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Safety Training and Incident Management in Ground Handling: Insights from A Case Study in Romania

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ABSTRACT: This article explores the relationship between safety training and incident management in the ground handling sector, using a case study of a large handling company operating at Romania's primary international airport. Ground handling is characterised by high operational tempo, equipment-intensive tasks, and significant exposure to human error, making training a central determinant of both safety and performance. Drawing on training records, incident logs, audit scores, and employee feedback, the study applied Kirkpatrick's four-level evaluation model integrated with safety management principles to assess training effectiveness between 2022 and 2025.

Baseline analysis revealed high compliance with mandatory training but also uneven distribution of training hours, occasional lapses in recertification, and persistent non-compliances in high-risk departments. In response, a blended training intervention was introduced, combining computer-based modules, hands-on sessions, scenario-based simulations, and micro-scheduling. The programme was associated with measurable improvements in safety performance, compliance, and employee confidence.

Beyond operational outcomes, the study demonstrates that safety training functions as a form of strategic human resource development (HRD), aligning investment with organisational risk, supporting experiential and adult learning principles, and reinforcing the characteristics of a learning organisation. The findings highlight the value of blended and recurrent training in building not only compliance and safety but also organisational resilience. While limited to a single case, the results offer transferable insights for HRD professionals in similarly complex environments such as logistics, healthcare, and energy.

KEYWORDS: Safety training; incident management; human resource development; ground handling; organizational learning

I. INTRODUCTION

Safety in aviation ground handling has long been recognised as a critical determinant of operational reliability and organisational sustainability. Ground handling activities—such as ramp operations, baggage handling, passenger services, and cargo logistics—take place in complex, high-pressure environments where operational precision and rapid decision-making are essential. Unlike highly automated cockpit or air traffic operations, ground handling remains heavily dependent on human labour, making staff competence and training central to both safety and service quality (IATA, 2024; ICAO, 2020).

Globally, human factors are estimated to contribute to 70–80% of aviation accidents and incidents (SKYbrary, 2024). Within ground handling, these range from equipment collisions and baggage-related injuries to delays in turnaround processes. The consequences extend beyond immediate operational disruptions, encompassing financial costs, reputational damage, and compliance risks. For handling companies, therefore, safety training is not simply a regulatory obligation but also a strategic investment in risk reduction and workforce development (EASA, 2024).

Despite the prominence of safety training in operational manuals and regulatory audits, there is limited empirical research on how such training translates into measurable outcomes in ground handling. Most studies on safety in aviation focus on flight operations or maintenance, leaving ground handling under-researched in both the aviation and HRD literature (Balk, 2008; Gultom et al., 2021). Moreover, training is often evaluated in terms of completion rates rather than behavioural or organisational impact, leading to a narrow understanding of its effectiveness (Salas et al., 2012).

This article addresses these gaps through an exploratory single-case study of a large international handling company operating in Romania. Drawing on safety records, training data, and audit results, it examines the relationship between safety training and incident management. The study applies Kirkpatrick's four-level training evaluation model, integrated with principles from safety management systems, to assess both learning outcomes and organisational performance. Rather than aiming for statistical generalisation, the study seeks to contribute to theory-building in HRD and organisational learning by showing how structured, recurrent training in a high-risk sector can reduce incidents, improve compliance, and strengthen safety culture.

II. LITERATURE REVIEW

A. Safety in Ground Handling Operations

Ground handling is among the most risk-intensive components of aviation, involving simultaneous operations around aircraft, heavy equipment, and time-critical tasks. Incidents in this environment may cause aircraft damage, worker injuries, and cascading delays (JetMate Aviation, 2024). Safety management, therefore, depends heavily on both technical compliance and human performance. The International Civil Aviation Organization (ICAO, 2018) defines aviation safety as "the state in which risks associated with aviation activities are reduced and controlled to an acceptable level," emphasising proactive management and continuous improvement.

Human error has been consistently identified as the primary contributor to ground handling incidents. Errors are typically categorised as skill-based lapses, decision errors, or perceptual errors, all of which may be exacerbated by fatigue, communication breakdowns, or insufficient training (SKYbrary, 2024). Frameworks such as the Human Factors Analysis and Classification System (HFACS) help unpack the systemic origins of error by linking unsafe acts to supervisory and organisational influences (Shappell & Wiegmann, 2000). In this context, training emerges as a key organisational lever to mitigate risks at both individual and systemic levels.

