delivering initial training, but also sustaining recurrent, meaningful, and performance-based training over time across a population that may be too large for traditional staffing models to support effectively.

This question also reinforces a broader concern present throughout the survey: current training capacity does not appear to be scaled to the size of the obligation. Where respondents are responsible for training large populations but rely on only a small number of trainers, training is likely to be compressed, simplified, or delivered in ways that favor efficiency over skill development.

As the training population grows, it becomes increasingly difficult to rely solely on labor-intensive methods. This is one of the clearest reasons respondents are signaling interest in more scalable training frameworks and technologies. The survey strongly suggests that many airports do not yet have a training system scaled to the demands of the operating environment.

QUESTION 6

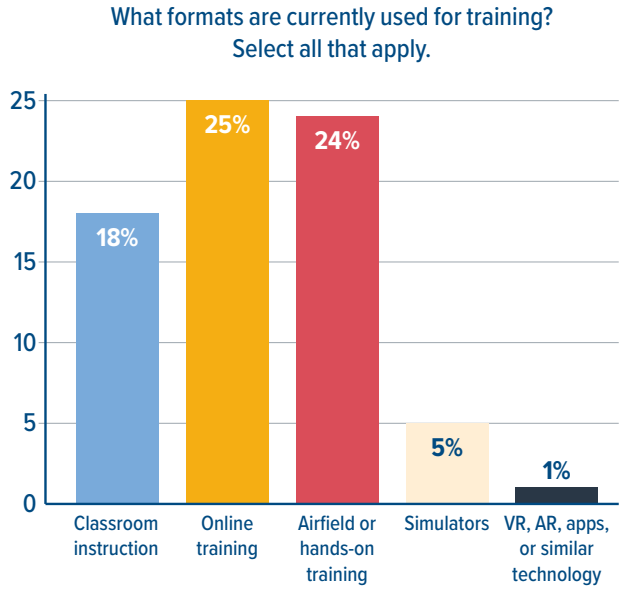
What formats are currently used for training? Select all that apply.

Of the 26 respondents, 25 indicated they use online training, 24 reported airfield or hands-on training, and 18 reported classroom instruction. By contrast, only 5 respondents reported using simulators, and only DFW reported using virtual reality, augmented reality, apps, or similar newer technology. This distribution shows that the industry has broadly adopted classroom, online, and field-based instruction as its standard model, while more advanced training tools remain the exception rather than the norm.

On the surface, this may suggest the industry is already using a blended approach. In practice, however, the survey points to a different conclusion. Respondents use multiple formats, but they remain within a largely conventional training structure. Classroom instruction, online modules, and limited hands-on exposure may satisfy a basic training obligation, but they do not necessarily produce measurable operational



competence. This remains a limitation, particularly in an environment where training time is limited, staff resources are constrained, and the consequences of poor judgment on the airfield are significant.



Nearly all respondents reported some form of online and hands-on training, and 69% reported classroom instruction, yet elsewhere in the survey respondents expressed concern about staffing limitations, inconsistency, retention, and the overall effectiveness of current training methods. This suggests that the dominant formats in use today do not appear to close the gap between training exposure and demonstrated proficiency. FSD noted that "it's a lot of information thrown at people all at once. The retention is not great." A response from CLT noted that "airfield familiarization and ATC communication" is a challenge that is difficult to address effectively through lectures or passive online modules alone.

The low adoption of simulation-based tools is equally important. With only 5 respondents reporting simulator use and only 1 respondent reporting use of VR, AR, or similar tools, the survey makes clear that the industry has not yet widely adopted technologies that could provide more repetition, more realistic scenarios, and more scalable performance-based practice. If airports are expected to train large populations with limited trainers and limited live-field time, methods that depend heavily on classroom delivery and basic recurrent review will continue to have structural limitations.

The survey indicates that the industry is still relying primarily on familiar, administratively manageable formats, even as respondents point to gaps in retention, scalability, and measurable proficiency. The next step is not to replace classroom, online, or airfield instruction, but to strengthen the model with tools that improve repetition, realism, retention, and measurable performance.

QUESTION 7

How many levels of movement area access does your airport use?

The poll results show that most respondents are still operating with relatively broad access structures. Of the 26 respondents, 15 (58%) reported using a single level of movement area access, 6 (23%) reported using two levels, and 5 (19%) reported using three or more levels. This indicates that, for most respondents, movement area access is managed in a relatively simple way rather than through a more layered system of restrictions.

From an operational standpoint, this is significant. A single access level may be easier to administer, but it suggests that once an individual is authorized, the range of areas they may enter is not differentiated as precisely as it could be. In a more mature access model, permissions would be more closely aligned with operational needs. Not every individual who needs access to one part of the airfield should have the same level of access to all areas, particularly the runway environment.

The survey does not indicate that access control is being ignored, but it does suggest that many airports may rely on broader permissions than the operating environment ideally requires.

This finding becomes more important when viewed alongside other survey results. Respondents have already highlighted limited training resources, inconsistent training quality, and challenges with retention and measurable proficiency. In that context, broad access structures increase exposure. If the training system is under pressure, access control should become more precise, not less.



Restriction is not only an administrative function; it is part of the safety model. A more layered access structure helps ensure that personnel are authorized only for the areas they need to operate in, and only at the level supported by their training and competency.

This is an area where access design requires greater attention within the training discussion. A strong airside training framework should not focus only on curriculum and recordkeeping. It should also address access philosophy, enabling airports to better align training, competency, and operational permissions, reduce unnecessary exposure, and strengthen control over the movement area.

QUESTION 8

Which emerging technology are you most interested in exploring?

The poll results show a clear willingness across the industry to improve training through technology, even if adoption has not yet caught up to interest. Of the 26 respondents, 18 expressed interest in simulators, 17 in remote learning platforms, 13 in virtual reality or augmented reality, 13 in training apps, 9 in AI analytics, and 8 in digital twins. Simulators emerged as the strongest area of interest, followed by remote learning and VR-related tools. Taken together, the results show that respondents are actively looking for better ways to train.

