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Project Management

**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

Table of contents

1. CH. 1: THE INTRODUCTION	5
1.1. BACKGROUND	6
1.2. RESEARCH PROBLEM.....	11
1.2.1. Theoretical Gaps	11
1.2.2. Empirical Gaps.....	12
1.3. RESEARCH SIGNIFICANCE	13
1.3.1. Theoretical Significance.....	14
1.3.2. Empirical Significance	14
1.4. RESEARCH QUESTIONS:	15
1.5. RESEARCH OBJECTIVES	16
1.6 RESEARCH HYPOTHESES.....	16
1.7. RESEARCH MODEL:	17
1.8. SCOPE OF THE STUDY	17
1.8.1. Introduction about Saudia Airlines.....	17
1.8.2. Vision	17
1.8.3. Mission	18
1.8.4. Operational and Training Domains Included.....	18
1.8.5. Population, Unit of Analysis, and Time Frame	18
1.8.6. Geographic and Organizational Boundaries	19
1.8.7. Inclusion and Exclusion Criteria.....	19
1.8.8. Measurement Overview aligned to the three hypotheses	19
1.8.9. Importance of studying Saudia within this scope	20
1.8.10. Limitations and Delimitations	20
1.8.11. Conclusion	20
1.9. THE PROJECT STRUCTURE:	21
2. CH. 2: LITERATURE REVIEW	22
3. CH. 3: RESEARCH METHODOLOGY	24
3.1. INTRODUCTION.....	25
3.2. OPERATIONAL DEFINITIONS FOR RESEARCH VARIABLES.....	25
3.2.1. Crew Resource Management (CRM) Training Effectiveness (The independent variable).....	25
3.2.2. On-Time Performance (The dependent variable).....	25
3.3. RESEARCH DESIGN	26
3.3.1. Research Design:	26
3.4. RESEARCH POPULATION & SAMPLING METHODS AND TECHNIQUE	27
3.4.1. Research Population.....	27
3.4.2. Research Sample	28
3.4.3. Sampling Method & Techniques	29
3.5. DATA COLLECTION METHOD	30
3.5.1. The Independent Variable – Crew Resource Management (CRM) Training Effectiveness.....	30
3.5.2. The Dependent Variable – On-Time Performance (OTP).....	31
3.6. TYPES OF DATA	32
3.6.1. Primary Data.....	32
3.6.2. Secondary Data	32

3.7. DATA ANALYSIS METHODS & PROCEDURES	33
3.8. CONCLUSION	34
4. CH. 4: STATISTICAL ANALYSIS & FINDINGS (DISCUSSION)	36
5. REFERENCES	38
6. APPENDIX	41

List of tables

TABLE1 : FREQUENCY AND PERCENTAGE DISTRIBUTION OF RESPONDENTS BY JOB ROLE/POSITION (N = 278)	28
TABLE 2: POPULATION AND SAMPLE SIZE FOR THE STUDY (MANAGEMENT AND EMPLOYEES).....	29
TABLE:3 SAMPLE COMPOSITION BY JOB LEVEL USING PROPORTIONATE STRATIFIED RANDOM SAMPLING.....	30
TABLE4 : INSTRUMENT FOR THE INDEPENDENT VARIABLE (CRM TRAINING EFFECTIVENESS).....	31
TABLE5 : INSTRUMENT FOR THE DEPENDENT VARIABLE (ON-TIME PERFORMANCE).....	32

