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DEVIATION IN COMMUNICATION: META-SENSEMAKING OF HUMAN ERRORS IN CIVIL AVIATION SAFETY INVESTIGATIONS AND REPORTS AS DISCURSIVE TEXTS

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Acceptance Page

This paper prepared by **JONNELL LLANTO** with the title: **"Deviation in Communication: Meta-Sensemaking of Human Errors in Civil Aviation Safety Investigations and Reports as Discursive Texts"** is hereby accepted by the Faculty of Information and Communication Studies, U.P. Open University, in partial fulfillment of the requirements for the degree, Doctor of Communication.

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Biographical Sketch

The author, Jonnell Llanto, is a Filipino migrant worker with extensive knowledge and experience in the civil aviation industry, spanning more than two decades across the Philippines and various countries. He believes that the aviation industry is a techno-social environment where technological advancements in science and social structures are interdependent, shaping and being shaped by each other.

His research interest in aviation safety communication relates to examining the deviations of communication that relate to the multi-meaning of human error among aviation professionals through the lens of interpretive phenomenological analysis and meta-sensemaking.

The author's professional expertise encompasses aviation safety, quality management systems, aviation training, and aerospace engineering. He has authored several aviation standards and procedure manuals approved by civil aviation authorities for use as operating references of various airlines and approved maintenance operators in different countries.

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Dedication

This successful doctoral work is dedicated to the author's wife, Nerissa, who was a fellow in bearing the struggles and challenges to make this endeavor possible. Also, to the author's sons, JD and Josiah. Nothing is impossible if one believes. Perseverance and commitment are important elements in achieving your dreams.

Table of Contents

University Permission Page ii
Acceptance Page iii
Biographical Sketch iv
Acknowledgement v
Dedication vi
List of Illustrations xi
List of Tables xii
Abstract xiii
Chapter I 1
INTRODUCTION 1
Background of the Study 1
Statement of the Problem 9
Research Questions 10
Objectives of the Study 12
Significance of the Study 12
Scope and Delimitations of the Study 14
Definition of Terminologies 16
Abbreviations 19
Chapter II 20
REVIEW OF RELATED LITERATURE 20
Human Errors Taxonomy from a Phenomenological Meta-Sensemaking Lens 23
Communication Lapses 25
A Multi-Layered Sensemaking on Human Factors (The HFACS) 28
From Human Errors to Organizational Learning 30
Meanings of Safety and Human Errors in Aviation 31
Aviation Professionals' Interpretive Engagements 37
Discursive Value of Safety Reports in Aviation Accidents and Incidents 41
Chapter III 47
FRAMEWORK OF THE STUDY 47
The Framework of the Study 47
Framework Diagram 48
Discourse of Understanding 48
Interpretive Phenomenological Analysis 49

Meta-Sensemaking of Aviation Safety Practices 51
Human Factors: Socially and Operationally Constructed Phenomenon 53
Communication in Safety Reports 55
Chapter IV 57
METHODOLOGY 57
Case Study: Asiana Airlines Flight 214 Investigation Report 58
Data Analysis Approach and Table Labeling 58
Contextual Sensitivity in IPA 60
Contextual Sensitivity in Meta-Sensemaking 61
Contextual Detail and Idiographic Commitment 62
Contextual Sensitivity, Reflexivity, and Researcher Positionality 62
Meta-Sensemaking as a Second-Order Analysis 63
Trustworthiness, Rigor, and Ethical Considerations 65
Chapter V 67
RESULTS AND DISCUSSIONS 67
Data Presentation 67
Rationale for Research Use 69
Data and Analysis 70
Demographics and Professional Background of the Key Flight Crew 70
Pilot Flying (PF): Captain Under Initial Operating Experience 70
Pilot Monitoring (PM): Line Instructor Captain 71
Relief First Officer (RFO): Jumpseat Occupant 71
Narrative Presentation of the Accident Data: Asiana Airlines Flight 214 ... 73
Interpretive Phenomenological Analysis 77
NTSB Replay Snapshots: 78
Emergent Themes Asiana Airlines Flight 214 79
Emergent Theme 1: Disorientation in Automation Mode Awareness 80
Emergent Theme 2: Silence and Unspoken Assumptions in the Cockpit .. 83
Emergent Theme 3: Authority Gradient and Instructional Ambiguity 86
Emergent Theme 4: Legacy of Prior Aircraft Experience 90
Emergent Theme 5: Temporal Compression and Fragmented Monitoring 92
Discussions 95
Emergent Theme 1: Disorientation in Automation Mode Awareness 95
Interpretive Insight: Lived Disorientation 96
Meta-Sensemaking Perspective: Epistemic Gaps in Automation Literacy . 97
Discursive Construction in the NTSB Report 97

Implications for Training and Organizational Learning 98
Emergent Theme 2: Silence and Unspoken Assumptions in the Cockpit .. 98
Interpretive Insight: Silence as Lived Mutual Deference 99
Discursive Construction: Silence as Institutional Blind Spot 100
Meta-Sensemaking Lens: Silence as a Site of Discursive Strain 100
Implications for Safety Culture and Organizational Learning 101
Emergent Theme 3: Authority Gradient and Instructional Ambiguity 102
Interpretive Insight: Lived Ambiguity in Role and Responsibility 102
Discursive Construction: Authority Gradient Rendered Neutral 103
Meta-Sensemaking: Role Displacement as Organizational Blind Spot 104
Implications for Training, CRM, and Safety Culture 104
Emergent Theme 4: Legacy of Prior Aircraft Experience 105
Interpretive Insight: Experience as Embodied Expectation 106
Discursive Construction: Experience Framed as Latent Variable 107
Meta-Sensemaking Perspective: Automation Schema as Discursive Inheritance 109
Implications for Training, Design, and Safety Culture 110
Transition Training: Regulations and Procedures 111
Emergent Theme 5: Temporal Compression and Fragmented Monitoring 112
Interpretive Insight: The Experience of Time Running Out 113
Discursive Construction: Flattening of Urgency in the Report 114
Meta-Sensemaking: Monitoring as a Distributed and Fragile Practice 115
Temporal Compression as a Structural Reality 115
Boeing 777 Automatic Flight System in Thrust and Speed Management 116
Automation Logic in Cross-Aircraft Type Transitions 120
Automation as a Cognitive Divestment 121
Integrative Perspective: Discursive Failures in the Flight Deck Ecosystem 122
Toward Reflexive Flight Deck Design and Communicative Training 123
The Invisible Communication of Automation 123
The Discursive Boundaries of Deference 124
Automation as an Actor in Cockpit Discourse 126
Toward Discursive Reflexivity in High-Reliability Flight Environments ... 126
Chapter VI 128
CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS 128
Understanding Human Errors through IPA and Meta-Sensemaking 128