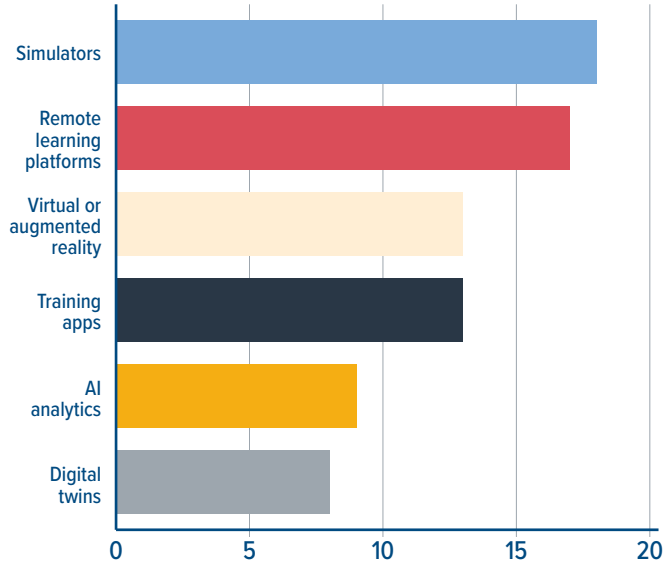
Interest is strongest in technologies that can expand training capacity, improve repetition, and create more realistic learning environments without requiring constant live-field availability. This aligns directly with the staffing and delivery challenges identified elsewhere in the survey. Respondents have already indicated that they do not have enough people, time, or operational flexibility to deliver all training using traditional methods. The responses suggest that technology is seen as one of the few practical ways to close that gap.

The lower response levels for AI analytics and digital twins should not be interpreted as a lack of value. More likely, they reflect lower familiarity or perceived immediacy.

Respondents understand simulation, remote learning, and VR at least conceptually, while AI analytics and digital twins appear less widely understood in their training application. Lower selection does not necessarily mean lower relevance, but rather lower exposure.

The survey suggests that respondents are ready to evolve. There is a clear interest in technologies that can make training more scalable, flexible, and effective. What is needed now is practical guidance on how these tools fit into a training system, how they improve outcomes, and how they can be implemented in a way that supports both safety and operational realities.

Which emerging technology are you most interested in exploring?



QUESTION 9

Are simulators or virtual reality currently used at your airport?

Of the 25 respondents, 20 reported that simulators or virtual reality are not currently used at their airport. Only 5 respondents reported any current use. Within that group, 4 reported use for movement-area training, 0 for non-movement-area training, and 1 for both. Despite strong interest in emerging training technologies, actual implementation remains limited because airports are not aware that affordable training systems exist.

Respondents expressed clear interest in simulators, remote learning, and other modern tools. However, most have not yet translated that interest into operational use. This indicates both recognition of value and the presence of barriers, including cost, internal processes, lack of familiarity, and uncertainty around regulatory alignment.

Among those using simulators or VR, most applications focus on movement-area training, where operational risk is highest and live-field access is limited. Overall adoption remains low, meaning the industry continues to rely on conventional methods despite their known limitations. The survey does not suggest resistance to simulation-based training, but rather that adoption has not yet become routine.

The industry appears to be in an early adoption phase. This creates a clear opportunity to expand understanding of how simulation and VR can support airside training in a scalable and operationally relevant way.

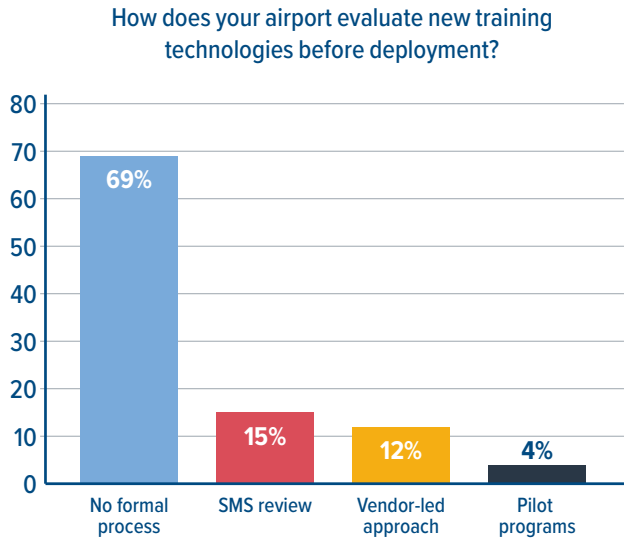
QUESTION 10

How does your airport evaluate new training technologies before deployment?

Most respondents do not have a defined process for evaluating new training technologies. 69% reported having no formal process. 15% use SMS review, 12% rely on vendor-led approaches, and only 4% reported using pilot programs.

While interest in new training tools is high, most airports are not institutionally prepared to assess them in a structured way. This ACT taskforce can create a framework to support this. Evaluation is often limited to safety considerations, vendor input, or internal judgment, rather than a comprehensive review of training effectiveness, usability, scalability, and long-term value.

The limited use of pilot programs is particularly notable. Pilot testing is one of the most effective ways to assess real-world performance, user adoption, and measurable impact. SMS review, while valuable, focuses primarily on risk and does not fully address training outcomes.



The findings suggest that while the industry is interested in innovation, the supporting decision-making framework remains underdeveloped. Airports need clearer methods to evaluate and adopt training technologies with confidence and consistency.

QUESTION 11

Has your airport attempted to quantify return on investment or safety benefits from training technology?

Most respondents are not formally measuring the value of training technology. 58% have not attempted to quantify ROI or safety benefits, 31% are in progress, and only 12% have done so. Those airports that have measured their investment have done so by observing reductions in VPDs and vehicle-vs-vehicle and vehicle-vs-aircraft incidents.