List of Figures

FIGURE 1: SUGGESTED PROJECT MODEL	17
FIGURE 2: RESEARCH DESIGN	26

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

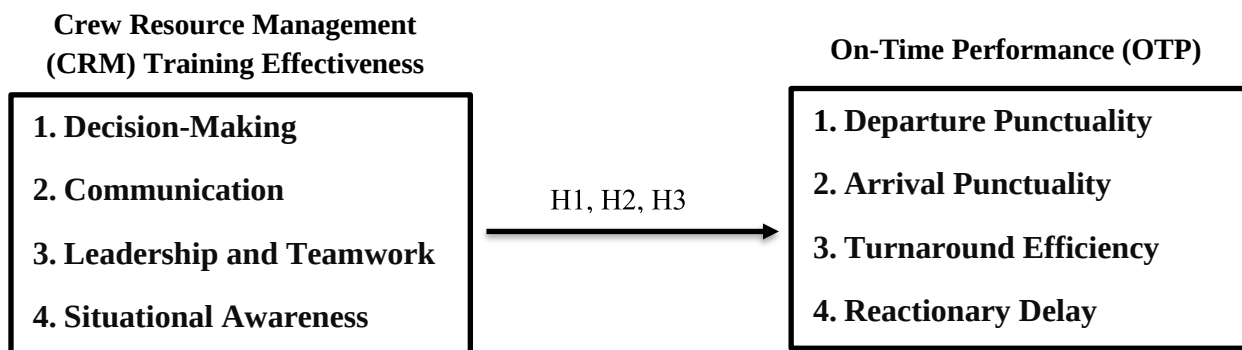
H1. There is a statistically significant positive relationship between Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP) at Saudia Airlines.

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. Scope of the Study

1.8.1. 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.

1.8.2. 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.

1.8.3. 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.

1.8.4. Operational and Training Domains Included

1.8.4.1. 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).

1.8.4.2. 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).

1.8.4.3. 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).

1.8.5. 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.

1.8.6. 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.

1.8.7. 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.

1.8.8. 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).

1.8.9. 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.

1.8.10. 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.

1.8.11. 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.

1.9. The Project structure:



2. Ch. 2: literature review

3. Ch. 3: Research Methodology

3.1. 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:

3.2. 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.

3.2.1. 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).

3.2.2. 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.

3.3. 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".

3.3.1. Research Design:

Research Philosophy: Positivist

Research Approach: Deductive

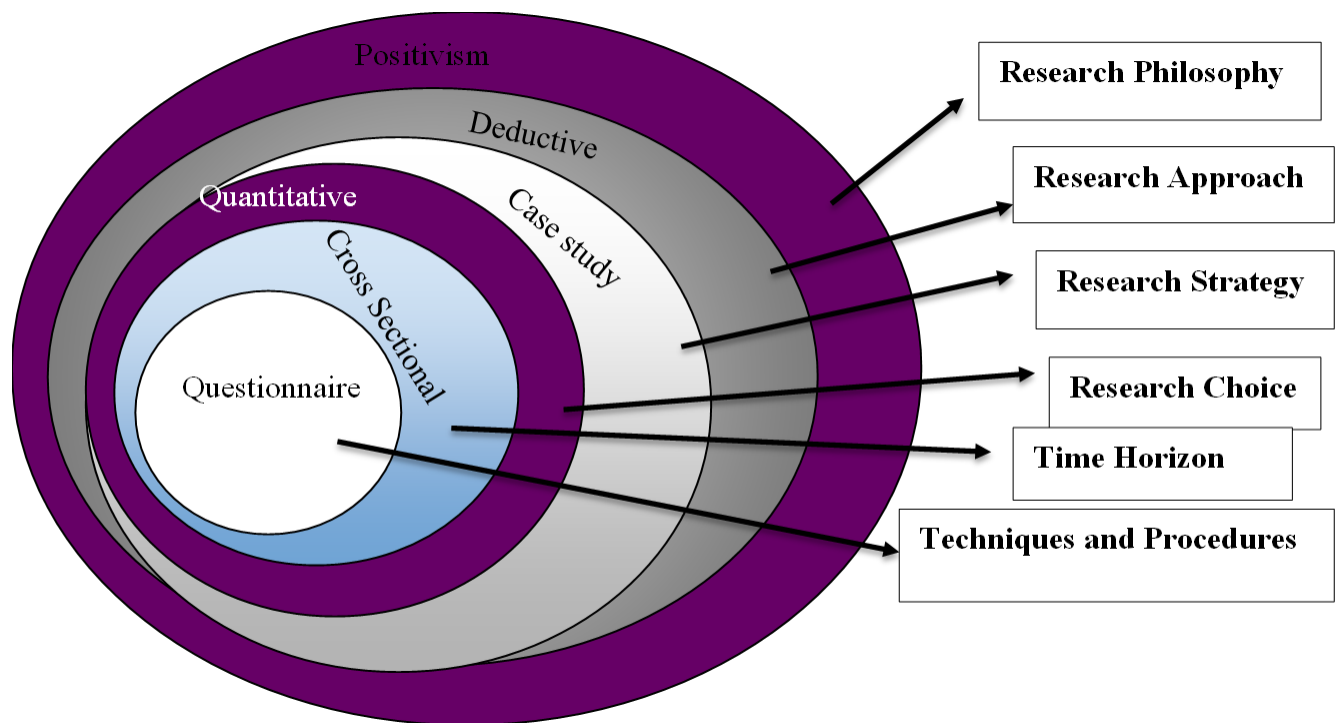
Research Strategy: Case study.