Communicative Deviations During Ambiguity and Stressful Conditions . 133
Sedimented Cognitive Structures in Temporal Disintegration 136
The Collapse of Monitoring Under Pressure 137
When Time Compression Shields Error from Challenge 138
Recommendations 140
Cross-Aircraft Automation Reflexivity in Training Aviation Professionals 140
Meta-Communicative Prompts in High Workload Scenarios 141
Implications for Further Study 143
REFERENCES 145
Printed book/E-book 145
Online Journals 147
Websites 159
General Web Articles – With Authors 159
General Web Articles – Without Authors 161
Thesis/Dissertations 163
ANNEXES 164
Annex 1: The NTSB Accident Report, 2013 (NTSB/AAR-14/01) with Recommendations 164
Annex 2: B777 FCOM 231
Annex 3: Airbus A320 FCOM 234

List of Illustrations

Illustrations	Page
Illustration No.01: Flight Crew Cockpit Seating Locations (B777)	72
Illustration No.02: Accident of Asiana Flight 214	76
Illustration No.03: Above glide path (slope) Asiana Flight 214	78
Illustration No. 04: Autopilot in HOLD MODE, Asiana Flight 214	78

List of Tables

Tables	Page
Table No. 01: Flight Crew Members Demographics and Background	70
Table No. 02: Emergent Themes on Asiana Flight 214	79
Table No. 03: Emergent Theme No.1 Analytical Dimensions	81
Table No. 04: Emergent Theme No.2 Analytical Dimensions	84
Table No. 05: Emergent Theme No.3 Analytical Dimensions	87
Table No. 06: Emergent Theme No.4 Analytical Dimensions	90
Table No. 07: Emergent Theme No.5 Analytical Dimensions	93

Abstract

My research focused on aviation safety investigation reports as discursive texts, examining deviations in aviation communication through my shared meaning-making as an aviation safety practitioner, using interpretive phenomenological analysis and meta-sensemaking of human errors.

Examining the National Safety Transportation Board's accident report on Asiana Flight 214, which provides the operational archived reference, and as a discursive representation of an aviation safety event, reveals how a legacy of prior aircraft experiences, temporal compression, and fragmented monitoring contributed to the emergence of human error in the investigated aviation accident.

Pilots with years of flying experience may bring an embedded automation schema from a previously flown airplane, which can influence their interpretation of system characteristics in a new operational context. The Pilot Flying (PF) in Asiana Flight 214 carried an Airbus-based expectation of automatic airspeed protection that persisted during the landing phase of a Boeing B777 on a visual approach, leading to a misalignment of the mental model that remained unchallenged until impact with the ground.

The assumption of the PF was compounded by the temporal compression that occurs during high-workload conditions, characterized by time pressure and fragmented monitoring responsibilities, which has narrowed the pilot's attention focus on a cockpit environment with reduced opportunities for meta-communication, contributing to the unmonitored decay of the airspeed that persisted until the flight situation went beyond recovery.

Keywords: aviation safety, legacy of prior aircraft experience, temporal compression, fragmented monitoring, meta-sensemaking, interpretive phenomenological analysis

Chapter I

INTRODUCTION

Background of the Study

There are diverse perspectives within the civil aviation community on how human error, as a key concern in human factors, is understood, categorized, and addressed. Over decades marked by catastrophic aviation accidents, significant knowledge and research have been devoted to examining this transportation issue. However, beyond technical analyses and procedural reforms lies a less explored dimension: the *communicative undercurrents* that may subtly shape or even contribute to the emergence of human error within safety systems. Through phenomenological inquiry, my study aims to contextualize discourses around human error as not only a technical failure but also a communicative phenomenon: an *"uninvited presence"* that infiltrates aviation safety measures and manifests during the execution of aviation professionals' duties.

Focusing on the human error dimension presents a particular challenge for aviation safety professionals, as it requires both deep experiential insight and years of training to detect hazards, understand their underlying nature, and implement effective mitigations and interventions. My research adopts a *reflexive approach*, firmly grounded in the communicative practices observed within the airline sector as reflected in the aviation-related incident reports. It examines how aviation professionals make sense and engage with the concept of human error within the operational contexts of aviation safety, specifically through their direct and unmediated interactions with others in the profession as depicted in aviation safety reports. By observing these dialogical relationships, this inquiry aims to analyze the communicative elements at play and uncover the contextual meanings and explanations embedded within them, thereby contributing to a deeper

understanding of how safety measures are interpreted, enacted, or challenged in practice.

Human Errors in Civil Aviation Communication

The evolution of the civilian air transportation industry has seen remarkable advancements in aircraft technology and systems integration. Modern aircraft are now equipped with highly sophisticated information and communication technologies (ICT), including advanced navigation systems, automated flight control systems (also known as autopilots), and fault-diagnostics tools. These features are designed to support aircrew operations, enhance ergonomic efficiency, and optimize safety through system-generated alerts and diagnostics, both in-flight and on the ground (Bauranov & Rakas, 2024; Hicks & Britto, 1999; Talib et al., 2025; Ulfvengren et al., 2001; Zolghadri, 2024). Despite these innovations and the implementation of rigorous safety measures across the civil aviation industry, aviation accidents and incidents continue to occur, often resulting in human casualties, economic losses, and environmental damage.

Notably, a significant proportion of these incidents is attributed to human errors, particularly in communication. The Federal Aviation Administration (FAA) estimates that human error contributes to 60–80% of all air carrier incidents and accidents, with ineffective communication being a primary factor. Further studies have identified that communication errors between pilots and air traffic controllers are prevalent and can lead to misunderstandings, especially under high workload conditions. Moreover, analyses of aviation accidents have shown that communication failures are not limited to pilot-controller interactions but also occur among flight crew members, maintenance personnel, and other stakeholders, emphasizing the need for comprehensive communication training and protocols (Xiong et al., 2024; Krivonos, 2007; Li & Harris,

2006; Shappell & Wiegmann, 2000; Helmreich & Foushee, 1993; Sassou & Reason, 1999).

According to the International Civil Aviation Organization's (ICAO) Safety Management Manual (Doc 9859), hazards are precursors to accidents and losses in the aviation domain. Among the recognized contributors to such hazards is human error, frequently rooted in communication breakdowns (Chatzi & Kourousis, 2024). Aviation workers today must navigate a complex and ever-changing operational environment marked by intricate aircraft systems, stringent regulatory standards, and overlapping procedural responsibilities issued by civil aviation authorities. The simultaneous and interdependent nature of these tasks places significant cognitive, emotional, and operational demands on aviation personnel, increasing the risk of diminished situational awareness and miscommunication (Chen et al., 2024).

Effective and conscious communication is foundational to safety performance within aviation organizations. It fosters team cohesion, develops hazard recognition, and ensures coordinated responses to volatile and uncertain situations (Conyers, 2011). In high-stakes, high-reliability settings like aviation, teamwork is not incidental but integral, enabled and sustained through clear, timely, and contextually appropriate communication. Conversely, communication failures have been consistently linked to operational inefficiencies, incidents, and major accidents (Frick et al., 2024; Leonard et al., 2004; Silla et al., 2025).