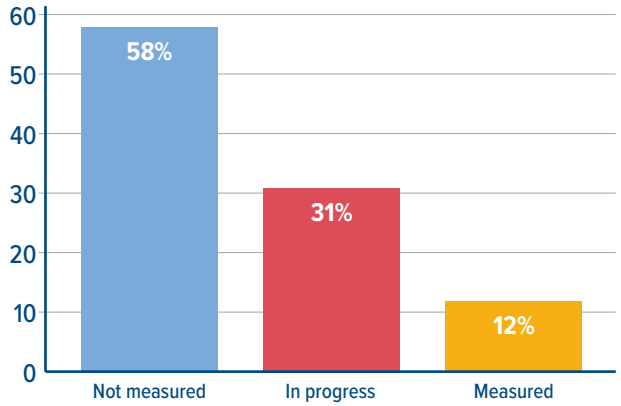
Without measurement, training effectiveness is difficult to manage, justify, or improve. If airports cannot demonstrate impact on safety, performance, or operational efficiency, it becomes challenging to support investment in more advanced training models.

This question is not only about financial ROI, but also about linking training to meaningful outcomes such as fewer incidents, improved operational performance, reduced delays, and stronger audit readiness.

The fact that nearly one-third of respondents are working on measurement suggests growing awareness of this need. However, without a consistent framework, approaches remain fragmented and difficult to compare across the industry.

The survey indicates that a mature measurement culture around training has not yet been established. Most airports focus on delivering training rather than validating its impact. For industry leaders, this highlights a critical gap. Improving training requires not only better tools, but also better ways to measure whether those tools deliver real operational and safety benefits.

Has your airport attempted to quantify return on investment or safety benefits from training technology?



QUESTION 12

What is the biggest challenge your airport faces in training today?

While wording varied across responses, the themes were highly consistent. The most common challenges include insufficient staffing, limited time, difficulty delivering recurrent hands-on training, weak standardization, and the challenge of training a growing or changing workforce in a way that ensures real knowledge retention.

ATL summarized the issue directly: "too many to train and not enough people to do the training." Another noted that "most is handled as a collateral duty that rotates from individual to individual." Together, these responses highlight the core issue: the training burden is increasing faster than the capacity to support it.

Respondents also pointed to limitations in current training methods as a key challenge, emphasizing that some of the most critical skills are difficult to develop



through classroom or online training alone. This points to a gap between training delivery and actual operational readiness.

Airports are attempting to train large numbers of personnel in environments that are busy, time-constrained, and operationally demanding. As one respondent explained, "as the airfield grows and gets busier, it limits the amount of time on the movement area we can utilize for training." Even when the need for more hands-on training is recognized, operational constraints often prevent consistent delivery.

The challenge is not simply to train more, but to train more effectively and consistently, using approaches that can scale within the realities of the operating environment.

The responses clearly indicate that current training models are constrained by limited personnel, limited time, limited standardization, and limited ability to deliver high-retention, performance-based training at scale. This aligns with earlier findings showing strong interest in simulators, VR, and digital learning tools that can extend training capacity beyond traditional methods.

QUESTION 13

What support tools or guidance would be most helpful from ACT?

Respondents are asking for a more comprehensive and structured training approach. They highlighted the need for an overall training framework, standardized minimum expectations, acceptable recordkeeping methods, improved training delivery platforms, stronger guidance on proficiency evaluation, and better visibility into best practices across the industry.

One respondent from ATL requested an "overall training structure" and a "record-keeping method acceptable to the FAA." Another pointed to the need for "standardized minimum standards for airport movement area qualification test or proficiency demonstration requirement." Atlanta's responses specifically indicate their clear demand for a practical system rather than isolated tools.

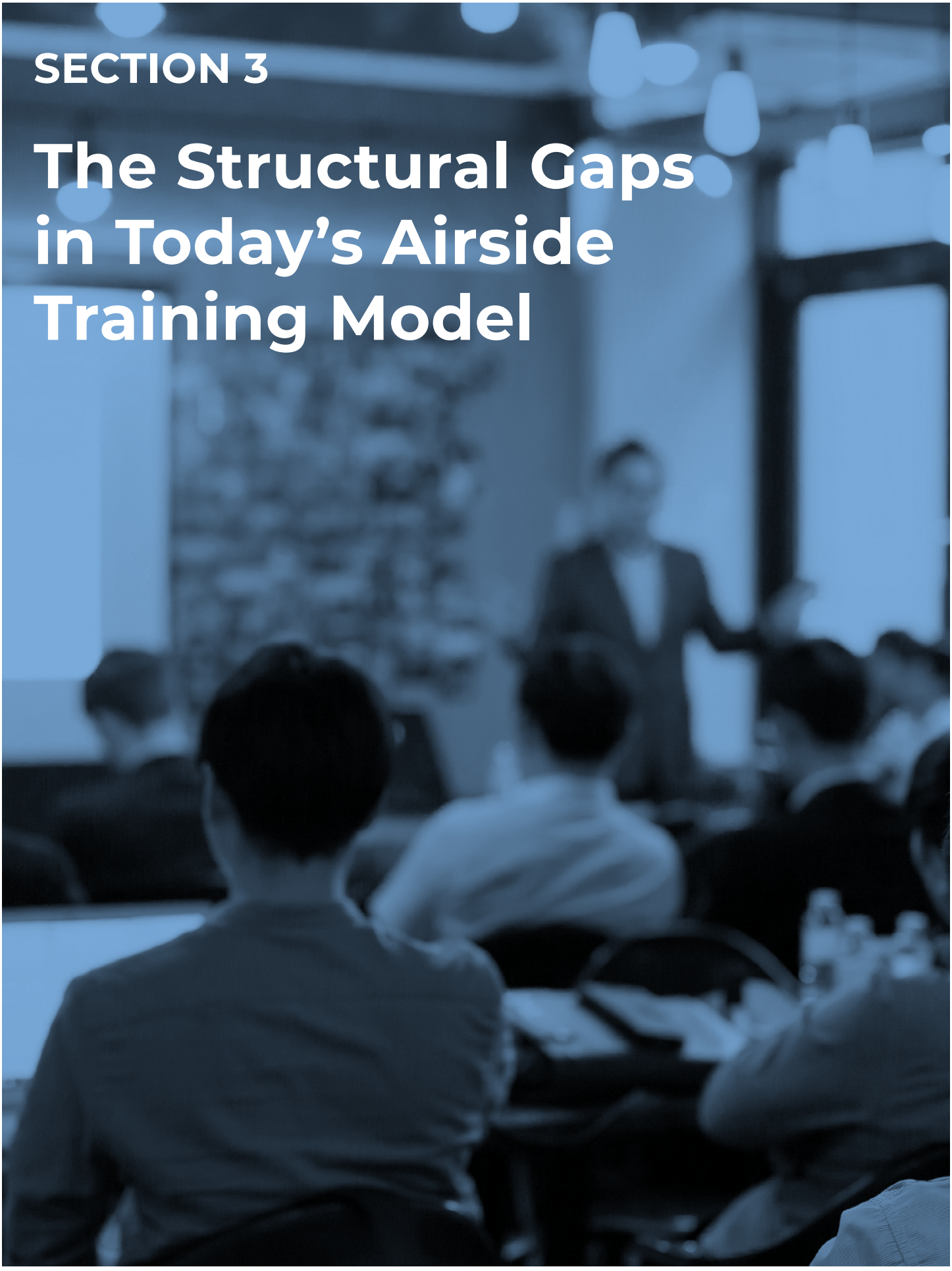
A key theme is the need for consistency combined with flexibility. Respondents want guidance that applies across initial training, recurrent training, movement-area qualification, non-movement-area operations, and documentation, while still being adaptable to different airport environments.