Research Choice: Quantitative

Time Horizon: Cross-sectional

Data Collection and Analysis Techniques : Questionnaire

Figure 2: Research Design



Source: Researcher

3.4. Research population & Sampling methods and technique

This section provides information about the study population & sample. Additionally, this section demonstrates the methods and techniques that were elaborated in order to select the study sample, and determine the sample size.

3.4.1. Research Population

The research population for this study consisted of flight and operational personnel at Saudi Arabian Airlines (Saudia), based in Jeddah, Saudi Arabia. The target population included employees directly involved in flight operations and processes influenced by Crew Resource Management (CRM) practices and On-Time Performance (OTP) outcomes. The population represented a diverse group of aviation professionals working across various crew and operational roles. The key demographic and professional characteristics of the research population were:

- Gender: Male, Female.
- Age Groups: 21–29, 30–39, 40–49, 50–60 years.
- Highest Educational Qualification: Aviation/Flight-Operations Diploma, Bachelor's, Master's, Doctorate, Other.
- Job Role: Captain, First Officer, Cabin Crew, Flight Dispatcher, OCC Staff, Safety & Quality, Other.
- Years of Experience at Saudia: <2 years, 2–5 years, 6–10 years, >10 years.
- CRM Training Attendance: Yes / No.
- Most Recent CRM Training: <6 months, 6–12 months, 1–2 years, >2 years.
- Operational Division: Flight Operations, Cabin Services, OCC/Dispatch, Safety & Quality, Training Department, Other.

These groups were selected because they directly contribute to and are influenced by CRM-based behaviors that can impact On-Time Performance.

The total size of the research population was 1,000 employees working across Saudia’s flight and operational divisions in Jeddah. Based on Krejcie and Morgan’s sample size table, a sample of 278 participants was identified as sufficient and representative of this population. Data for this study was collected through an online survey distributed electronically to the target group. The survey instrument utilized a five-point Likert scale, where 1 represented “strongly disagree” and 5 represented “strongly agree.” The survey link was shared through Saudia’s internal communication channels, and responses were collected electronically. The questionnaire covered topics related to the effectiveness of Crew Resource Management (CRM) training and its impact on On-Time Performance (OTP) within commercial airline operations.

Table1 : Frequency and Percentage Distribution of Respondents by Job Role/Position (n = 278)

Characteristic	Percentage	Frequency
Role / Position		
• Cabin Crew	90	32.40%
• Captain	60	21.60%
• First Officer	58	20.90%
• OCC / Dispatch	40	14.40%
• Safety & Quality	20	7.20%
• Training Department	6	2.20%
• Other	4	1.40%
Total	278 respondents	100%

Source: Researcher

3.4.2. Research Sample

The research sample for this study consists of 278 employees, selected through Proportionate Stratified Random Sampling from the total population of 1,000 operational and flight personnel at Saudi Arabian Airlines (Saudia). The sample size was determined using the Krejcie and Morgan (1970) sample size table, which specifies that a population of 1,000 requires a minimum sample of 278 respondents to achieve a 95% confidence level and a 5% margin of error. This ensures that the sample is statistically representative of the broader population and that the findings can be reliably generalized to Saudia’s operational workforce.