Aviation safety reports consistently reveal that many accidents are preceded by identifiable communicative lapses that ultimately culminate in human error. The airline industry, as a *socio-technological system,* comprises multiple interacting subsystems: flight operations, aircraft maintenance and engineering, ground handling, and air traffic control. Human errors occur across all of these domains and are widely acknowledged

as leading contributors to aviation mishaps. Accordingly, various human error management frameworks have been developed to mitigate their effects, yet the persistent recurrence of such errors points to unresolved complexities in how communication shapes safety outcomes (Muecklich et al., 2023; Ulfvengren et al., 2001).

Influenced by systemic, organizational, and interpersonal factors, human factors can manifest in various forms in the aviation industry. Among those variations are:

(1) Latent Organizational Conditions, where errors originate from systematic issues within an organization, such as inadequate training programs, flawed maintenance procedures, or insufficient safety cultures. These latent conditions may remain dormant until active failures and other conditions lead to safety risks.

(2) Active failures are manifestations of direct and observable errors by individuals. Among the observable active failures are miscommunication between air traffic controllers, misinterpretation of flight information, malfunction of onboard operational instruments, and failure to follow standard operating procedures. Another variation of human errors in civil aviation is the cultural and hierarchical influence, where subordinates may be hesitant to challenge or question decisions made by superiors, even in the face of potential errors (Muecklich et al., 2023; Ulfvengren et al., 2001; Fabre et al., 2022).

(3) Further variation in human errors in the age of a new generation of aircraft is the dependency on automation. With the development of advanced cockpit automation, pilots may become more dependent on automation, which could potentially lead to skill degradation. This dependency may result in delayed or

inappropriate responses during equipment failures in flight or unexpected situations (Causse et al., 2025; Wickens et al., 1997).

Effective communication is a cornerstone of safety in civil aviation, where precision and clarity are crucial in preventing accidents and incidents. Despite standardized protocols and rigorous training, deviations in communication, such as ambiguous phraseology, misinterpretations, and non-adherence to standard procedures, continue to pose significant risks and hazards.

Empirical studies have highlighted the prevalence of communication-related issues in aviation mishaps. For instance, research indicates that incorrect or incomplete communication between controllers and pilots constitutes a circumstantial or causal factor in approximately 80% of incidents or accidents. Additionally, a study analyzing 151 investigation reports found that communication issues were present in 63% of the events, with the most frequent problems occurring in human-human interactions, particularly between pilots and air traffic controllers, these communication breakdowns may lead to misaligned perceptions of risk, delayed decision-making, and in worse case scenarios, catastrophic accidents (Vieira et al., 2014; dos Santos et al., 2014; Karanikas et al., 2022).

My research aims to investigate the complexities of risk and hazards arising from deviations in civil aviation communication by systematically analyzing aviation safety reports. By examining the narratives and contexts within these reports, the study seeks to uncover patterns and factors that contribute to communication-related risks, ultimately informing strategies to enhance communication protocols and mitigate hazards in aviation operations.

The Safety and Investigation Reports

An aviation safety investigation report is a structured document produced after an aircraft accident, incident, or safety concern. It is designed to determine causes, contributing factors, and safety recommendations, providing a fact sheet on the safety event. The baseline format of a safety investigation support contains the following information (ICAO Annex 13, Chapter 6 – Final Report Format):

1. Factual Information – Objectively represents the exact details of an aviation safety event that happened.

   The information under this section includes –

   - Flight History: Narrative timeline from pre-flight to occurrence
   - Injuries and Damage: To crew, passengers, third parties, and aircraft
   - Personnel Information: Qualifications, training, health, and experience of the crew
   - Aircraft Information: Type, maintenance status, weight & balance
   - Meteorological Information: Weather conditions affecting the flight
   - Aids to Navigation & Communications: Availability and usage
   - Aerodrome Information: Runway, lighting, air traffic control status
   - Flight Recorders: CVR and FDR data summaries
   - Wreckage and Impact Information: Distribution and significance of debris

2. Analysis – The facts of a safety event are investigated with the following narratives:

   - Sequence of Events: Logical reconstruction based on evidence.
   - Human Factors: Cognitive, physical, and organizational influences.
   - Systemic Issues: Training gaps, procedural drift, equipment design.
   - Comparative Data: Similar past incidents or trends.

3. Conclusions contain the narratives of the following:
    - Findings: Summarized points of fact, causality, and relevance.
    - Probable Cause(s): The most immediate trigger(s) for the event.
    - Contributing Factors: Latent conditions or decisions that made the occurrence more likely.
4. Safety Recommendations – These are actionable suggestions for regulators, operators, manufacturers, or training organizations that must be:
    - Clear, feasible, and aimed at preventing recurrence
    - Not legally binding but often influential in policy or procedural change
5. Appendices – Contains supporting documents, transcripts of recordings in the aircraft, graphs, pictures, videos, regulatory and other essential references for the safety event.

Throughout this doctoral work, the terms “accidents” and “incidents” are fundamental to the aviation industry, each with its technical distinctions as defined by the ICAO and the regulatory bodies of member States to categorize occurrences based on severity and outcomes. The distinction between accidents and incidents primarily lies in the severity of the outcomes. Accidents involve serious injury, significant aircraft damage, or loss, whereas incidents are events that could compromise safety but do not result in severe consequences. Understanding these definitions is vital for aviation professionals to ensure accurate reporting, effective safety management, and the continual improvement of aviation safety standards (SKYbrary, n.d.; Annex 13, ICAO, n.d.).

Positionality of the Researcher

As part of my work in aviation safety and quality management, I conducted safety interviews and, alongside, carried out operational human error investigations with several air operators' certificate holders and approved maintenance organizations. In this doctoral work, I examined the communicative practices of aviation professionals, the pilots, through a textual analysis of aviation safety and incident reports. My purpose was to gain a deeper understanding of how the safety investigators through the narratives in the safety investigation report make sense of the human errors and communicative elements as they referred to and approached the 'other' in their discursive accounts, particularly in the context of how they understood human factors, their capabilities, limitations, and the potential for human error in civil aviation.

Even though I, as the researcher of this study has acquired an appreciable understanding of human errors as a principle in human factors studies gained from years of professional aviation safety and quality standards practice, the existing knowledge among fellow professional practitioners through their dialogues, that is, the interface between communicative elements, I will be systematically observing, analyzing, and interpreting through reflexive awareness, or meta-sense between my subjective position, as the researcher, and those of the observed subjects' positionality in their multi perspectives on human errors and the various aviation safety measures, through my shared meaning as a safety investigator or officer, developed after years of aviation related accidents and incidents.

Statement of the Problem

Within established civil aviation safety practices, licensed aviation professionals operate under a complex framework of rigorously developed regulations, standards, and safety and quality systems. These frameworks are intricately woven into aircraft system designs to provide the operational information necessary for ensuring airworthiness, flight safety, operational efficiency, and passenger comfort. These systems and protocols were mainly instituted in response to a history of fatal aviation accidents, particularly within commercial aviation, which carries significant volumes of passengers and cargo.