There is also strong demand for practical implementation support. Respondents are looking for best practices, examples from other airports, insights into available technologies, and clarity on how new systems align with regulatory expectations. Questions about compatibility with existing platforms, adaptability to local conditions, and FAA alignment are common.

Overall, respondents are not just asking for support in meeting minimum requirements. They are seeking solutions that improve performance and provide confidence that training programs are effective, measurable, and operationally credible. The survey indicates that the industry is looking to ACT for leadership in defining what a more effective training system should look like. Respondents are asking for a framework that enables more consistent training, better documentation, credible evaluation, and measurable improvements in performance.

SECTION 3

The Structural Gaps in Today's Airside Training Model



The survey findings point to a clear structural tension. Airside operations have become more complex, more time-sensitive, and increasingly dependent on a workforce that is less experienced and more dynamic, with higher turnover and shorter operational tenure. At the same time, the training systems designed to prepare that workforce have not evolved at the same pace. Airports are investing time and resources into training, personnel are being trained and certified, yet the dominant training model is not designed to match the scale, speed, and variability of the operating environment it is meant to support.

As a result, a series of interconnected gaps emerges. Each reflects a different dimension of the same underlying issue: a mismatch between how training is delivered and what operational reality now requires.

GAP	CURRENT LIMITATION
Capacity and scalability gap	• number of personnel requiring training exceeds organizational capacity • limited availability of qualified instructors • difficulty onboarding new employees quickly • challenges in delivering effective recurrent training
Experiential learning gap	• limited safe exposure to high-risk operational scenarios • insufficient training for rare and extreme events • winter operations scenario training dependent on actual weather conditions • constraints in conducting realistic team-based training • vast amount of information with insufficient time to master
Training quality and retention gap	• low knowledge retention after one-time training activities • difficulty aligning training methods with diverse learning styles • limited use of structured microlearning and refresher learning • restricted opportunities to repeat critical scenarios
Standardisation and governance gap	• inconsistent training models across airports • lack of common competency frameworks • challenges in developing coherent training pathways
Performance gap	• difficulty linking training outcomes to measurable safety performance • absence of clear KPIs for training effectiveness, with focus placed on • certification rather than demonstrated competence • training is often treated primarily as a compliance requirement • limited adoption of data-driven training management
Operational resilience gap	• training activities are frequently deprioritised under operational pressure • limited ability to schedule training in highly dynamic environments • challenges in maintaining continuity of training during seasonal peaks



Capacity and Scalability Gap

The first and most visible gap is capacity. The number of personnel requiring training continues to grow, often reaching hundreds of movement-area drivers and thousands of non-movement-area staff, while organizational capacity to deliver training has not expanded proportionally. Only 40% of respondents reported having full-time dedicated training staff, with the remainder relying on collateral duty, hybrid models, or no formal training structure. In practice, this means training is frequently delivered alongside operational responsibilities rather than as a fully owned function.

This creates immediate constraints. The availability of qualified instructors is limited, training must be scheduled around operational demands, and in many cases, the same individuals are responsible for both operations and training delivery. The implications extend beyond initial training. Onboarding new employees becomes difficult in high-tempo environments, and recurrent training - essential for maintaining proficiency over time - is often inconsistent or deprioritized. As demand increases and delivery capacity remains constrained, organizations are forced to compress, simplify, or delay training activities, gradually reducing the depth and consistency of workforce preparation.

Experiential Learning Gap

A second gap emerges, like learning itself. Airside operations require not only knowledge but experience, particularly in handling high-risk or non-routine situations. Current training models provide limited opportunities for safe exposure to such conditions. High-risk scenarios

cannot be practiced freely in live operations, so personnel often encounter them for the first time in real environments.

This is particularly visible in rare and extreme events. Situations involving aircraft emergencies, low visibility, severe weather, equipment malfunction, or coordination breakdowns are infrequent but high-impact, yet training for them is often limited. Winter operations are a clear example, where training depends heavily on actual weather conditions, resulting in inconsistent exposure.

