



Abstract Title: Reimagining Rail Safety: Moving Beyond, with Safety Intelligence and the Adaptive Safety Learning Framework

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Background / Context

The rail industry, like other safety-critical sectors, faces persistent challenges in maintaining high reliability within increasingly complex socio-technical systems. Historically, safety assurance has been grounded in compliance, investigation, and retrospective analysis of adverse events. However, emerging challenges—including shifting passenger expectations, technological integration, and workforce pressures—demand a more adaptive and intelligence-driven approach. Recent developments in aviation and healthcare demonstrate how learning from everyday work, not only from incidents, strengthens organisational resilience. Rail can benefit from this evolving safety science by adopting collaborative models that go beyond sectoral boundaries.

Objectives

This paper aims to explore how the concept of safety intelligence, embedded within the Adaptive Safety Learning Framework (ASLF), can enhance the rail industry's ability to learn, adapt, and anticipate emerging risks. Specifically, it will:

1. Examine how collaboration across safety-critical sectors supports the development of intelligence-based safety practices.
2. Identify cultural challenges in rail, including balancing accountability, restorative justice, and open reporting.
3. Demonstrate how lessons from aviation can be transferred to rail— and conversely, how rail innovations may inform aviation and other industries.

Methods / Approach

Drawing on empirical findings from aviation safety audits, operational learning reviews, and case studies underpinning the ASLF, this paper applies a comparative lens to highlight cross-sector lessons. It integrates qualitative evidence from frontline reporting systems, incident reviews, and safety culture assessments, combined with theoretical insights from safety science. The ASLF is used as a framework to structure the analysis, illustrating how tacit knowledge, psychological safety, and restorative practices enable effective safety intelligence.



Results / Findings

The findings suggest that rail organisations can strengthen adaptive capacity by:

- Establishing mechanisms for sharing tacit frontline knowledge systematically across organisational levels.
- Embedding restorative justice culture to balance accountability with learning.
- Integrating safety intelligence into decision-making processes, thereby enhancing foresight rather than relying solely on hindsight.

Examples from aviation demonstrate measurable improvements in engagement, resilience, and predictive safety performance, with potential applicability to rail contexts. Conversely, rail's experience with system redundancy and public accountability offers valuable insights for other high-reliability sectors.

Conclusions

Cross-sector collaboration is a powerful enabler for reimagining rail safety. By adopting frameworks such as the ASLF, rail operators can transition from reactive models to proactive, intelligence-driven systems that promote both safety and performance. The transfer of lessons between aviation and rail underscores the universality of safety culture challenges and the value of shared learning across industries. Ultimately, embedding safety intelligence through collaboration will not only enhance risk management but also foster more inclusive, accountable, and resilient organisations.