Table 2: Population and Sample Size for the Study (Management and Employees)

Management and employees	Population	Sample
	1000	278

Source: Researcher

3.4.3. Sampling Method & Techniques

The probability sampling method used in this study was Proportionate Stratified Random Sampling. To ensure that the sample accurately represented the diversity within Saudia's operational workforce, the population was first divided into clearly defined strata based on the key demographic and professional characteristics included in the survey. These strata were organized as follows:

- Gender (Male, Female)
- Age Groups (21–29, 30–39, 40–49, 50–60 years)
- Job Role (Captain, First Officer, Cabin Crew, Flight Dispatcher, OCC Staff, Safety & Quality, Other)
- Educational Level (Diploma, Bachelor's, Master's, Doctorate, Other)
- Years of Experience (< 2 years, 2–5 years, 6–10 years, >10 years)
- Operational Division (Flight Operations, Cabin Services, OCC/Dispatch, Safety & Quality, Training Department, Other)

After identifying these strata, participants were randomly selected proportionally from each group to reflect their actual representation within the total population of 1,000 employees. Using the Krejcie and Morgan (1970) sample size table, a sample of 278 employees was determined as the minimum required to achieve a 95% confidence level and a 5% margin of error.

This stratified approach ensured that all major operational categories within Saudia were fairly represented, thereby enhancing the validity, accuracy, and generalizability of the study's findings on the relationship between CRM training effectiveness and On-Time Performance within commercial airline operations.

Table:3 Sample Composition by Job Level Using Proportionate Stratified Random Sampling

JOB LEVEL	No. in research population	No. in final sample (27.8 %)
• Cabin Crew	323	90
• Captain	216	60
• First Officer	209	58
• OCC / Dispatch	144	40
• Safety & Quality	72	20
• Training Department	22	6
• Other	14	4
Total	1000	278

Source: Researcher

3.5. Data Collection Method

This section outlines the research instruments and procedures used to gather the data necessary to answer the study questions and test the research hypotheses. In line with the quantitative nature of the study, the researcher relied on the survey method, using a structured questionnaire as the primary tool for data collection. The questionnaire was designed to measure the two main variables of the study—Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP)—through clearly defined dimensions and Likert-scale statements.

The survey was distributed electronically to participants within the targeted sample through Saudia’s internal communication channels. The instrument consisted of three sections:

- a. demographic information.
- b. CRM Training Effectiveness.
- c. On-Time Performance.

The following sections detail the instruments used to measure each research variable.

3.5.1. The Independent Variable – Crew Resource Management (CRM)

Training Effectiveness

The researcher relied on a structured questionnaire developed specifically to measure the independent variable Crew Resource Management (CRM) Training

Effectiveness. This variable was assessed through four core CRM dimensions, widely recognized in aviation human-factors practices. These dimensions include: Decision-Making, Communication, Leadership and Teamwork, and Situational Awareness. A total of 8 items were used to measure the entire variable, with 2 items for each dimension. All items were measured using a 5-point Likert scale, where 1 = strongly disagree and 5 = strongly agree. This format allows participants to indicate the extent to which CRM training has enhanced their non-technical skills across the four dimensions.

Table4 : Instrument for the Independent Variable (CRM Training Effectiveness).

Variable	Dimensions	Number of Items	Sources
Crew Resource Management (CRM) Training Effectiveness	Decision-Making	2	Flin, O'Connor & Crichton (2008)
	Communication	2	Civil Aviation Authority (2023)
	Leadership & Teamwork	2	Flin, O'Connor & Crichton (2008)
	Situational Awareness	2	Civil Aviation Authority (2023)
	Overall	8	

Source: Researcher

3.5.2. The Dependent Variable – On-Time Performance (OTP)

The researcher relied on a structured questionnaire developed specifically to measure the dependent variable On-Time Performance (OTP). This variable was assessed across four operational performance dimensions, which reflect common industry indicators used to evaluate airline punctuality. These dimensions include: Departure Punctuality, Arrival Punctuality, Turnaround Efficiency, and Reactionary Delay Management. A total of 8 items were used to measure the entire variable, with 2 items assigned to each dimension. All items were measured using a 5-point Likert scale, where 1 = strongly disagree and 5 = strongly agree. This measurement approach allows respondents to indicate the extent to which operational practices support punctual performance across the four OTP dimensions.

