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**The Effectiveness of Crew Resource Management (CRM)
Training on On-Time Performance: A Case Study of Saudi
Arabian Airlines (Saudia), Jeddah, Saudi Arabia**

“A Case Study”

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Abstract

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1. Ch. 1: The Introduction

1.1. Background

Aviation captivates the imagination with speed, reach, and precision, yet day-to-day success is judged by disciplined delivery on schedule. Cirium (2021) defines on-time performance (OTP) as arriving within 15 minutes of the published schedule and treats it as a transparent, comparable benchmark across airlines and airports worldwide, turning punctuality into a public scorecard for reliability.

Building on this, Cirium (2025) shows how OTP rankings shape competitive positioning, reinforcing passenger expectations of consistency while signaling operational discipline to regulators and partners. From an industry standpoint, IATA (2025) frames punctual, dependable operations as integral to the sector's broader recovery and resilience narrative, linking on-time delivery to customer trust, network stability, and cost control in a capacity-constrained, disruption-prone environment. In short, OTP crystallizes the stakes of modern airline management: it is a headline KPI that translates operational precision into reputational capital and financial performance. Beyond headline metrics, punctuality reflects how well an airline orchestrates people, processes, and technology.

Airline punctuality emerges from a tightly coupled system where crews, aircraft, airports, and air traffic control interact in real time. EUROCONTROL's CODA Annual 2023 explains that delays rarely stem from a single cause; primary disruptions weather, ATC capacity, aircraft availability, or maintenance cascade into reactionary knock-on effects as late-arriving aircraft and crews propagate schedule slippage across the network. This propagation dynamic means a minor perturbation at one station can degrade performance across multiple downstream legs, especially under high utilization and limited buffer times. CODA's taxonomy and analytics further show how turnaround processes, gate conflicts, and ground-handling variances amplify or absorb shocks, making OTP a property of the whole operating

system rather than a timetable statistic. Cirium’s global benchmarking places these mechanisms in a competitive frame: carriers are compared on their ability to contain primary delays and prevent reactionary spread, turning operational discipline into measurable advantage. Because infrastructure and schedules cannot guarantee punctuality alone, outcomes hinge on human coordination.

At the core of airline reliability is the human element: decisions made under uncertainty, information exchanged under time pressure, and workload distributed across tightly choreographed teams. The FAA’s Pilot’s Handbook of Aeronautical Knowledge explains Aeronautical Decision-Making (ADM) as a systematic, risk-focused process that translates perception and judgment into safer, more consistent actions; it also highlights how hazardous attitudes, communication breakdowns, and poor workload management can erode performance when minutes matter (FAA, 2016). Building on this foundation, CAP 737 frames non-technical skills as explicit competencies leadership, teamwork, communication, situational awareness, and decision-making each with observable behavioural markers that can be trained, briefed, and evaluated within routine operations and time-critical turnarounds (UK CAA, 2023). Critically, these competencies map directly to the operational frictions that drive delays: unclear briefings, weak cross-checks, fragmented authority, and saturated cognitive load during gate, pushback, and taxi phases. By treating human performance as measurable and improvable not a residual after technology and schedules modern guidance positions non-technical skills as levers of consistency, resilience, and ultimately punctuality. These human-performance risks motivated the industry to formalize a training response.

In parallel, Cirium’s on-time reviews show that industry leaders distinguish themselves not merely by fleet or infrastructure, but by the ability to contain knock-

on delays and sustain consistent arrival performance an outcome that hinges on precise, repeatable crew processes under time pressure (Cirium, 2024/2025).

Taken together, these perspectives reposition CRM from a safety-only intervention to a performance lever: the same competencies it trains communication, situational awareness, leadership, and decision-making mirror the behaviours required for on-time turnarounds and network stability. Prior literature rarely models this pathway explicitly from CRM to OTP, leaving a practical, testable link at the heart of airline reliability. This under-examined link is especially relevant where punctuality is strategically salient.