B. Training Foundations: Adult Learning and Competency Development

Aviation safety training is rooted in principles of adult learning. Knowles' (2015) andragogy framework highlights that adult learners are self-directed, goal-oriented, and motivated by the immediate applicability of learning. This aligns with the operational demands of ground handling staff, who require training that is practical, scenario-based, and closely tied to daily tasks. Kolb's (1984) experiential learning theory further reinforces the value of simulations, role-playing, and reflective debriefs in developing competencies that extend beyond procedural knowledge to adaptive decision-making.

The aviation industry has increasingly moved towards competency-based training and assessment (CBTA), which shifts the focus from knowledge acquisition to demonstrable performance under real conditions (IATA, 2024). CBTA ensures alignment between training programmes and operational roles by defining performance standards, enabling continuous assessment, and individualising learning paths. Evidence-based training (EBT), which integrates incident data into training design, further strengthens this alignment by ensuring that recurrent training reflects emerging risks (ICAO, 2024).

C. Evaluating Training Effectiveness

While the importance of safety training is widely acknowledged, its evaluation remains uneven across organisations. Kirkpatrick's four-level evaluation model (2006) offers a structured approach, assessing training at the levels of reaction (learner satisfaction), learning (knowledge and skills), behaviour (workplace application), and results (organisational impact). Studies applying this model in aviation have demonstrated that safety training can influence behavioural compliance, communication practices, and ultimately reduce incident rates (Gultom et al., 2021).

However, evaluation in practice often remains limited to Levels 1 and 2—satisfaction surveys and knowledge tests—while neglecting the more critical organisational outcomes (Salas et al., 2012). For HRD scholars and practitioners, this gap underscores the importance of linking training design and evaluation with safety performance metrics, such as incident frequency, severity, and audit compliance.

D. Digital Transformation and Experiential Balance

Recent years have seen the rise of computer-based training (CBT), learning management systems (LMS), and simulation technologies in aviation training. These approaches offer flexibility, scalability, and cost savings (Lee & Wang, 2021). During the COVID-19 pandemic, they enabled continuity in training when in-person sessions were not feasible (Airport College International, 2020). Yet, while digital solutions are effective for theoretical instruction, they cannot fully replace the embodied skills and situational judgement required in ramp or cargo operations (Salas et al., 2002; Gibbings et al., 2012).

A balanced approach is therefore advocated: digital methods for regulatory and theoretical modules, complemented by hands-on practice and scenario-based exercises for high-risk tasks. For HRD research, this highlights the need to examine blended training strategies that address both cognitive and behavioural dimensions of safety competence.

III. METHODOLOGY

A. Case Study Design

This study adopted a single-case study design to explore the role of safety training in incident management within a Romanian ground handling company. A case study approach was selected because it enables an in-depth examination of organisational processes in their real-life context (Yin, 2018). Ground handling is a complex, safety-critical domain where training outcomes are influenced by multiple interacting factors, including operational pressures, workforce demographics, and regulatory frameworks. A case study allows for triangulation of diverse data sources to capture this complexity and provide a holistic understanding of how training interventions affect safety outcomes.

The study followed a quasi-experimental design, comparing organisational performance indicators before and after the implementation of an enhanced safety training programme. The analysis covered a three-year baseline period (2022–2024) and a subsequent pilot intervention period (2024–2025). This timeframe was chosen to ensure sufficient longitudinal data to identify changes in incident patterns and training effectiveness.

B. Data Sources

Four categories of data were analysed: training records, safety incidents logs, audit reports and employee feedback. First, the training records were extracted from the company's learning management system (LMS), these included module completion rates, validity status, average training hours per employee, and participation by department. Particular attention was given to safety-critical modules such as Dangerous Goods Handling, Human Factors, and Equipment Operation.

Secondly, data were drawn from the company's internal safety management system (SMS), including reported hazards, near misses, personal injuries, and property damage. Incidents were coded by type, severity, and department, allowing for correlation with training coverage.

Thirdly, the internal and external safety audits conducted between 2022 and 2025 were reviewed. Scores and non-compliance findings were used to assess procedural adherence and training recertification performance.

Finally, employee feedback was collected from structured surveys and semi-structured interviews conducted with operational staff and supervisors. Feedback focused on training relevance, confidence in handling incidents, and observed behavioural changes post-training.

This combination of quantitative and qualitative data supported a triangulated analysis, strengthening the reliability of findings and minimising bias from any single data source.

