Synergy between Artificial Intelligence and Role-Playing: A New Paradigm in the Training of Aeronautical Engineering Auditors

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ABSTRACT

In the aviation industry, the presence of leaders capable of ensuring safety through elite quality standards is required. In this article, an innovative training model for auditors is presented, which is based on the ISO 19011:2018 standard and was implemented at Don Bosco University in El Salvador during the years 2025 and 2026. Theory was transformed into action through the integration of Artificial Intelligence (AI) and Role-Playing, so that the gap between classroom learning and strategic field operation could be closed.
While theoretical mastery is ensured through traditional education, a critical "stress gap" in audit planning and decision-making under pressure is identified in the findings of this research. To address this issue, audit simulations were implemented, based on the regulatory framework of the Civil Aviation Regulations (RAC) — which constitute the technical legal framework governing aeronautics in El Salvador. These simulations were executed in three types of organizations: Approved Maintenance Organizations (RAC 145), Training Organizations (RAC 147), and Aerodromes (RAC 139).

On the one hand, the generation of customized assessment scenarios was enabled by the use of AI, while on the other hand, participants were compelled to manage their emotional intelligence when facing hostile auditees through role-playing. Through the results obtained, it is demonstrated that, by means of this technological and pedagogical synergy, not only are auditors trained, but resilient leaders are created. With this model, a new paradigm for aeronautical training is established, so that operational excellence is guaranteed for the next generation of professionals in any high-risk environment.

KEYWORDS

ISO 19011:2018, Artificial Intelligence, Role-Playing, Aeronautical Auditing, Safety Oversight, Flight Inspection Standards.

INTRODUCTION

The aviation industry is characterized by disruptive evolution and an unceasing pursuit of operational optimization; therefore, human capital is required in which not only is technical expertise mastered, but rigor in quality and safety standards is evidenced.
In the contemporary aeronautical landscape, an imperative transition from purely prescriptive auditing models toward dynamic methodologies centered on results and risk management is identified. This evolution is driven by the integration of emerging technologies and by the need to optimize limited resources so that Universal Safety Oversight Audit Programme (USOAP) and Universal Security Audit Programme (USAP) surveillance are strengthened [1].

For this purpose, a strategic alliance was consolidated between the Faculty of Aeronautics and the Academic Quality Department of Don Bosco University for the development of a specialized training plan for aeronautical quality system auditors. This training, titled "Auditor Training according to ISO 19011:2018," is based on international technical standards and is adapted to the profile of graduates from the Aeronautical Engineering program. Through this initiative, a transfer of competencies is ensured, spanning from the comprehensive management of audit programs to the delivery of the audit report.

METHODOLOGY

In Figure 1, the T-Audit (Training Auditor) model is observed, which is conceived as a dynamic system where technical competence is fused with technological agility and human self-reflection.
The core of the model is composed of three main circles:

- *a. Knowledge.*
- *b. Soft skills.*
- *c. Do.*

Through the intersection of these three circles, the professional trained to act as a high-level auditor—referred to as a holistic auditor—is represented.
These three main circles are intersected by four oval rings, through which information from both the real-world environment and academic planning is collected toward the teaching-learning environment:

- *Ring 1:* Feedback from previously trained groups and learning assessment.
- *Ring 2:* Role-playing.
- *Ring 3:* The environment that is experienced in real-time with the participant group.
- *Ring 4:* The integration of Artificial Intelligence (AI) with Information and Communication Technologies (ICT).

Training path

The training path (based on instruction, experience, lived experience, and observation) is defined as a spiral trajectory. These three main circles are surrounded by this spiral, which is integrated by the principles of planning, interactive support materials, and learning evaluation (both quantitative and qualitative).
To these elements, self-study, real-time monitoring, self-reflection, and reflective discussion are added. In essence, this training path is projected as an upward spiral oriented toward excellence.

Feedback process

The feedback process is developed in two main stages:

- *First Stage:* This is executed during synchronous sessions through the use of interactive platforms; this allows for contents to be adjusted in real time according to the performance of the participants.

- *Second Stage:* This is carried out at the conclusion of each cohort through learning evaluation. The results obtained are analyzed so that continuous quality improvements may be implemented in future editions.