Within the Middle East, carriers have become increasingly visible in global punctuality tables, with Cirium's annual reviews highlighting how the region's hubs and mainline operators compete on consistent schedule adherence amid rapid growth and network complexity. Cirium (2025) situates punctuality as a comparative yardstick across carriers in the Gulf and beyond, underscoring that competitive advantage in the region is now inseparable from disciplined, time-reliable operations. In parallel, IATA (2025) frames the sector's priorities around resilience, reliability, and data-driven improvement as traffic scales back to, and beyond, pre-pandemic levels an agenda that places day-to-day operational consistency at the center of airline strategy. Against this backdrop, Saudi Arabian Airlines (Saudia) operates as a flagship carrier within a national push to enhance connectivity and service quality, participating in the same benchmarking ecosystem that publicly compares OTP performance across markets. Cirium's coverage shows how regional leaders differentiate themselves by containing reactionary delays and sustaining repeatable arrival performance, a standard directly relevant to Saudia's competitive context (Cirium, 2025). This setting provides an opportunity to examine whether

CRM training translates into measurable punctuality, linking human-performance capabilities to a strategically salient outcome in Saudi airline operations.

A clear conceptual framework connects CRM training effectiveness to punctuality outcomes through measurable operational performance indicators. The independent variable in this study is Crew Resource Management (CRM) Training Effectiveness, which represents the overall quality and consistency of the training delivered to Saudia's flight crews. This includes the scope and frequency of recurrent training cycles, the use of scenario-based simulations, instructor qualifications, and performance assessments that evaluate behavioural competence. According to *CAP 737* (UK CAA, 2023), CRM is structured as a competency-based model encompassing four key dimensions decision-making, communication, leadership, and situational awareness each serving as an observable and assessable behavioural domain. These dimensions form the operational foundation through which CRM training is expected to influence On-Time Performance (OTP), measured in terms of departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management. Thus, the conceptual model underpinning this study assumes a direct, positive relationship between CRM training effectiveness and the core components of OTP, aligning with the three hypotheses established for the research.

These competencies serve as mediators that connect training to day to day performance. The FAA's Aeronautical Decision Making framework supports measuring judgement, workload management, and communication under time pressure, which are precisely the behaviours that affect turnarounds and schedule adherence (FAA, 2016). The dependent variable is on time performance using the industry definition of arrival within fifteen minutes of schedule and tracked as a monthly percentage at the flight, route, and unit levels, which aligns with global benchmarking practices reported by Cirium in 2021 and 2025 (Cirium, 2021;

Cirium, 2025). To isolate the human factor pathway, the model controls for weather and air traffic constraints, maintenance events, fleet and station differences, and reactionary delay propagation, following EUROCONTROL's delay taxonomy and analytics in the CODA Annual 2023.

Managerial levers around turnaround discipline, cross functional coordination, and shock absorption buffers provide additional contextual variables as recommended in BCG's operational analyses from 2016 and 2025. Given this scaffold, the next section articulates the precise problem and gap.

Taken together, the background points to a dual imperative in modern aviation: sustaining the highest safety standards while delivering dependable punctuality as a visible marker of organizational maturity. Industry narratives frame OTP as a public test of operational discipline, where competitive carriers convert process precision into reliability and customer trust (Cirium, 2025; IATA, 2025). At the core of this capability sits the human system. FAA guidance and CAP737 both position non-technical skills decision-making, communication, leadership, and situational awareness as trainable levers that stabilize performance under time pressure, turning routine turnarounds into repeatable results (FAA, 2016; UK CAA, 2023). Decades of CRM research reinforce this premise by showing consistent gains in teamwork and safety-relevant behaviours, suggesting a credible behavioural pathway from training to schedule discipline (Salas et al., 2006; O'Connor et al., 2008). In the Saudi context, Saudia operates within a benchmarking ecosystem that openly compares punctuality, making it a practical lens for generating insights that managers and policymakers can generalize across similar network settings (Cirium, 2025; IATA, 2025). With this foundation, the next section specifies the problem and gap to be addressed in 1.2. Problem Statement. Top of Form

1.2. Research Problem

Modern commercial aviation defines success through two interdependent pillars: safety and operational reliability, particularly on-time performance (OTP). While *Crew Resource Management (CRM)* training has become a global standard to enhance teamwork and minimize human error, most academic and regulatory frameworks still conceptualize CRM primarily as a safety tool, not as a mechanism for improving operational efficiency. Global benchmarking platforms such as *Cirium* and *IATA* emphasize OTP as a key indicator of airline reliability, yet they rarely explore how effective crew coordination and communication core CRM outcomes translate into punctuality improvements.

In the Saudi context, *Saudia Airlines* operates within an increasingly competitive and data-driven regional aviation ecosystem, where OTP is not only a performance metric but also a reflection of national service quality and operational discipline. However, there remains a significant lack of empirical understanding of whether the effectiveness of CRM training directly influences punctuality outcomes, and if the CRM dimensions of decision-making, communication, leadership, and situational awareness contribute to specific components of OTP, such as departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management.