C. Analytical Framework

The analysis was guided by Kirkpatrick's Four-Level Training Evaluation Model (Kirkpatrick & Kirkpatrick, 2006), adapted to the safety-critical context of ground handling. The four levels were operationalised as follows:

- Level 1 (Reaction): Employee satisfaction with training, measured through post-training surveys.
- Level 2 (Learning): Knowledge and skills acquired, assessed through pre/post-tests and scenario-based exercises.
- Level 3 (Behaviour): Observed application of procedures in daily operations, monitored via supervisor reports and audit observations.
- Level 4 (Results): Organisational outcomes such as reductions in incident rates, improved audit scores, and enhanced hazard response times.

To complement this, safety management system (SMS) principles were incorporated, ensuring that training outcomes were analysed not only at the individual level but also in terms of systemic risk mitigation and organisational safety culture.

All data were anonymised to protect employee identity and organisational confidentiality. The company and its personnel are not named in this study; instead, it is referred to generically as "the handling company." Employee surveys and interviews were conducted with informed consent, and participation was voluntary. Data management complied with the European Union's General Data Protection Regulation (GDPR), ensuring that records were securely stored and accessible only to the research team. Ethical approval for the study was obtained from the company's internal compliance and ethics board.

IV. CASE STUDY CONTEXT

The handling company examined in this study is part of a large international group providing aviation services across multiple continents. The Romanian branch operates primarily at the country's largest international airport, which serves as the national hub for passenger and cargo traffic. The company employs a workforce of several thousand staff, spanning ramp operations, passenger services, cargo handling, and support functions.

In 2024, the company managed operations on the scale of hundreds of thousands of aircraft turns and several million passengers annually, illustrating the high operational tempo and complexity of its activities. Rather than focusing on absolute figures, the key implication for HRD is that such scale magnifies the importance of consistent training systems to prevent variability in safety performance across departments (Garavan, 2007). This volume places the organisation among the largest ground handling operators in the region, comparable to other major international service providers. Its service portfolio covers a wide spectrum of activities, including baggage handling, check-in and boarding, aircraft pushback and marshalling, fuelling coordination, and cargo logistics.

Financially, the handling company is a stable and profitable operator, with revenues in the hundreds of millions. More importantly, at this level of financial and operational scale, investments in workforce development and safety training can be interpreted not only as compliance costs but as strategic levers of organisational resilience, aligning with the HRD perspective that training contributes to long-term organisational performance (Watkins & Marsick, 1993).

Safety and training have been positioned as strategic priorities within the organisation. The company's safety culture is reinforced through structured reporting systems, recurrent training programmes, and internal campaigns encouraging hazard

identification. In 2024, for example, the company recorded tens of thousands of hazard reports, which not only indicate active staff engagement in risk monitoring but also reflect characteristics of a learning organisation, where employees are empowered to contribute to organisational knowledge and safety improvements (Marsick & Watkins, 2015). Investment in training has also grown: annual training hours per employee increased substantially compared to pre-pandemic levels, with safety-related modules accounting for a significant proportion of total training activity.

Taken together, this context illustrates the interplay between operational complexity, organisational learning, and HRD strategy. As a large-scale operator with a diverse workforce, high operational tempo, and multiple sources of risk, the handling company provides an exemplary case for examining how structured, recurrent training interventions can influence safety culture and incident management.

V. BASELINE FINDINGS (2022–2025)

Between 2022 and 2025, the handling company recorded a range of operational incidents, including hazards, near misses, personal injuries, and property damage. The total number declined from approximately 200 cases in 2022 to approximately 100 in 2024, before stabilising the following year. This downward trend suggests that existing safety measures had a measurable impact, yet the persistence of incidents highlights the challenge of sustaining continuous improvement in complex, labour-intensive environments (Salas et al., 2012).

In terms of severity, most incidents fell into lower categories, consistently accounting for over 60% of cases, while high-severity events represented only around 10%. This pattern is consistent with safety literature, which notes that while minor events are more frequent, even small lapses can signal latent conditions that may escalate into serious incidents if not addressed (Shappell & Wiegmann, 2000). As shown in Figure 1, frequency was reduced, but the underlying risk profile of serious events remained largely unchanged, underscoring the need for recurrent and scenario-based training that directly targets high-risk behaviours.