There are also structural constraints in conducting realistic team-based training. Airside operations are inherently collaborative, but recreating multi-actor, high-pressure scenarios within traditional training environments is difficult. As a result, a gap emerges between what personnel know and what they have actually experienced, and in high-pressure situations, this gap becomes critical.

Training Quality and Retention Gap

A third gap concerns training effectiveness and knowledge retention. Many current approaches rely on one-time exposure to information through classroom sessions or online modules. While these methods support knowledge transfer, they do not ensure retention or the ability to apply knowledge in operational contexts. Training is often structured around completion rather than reinforcement. Once a module is completed, there is limited systematic follow-up to ensure knowledge is retained and translated into practice.

Adult learning theory, particularly the principles of andragogy and the experiential learning model developed by David Kolb, provides a useful lens to interpret this gap. Andragogy emphasizes that adult learners are problem-oriented, draw on prior experience, and require immediate relevance to remain engaged. Kolb's learning cycle further defines effective learning as a process moving through concrete experience, reflective observation, abstract conceptualization, and active experimentation. When training design does not align with these principles - particularly when it relies on passive content delivery and lacks opportunities for practice and reflection - knowledge retention remains limited and transfer to operational



performance is significantly reduced. The limited use of refresher training further compounds the issue. Without regular reinforcement, knowledge decays, and critical procedures may be remembered in principle but not executed correctly under pressure. Opportunities to repeat and practice scenarios are also restricted, limiting the development of confidence and automaticity.

Standardization and Governance Gap

Another gap concerns standardization and governance. Airports operate within complex ecosystems involving multiple stakeholders, yet training models often vary significantly across organizations and even within the same operational environment. The delivery of training has no standardization. Only the topics are standardized. Survey findings highlight fragmentation as a core issue. Nearly 39% of respondents indicated that collaboration with external partners on training is limited or nonexistent, meaning personnel operating in the same environment may be trained under different standards and expectations.

The absence of common competency frameworks further limits consistency. Certification confirms completion, but not necessarily alignment in competence. Training is often structured as a series of discrete activities rather than as a coherent, continuous pathway, making it difficult to track development or identify gaps at a system level. In such an environment, airports retain responsibility for safety without having full control over how personnel are prepared to operate within it.

Performance Gap

Closely linked to these issues is a gap in how training effectiveness is measured. In many cases, training is evaluated based on completion metrics rather than operational outcomes. Certification becomes the primary indicator of readiness, even though it does not necessarily reflect actual competence in real conditions.

There is limited use of defined KPIs linking training to safety performance. Few organizations systematically measure whether training reduces incidents, improves decision-making, or enhances operational efficiency. This creates a disconnect between training activity and operational outcomes.

The survey confirms this gap. Most respondents have not attempted to quantify the return on investment or safety benefits of training, and many lack formal processes for evaluating new training approaches. As a result, training is often treated primarily as a compliance requirement, with limited use of data to inform decision-making or improvement.

Operational Resilience Gap

The final gap relates to operational resilience. Training must be delivered within environments defined by fluctuating demand, limited resources, and constant operational pressure. In practice, training activities are frequently deprioritized when operations intensify.

When schedules are disrupted or workloads increase, training is often postponed or reduced until recurrent deadlines are imminent. This creates a cycle in which reduced training leads to lower preparedness, increasing operational risk, and further pressure on the system. Scheduling training in dynamic environments is inherently difficult. Access to the airfield is limited, personnel availability varies, and operational priorities shift rapidly. Maintaining continuity of training during seasonal peaks becomes particularly challenging, even though these are the periods when operational risk is highest.

A further limitation of current training models lies in insufficient preparation for high-risk and non-routine situations, as well as in the lack of a systematic approach to developing decision-making competencies. Personnel who are not part of formal emergency services - such as equipment operators, ramp agents, or technical staff - often play a critical role in early response, yet have limited opportunity to practice such scenarios in controlled conditions. At the same time, training remains predominantly focused on individual qualifications, with limited emphasis on team-based performance. This creates a gap in preparedness, particularly given that many aviation incidents are linked to communication breakdowns and ineffective coordination. Realistic team training, requiring multiple roles to operate under time pressure, stress, and constrained communication, is difficult to organize in live environments and therefore remains underrepresented, despite its critical importance for operational resilience.

Conclusion

Taken together, these gaps point to a fundamental misalignment between the current training model and the realities of contemporary airside operations. The issue spans capacity, learning design, standardization, measurement, and operational integration, with each gap reinforcing the others. The consequences are visible in incident trends, variability in performance, and increasing operational pressure. The existing training model was not designed for the scale, pace, and complexity of today's environment, and as operations continue to evolve, this gap is likely to widen unless the training model itself is rethought.

SECTION 4

Technology Enabled Training Available Approaches



The Industry is Ready for Better Tools

The survey results indicate a clear shift in mindset across the industry. Airports are no longer questioning whether training should evolve. The question is how to do it in a way that is practical, scalable, and aligned with operational realities.

Interest in technology is strong. Simulators, remote learning platforms, VR-based tools, and training applications were all identified as areas of focus. At the same time, adoption remains limited, and evaluation frameworks are underdeveloped. We may have an impression that airports are asking for a structured, operationally grounded training system. As one respondent summarized, the need is for an "overall training structure," not another standalone solution.

In this context, technology should not be understood as a replacement for existing training methods. Classroom instruction, field training, and on-the-job experience will remain, but the role of technology is to extend, strengthen, and connect these elements into a more effective and scalable system. What follows is not a vision of future concepts. These are already available approaches that can be implemented progressively, depending on the airport profile and training maturity.

Simulation Based Training

Simulation is the most mature and operationally relevant form of technology-enabled training in aviation, widely used in pilot training for decades. However, its application in airside operations remains underutilized despite its clear relevance.