1.2.1. Theoretical Gaps

Theoretically, the existing literature predominantly situates CRM within the domain of safety management and human error reduction (Salas et al., 2006; O'Connor et al., 2008), providing limited explanation of its role in improving time discipline and operational consistency.

Although the *CAP737* framework defines CRM competencies including leadership, decision-making, communication, and situational awareness as measurable and

improvable skills (UK CAA, 2023), their connection to punctuality and turnaround efficiency remains under-theorized.

Furthermore, the *FAA's Aeronautical Decision-Making (ADM)* model identifies judgment, workload, and time management as core human-factor skills, but their link to managing reactionary delays and minimizing schedule deviation is not clearly modeled (FAA, 2016). Existing theories also overlook contextual moderators such as airport congestion, fleet configuration, and crew pairing frequency that shape how CRM competencies translate into operational outcomes (EUROCONTROL CODA, 2023; Hajko & Badánik, 2020).

Thus, there is a conceptual gap between CRM's established behavioral benefits and its potential to drive operational performance metrics like OTP.

1.2.2. Empirical Gaps

Empirically, very few studies directly examine the relationship between CRM training effectiveness and on-time performance at the airline level. Prior evaluations of CRM programs have focused almost exclusively on safety indicators, crew attitudes, and incident reduction (Salas et al., 2006; O'Connor et al., 2008), without assessing how these behavioral improvements affect punctuality outcomes.

Industry analyses from *EUROCONTROL* and *Cirium* primarily attribute delays to weather, ATC constraints, or maintenance issues, while giving limited attention to human coordination, communication, and workload management, which are central to CRM (EUROCONTROL CODA, 2023; Cirium, 2025). In the Saudi aviation context, public OTP benchmarks exist, but they are not correlated with CRM training records or competency evaluations, leaving the CRM→OTP pathway untested.

Methodologically, most available studies lack longitudinal or quasi-experimental designs that measure pre- and post-training differences in crew behavior and connect

these changes to delay patterns. This absence of integrated human-factor and operational datasets limits the ability to determine whether CRM training directly enhances departure and arrival punctuality, improves turnaround efficiency, or reduces reactionary delays (BCG, 2016; EUROCONTROL CODA, 2023).

❖ Main Research Question

To what extent does the effectiveness of Crew Resource Management (CRM) training at Saudia Airlines influence on-time performance (OTP), and how do CRM dimensions decision-making, communication, leadership, and situational awareness affect specific aspects of OTP such as departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management?

1.3. Research Significance

This study contributes to aviation management and human-factors scholarship by establishing a direct empirical link between Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP) within *Saudia Airlines*. It reframes CRM from a traditional safety-centered concept into a strategic operational performance tool that can improve punctuality, reliability, and customer trust.

By integrating *human-factor theory* with *operational performance analytics*, this research explains how improved competencies in decision-making, communication, leadership, and situational awareness can stabilize departure and arrival times, enhance turnaround efficiency, and reduce reactionary delays the core dimensions of OTP.

Within the *Saudi aviation context*, where OTP is a national and reputational benchmark, this study provides a new analytical framework for understanding how training quality translates into measurable operational gains, thereby enriching both academic theory and industry practice.

1.3.1. Theoretical Significance

Theoretically, this research builds a conceptual bridge between human-factors training models and real-world operational performance.

Drawing from the *FAA's Aeronautical Decision-Making (ADM)* principles and the *CAP737 CRM Competency Model*, the study operationalizes non-technical skills decision-making, leadership, communication, and situational awareness as mediating variables that link training inputs to OTP outcomes (FAA, 2016; UK CAA, 2023).

While previous meta-analyses (Salas et al., 2006; O'Connor et al., 2008) confirmed CRM's role in improving teamwork and safety culture, this research extends the theoretical framework to include time discipline and delay control as measurable outputs of CRM competence.

By connecting behavioral theory with performance data, it introduces a performance-oriented CRM model:

CRM Training Quality → Enhanced Crew Competencies → Reduced Operational Delays → Improved On-Time Performance.

This positions CRM not only as a safety mechanism but also as a predictive model of reliability and operational stability within airline systems.