While the technical and procedural foundations of aviation safety are well-documented, the communicative dimensions through which these safety systems are interpreted, enacted, or potentially subverted are less understood. What remains underexplored is how aviation professionals make sense of these safety systems in practice, *particularly in moments that precede or follow safety lapses.* My research aims to contribute to an underexplored area by engaging in a meta-sensemaking inquiry: a reflexive examination of aviation workers' communicative practices as captured in aviation accident and incident reports, which are treated within the scope of this study as discursive texts.

By analyzing how aviation professionals understand and respond to operational contexts, my study aims to uncover the underlying *communicative logics* that inform their interpretations of safety systems. Through a phenomenological lens, it explores how meanings are constructed, negotiated, and enacted in practice, often under *high-pressure or ambiguous* conditions, as captured in the civil aviation reports. In doing so, it aims to reveal the contextual factors behind communicative choices and actions that may have contributed to *communication safety deviations*, despite the presence of well-established measures.

Despite the aviation industry's rigorous technical standards and regulatory frameworks, human error remains a leading contributor to aviation accidents and incidents. While technical failures are often well-documented, the communicative and interpretative processes through which aviation professionals understand and enact safety protocols are less explored.

My research aims to analyze aviation safety reports as discursive texts to examine how concepts of safety and human error are constructed through the narratives and language used by aviation personnel. By examining these reports, the study aims to identify the contextual and communicative factors that influence decision-making and actions in high-pressure or ambiguous situations, thereby contributing to a deeper understanding of human factors in aviation safety.

The extent of human error as a predominant factor in aviation accidents accounts for approximately 70% globally, with at least 65% attributed to commercial air transport in the United States over a ten-year period, and 85% in general aviation accidents (Mineta, 1997; Li et al., 2001). The contributing factors to these human errors in the aviation context, among others, were attributed to communication breakdowns resulting from misunderstandings or misinterpretations by the crew during operations (Mineta, 1997).

Research Questions

Main research questions

1. How do deviations in aviation communication, as documented in civil aviation safety investigations and reports, contribute to the emergence and understanding of human errors through meta-sensemaking analysis?
2. How do aviation professionals construct, negotiate, and enact the meanings of safety and human error through their communicative practices during

high-pressure or ambiguous situations, as reflected in civil aviation safety reports?

Further supporting research questions:

1. What is the understanding of aviation professionals regarding the meaning of human-induced errors about aviation safety systems as narrated in a safety investigation report?
2. How does this sensemaking shape their routine communicative practices related to error-avoidance and safety compliance that were documented in an aviation safety investigation report?
3. How do aviation professionals, in their interpretive engagement with safety systems as narrated in an aviation safety investigation report, navigate the complexities of human performance and human error in aviation operations?
4. As discursive texts, what do aviation accident reports reveal about the perceptions and conceptions of aviation professionals regarding human error, hazard, and risk?

Objectives of the Study

This doctoral research aims to explore and uncover the less visible dimensions of communicative practices among licensed aviation professionals through a meta-sensemaking approach grounded in qualitative inquiry. Specifically, it examines how aviation professionals interpret human errors within the context of aviation safety through their day-to-day interactions, and how these communicative practices are reflected in civil aviation operations, as evident in the detailed and nuanced representations in aviation safety investigations and reports.

By employing interpretive phenomenological analysis, the study aims to examine the values, meanings, and sense-making processes embedded in aviation safety standards, particularly as these are revealed through aviation accident reports, which are treated as discursive texts. These reports offer a phenomenological viewpoint through which to analyze not only procedural failures but also the underlying communicative dynamics, particularly communication deviations, that contribute to human error-latent conditions, active failures, and the dependency on flight and operational automation.

The ultimate objective is to provide a contextual and interpretive understanding of how aviation professionals construct, negotiate, and enact safety in practice. In doing so, the research aims to contribute to both theoretical perspectives on human factors and practical advancements in aviation safety communication.

Significance of the Study

My study applies a meta-sensemaking approach within an interpretive phenomenological framework to examine the direct, unmediated communicative practices of licensed aviation professionals. By situating these practices within the context of civil aviation accidents, the research seeks to uncover how aviation workers make sense of human factors, particularly human error, as they interact with

operational hazards and safety measures. Aviation accident and incident reports serve as rich discursive texts that reveal how professionals construct meaning from their experiences, offering plausible explanations for how errors emerge despite the presence of formal safety systems.

The aviation industry, especially the airline sector, is classified as a high-risk organizational environment (HRO), where effective communication is both a necessity and a safeguard (Hardie et al., 2020). Communication demands intensify in complex operational conditions, such as high air traffic volumes, adverse weather, equipment malfunctions, and restricted dispatch conditions. In such contexts, miscommunication can quickly escalate into safety threats.

Although modern airliners are equipped with advanced avionics and digital communication technologies designed to enhance operational efficiency and mitigate risks, communication breakdowns remain a leading factor in aviation incidents. Technologies that optimize voice, data, and symbolic messaging have increased system reliability, yet human error, often rooted in flawed or failed communication, continues to play a central role in events such as mid-air collisions and controlled flight into terrain (CFIT) incidents (Bauranov & Rakas, 2024; Llanto, 2014; Materna et al., 2023).

My research contends that understanding how human error and safety measures are interpreted and enacted through communicative practice is essential to advancing both theory and safety outcomes in civil aviation. Through interpretive phenomenological inquiry, the study aims to provide deep insight into how aviation professionals engage with safety systems, not just procedurally, but meaningfully, as they perform their duties in complex and high-stakes environments, considering also the meta-sensemaking (i.e., sensemaking of the sensemaking) from my standpoints as a reflective practitioner.

Scope and Delimitations of the Study

My study focuses on the communicative practices among aviation professionals within civil aviation organizations, specifically examining how these practices relate to safety performance and the prevention of human-related errors.

While interactions in aviation inherently involve people, standards, and technology, my research foregrounds interpersonal communication, particularly among licensed aviation professionals, as a central site for sense-making and meaning construction about safety elements (Newman & Scott, 2023; Mohamad et al., 2021).

The study does not aim to examine the technical or mechanical aspects of aircraft systems directly, but rather to investigate how safety-related communication unfolds in operational contexts.

This inquiry is situated within high-capacity commercial aviation, including both passenger and cargo operations. It considers the established regulatory frameworks, safety standards, and quality management systems that guide aviation practice and aircraft design. These systems were developed in response to a legacy of fatal accidents and operational failures, and they continue to shape the professional discourse and decision-making processes of aviation personnel.

The study does not aim to identify causal relationships between specific accidents and communication failures, nor does it seek to replicate or validate prior research. Instead, it offers a supplementary, interpretive perspective that contributes to the broader discourse on aviation safety communication. Any thematic or epistemological similarities to other works are incidental and reflective of the shared realities of the civil aviation industry. My study is strictly qualitative, and its findings are intended to be contextually grounded and exploratory, rather than generalizable or predictive in nature.