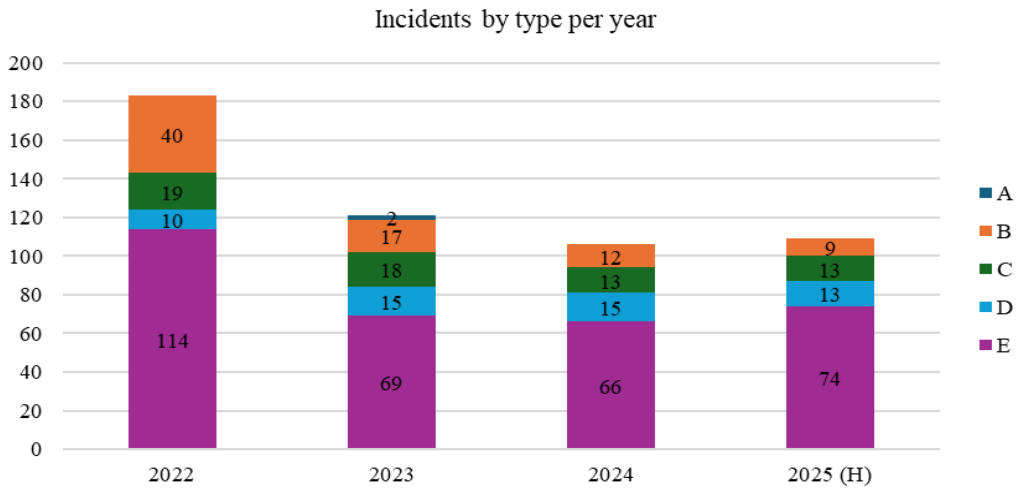

Figure 1. Total incidents by severity, 2022–2025 (adapted from project data)

Departmental distribution showed that ramp operations consistently accounted for the largest share of incidents, followed by cargo and passenger services. This concentration reflects the operational intensity and direct exposure of frontline staff to equipment-related risks, where skill decay and situational judgement are critical concerns (Kolb, 1984). Notably, vehicle and ground support equipment collisions declined by over 40% during the period, coinciding with targeted driver training initiatives—an example of how well-designed HRD interventions can directly influence safety outcomes.

Training records revealed high overall compliance, with nearly nine in ten mandatory modules completed on time. However, the distribution of training hours across departments was uneven. For instance, passenger services leaders averaged just over two hours annually, while ramp staff and bussing operators received closer to one. This imbalance highlights a misalignment between training allocation and operational risk. HRD scholars emphasise that strategic training investment must be proportionate to exposure in order to maintain competence and minimise risk in safety-critical roles (Garavan, 2007).

Audit results showed incremental improvement in compliance scores, rising from roughly 80% to 83% across the two years. Yet the number of recorded non-compliances also increased, from the mid-30s to just over 40. This paradox illustrates that while certain procedures improved, systemic gaps persisted, particularly in ramp and bussing operations where compliance scores fell below 70%. From a learning organisation perspective, this suggests that compliance gains were not yet embedded into broader cultural or behavioural change (Watkins & Marsick, 1993). Cargo departments, by contrast, achieved near-perfect results, indicating that effective practices were present but unevenly distributed.

Finally, a small but significant correlation was observed between overdue training certifications and incident occurrence. For example, in 2024 two ramp incidents involved staff whose training was more than a month out of date, directly related to competencies such as load restraint and equipment operation. While statistically marginal, the operational impact of such lapses is critical. Even isolated cases demonstrate the "weakest link" effect common in high-risk environments, where a single gap in recurrent training can compromise safety. This finding reinforces the importance of systematic monitoring of training validity, in line with Kirkpatrick's Level 3 and Level 4 evaluation outcomes, where behaviour and organisational results are directly linked to training recency and quality (Kirkpatrick & Kirkpatrick, 2006).

The baseline findings reveal a mixed picture: overall safety performance improved, yet persistent imbalances in training allocation, departmental compliance, and recurrent certification limited progress. These results underscore the need for more strategically aligned HRD practices, ensuring that training investment not only satisfies regulatory requirements but also drives behavioural change and strengthens the organisation's safety culture.