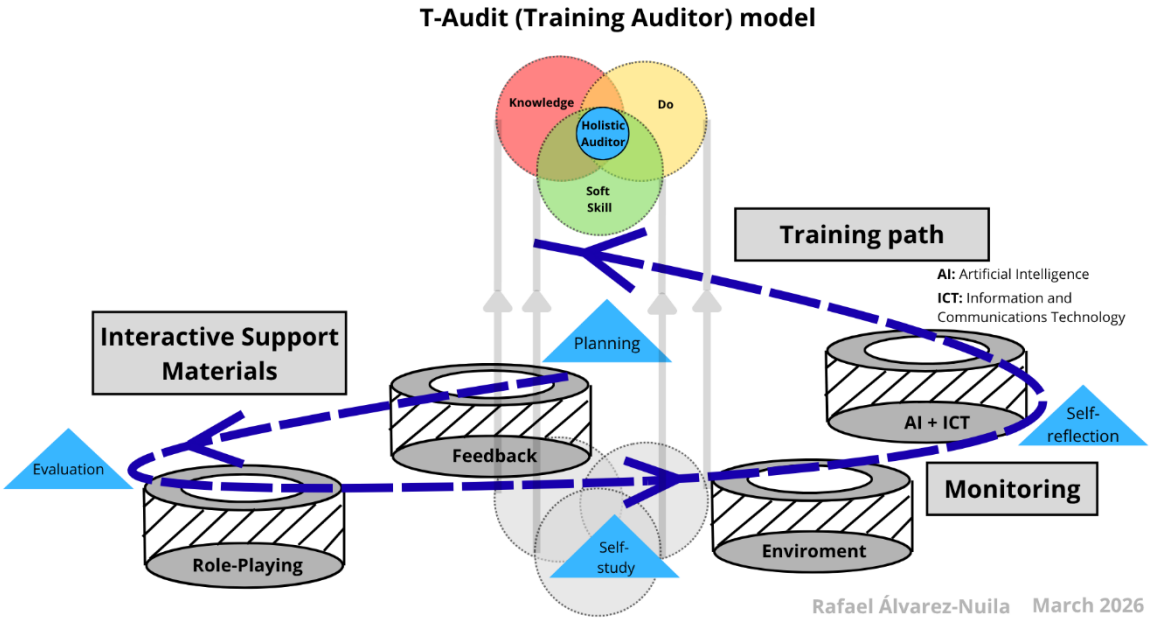

Figure 1. Teaching-learning model, T-Audit (Training Auditor) model.

Interactive materials are comprised of bibliographic sources derived from recent research and international regulatory frameworks. These contents are adapted through the critical thinking of the instructor, which is sustained by the experience acquired in teaching within the aeronautical sector.

Additionally, Artificial Intelligence tools are employed for the generation of hypothetical examples, as can be observed in Figure 2.

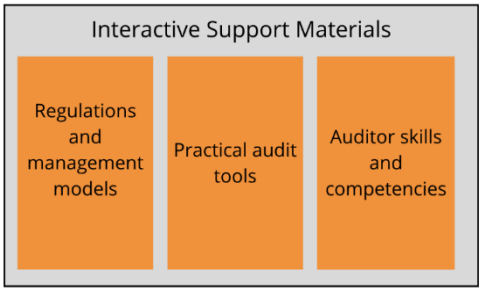

Figure 2. Composition of information sources.

Through the evidence presented in Figures 3, 4, 5, and 6, the execution of the T-Audit model is detailed via a methodology of technological and practical immersion. The process was sustained by synchronous meetings and autonomous study (Figure 3), the pedagogical efficacy of which was enhanced by the real-time adjustment of content through interactive platforms (Figure 4). Furthermore, Artificial Intelligence (AI) was integrated for the automated creation of checklists based on RAC regulations (Figure 5), culminating in the validation of competencies through simulated audits using the role-playing technique between participants and instructors (Figure 6).

Figure 3. Synchronous session via Microsoft Teams and session recording for self-study, virtual environment.

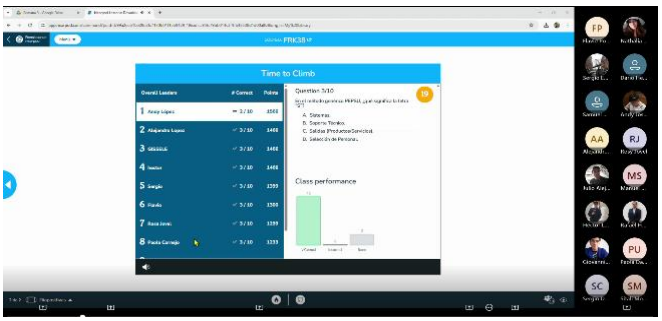

Figure 4. Utilization of an interactive platform for feedback and real-time content adjustment.