1.3.2. Empirical Significance

Empirically, this study develops a measurable framework that links CRM training effectiveness to on-time performance using Saudia Airlines as a case study.

It collects operational data on OTP indicators (departure and arrival punctuality, turnaround efficiency, reactionary delay containment) and relates them to training records and competency evaluations based on CAP737 benchmarks (UK CAA, 2023; Cirium, 2025).

By statistically controlling for external factors such as weather, ATC constraints, maintenance issues, and fleet type, the study isolates the human-performance contribution to airline punctuality (EUROCONTROL CODA, 2023).

The findings are expected to:

- Provide evidence-based recommendations for enhancing recurrent CRM training programs.
- Guide managers and regulators in aligning training investments with measurable OTP improvements.
- Offer practical insights for optimizing crew coordination and turnaround management.

Ultimately, this study enables *Saudia Airlines* and by extension other regional carriers to translate human-factor development into competitive operational reliability, enhancing both safety and customer satisfaction.

1.4. Research Questions:

Main Research Question

What is the relationship between Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP) at Saudi Arabian Airlines (Saudia)?

Sub-questions

1. How strongly does overall CRM Training Effectiveness relate to overall OTP at Saudia during the study period?
2. How do the CRM dimensions decision-making, communication, leadership, and situational awareness contribute to overall OTP?

3. To what extent does CRM Training Effectiveness influence each OTP dimension: departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management?
4. Which CRM dimension shows the strongest association with OTP when compared across the four dimensions?

1.5. Research Objectives

1. Examine the overall influence of CRM Training Effectiveness on On-Time Performance (OTP) at Saudi Arabian Airlines (Saudia).
2. Identify the contribution of CRM dimensions decision-making, communication, leadership, and situational awareness to overall OTP and determine which dimension shows the strongest association.
3. Assess the impact of CRM Training Effectiveness on each OTP dimension: departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management.
4. Evaluate the current implementation level of CRM training at Saudia (exposure, recency, scenario-based practice) to inform targeted improvements aligned with punctuality outcomes.

1.6. Research Hypotheses

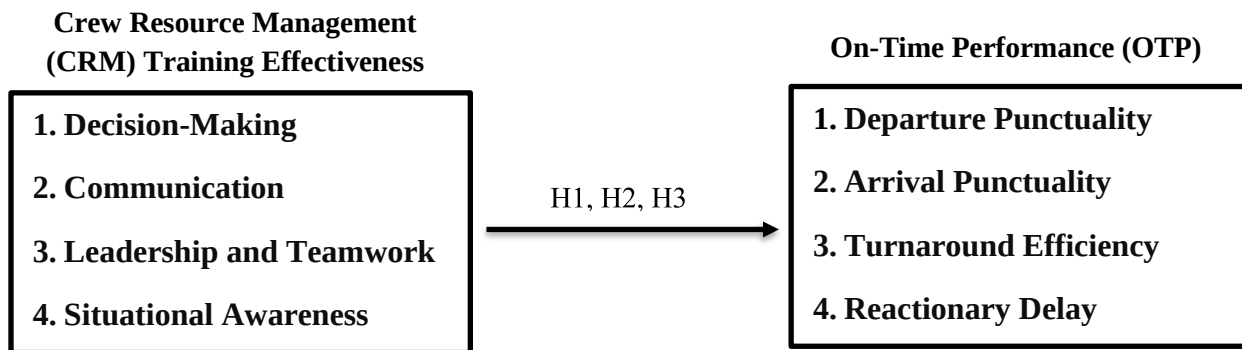
H1. There is a statistically significant positive relationship between Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP) at Saudia Airlines.

H2. There is a significant positive correlation between of decision-making, communication, leadership, and situational awareness and the overall On-Time Performance.

H3. There is a statistically significant positive relationship between Crew Resource Management (CRM) Training Effectiveness and of departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management.

1.7. Research model:

Figure 1: Suggested project model



Source: Researcher

1.8. Research Methodology

1.8.1. Introduction

This section explains the methodology that was applied in the current project, in order to answer the study questions and test the study hypotheses. The following titles explain, the operational definitions for the research variables, and what has been applied, as follows:

1.8.2. Operational definitions for research variables

In research studies, operational definitions are key in clearly defining the variables being measured. An operational definition describes how a variable will be measured, observed, or manipulated. It helps researchers ensure that their studies are consistent, reliable, and valid.