Modern simulation systems range from desktop-based environments to advanced, fully immersive platforms. They allow airports to recreate realistic operational scenarios, including traffic density, weather variability, equipment behavior, and communication dynamics, without exposing operations to risk. Simulation enables training across multiple domains. These include vehicle operations, pushback and towing, de-icing, maintenance, apron coordination, and crisis management. More advanced systems support interdisciplinary training, where multiple roles interact within a shared scenario, reflecting the true complexity of airport operations.

The key value lies in controlled exposure. Personnel can practice high-risk and non-routine situations that cannot be safely recreated in live operations. This includes low-visibility procedures, equipment failures, communication breakdowns, and time-critical decision-making under pressure. Equally important is repetition. Scenarios can be repeated until competence is demonstrated, not just assumed. This directly addresses one of the core limitations of traditional training: limited opportunity to practice critical situations. Simulation also introduces a measurable dimension to training. Systems can capture reaction times, procedural accuracy, decision paths, and error patterns, enabling objective assessment and targeted retraining.

From an operational perspective, simulation allows airports to train large populations without removing vehicles, equipment, or infrastructure from active use. Up to 90% of critical airside operations can be trained in a simulated environment without impacting live operations.



Virtual and Immersive Learning VR and AR

Virtual and augmented reality technologies complement simulation by extending it into more accessible and flexible formats. While full simulators provide high-fidelity environments, VR and AR enable immersive learning with lower infrastructure requirements. These technologies are particularly effective in procedural training, inspections, and spatial awareness. For example, VR-based walkaround inspections allow trainees to perform detailed equipment checks, identify faults, and follow procedures in a fully interactive 3D environment.

Immersive learning also improves cognitive engagement and performance outcomes. Research shows that participants trained in VR environments demonstrate significantly higher confidence in applying learned skills - up to 275% higher compared to traditional classroom training - and achieve up to 80% greater knowledge retention over time (PwC, "The Effectiveness of Virtual Reality Soft Skills Training in the Enterprise). In addition, learners can complete training up to four times faster while maintaining or improving learning outcomes, reducing time-to-competence by as much as 30-50% (Accenture, "Immersive Learning for the Future Workforce").

These improvements translate directly into operational performance. In industrial environments, immersive training has been shown to increase "first-time-right" task execution by 20-35% and significantly reduce early-stage operational errors (Accenture). Higher engagement levels further reinforce these outcomes, with immersive environments generating up to 3.7 times stronger emotional connection to training content, supporting retention and decision-making under pressure (PwC).

VR and AR also support distributed training. Personnel can access training scenarios without the need for centralized facilities, making it easier to deliver consistent training across multiple locations and teams. Despite this potential, adoption remains limited. This is less a reflection of value and more a function of familiarity and



implementation readiness. As understanding increases, immersive technologies are likely to play a larger role, particularly as part of blended training models.

Furthermore, regulatory expectations are evolving. Aviation authorities are increasingly shifting from reactive safety models toward proactive and predictive safety frameworks, requiring organizations to identify and mitigate risk before incidents occur. This creates a more demanding safety landscape, where operational performance and safety performance are inseparable.

Microlearning Ecosystems

The third pillar of technology-enabled training is microlearning and digital learning ecosystems. This approach addresses one of the most fundamental limitations of traditional training: retention. Microlearning delivers training in short, focused modules, typically lasting a few minutes and accessible on mobile or desktop devices. These modules are designed to reinforce knowledge over time rather than deliver it in a single session.

The effectiveness of this approach is well supported by data. Microlearning can lead to 22% faster completion and up to 28% better performance compared to traditional training methods, according to Dr. Peter Groth at Dresden University of Technology. Retention is significantly higher, with studies indicating that 75% of participants report improved knowledge retention, and spaced reinforcement can improve recall by up to 150% over time as reported by Association for Talent Development.

Engagement is also materially higher. Up to 85% of learners find microlearning more engaging than traditional formats, and completion rates can reach around 80%, compared to approximately 20% for longer training modules.

These results directly address the challenges identified earlier in the report. Limited time, high workload, and diverse learning preferences make long-form training difficult to sustain. Microlearning aligns with how today's workforce learns - frequently, in short intervals, and often on mobile devices.

Digital learning ecosystems extend this concept further. They integrate microlearning, knowledge bases, AI-assisted support, and training analytics into a single platform. This enables continuous learning, personalized training paths, and real-time visibility into workforce competence. Instead of training being an isolated event, it becomes a continuous process embedded in daily operations.

What Airports Can Gain from Using Technology in Training

Training Effectiveness and Safety Improvement

Technology-enabled training directly improves training effectiveness by shifting the focus from knowledge transfer to skill acquisition. Simulation and immersive tools enable active learning, where trainees make decisions, experience consequences, and receive immediate feedback. This leads to stronger procedural memory, better decision-making, and reduced error rates in operational environments. Simulation-based training has been shown to significantly reduce procedural errors in early stages of employment and improve compliance in critical situations. At a system level, technology also supports standardization. Training scenarios can be replicated consistently across locations, ensuring a uniform level of competence.

Training for Extreme Situations and Rare Incidents

One of the most significant advantages of technology is the ability to train for situations that are rare but high-impact. Traditional training cannot safely replicate scenarios such as extreme weather operations, equipment failures, or multi-incident crises. Technology removes this limitation. Simulated environments allow personnel to practice these situations repeatedly, under controlled conditions, and with increasing levels of complexity. This builds both technical competence and psychological readiness. Research shows that training in simulated crisis conditions improves coordination and response effectiveness, particularly in multi-team environments.

Training Flexibility and Increased Accessibility

Technology introduces a level of flexibility that traditional training models cannot match. Training can be delivered remotely, asynchronously, or in hybrid formats. It can be tailored to individual needs, allowing trainees to focus on specific skill gaps rather than repeating entire training cycles. This is particularly important in environments where operational schedules are unpredictable and staff availability is limited. Blended learning models - combining digital learning, simulation, and practical experience - enable faster onboarding and more efficient recurrent training.