Table5 : Instrument for the Dependent Variable (On-Time Performance).

Variable	Dimensions	Number of Items	Sources
On-Time Performance	Departure Punctuality	2	Hajko & Badánik (2020)
	Arrival Punctuality	2	Jetzki (2009)
	Turnaround Efficiency	2	Hajko & Badánik (2020)
	Reactionary Delay Management	2	Jetzki (2009)
	Overall	8	

Source: Researcher

3.6. Types of Data

3.6.1. Primary Data

Primary data refers to information collected directly from the original source for the specific purposes of this research study. In this study, primary data was obtained through the following method:

- **Survey Questionnaire:**

The researcher administered a structured online questionnaire to a stratified random sample of 278 employees from the total population of 1,000 operational and flight personnel at Saudi Arabian Airlines (Saudia). The questionnaire was designed to collect participants' perceptions and evaluations regarding Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP). The survey included demographic questions, along with Likert-scale items covering the four CRM dimensions (decision-making, communication, leadership & teamwork, situational awareness) and the four OTP dimensions (departure punctuality, arrival punctuality, turnaround efficiency, reactionary delay management). Data were collected electronically through Saudia's internal communication channels to ensure accessibility and confidentiality.

3.6.2. Secondary Data

Secondary data refers to information that has been previously collected, published, or documented by other sources and is used to support, validate, and complement

the primary data. In this research, secondary data was obtained from the following sources:

- **Academic Books and Scientific Articles:**
Relevant literature on CRM training, non-technical skills, aviation human factors, and airline on-time performance was reviewed. Foundational works such as Flin et al. (2008), UK CAA (2023), Hajko & Badánik (2020), and Jetzki (2009) were used to establish the theoretical basis and define the dimensions of both study variables.
- **Previous Studies:**
Prior empirical research on CRM effectiveness, safety performance, airline punctuality, delay propagation, and operational efficiency was analyzed. These studies provided insights, validated frameworks, and supported the conceptual model used in this research.
- **Scientific Dissertations and Research Papers:**
Doctoral theses, master's dissertations, and peer-reviewed aviation research papers were reviewed to understand methodologies, measurement instruments, and analytical approaches relevant to CRM and OTP.
- **Industry Reports and Aviation Documents:**
Operational documents from civil aviation authorities and industry organizations (e.g., CAP 737, ICAO human-factors guidance, EUROCONTROL CODA reports, airline punctuality benchmarks) were used to define OTP standards and CRM competency structures.
- **Company Contextual Information:**
General operational information publicly available about Saudia's flight operations, punctuality targets, training programs, and safety/quality frameworks was reviewed to contextualize the study and support interpretation of the findings.

3.7. Data Analysis Methods & Procedures

After collecting the required data, it was essential to analyze the information systematically to reach meaningful and accurate conclusions. For this purpose, the Statistical Package for the Social Sciences (SPSS), Version 28, was used to perform all statistical analyses related to the study's variables: Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP).

The following analytical procedures were applied:

- **Descriptive Analysis (Sample Profile Test):**

Descriptive statistics were conducted to summarize the characteristics of the sample. This included frequencies, percentages, means, and standard deviations for all demographic variables such as gender, age, job role, educational level, experience, and CRM training attendance. This analysis helped the researcher gain insights into the composition of the sample and understand the distribution of the respondents involved in the study.

- **Validity Testing (Exploratory Factor Analysis):**

Exploratory Factor Analysis (EFA) was performed to examine the construct validity of the measurement instruments and to ensure that the questionnaire items accurately represented the theoretical dimensions of both the CRM Training Effectiveness and OTP variables. This procedure helped verify whether the items grouped as expected under each designated dimension.