References to past incidents or industry practices are treated analytically, rather than as assertions of fault or deterministic cause. Researchers and practitioners may find my study to be a valuable complementary viewpoint on how communicative practices shape, support, or challenge the implementation of aviation safety-related elements.

Definition of Terminologies

The following definitions are provided to ensure consistent interpretation of key terms as they are used throughout my research. In cases where there may be discrepancies between these definitions and those found in other academic or industry literature, the definitions provided herein shall take precedence for the purposes of my study: unless otherwise stated as originating from authoritative bodies such as the International Civil Aviation Organization (ICAO) or original equipment manufacturers (OEMs) of aircraft, engines, and standardized components. These definitions are intended to clarify contextual meanings and support the coherence of the study's theoretical and analytical discussions.

- Accident

An accident has occurred when a person is fatally or seriously injured, and is associated with the operation of an aircraft, taking place between the time any person boards the aircraft with the intention of flight until all such persons have disembarked, wherein:

A person is fatally or seriously injured as a result of:

- Being in the aircraft,
- Direct contact with any part of the aircraft, including parts that have become detached, or
- Direct exposure to jet blast,

except when the injuries are from natural causes, self-inflicted, or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to passengers and crew;

- The aircraft sustains damage or structural failure that adversely affects its structural strength, performance, or flight characteristics, and would normally require major repair or replacement of the affected component, excluding

engine failure or damage limited to the engine, its cowlings, or accessories, or damage limited to propellers, wing tips, antennas, tires, brakes, fairings, small dents, or puncture holes in the aircraft skin; or

- The aircraft is missing or is completely inaccessible.

(Air Safety Support International, n.d.; CAA and AvSec New Zealand, n.d.; ICAO, n.d.; SKYbrary, n.d.; UNDRR, n.d.; U.S. Department of the Interior, n.d.).

- Airman

Airman is a term generally used by the FAA for individuals certified to exercise the privileges defined in Title 14 of the Code of Federal Regulations (CFR). Also see the term Aviation Professionals.

- Airlines (Cambridge Dictionary, 2024)

“Any business that operates or manages regular services for carrying passengers and goods, or a combination thereof, by aircraft *(Cambridge Dictionary, 2024)*.”

- (Aviation workers) Aviation Professionals

Refers to individuals licensed and authorized by a Civil Aviation Authority of an ICAO contracting state to perform aviation-related professional functions. This includes, but is not limited to, pilots, aircraft maintenance engineers, and air traffic controllers.

- Aviation (Britannica, 2024) (NOTE: Transfer before the aviation wokers.)

“The development and operation of heavier-than-air aircraft.” In my study, the term refers specifically to the civil air transportation of passengers and cargo (Britannica, 2024).

- IATA (International Air Transport Association) (IATA, 2024)

The global trade association representing over 80% of the world’s airlines. IATA is responsible for developing industry standards and policies that influence commercial aviation operations.

- ICAO (International Civil Aviation Organization) (ICAO, 2024)

A specialized agency of the United Nations, established in 1944 to facilitate international cooperation in civil aviation. ICAO sets global standards for aviation safety, security, efficiency, and environmental protection.

- Incident

An incident refers to an occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operations. This encompasses a wide range of events, from minor technical malfunctions to procedural deviations, which, while not resulting in serious injury or significant aircraft damage, still pose potential safety concerns (Air Safety Support International, n.d.; CAA and AvSec New Zealand, n.d.; ICAO, n.d.; SKYbrary, n.d.; UNDRR, n.d.; U.S. Department of the Interior, n.d.).

- . IOSA Program (IATA Operational Safety Audit) (IATA, 2023)

A globally recognized evaluation system designed to assess the operational management and control systems of civil aviation operators. It applies to fixed-wing operators using multi-engine, two-pilot certified aircraft with a maximum takeoff weight above 5,700 kilograms.

- ISO (International Organization for Standardization) (ISO, 2024)

A non-governmental international body that brings together experts to develop voluntary, consensus-based standards for products, services, and systems to ensure quality, safety, and efficiency.

- SMS (Safety Management System) (ICAO, 2013)

“A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures.” SMS is a core element of ICAO’s safety framework, adopted globally by civil aviation authorities.

Abbreviations

AAR – Air Accident Report
AFS – Automatic Flight System
AFDS – Autopilot Flight Director System
AGL – Above Ground Level
AME – Aviation Maintenance Engineer
APA – American Psychological Association
A/T – Auto throttle
BPS – British Psychological Society
CAA – Civil Aviation Authority
CRM – Crew Resource Management
CVR – Cockpit Voice Recorder
DoT – Department of Transportation
EASA – European Union Aviation Safety Agency
FAA – Federal Aviation Administration
FCOM – Flight Crew Operating Manual (Airbus) / Flight Crew Operations Manual (Boeing)
FLCH – Flight Level Change
FMA – Flight Mode Annunciator
HFACS – Human Factors Analysis and Classification System
HRO – High Risk Organization
ICAO – International Civil Aviation Organization
IOE – Initial Operating Experience
IOSA – IATA Operational Safety Audit
IPA – Interpretive Phenomenological Analysis
ISO – International Organization for Standardization
LOC – Localizer
NTSB – National Transportation Safety Board
PF – Pilot Flying
PFD – Primary Flight Display
PM – Pilot Monitoring
SMS – Safety Management System
SOP – Standard Operating (Operations) Procedures
SPD – Speed
VFR – Visual Flight Rule
V/S – Vertical Speed

Chapter II

REVIEW OF RELATED LITERATURE

This meta-sensemaking process involves reflecting on past incidents to derive lessons and adjust future behaviors accordingly. By examining the narratives within safety reports, researchers can uncover underlying assumptions, values, and cultural norms that influence how communication errors are perceived and addressed. Moving beyond traditional analyses, phenomenological inquiry provides a lens for understanding how individuals and organizations make sense of communication deviations. The narratives among aviation professionals on human errors and near-misses serve as tools for collective learning and the reinforcement of safety cultures (Catino & Patriotta, 2013).

Phenomenology provides a lens for exploring the lived experiences of aviation professionals. By understanding how pilots perceive and interpret their environments, researchers can gain insight into the subtle factors that influence communicative practices taking place in a cockpit, both on the ground and in flight. The value of phenomenological study in exploring the communicative dimension among aviation professionals through phenomenology is in the in-depth capture of the essence of human experiences in professional contexts (Hultgren, 1990; Farrel, 2020).

Human error remains a predominant factor in aviation accidents, with communication breakdowns often at the root of the issue. While traditional analyses focus on procedural and technical aspects, there is a growing recognition of the need to explore the discursive dimensions of safety reports. This literature review examines how communication deviations are interpreted within civil aviation safety investigations and reports, with an emphasis on the role of discourse in shaping understandings of human error. Numerous studies have identified communication errors as significant

contributors to aviation accidents. As an example, approximately 70% of the reported incidents in the Aviation Safety Reporting System involved communication issues, often stemming from misinterpretations or failures to transmit vital information (Archer, 2015).