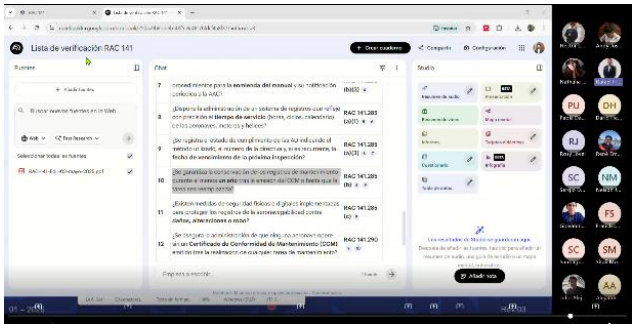

Figure 5. Explanation of the use of an Artificial Intelligence tool to generate a checklist based on current aviation regulations.

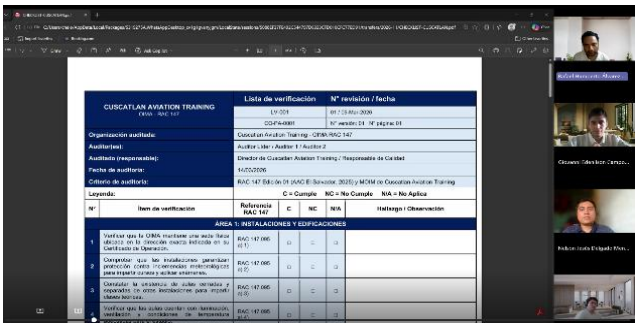

Figure 6. Simulated audit, role-playing technique during the activity. (Audit team – students / Auditee – instructor).

Approach

The training model was developed through a blended learning methodology, which was structured to facilitate comprehension in hybrid environments. The program was comprised of 40 instructional hours, in which competencies for planning, executing, and leading internal and external audits were prioritized.

Integration of innovative tools

The methodology was extended beyond traditional instruction through the incorporation of various elements; this integration of innovative tools can be visualized in Figure 7. Among these elements, the following are included:

- ***Artificial Intelligence (AI):*** AI tools, such as NotebookLM and Gemini, were utilized for the implementation of knowledge through practical cases and exercises contextualized within the aeronautical sector. Through this resource, the generation of customized assessment scenarios and the analysis of complex documentation were made possible.

- ***Role-Playing:*** To address "human-centric skills," role-playing was employed to simulate high-pressure scenarios, such as the communication of critical non-conformities or the conduct of interviews with hostile personnel. This approach was focused specifically on emotional intelligence and stress management.

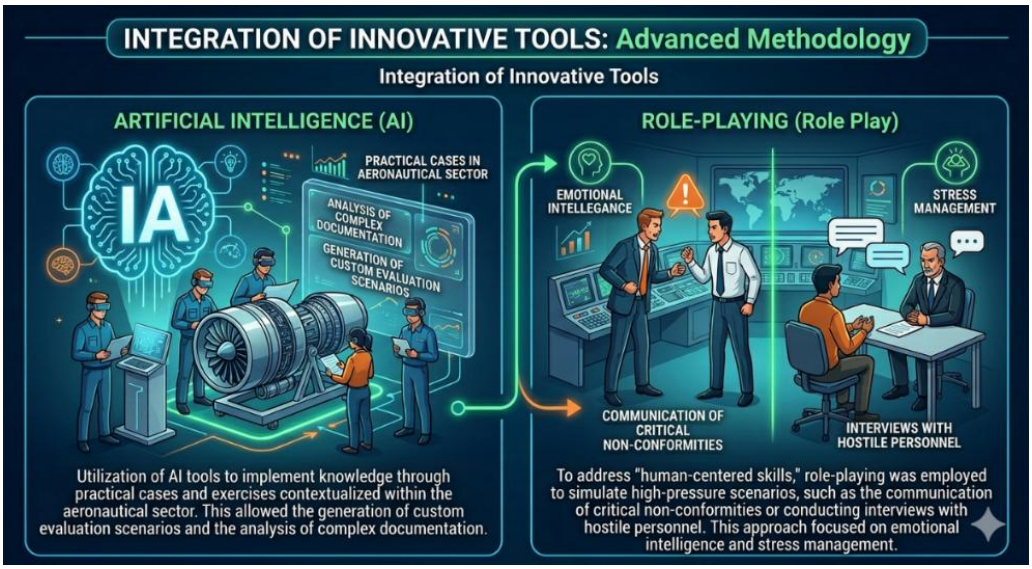

Figure 7. Integration of innovative tools in training.