VI. TRAINING INTERVENTION (2024–2025 PILOT)

In response to the baseline findings, the handling company implemented a pilot safety training programme between January 2024 and June 2025. The intervention adopted a blended design that combined computer-based learning for regulatory knowledge, hands-on practice in ramp and cargo operations, and scenario-based simulations tailored to local risks such as ground support equipment collisions or baggage-handling injuries. To accommodate a 24/7 operational schedule, the company also introduced micro-scheduling, offering shorter sessions integrated into shift patterns to maximise attendance while reducing operational disruption. The high-risk departments of ramp, cargo, and passenger services were prioritised, as they accounted for more than two-thirds of the incidents identified during the baseline period. This targeting reflects the HRD principle of aligning training resources with areas of greatest organisational risk, ensuring strategic relevance and return on investment (Garavan, 2007).

The pilot generated measurable improvements in both safety and compliance outcomes. Overall incidents decreased by around one-sixth compared to the baseline, while high-severity cases fell by nearly a quarter. Such reductions are particularly significant in safety-critical industries, where even modest percentage improvements represent major organisational gains in risk mitigation (Salas et al., 2012). Ramp operations recorded the most notable change, with vehicle-related incidents declining by more than one-third following intensified driver and equipment training. Departmental audit scores also rose by approximately eight percentage points on average, with the greatest progress observed in ramp operations, where compliance with load restraint and equipment use procedures improved significantly. This aligns with Kirkpatrick's Level 4 evaluation, demonstrating that training can translate into tangible organisational results when closely tied to operational needs (Kirkpatrick & Kirkpatrick, 2006).

Supervisors additionally reported faster and more consistent responses to hazards, with containment times improving by an estimated 15%. From the perspective of learning organisation theory, this indicates that staff not only absorbed procedures but also applied them proactively, reflecting deeper cultural shifts toward continuous learning and adaptive problem-solving (Watkins & Marsick, 1993). Employee feedback reinforced this perspective: nearly nine out of ten participants rated the training directly relevant to their daily work, and more than four-fifths expressed greater confidence in handling hazards. Qualitative responses particularly valued the scenario-based simulations, which enabled participants to rehearse high-pressure situations in a safe environment. This resonates strongly with Kolb's (1984) experiential learning theory, which emphasises that concrete practice and reflection underpin the transformation of knowledge into effective workplace behaviour.

These outcomes suggest that recurrent, experiential, and context-specific training is essential not only for procedural compliance but also for building organisational resilience. The intervention demonstrated that blended learning models—when strategically targeted and supported by flexible scheduling—can succeed even in round-the-clock operations. For HRD, this case illustrates how training interventions designed around adult learning principles and evaluated through robust frameworks can yield significant operational benefits, reinforcing the argument that safety training should be viewed as a strategic, rather than purely regulatory, investment.

VII. DISCUSSION

A. Linking Training to Incident Outcomes

The findings from this case study confirm the strong relationship between structured safety training and incident management in a ground handling context. The observed reduction in overall incidents and decline in high-severity cases align with previous research emphasising that recurrent and context-specific training improves procedural compliance and reduces operational errors (Balk, 2008; Gultom et al., 2021). By integrating both technical and behavioural components, the training intervention reinforced not only the "what" of safety procedures but also the "how" of applying them under operational pressures.

Kirkpatrick's (2006) four-level model provides a useful lens for interpreting these outcomes. Levels 1 (reaction) and 2 (learning) were evidenced by strong participant satisfaction and measurable knowledge gains in scenario-based modules. More critically, Levels 3 (behaviour) and 4 (results) were demonstrated in supervisor observations of improved procedural adherence and in quantifiable reductions in incident rates and audit non-compliances. This progression illustrates the value of evaluating

training beyond immediate learner feedback and underscores the importance of linking HRD interventions to organisational performance metrics (Salas et al., 2012).

B. Experiential and Blended Learning in High-Risk Contexts

The success of the pilot training highlights the centrality of experiential learning in safety-critical industries. Kolb's (1984) experiential learning cycle—combining concrete experience, reflection, and active experimentation—was operationalised through simulations, hands-on exercises, and structured debriefs. Employee feedback indicated that scenario-based modules provided not just technical reinforcement but also improved confidence in hazard response, an outcome that aligns with broader HRD research on experiential and constructivist methods (Knowles et al., 2015).

At the same time, the integration of computer-based training (CBT) supported regulatory knowledge transfer and flexible scheduling, particularly in a 24/7 operational environment. The blended model addressed some of the shortcomings of digital-only training noted in the literature, such as disengagement or lack of embodied practice (Salas et al., 2002; Gibbings et al., 2012). The findings therefore support a balanced training strategy, where digital delivery ensures scalability and consistency, while experiential methods provide depth and application. For HR managers, this reinforces the value of hybrid learning frameworks in environments where operational exposure cannot be fully replicated online.