Cost Effectiveness

While technology-enabled training requires initial investment, its economic benefits are substantial over time. Small systems with three simulator stations and 1 trainer station, where all three trainees can operate in the same environment or in three separate environments, can cost less than $500,000 over the first five years of use. Simulation reduces the need to use live equipment, lowering fuel consumption, wear and tear, and maintenance costs. It eliminates the risk of costly training-related incidents and reduces operational disruptions. It also shortens onboarding time and accelerates workforce readiness. In environments where full operational competence can take months to achieve, even marginal improvements in training efficiency translate into significant financial impact. At scale, the cost per trainee decreases, making technology particularly effective for airports with large training populations.

Environmental and Sustainability Impact

Technology-enabled training also contributes directly to environmental objectives by decoupling training activity from operational resource consumption. In traditional training models, practical exercises often require the use of vehicles, fuel, de-icing fluids, and other consumables, generating emissions, waste, and environmental exposure. By contrast, simulation-based training enables the execution of airside scenarios without running engines or equipment, resulting in zero fuel burn and no associated training emissions. It also eliminates the need for de-icing fluids during training, removing both glycol usage and the risk of runoff and related environmental costs.

Additional benefits include reduced wear on operational equipment, extending asset life and lowering maintenance impact, as well as the removal of consumables such as paper, plastics, and single-use materials. Simulation environments also reduce the risk of spills and contamination by avoiding live drills that could affect soil and drainage systems. These effects are not only operationally relevant but can also be measured and reported through sustainability KPIs, supporting audit-ready environmental performance.

The Airport Rescue and Fire Fighting industry has largely transitioned from relying solely on live-fire and foam-based training to incorporating testing/simulations and foam proportioning test systems that reduce environmental impacts.

In the context of aviation's broader sustainability agenda, this represents a practical and scalable contribution. Training can be delivered without adding environmental burden to already complex airport operations, supporting both efficiency and responsible resource management.

SECTION 5

Way Forward



The findings presented in this report point to a clear and consistent conclusion. The current airside training model, while still operationally functional, is no longer aligned with the scale, pace, and complexity of today's airport environment. At the same time, the industry is not standing still. Airports are actively looking for better ways to train, more effective tools, and more structured approaches that move beyond minimum compliance.

The path forward should not be framed as a choice between compliance and innovation. The survey points to a more practical conclusion: the industry needs a stronger training model that exceeds minimum requirements, enhances operational readiness, and provides airports with realistic ways to train at scale in a complex environment. The question is what framework the industry is prepared to build in response.

At a strategic level, investment in advanced training solutions is no longer optional. It is directly linked to safety performance, operational efficiency, and competitiveness. Airports are operating in environments where even small errors can have disproportionate consequences, both operational and financial. Training is one of the few levers that can systematically reduce this exposure while improving workforce readiness.

This does not imply that every airport must adopt the same tools or move at the same pace. The more realistic approach is progressive integration. Technology-enabled training, improved governance models, and clearer competency frameworks can be introduced step by step, aligned with each airport's operational profile and resources. What matters is direction. Moving from fragmented, capacity-constrained training toward structured, scalable systems that are designed around performance.

The results make it clear that the industry is ready for a more structured, modern, and performance-based approach to airside training.



From a subject matter perspective, the need for evolution is increasingly evident. Training can no longer be treated as a periodic requirement or a compliance exercise. In high-risk operational environments, competence is dynamic. It degrades without reinforcement, and it must be continuously developed in response to changing conditions. This requires a shift in how training is understood. Not as an event, but as an ongoing process embedded in daily operations.

This also requires a cultural shift. A forward-looking training culture is one where continuous competence development is expected, supported, and measured. Where training is not deprioritized under operational pressure, but recognized as an integral part of operational resilience. Where data is used not only to document completion, but to understand performance, identify gaps, and guide improvement.



The survey responses suggest that airports are ready for this shift, but they are not expected to navigate it alone. There is a clear role for industry collaboration in shaping what comes next. The ACT Airside Training Task Force provides a practical platform for this work. It brings together airports, industry partners, and subject matter experts to build shared understanding, exchange experience, and explore scalable solutions. The goal is not to impose a single model, but to develop a framework that is operationally credible, adaptable, and aligned with regulatory expectations.

Future work may include the development of more structured guidance. This could cover areas such as competency frameworks, training pathways, evaluation methods, and integration of technology into training systems. It may also include practical tools to support implementation, helping airports move from concept to execution with greater confidence.

There is also a role for leadership at the local level. Every airport, regardless of size, can take steps to strengthen its training approach. This may begin with small changes: introducing more structured recurrent training, exploring microlearning formats, piloting simulation-based exercises, or improving how training outcomes are measured. Over time, these incremental steps can build into a more coherent and effective system. In that sense, change does not depend solely on large-scale initiatives. It is also driven by individual organizations and the people within them. Each airport, each team, and each professional involved in training has the ability to contribute to this shift. Everyone can be an ambassador of change.

The next phase of this work will depend on continued collaboration, practical experimentation, and a shared commitment to improving how the industry prepares its workforce. The direction is clear. The opportunity now is to translate that direction into action.

Appendix

Human Performance as the Next Safety Frontier

In the high-pressure environment of ground handling operations (GHO), the industry has reached a plateau. We have engineered safer equipment, drafted exhaustive Standard Operating Procedures (SOPs), and implemented rigorous Safety Management Systems (SMS). Yet, the human being at the heart of everything in ground handling remains the stubborn variable in many incident reports. The next frontier of safety advancement is not found in more manuals or stricter discipline; it is found in addressing the issue of Human Performance. Specifically, the intersection of Neuroergonomics* and operational execution.

Neuroergonomics *is the study of the brain at work.*

It combines neuroscience with traditional ergonomics to understand how cognitive factors such as memory, perception, and stress affect physical performance. It recognizes the limitations of our 'biological hardware' and moments of potential system-brain incompatibility.