- **Reliability Testing (Cronbach's Alpha):**

Cronbach's Alpha reliability test was conducted for all scales and subscales to assess the internal consistency of the items measuring each dimension. A Cronbach's Alpha value of 0.70 or higher was considered acceptable, indicating that the items consistently measured the same underlying construct.

- **Inferential Statistical Analysis:**

Inferential analyses were performed to test the study's hypotheses and examine the relationship between CRM Training Effectiveness and On-Time Performance. This included correlation analysis to determine the strength and direction of the relationship between the variables, and regression analysis to assess the predictive impact of CRM training on OTP outcomes.

Through these procedures, the researcher ensured that the collected data were analyzed accurately, leading to valid conclusions regarding the relationship between CRM training and operational performance within Saudia.

3.8. Conclusion

The methodology adopted in this study provided a rigorous and comprehensive approach for examining the relationship between Crew Resource Management (CRM) Training Effectiveness and On-Time Performance (OTP) at Saudi Arabian

Airlines (Saudia). Through the clear specification of the theoretical model and the precise operationalization of the study variables, the research ensured that each construct—across its defined dimensions—was measured accurately and consistently.

The selection of the research population, which included employees from various operational divisions such as flight crew, cabin crew, dispatch, OCC, and safety departments, allowed the study to capture the full operational context in which CRM behaviors influence punctuality outcomes. The use of proportionate stratified random sampling ensured that the final sample of 278 participants faithfully represented the overall population of 1,000 employees, thereby enhancing the generalizability and credibility of the study's findings.

The administration of the structured survey instrument, based on a 5-point Likert scale, facilitated the collection of quantifiable data suitable for statistical and analytical techniques. The questionnaire items were carefully designed to reflect the four dimensions of CRM Training Effectiveness (decision-making, communication, leadership and teamwork, situational awareness) and the four dimensions of OTP (departure punctuality, arrival punctuality, turnaround efficiency, reactionary delay management). The combination of primary data (survey responses) and secondary data (academic literature, aviation industry standards, operational frameworks, and CRM competency references) strengthened the overall validity and reliability of the study. This dual-data approach ensured that the findings were supported by both empirical evidence and established theoretical foundations.

In summary, the research methodology employed in this study was robust, systematic, and well-suited to support the subsequent data analysis and interpretation. The structured procedures followed throughout the research process provide confidence in the accuracy and applicability of the findings, which can inform meaningful improvements in CRM training practices and operational performance management within Saudia and the broader aviation industry.

4. Ch. 4: Statistical Analysis & Findings (discussion)

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6. Appendix

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”

Dear Participant,

Thank you for taking the time to complete this survey. This questionnaire is part of an academic research project conducted by Ahmed Dakhilallah Al-Thobaiti, from the Faculty of Management – Midocean University, as part of the requirements for Graduation Project 2.

The purpose of this study is to examine the effectiveness of Crew Resource Management (CRM) training and its impact on On-Time Performance (OTP) within Saudi Arabian Airlines (Saudia). The research focuses on key CRM dimensions—decision-making, communication, leadership and teamwork, and situational awareness—and evaluates how these competencies relate to operational performance indicators such as departure punctuality, arrival punctuality, turnaround efficiency, and reactive delay management.

Your participation in this survey is voluntary, and all responses will be treated with strict confidentiality. No personal identifiers will be collected, and the data will be used solely for academic purposes. Completing the questionnaire should take approximately 10–15 minutes.

The information gathered from this study will help provide a deeper understanding of how CRM practices influence punctuality and operational efficiency within the airline industry. The findings may contribute to enhancing training programs and improving performance outcomes in commercial aviation.

Thank you in advance for your valuable participation.