C. Organisational and HRD Implications

From an HRD perspective, the study demonstrates that training functions not only as a compliance mechanism but also as a form of strategic human resource development. By aligning training investments with high-risk departments, the intervention illustrated how HRD can be positioned as a strategic enabler of organisational resilience (Garavan, 2007). The improvements in audit scores, hazard response times, and employee perceptions illustrate how training contributes simultaneously to safety culture and operational performance.

The findings also reveal the importance of equitable training allocation. Baseline data showed uneven distribution of training hours across departments, with ramp operations—despite being the highest risk—receiving relatively low averages. Addressing such disparities is critical for sustaining a culture of continuous learning, which is a defining feature of learning organisations (Watkins & Marsick, 1993).

D. Challenges and Transferability

Despite positive outcomes, several challenges were identified. Scheduling in a 24/7 operational environment remains a persistent barrier to training participation. The pilot addressed this through micro-scheduling, yet scalability across larger networks will require additional HR and operational coordination. Similarly, the study was conducted in a single airport context, limiting generalisability. Nevertheless, the theoretical grounding of the intervention—drawing on strategic HRD, experiential learning, and learning organisation perspectives—provides a strong foundation for transferability to other high-risk industries such as logistics, healthcare, and energy. These sectors share similar characteristics of time-critical operations, safety dependence on human performance, and the need to integrate training with organisational culture.

Finally, the case reinforces the value of data-driven HRD. The integration of learning management system (LMS) analytics with incident and audit data provided actionable insights, allowing the organisation to adapt training content to emerging risks. For HR practitioners, this points to the growing role of digital HR tools and analytics in linking training to workforce performance and safety outcomes.

VIII. CONCLUSION AND IMPLICATIONS

This study examined the relationship between safety training and incident management in a Romanian ground handling company, providing empirical evidence that structured, blended training interventions can produce measurable improvements in both safety and organisational performance. By applying Kirkpatrick's four-level evaluation model alongside safety management principles, the analysis demonstrated how training outcomes extend beyond compliance to influence behaviour, safety culture, and incident reduction.

The baseline findings highlighted several key challenges: uneven distribution of training hours across departments, occasional lapses in recurrent certification, and persistent procedural weaknesses in high-risk operational areas such as ramp services. These weaknesses contributed to audit non-compliances and incident recurrence. The pilot intervention, however, showed that targeted, scenario-based training combined with micro-scheduling and blended delivery methods led to tangible improvements, including a 16% reduction in overall incidents, a 23% decline in high-severity events, and an 8-point increase in audit scores.

Beyond the operational domain, the study underscores the importance of situating safety training within a broader HRD framework. Training was shown to function as a strategic investment (Garavan, 2007), aligning resource allocation with operational risk and supporting long-term organisational resilience. The rise in hazard reporting and faster hazard response times reflected features of a learning organisation (Watkins & Marsick, 1993), where employees actively contribute to knowledge

creation and cultural change. Furthermore, the use of simulations and hands-on practice demonstrated the application of experiential learning theory (Kolb, 1984), translating adult learning principles into practical competence development.

From an HR and training perspective, the findings suggest that recurrent and risk-based allocation of training hours is essential, and that blended learning models combining digital scalability with experiential practice are both feasible and effective in round-the-clock operations. This illustrates how HRD frameworks can be operationalised in high-risk environments, linking learning design to measurable behavioural and organisational outcomes.

The study is not without limitations. The single-case design, focused on one airport location, restricts generalisability, and improvements cannot be attributed exclusively to training, as other operational factors may have contributed. Nevertheless, the triangulation of multiple data sources strengthens the reliability of findings, and the intervention design offers a replicable model for other contexts.

Future research should broaden the scope by comparing multiple organisations across industries, conducting longitudinal studies of training sustainability, and integrating qualitative employee perspectives on workplace learning. Such directions would help refine the theoretical integration of training evaluation, experiential learning, and learning organisation frameworks within HRD scholarship.

In conclusion, this exploratory single-case study contributes to HRD theory and practice by showing how safety training in a high-risk industry can operate simultaneously as compliance assurance, behavioural development, and strategic organisational learning. While the findings are context-specific and not intended for statistical generalisation, they provide a foundation for further theory-building and comparative research. The implications extend beyond aviation, offering transferable lessons for HRD professionals in logistics, healthcare, energy, and other complex operational environments

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