Note for Figure 7: The image was generated through the Artificial Intelligence tool NotebookLM; the prompt was provided and the result was reviewed by the author.

Furthermore, time in auditing activities is accelerated and optimized through the use of Artificial Intelligence tools. Therefore, these tools are initially utilized so that the teaching-learning process is enhanced during training; subsequently, the tools are employed by the participant in their professional performance as an auditor.

Operational context

Simulated audits in three types of organizations belonging to the aeronautical environment were included in the training:

- Certification, Operation, and Surveillance of Aerodromes (RAC 139) [2].
- Regulation of Approved Maintenance Organizations (RAC 145) [3].
- Regulation for Approved Maintenance Training Organizations (RAC 147) [4].

The approach was guided by the guidelines of the ISO 19011:2018 standard, and ICAO TRAINAIR PLUS methodologies were incorporated. The latter are defined as standardized, competency-based training programs so that global aviation safety and efficiency are improved.

ANALYSIS OF RESULTS

1. Contextualization and General Performance

The training program was executed during three semester periods between the years 2025 and 2026, a period in which a total sample of 50 professionals was involved.

- In the First Semester of 2025, instruction was imparted to 22 participants, by whom a final evaluation average of 8.46 was obtained.

- During the Second Semester of 2025, the process was completed by 7 attendees, with a mean of 8.21 being recorded.

- In the First Semester of 2026, training was received by 21 professionals, with the most outstanding average performance of 8.85 being reached.

2. Methodological Variables and Innovation

To strengthen technical competencies, various strategies were progressively integrated:

- **PDCA Cycle:** From the initial 2025 cohort to the first cohort of 2026, the Plan-Do-Check-Act (PDCA) cycle was implemented as a transversal methodological axis.

- **Simulated Audit and AI (2025-2):** In the second cohort of 2025, the role-playing technique (simulated audit) was incorporated, which was enhanced by the use of Artificial Intelligence as a supporting tool in the teaching-learning process.

- **Sequential Optimization (2026-1):** In the final cohort analyzed, in addition to the use of AI and role-playing, the contents were arranged in a sequence so that the commencement of the simulated audit was facilitated from the first week of instruction.

3. Comparative Analysis of Results by Content

In Figure 8, the evolution of learning by thematic areas is visualized. Trend lines are identified by colors: the blue line represents the First Semester of 2025, the orange line the Second Semester of 2025, and the green line the First Semester of 2026. It is imperative to consider that the maximum average score to be reached was 0.25 and the minimum was 0 for each content item.

Quantitative Analysis

- **Performance Peaks:** It was observed that the maximum score of 0.25 was reached by the 2026-1 cohort (green line) in the "Audit Opening and Closing" and "Checklist" modules.
- **Stability in 2025-2:** Following the introduction of AI and simulation, a consistently high performance in "ISO 9001 Principles" (0.240) and "Auditor Attributes" (0.235) is shown by the orange line.
- **Recorded Deviations:** A decrease to 0.178 was recorded in the PDCA Cycle category within the 2026-1 cohort, representing the lowest point of said series.

Qualitative Analysis

From an aviation auditing perspective, where regulatory compliance is critical, the following conclusions are yielded by the results:

1. **Impact of AI and Early Simulation:** The attainment of perfect scores (0.25) in the preparation of Checklists and the execution of opening meetings in 2026-1 demonstrates that practical immersion from the first week, supported by Artificial Intelligence tools, favors the consolidation of procedural competencies.

2. **Regulatory Robustness:** It was detected that knowledge of ISO 9001 Principles was significantly strengthened starting from the second cohort, which is attributed to the application of simulated practical cases where AI allowed for the generation of complex non-compliance scenarios.

3. **Management of Continuous Improvement:** Although the PDCA cycle was applied transversally, fluctuations were presented in its theoretical comprehension. However, its practical application in auditor training is evidenced by the general improvement of final averages (from 8.46 to 8.85), indicating that the teaching model was successfully corrected and optimized over time.