1.8.2.1. Crew Resource Management (CRM) Training Effectiveness (The independent variable)

Operational Definition: CRM training effectiveness refers to the extent to which the airline's CRM program develops, assesses, and sustains non-technical skills that support safe, efficient, and time-reliable operations. This includes activities such as

recurrent CRM modules, scenario-based LOFT/LINE simulations, instructor-led briefings and debriefings, competency-based assessments using behavioral markers (e.g., communication, teamwork/leadership, situational awareness, decision-making, workload/automation management, and threat-and-error management), training recency/frequency tracking, and post-training follow-up (e.g., line checks, LOSA/TEM observations).

1.8.2.2. On-Time Performance (The dependent variable)

Operational Definition:

On-Time Performance (OTP) is the airline's operational measure of the punctuality of its flights, defined by the industry standard as arriving within 15 minutes of the scheduled time. It reflects the overall efficiency and coordination of flight operations. OTP includes factors such as departure punctuality, arrival punctuality, turnaround time efficiency, and the airline's ability to reduce or prevent reactionary delays. OTP is assessed from actual operational records and represents the final performance outcome experienced by passengers, crew, and the airline.

1.8.3. Research design

In this template, we'll present a structure that covers five important methodological matters (as outlined above). This structure is loosely based on "research onion".

1.8.3.1. Research Design:

Research Philosophy: Positivist

Research Approach: Deductive

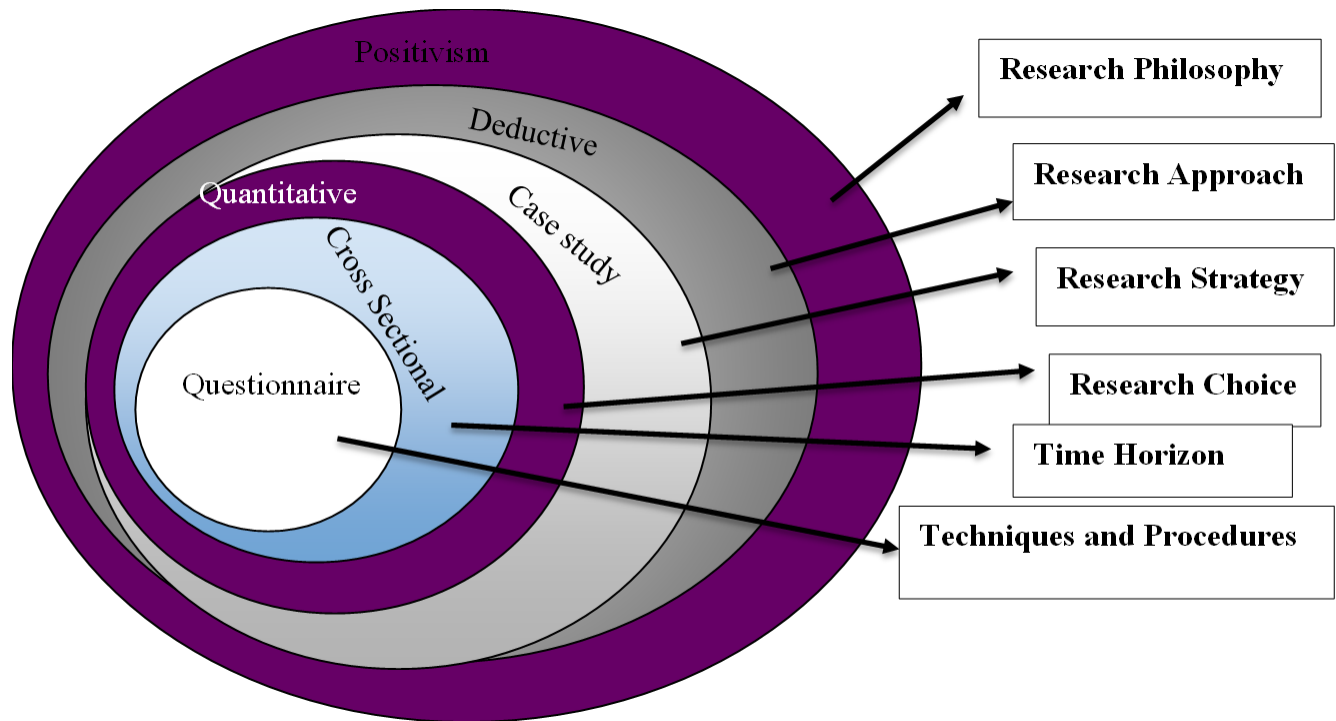
Research Strategy: Case study.