Human error has long been recognized as a predominant factor in aviation incidents. In Reason's (1990) "Swiss Cheese Model," accidents are conceptualized as the result of multiple system failures, where human error is seen as a symptom of deeper organizational issues. This perspective shifts the focus from individual blame to systemic vulnerabilities (Gray et al., 1993).

The benefits of ICT and Artificial Intelligence have been incorporated into the design of new-generation aircraft, intended to augment the highly demanding tasks that aviation professionals encounter through automation in most aircraft systems. However, the increasing automation in cockpits has introduced new challenges. While automation aims to reduce workload, it can lead to decreased situational awareness and over-reliance on systems by reducing the ability of pilots to perform active engagements in aircraft systems during operations (Konnikova, 2014; Langewiesche, 2014).

Exploring the communicative undercurrents that influence human error in aviation aligns with contemporary research, which emphasizes the interplay between interconnected elements and factors, communication dynamics, and individual experiences. By adopting a phenomenological approach, my study may provide valuable insights into the nuanced realities of aviation professionals, potentially informing more comprehensive and holistic safety interventions.

The development of Crew Resource Management (CRM) in the late 1970s emphasized the importance of interpersonal communication, leadership, and decision-making. Many accidents stemmed from communication breakdowns rather than

technical failures. Beyond procedural lapses, communication nuances can precipitate errors. As an example, the tragic crash of Air France Flight 447 in 2009 underscored how miscommunications and misunderstandings among crew members can escalate into disasters. Investigations revealed that ambiguous dialogues and hierarchical barriers hindered effective decision-making (Langewiesche, 2014).

This accident demonstrates that communication in aviation is not a mere vehicle for transmitting information, but a constitutive process of co-creating operational reality. When the mechanisms of feedback, clarification, and inquiry are weakened, whether by hierarchy, cultural norms, or dependency on automation, the cockpit ceases to function as a site of collaborative meaning-making.

The implications of this event extend beyond technical training to encompass the need for a deeper integration of crew resource management (CRM) practices, which foreground meta-communication, that is, the explicit negotiation of assumptions, intentions, and interpretations in real-time. In doing so, safety-essential teams may better align their sense-making practices, thereby mitigating the latent risks posed by silence, ambiguity, and over-trust in automation.

The development of technology for automation has increased human-to-machine interaction in the new generation of airliner aircraft. This increasing reliance on automation in aviation has introduced new complexities in human-machine interaction. While automation reduces workload and enhances safety, it may lead to skill degradation and overreliance, potentially exacerbating errors during unexpected situations (Wiener & Curry, 1980; Parasuraman et al., 2000; Dekker, 2014). Incidents like the Air France Flight 447 crash underscore the importance of maintaining manual flying skills and situational awareness.

Meta-communication, as a concept in cockpit communication, refers to the communication of communication within the cockpit during operations, where

interpretive frames negotiate meanings and underlying assumptions (Watzlawick et al., 2011). This cockpit communication may involve verbal or non-verbal cues and actions among pilots, allowing them to interpret the status of airplane systems in relation to each flight crew's intentions, rather than just the transmission of factual flight details.

Human Errors Taxonomy from a Phenomenological Meta-Sensemaking Lens

Phenomenological meta-sensemaking in aviation safety investigations may serve dual purposes; that is, this approach provides insight into how individuals and systems interpret, construct meaning from, and respond to events where communication lapses occur, particularly those contributing to human error and additionally, viewing aviation safety investigations through the phenomenological meta-sensemaking lens allows valuable opportunity among investigators themselves to examine safety information, findings, and conclusions beyond what is already presented to them as a narrative of safety events. This perspective extends beyond technical classifications to examine the lived experiences, perceptual dynamics, and cognitive narratives of individuals involved in aviation mishaps. A Human Factors Analysis and Classification System (HFACS) provides a structured taxonomy to analyze human errors, which, when interpreted through a phenomenological lens, reveals deeper patterns of meaning-making, adaptation, and systemic drift (Shappell & Wiegmann, 2000).

Phenomenological meta-sensemaking offers a powerful approach for reinterpreting human error in aviation safety, not merely as a deviation from norms, but as an interpretive process embedded in real-world complexity. Unlike traditional taxonomies that emphasize discrete categorizations, such as slips, lapses, or violations, this lens prioritizes how individuals experience, construct, and

communicate meaning amid operational ambiguity. In this context, human error is not simply the result of a procedural breakdown, but often a reflection of how frontline personnel make sense of high-pressure situations under conditions shaped by shifting norms, organizational logics, and system constraints (van Manen, 2016; Weick, 1995).

The Human Factors Analysis and Classification System (HFACS), developed by Shappell and Wiegmann (2000), remains a foundational framework for understanding human error in aviation. Its tiered structure, spanning unsafe acts, preconditions for unsafe acts, unsafe supervision, and organizational influences, offers a practical taxonomy for categorizing errors in safety investigations (Shappell & Wiegmann, 2000). However, when examined through a phenomenological meta-sensemaking lens, HFACS can be expanded from a purely diagnostic tool into a window into how meaning is produced, distributed, and institutionalized within safety discourses. In other words, it is not just a matter of what category the error falls into, but how and why the involved actors framed, enacted, or even normalized such deviations.

This deeper reading aligns with recent critiques of overly technical or decontextualized views of human error, which risk simplifying complex sociotechnical realities into linear cause-effect chains (Dekker, 2014). For instance, while HFACS may code a pilot's action as a "decision error," a phenomenological analysis would explore how that decision was shaped by factors such as fatigue, trust in automation, organizational silence, or ambiguous risk cues, all experienced subjectively and embedded within a larger communicative and cultural system (Flin et al., 2008). Phenomenological meta-sensemaking thereby reframes HFACS categories not as endpoints of analysis, but as entry points into the lived world of operators whose interpretations, judgments, and actions are formed within social, linguistic, and institutional constraints.

Moreover, sensemaking in aviation often unfolds as a collaborative, dialogic process, particularly during unexpected events that require improvisation. Communication lapses, frequently coded in traditional analyses as “failures,” can instead be viewed as breakdowns in shared meaning-making or failures in meta-communication about roles, expectations, or interpretations (Mogford, 1997; Orasanu & Fischer, 1997). These lapses are not always errors of negligence, but may result from organizational or cultural conditions that inhibit questioning, dissent, or open dialogue, particularly in high power-distance environments (Helmreich & Merritt, 1998). Thus, error becomes a phenomenon co-authored by system design, communicative norms, and the unfolding of events as understood by the actors themselves.

Ultimately, the integration of phenomenological meta-sensemaking with structured tools, such as HFACS, offers a richer and more human-centered approach to safety analysis. It shifts the focus from simply identifying errors to understanding the experiential and systemic contexts in which those errors arise, are reported, and become part of the safety narrative. This layered interpretation not only enhances learning from incidents but also supports the development of more reflective safety cultures that honor the complexity of human engagement in dynamic aviation environments.