The Training Paradox: Skill vs. Execution

Traditional training focuses on **competency**, the ability to perform a task under controlled conditions. While foundational, competency is a poor sole predictor of performance during a live aircraft turn. The cognitive gap between a classroom and the live ramp is filled with **cortisol** (stress hormone) and **'Clock Focus'**.

Neuroergonomics teaches us that under high-pressure, time-constrained conditions, the brain shifts from the reflective prefrontal cortex to the reactive amygdala. The situation or environment triggers our nervous systems' Fight or Flight mode which negatively impacts our brain functioning.

Training builds the "what" and the "how," but neuroergonomic protocols are what govern whether those skills actually manifest when the pressure is on. Without these protocols, an experienced ground handler is essentially operating a high-performance machine (the aircraft turn) with a glitching processor (a cortisol-drenched brain).

Addressing Inattentional Blindness: The Neuroscience of Failure

It is a common frustration in GHO: an experienced Team Leader, with thousands of turns under their belt, misses a glaring hazard like a still-attached GPU cable or a hold door that hasn't been properly closed. This isn't laziness; it is **Inattentional Blindness**.

In a stressed veteran, the brain's 'internal refresh rate' slows down; after thousands of turns, the brain naturally stops processing every detail to save energy, preferring to 'predict' using the mental map (Schema) of a normal turn. They might physically sweep their eyes across the wing, but they are mentally preoccupied with the mission-critical task (getting the bags on the belt), so they look but don't register what they are seeing.

When the brain is locked into 'Clock Focus,' it enters a state of Tunnel Vision. The cognitive load of managing a 45-minute turnaround forces the brain to filter out any stimuli it deems 'non-essential' to the immediate goal. To the brain, the clock is the predator, and the SOP is secondary. It's neurologically expected, therefore, to observe how constant perceived time-pressure actually normalizes deviance from SOPs.

Cognitive-Resets: The Circuit Breaker

To counter this 'automaticity' of the brain through habituation and taking repeated actions, we must move beyond the 'stay alert' and 'safety first' mantras. We need to engineer Cognitive-Resets into existing SOPs; brief, purposeful interventions at critical transition points. By forcing a physical shift in gaze or issuing a verbalized confirmatory check, the operator breaks the neurological loop of tunnel vision, re-engaging the prefrontal cortex and bringing peripheral hazards back into focus.

Shifting the Mindset: Predictive vs. Reactive

Historically, ground handling safety development and management has often been a "post-mortem" exercise. We investigate why a wingtip was clipped and then update a policy or process. This is **Reactive**.

The future of human performance is **Predictive**: observing your operations 'heat map' of cognitive load and engineering 'Right First Time' transitions.

Predictive safety treats the human as a variable that can be optimized through environmental design and mental priming. Instead of asking "What went wrong?" after a near miss or safety event, we ask "What cognitive load was the lead carrying during the transition?"

By identifying high-load 'Red Zones' in the turn, we can engineer protocols that simplify decision-making at the exact moment the brain is most likely to fail.

The Business Case: Efficiency is a Human Factor

There is a lingering misconception, stigma even, that addressing human factors is 'soft,' a time sink, or purely about individuals' behavior. Rather, human factors should be viewed as a surgical tool for **Operational Efficiency**. Identifying points where human fatigue and stress arise - not as character flaws - but as evidence of systemic friction allows mitigations to be taken. Removing friction doesn't just improve morale; it forces a positive shift in performance and safety metrics.

When human performance is ignored, the results are tangible hard costs, or worse:

- **Re-work:** Often caused by 'rushed' errors that require the entire process to be halted or repeated.
- **Logjams:** Cognitive bottlenecks where a lead loses the big picture of the ramp, leading to equipment congestion.
- **Aircraft / Equipment Ground Damage Costs:** The obvious financial burden of ground strikes and equipment failure.
- S**taff injuries or death:** the worst-case scenario, in what is a very dangerous working environment.

When coupled with comprehensive, relevant training, the integration of such neuroergonomic protocols doesn't just make the turn safer; it also makes it smoother. A 'Right First Time' transition is, by definition, the fastest way to turn an aircraft.

Conclusion: From Paperwork to Performance

The transition to Human Performance as the next safety frontier is no longer a theoretical luxury; it is an operational necessity.

Recent industry data suggests current airside training models are failing to keep pace with an increasingly complex ramp environment. While organizations are trapped in 'administratively manageable' formats like classroom sessions and sign-in sheets, there is a clear, systemic gap between mere training exposure and actual demonstrated proficiency on the ramp.

We must stop treating training as a box-ticking exercise. The regulator is explicitly asking for a more structured, scalable, and credible approach. One that moves beyond fragmented collaboration and 'information overload' to prioritize actual retention and performance. The introduction of neuroergonomic protocols is a positive and significant first step in providing the 'practical, proactive, operationally grounded framework' the industry is seeking.

By integrating predictive engineering and brain-based resets, we can comprehensively bridge the divide between classroom instruction and live-field execution. Moving from a reactive model of investigating failures to a proactive one that ensures 'Right First Time' transitions.

Current airside training models are not keeping pace with the complexity of the live environment. The question for leadership is simple: will you continue to manage an illusion of genuine safety compliance through paperwork, or will you pivot to a model that masters the high-stakes neurological reality of human performance? The difference will swiftly be reflected in your safety metrics and your bottom line.





ABOUT THE AUTHORS

Kirsty & Andy Dobson are Partners and Co-Founders of Clarity& Ltd, specialising in the interplay of human factors, neuroscience, and aviation operations. Following careers handling the complexities of the NHS and aviation operations respectively, they now partner with global aviation organisations to operationalise improved resilience and safety performance. They bridge the gap between the boardroom and the tarmac, using data-driven initiatives to help organisations truly embed wellbeing into their workplace culture.

NOTES





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