Supervisor:
Abdul Rahim Nader

Researcher:
Ahmed Dakhilallah Al-Thobaiti

Faculty of Management – Midocean University

Year:
2025–2026

Variable	Variable Dimensions	Number Of Statements	Source
Crew Resource Management (CRM) Training Effectiveness	1. Decision-Making 2. Communication 3. Leadership and Teamwork 4. Situational Awareness	1-8	Flin, O'Connor & Crichton (2008) Civil Aviation Authority (2023)
On-Time Performance	1. Departure Punctuality 2. Arrival Punctuality 3. Turnaround Efficiency 4. Reactionary Delay Management	9-16	Hajko & Badánik (2020) Jetzki (2009)

1. Personal Information:

What is your gender?						
Male				Female		
What is your age?						
21–29 years		30–39 years		40–49 years		50–60 years
What is your highest educational qualification?						
Diploma in Aviation / Flight Operations		Bachelor's Degree		Master's Degree	Doctorate	Other
What is your job role?						
Captain	First Officer	Cabin Crew	Flight Dispatcher	OCC Staff	Safety & Quality	Other
How many years of experience do you have at Saudia?						
Less than 2 years	2–5 years	6–10 years	More than 10 years			
Have you attended CRM training at Saudia?						
Yes		No				
When was your most recent CRM training?						
Less than 6 months ago	6–12 months ago	1–2 years ago	More than 2 years ago			
Which operational division do you belong to?						
Flight Operations	Cabin Services	OCC / Dispatch	Safety & Quality	Training Department	Other	

1. The Independent Variable: Crew Resource Management (CRM) Training Effectiveness:

CRM training effectiveness refers to how well an airline's CRM program builds and sustains the non-technical skills that enable safe, efficient, and time-reliable operations. It covers structured learning and assessment of decision-making, communication, leadership and teamwork, and situational awareness, reinforced through recurrent modules, scenario-based simulations (LOFT/LINE), standardized briefings/debriefings, and post-training follow-up (e.g., line checks and observations). Higher effectiveness is reflected in consistently demonstrated behaviors on the line and measurable improvements in operational coordination.

No.	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Decision-Making						
1.	CRM training has improved my ability to make timely and effective operational decisions during routine and unexpected situations.					
2.	CRM training helps me evaluate available options and choose the most appropriate course of action under time pressure.					
2. Communication						
3.	CRM training has enhanced my ability to communicate clearly and accurately with crew members and operational teams.					
4.	CRM training encourages the use of structured communication techniques (such as closed-loop communication) during flight operations.					

3. Leadership and Teamwork						
5.	CRM training has strengthened my ability to work collaboratively with other crew members to achieve operational objectives.					
6.	CRM training helps promote effective leadership behaviors, such as coordinating responsibilities and supporting team members.					
4. Situational Awareness						
7.	CRM training has improved my ability to maintain awareness of operational conditions, threats, and changes during a flight.					
8.	CRM training helps me anticipate potential issues and respond proactively to maintain safe and efficient operations.					

2. The Dependent Variable – On-Time Performance (OTP):

On-Time Performance refers to the punctuality of an airline’s operations—typically defined as a flight departing and/or arriving within 15 minutes of its scheduled time. It reflects the effectiveness of end-to-end coordination across flight operations, including departure and arrival punctuality, turnaround efficiency, disruption handling, and reactionary delay control. Higher OTP indicates robust planning, clear communication, and timely execution across crews and ground teams, resulting in fewer propagated delays and more reliable service.

No.	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Departure Punctuality						

1.	Operational procedures in my department support timely departure of flights according to the published schedule.					
2.	Crew coordination and communication contribute positively to minimizing delays before departure.					
2. Arrival Punctuality						
3.	Efficient in-flight and operational practices help ensure that flights arrive within the scheduled time window.					
4.	The crew's ability to manage unexpected events contributes to maintaining punctual arrival times.					
3. Turnaround Efficiency						
5.	Ground and cabin teams work effectively to complete turnaround tasks within the allocated time.					
6.	Communication and coordination during turnaround help reduce unnecessary delays between flights.					
4. Reactionary Delay Management						
7.	Operational teams respond effectively to disruptions to prevent delays from affecting subsequent flights.					
8.	Procedures and crew behavior help contain and minimize the impact of reactionary delays on the schedule.					