Communication Lapses

HFACS identifies communication breakdowns primarily within the layers of unsafe acts (e.g., decision and skill-based errors) and preconditions (e.g., adverse mental states, crew coordination issues). From a phenomenological standpoint, these are not just error categories, they are disruptions in the intentional flow of action and shared understanding among crew members. For instance, when a pilot misinterprets a

clearance due to ambiguous ATC phraseology, the error emerges from a breakdown in intersubjectivity, the shared assumptions about roles, intent, and context that make communication intelligible.

Communication lapses in aviation are not merely procedural disruptions; they are phenomenological events that reflect the breakdown of shared meaning in high-stakes, time-pressured environments. This breakdown often provokes cognitive dissonance, especially in the aftermath of incidents where the expected flow of coordinated action fails. As both frontline operators and investigators confront the discrepancy between intention and outcome, they engage in a process of meta-sensemaking – an effort to "make sense of how sense was made." In the lens of sensemaking, organizational life is an ongoing process of interpreting equivocal events. In the context of aviation, communication is one of the most essential mechanisms through which this interpretation occurs. However, when a lapse happens, such as a missed callout, incorrect readback, or failure to challenge a procedural deviation, it exposes a rupture in the ongoing construction of reality. These moments of ambiguity trigger a reflective process, not only to understand what happened, but also how the situation was interpreted at the time it occurred. Sensemaking is rooted in the construction of retrospective meaning. For aviation professionals, this becomes particularly salient in post-event analysis, where investigators sift through cockpit voice recordings and narratives to reconstruct the interpretive processes that shaped decision-making in real time (Czarniawska, 1997; Weick, 1995). Through the framing of sensemaking, the capability to act and interpret in environments characterized by uncertainty. In aviation, communication lapses are often symptoms of such environments, including high workload, cognitive overload, or misaligned mental models between the crew and air traffic control. In these cases, meta-sensemaking becomes not only an analytical tool for post-event investigation but

also a cognitive and organizational capacity that allows systems to adapt, learn, and prevent future occurrences. Sensemaking has been neglected, yet it is crucial in leadership skills, especially under chaotic conditions. This resonates deeply with the aviation domain, where leaders, such as safety managers and flight operations supervisors, must interpret complex information flows, often marked by contradictory signals or incomplete data. Communication failures, therefore, serve as both warning signs and learning portals, prompting a deeper inquiry into how collective sense was created, maintained, or disrupted (Ancona, 2012; Ancona et al., 2020).

The phenomenological experience of communication breakdowns, particularly as captured in safety reports and debriefings, reveals how deeply tied human error is to issues of interpretation, expectation, and narrative coherence. Instead of framing these events as violations or individual mistakes, a sensemaking perspective enables aviation professionals to explore how cognitive frameworks, organizational scripts, and contextual pressures shape the communicative environment. Aligning with Weick's (1995) assertion that "sense is made retrospectively," one may see that meaning is constructed not during, but after the moment of decision or action. This delay in meaning-making is important in aviation, where rapid decisions are often made with limited clarity, and their full significance is only understood later. Communication lapses in aviation must be viewed not only as technical errors but as ruptures in lived experience and shared meaning (Weick, 1995). The ensuing cognitive dissonance drives a process of meta-sensemaking, wherein both aviation professional practitioners and investigators attempt to reconstruct the interpretive pathways that led to failure; a perspective that invites a richer, more systemic understanding of human error, one that prioritizes context, cognition, and the collective framing of complex events.

A Multi-Layered Sensemaking on Human Factors (The HFACS)

Understanding human error in aviation requires examining not only the observable actions of individuals but also the deeper systemic and experiential contexts that shape those actions. The HFACS brings a structured taxonomy that classifies human errors across four interconnected levels: Unsafe Acts, Preconditions for Unsafe Acts, Unsafe Supervision, and Organizational Influences. While HFACS is primarily a diagnostic model for incident analysis, its layered structure also facilitates a phenomenological and recursive approach to sensemaking: a process by which individuals and systems interpret, act upon, and derive meaning from complex operational environments (Shappell & Weigman, 2000; Dekker, 2014).

The HFACS framework unfolds across four systemic levels:

- Unsafe Acts (e.g., miscommunication, misinterpretation)
- Preconditions for Unsafe Acts (e.g., CRM breakdowns, stress)
- Unsafe Supervision (e.g., failure to correct communication deficiencies)
- Organizational Influences (e.g., inadequate training policies)

Phenomenologically, each level represents a distinct horizon of sensemaking. For example, at the precondition level, communication errors often stem from emotional fatigue or attentional narrowing, conditions that shape what is noticed and prioritized in a given moment. At the organizational level, policies and norms influence what is sayable, what counts as an error, and how individuals are encouraged (or discouraged) to communicate their uncertainty. This stratification enables a recursive analysis of how sense was made at each point of interaction and decision-making. Communication failures are thus not simply procedural breaches but disruptions in the layered narrative of operational life.

At the most immediate level, unsafe acts, errors such as miscommunication or misinterpretation, are commonly documented. These surface-level mistakes are often

the result of deeper issues, including attentional breakdowns, skill-based lapses, or failures in decision-making. However, when examined through the lens of sensemaking, these acts are not isolated failures but manifestations of disrupted cognitive framing. Pilots or controllers operate based on real-time interpretations of their context; thus, a communication lapse can be understood as the outcome of how the situation was subjectively construed under pressure (Flin et al., 2008).

The second layer, preconditions for unsafe acts, captures internal and interpersonal factors that affect performance, such as stress, fatigue, and breakdowns in Crew Resource Management (CRM). These preconditions significantly influence what is noticed, how it is interpreted, and which actions are considered reasonable. From a phenomenological standpoint, these factors shape the actor's horizon of awareness, mediating how meaning is constructed in the moment (van Manen, 1990). For instance, attentional narrowing under fatigue may lead a pilot to miss or mishear a vital clearance, not due to negligence, but rather because of a constrained field of perceptual engagement.

The third HFACS tier, Unsafe Supervision, involves the supervisory conditions that either contribute to or fail to prevent human error. These include inadequate oversight, failure to correct known communication issues, or tolerating deviations from standard procedures. This level adds a meta-layer to sensemaking: supervisors not only interpret unfolding events themselves but also shape the interpretive environments of those they oversee. The ability of supervisors to foster adaptive sensemaking is a key determinant of organizational resilience (Carroll, 1997).

Finally, Organizational Influences, the broadest HFACS category, highlight how structural factors such as resource management, training programs, and cultural norms define what is communicable, what counts as a reportable error, and how voice is encouraged or silenced in operational settings. Organizations act as sensemaking

systems, constructing and reinforcing narratives that render specific interpretations rational while marginalizing others (Carroll, 1997; Flin et al., 2008; van Manen, 1990). In aviation, this means that poor communication practices may persist not just from individual failings, but because institutional sensemaking suppresses uncertainty or dissent (Tomlinson, 2012).