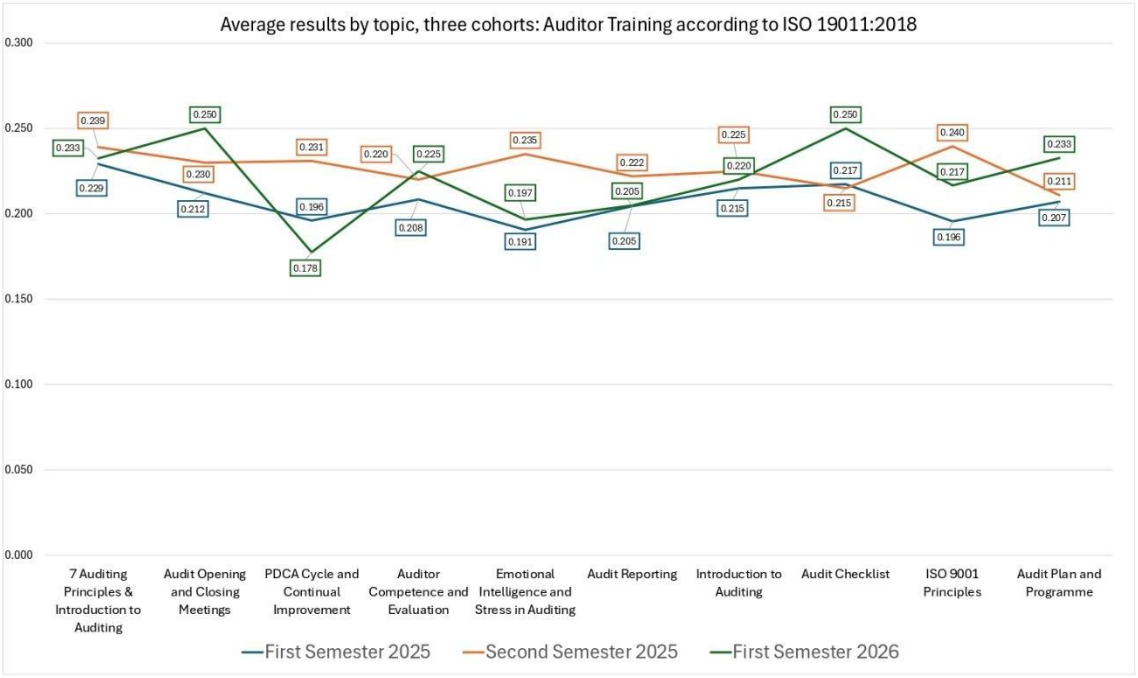

Figure 8. Comparative analysis of average results by topic across three auditor training cohorts according to ISO 19011:2018 (2025-2026).

DISCUSSION

The "stress gap" identified was addressed by the synergy between AI and Role-Playing by exposing participants to realistic scenarios that demanded immediate and effective responses. The management of stress for those exposed to conditions similar to the work environment was enhanced by the implementation of simulated audits under the Civil Aviation Regulations (RAC) of El Salvador.

Challenges in Strategic Planning

It is suggested by the constant weakness in the "Audit Plan and Program" content that strategic planning is a universal learning challenge in aeronautical auditing. A more practical and contextualized pedagogical approach is required, moving beyond simple compliance checklists.

AI as a Pedagogical Catalyst

The use of AI was found to be fundamental for identifying specific training needs and adapting content. However, the human factor is still regarded as the fundamental pillar in the management of operational safety and process integrity. A transition toward results-based auditing is required, necessitating professionals by whom technology is not only utilized, but by whom objectivity is also maintained in high-pressure labor environments.

CONCLUSIONS AND FUTURE WORK

The consolidation of the ISO 19011:2018 auditor training program has successfully transferred international competencies to graduates of the aeronautical engineering program, whereby their role in safety management is strengthened. The integration of AI and role-playing has been demonstrated to be essential for closing the gap between theoretical knowledge and field operations.

To improve the model, future editions **shall**:

1. **Strengthen Planning Modules:** Practical workshops will be incorporated where annual audit programs for complex study cases are developed by the participants.
2. **Transversal Soft Skills:** Role-playing will be integrated throughout the program so that emotions and objectivity are managed in real-world scenarios.
3. **Continuous Improvement:** Diagnostic tests will be utilized, and the impact of simulated audits will be systematically documented to refine the training content.

The results from 2025 and 2026 are represented as the starting point for a semester of continuous improvement, ensuring that graduates are maintained as resilient leaders capable of upholding the highest standards of quality and safety in the regional aeronautical sector.

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