Research Choice: Quantitative

Time Horizon: Cross-sectional

Data Collection and Analysis Techniques : Questionnaire

Figure 2: Research Design



Source: Researcher

1.9. Scope of the Study

1.9.1. Introduction about Saudia Airlines

This study examines Saudi Arabian Airlines Saudia as a single case within the Saudi aviation context. The focus is on line operations that affect schedule adherence and on the training ecosystem that develops crew non-technical skills. The scope is limited to flights operated by Saudia during the defined study window and to crew groups who completed CRM training within the same period.

1.9.2. Vision

To provide evidence that strengthening human-factor competencies through CRM training can support reliable, punctual operations and visible improvements in on-time performance that matter to passengers, partners, and regulators.

1.9.3. Mission

To measure, analyze, and explain the link between CRM training effectiveness and on-time performance at Saudia by integrating training records, competency evidence, and operational punctuality indicators, and by producing actionable guidance for managers.

1.9.4. Operational and Training Domains Included

1.9.4.1. CRM Training Domain.

Coverage includes exposure and quality of CRM training. Examples include recurrent cycles, scenario based exercises, instructor standards, and assessment outcomes. Competency focus follows recognized guidance on decision making, communication, leadership, and situational awareness (FAA, 2016; UK CAA CAP737, 2023).

1.9.4.2. On-Time Performance Domain

Coverage includes departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management, using the industry convention of arrival within 15 minutes of schedule for OTP benchmarking (Cirium, 2021; Cirium, 2025).

1.9.4.3. Controls and Context

Analysis controls for weather, air traffic constraints, maintenance events, fleet and station differences, and delay propagation, following established delay causality frameworks (EUROCONTROL CODA, 2023).

1.9.5. Population, Unit of Analysis, and Time Frame

- Population: Saudia flights and operating crews active within the study period.
- Unit of Analysis: Flight level and aggregated route or unit level, with crew level training linkages where data are available.

- Time Frame: A continuous window sufficient to observe pre and post training exposure and to compute reliable monthly OTP percentages. The exact dates will be set based on data availability and training cycles.

1.9.6. Geographic and Organizational Boundaries

- Geographic: Domestic and international stations served by Saudia that fall within the data window.
- Organizational: Flight operations and ground turnaround interfaces relevant to crew coordination. Third party providers are in scope only where their activities directly intersect with the crew processes under study.

1.9.7. Inclusion and Exclusion Criteria

- Included: Scheduled passenger services with complete records for CRM training variables and OTP indicators.
- Excluded: Charter or irregular operations if they lack comparable schedules, flights with missing core variables, and events dominated by extraordinary disruptions outside operational control.

1.9.8. Measurement Overview aligned to the three hypotheses

- Independent Variable: CRM Training Effectiveness operationalized through exposure and quality indicators and mapped to competencies in decision making, communication, leadership, and situational awareness (FAA, 2016; UK CAA CAP737, 2023).
- Dependent Variable: On-Time Performance measured as monthly percentages and decomposed into departure punctuality, arrival punctuality, turnaround efficiency, and reactionary delay management (Cirium, 2021; Cirium, 2025).

- Model Context: Weather, ATC, maintenance, fleet and station differences, and reactionary delay chains are modeled as controls to isolate the human-performance pathway (EUROCONTROL CODA, 2023).

1.9.9. Importance of studying Saudia within this scope

- Strategic relevance: OTP is a public benchmark that differentiates carriers and shapes market confidence. Demonstrating a human-performance route to punctuality can guide training investment and operational design (IATA, 2025; Cirium, 2025).
- Generalizability: Findings from a high visibility, network carrier can inform similar operations where CRM training and punctuality are joint priorities.

1.9.10. Limitations and Delimitations

- Limitations: Potential constraints include incomplete linkage between training and operational records and unobserved external shocks.
- Delimitations: The study deliberately centers on CRM related behaviours and OTP outputs rather than broader commercial metrics.

1.9.11. Conclusion

The study scope aligns data, measures, and boundaries with the three hypotheses. It concentrates on Saudia's CRM training effectiveness as the independent variable and on-time performance as the dependent variable, while accounting for operational context. This setting enables a focused test of whether enhancing crew competencies can translate into measurable punctuality improvements.

1.10. The Project structure:



2. Ch. 2: literature review

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