From Human Errors to Organizational Learning

Shappell and Wiegmann do not directly frame HFACS as a phenomenological tool; however, their emphasis on systemic precursors to unsafe acts lends itself to such an interpretation. When viewed through a meta-sensemaking lens, HFACS enables a qualitative shift from blaming individuals to interrogating how communication norms are lived, transmitted, and occasionally violated within sociotechnical systems.

The aftermath of a communication-related incident, often studied in accident investigation reports, becomes a rich site of collective sensemaking. Interviews, cockpit voice recordings, and debriefings offer phenomenological data: accounts of confusion, silence, improvisation, and gut feelings. These narratives enable safety investigators to reconstruct the lived texture of error, revealing the fragility and resilience of communication practices in real-time.

By interpreting HFACS through a layered sensemaking lens, investigators are better equipped to understand not just what went wrong but how meaning was made, negotiated, and lost across different levels of the organization. Communication failures, in this view, become disruptions in narrative coherence, fractures in the shared storyline of safe flight operations. This approach aligns with contemporary safety paradigms that emphasize systemic inquiry over individual blame (Reason, 1997; Hollnagel, 2014).

The HFACS framework, when viewed through a phenomenological sensemaking lens, offers more than a taxonomy of failure; it becomes a narrative scaffold for understanding how communication errors unfold across the lived experience of aviation professionals. By acknowledging the layered and interpretive nature of human action, safety investigations can move beyond procedural diagnoses to uncover the deeper cognitive and cultural dynamics that shape operational risk.

Meanings of Safety and Human Errors in Aviation

Ineffective interpersonal communication remains a frequently cited precursor to human-error events in civil aviation. A literature review by the FAA establishes that 60–80 % of incidents involve communication breakdowns (Krivonos, 2007). From Crew Resource Management (CRM) studies, it has been found that nontechnical skills, such as briefings, cross-checking, and challenge–response, contribute to reductions in error, establishing “communication competence” as a core safety barrier. More recent network analysis of 1,226 accident narratives confirms that “miscommunication” nodes exhibit the highest centrality among error types, amplifying risk propagation across the system (Matthews et al., 2022).

Human errors in aviation, particularly in a communicative dimension, can be viewed as a co-construction that occurs before, during, and after high-pressure events. Examining safety reports as authoritative texts reveals that communicative practices were made more explicit in institutional memory, thereby influencing future communicative and behavioral practices. A meta-sensemaking lens foregrounds how aviation professionals negotiate meaning, relational dynamics, and accountability through discourse—an indispensable dimension for advancing civil-aviation safety. Further emerging challenges to aviation safety through human errors viewed from a communicative context are the rise of automation in aviation.

Human error in aviation is not merely a matter of individual failure or procedural non-compliance; it is deeply embedded in the communicative dimension that shapes operational realities. From a communicative dimension, errors emerge as co-constructed phenomena, unfolding through interactional patterns before, during, and after high-stakes events. These interactions, whether verbal, written, or gestural, serve as vehicles for meaning-making, situational framing, and ultimately, decision-making in safety-essential environments (Petersen et al., 2021). Communication is not a neutral medium, but a constitutive force that shapes how safety is understood, enacted, and reinforced across the aviation system.

Safety reports, often viewed as authoritative texts, play a vital role in formalizing these communicative practices. They do more than document technical deviations or causal chains; they encode and institutionalize specific narratives of accountability, judgment, and professional identity (Pupulidy, 2015; Dekker, 2014). In this way, safety reports contribute to an evolving institutional memory, influencing how aviation personnel frame future incidents and engage with emerging threats. The act of writing and interpreting these reports reflects an embedded process of discursive sensemaking, where the communicative dimension in a safety report becomes both a mirror and a mold for organizational safety culture (Bieder & Bourrier, 2013).

A meta-sensemaking lens, grounded in phenomenological inquiry, allows for a deeper understanding of how aviation professionals construct shared meanings, negotiate relational dynamics, and assign or diffuse responsibility through discourse. This perspective foregrounds the interpretive work performed by individuals and collectives in response to ambiguity, uncertainty, and breakdowns in routine operations (Weick, 1995; van Manen, 2016). Human errors, therefore, are not isolated

acts but discursive events situated within a network of communicative exchanges, shaped by organizational hierarchies, cultural norms, and technological interfaces.

One increasingly significant challenge within this communicative context is the growing reliance on advanced automation in flight operations. While automation has improved many aspects of safety and efficiency, it also alters the communicative demands placed on pilots and crew. Interactions shift from human-human to human-machine-human, requiring new forms of sensemaking, coordination, and trust. Studies have shown that overreliance on automation can degrade manual flying skills and reduce situational awareness, particularly when communication between humans and machines becomes unclear or misinterpreted (Parasuraman et al., 2000; Sarter & Woods, 1995). In such cases, breakdowns in human-machine communication can ripple through the system, influencing how crews make sense of unfolding anomalies and how they communicate corrective actions under pressure.

These shifts underscore the importance of examining human error not simply as a behavioral artifact but as a communicative construction. Meaningful improvements in aviation safety require attention to how communicative practices are embedded in training, reporting, supervision, and operational procedures. This includes examining how silences, hesitations, or standard phraseologies may obscure important safety signals—or conversely, how emergent forms of informal communication may surface new risks or challenge dominant safety narratives (Mavin & Roth, 2015).

In sum, the communicative framing of safety and human error in aviation is central to both understanding and mitigating operational risk. By integrating a meta-sensemaking lens with discursive and phenomenological inquiry, researchers and practitioners can uncover the often-overlooked human dimensions of safety systems,

those rooted not in isolated actions but in the social construction of meaning, responsibility, and control. Such insights are vital for building more adaptive, reflective, and communicatively resilient safety cultures in the face of an increasingly automated and complex aviation landscape.

Aviation professionals' understanding of human-induced errors has broadened from merely viewing them as individual failings to acknowledging them as systemic issues influenced by complex interactions between humans, technology, and organizational factors (Reason, 1997; Hollnagel, 2014). This holistic perspective has led to the development of comprehensive frameworks, training programs, and reporting systems designed to manage and mitigate errors, ultimately enhancing the safety and resilience of aviation operations. Aviation human error is perceived not as isolated individual failings but as emergent properties of complex socio-technical systems (Dekker, 2014).

Frameworks like the Human Factors Analysis and Classification System (HFACS) and the SHELL model have been instrumental in shaping this understanding. HFACS categorizes human error across four levels: unsafe acts, preconditions for unsafe acts, unsafe supervision, and organizational influences, emphasizing that errors often stem from systemic issues rather than individual negligence. Similarly, the SHELL model highlights the interactions between Software, Hardware, Environment, and Liveware (human elements), underscoring that mismatches in these interfaces can lead to errors (Cacciabue, 2004; Campbell & Bagshaw, 2002; Hawkins, 1993; Johnson & McDonald, 2017; Reason, 1990).

The aviation industry's safety culture has evolved to view human errors as inevitable and manageable, rather than solely preventable. The Crew Resource Management (CRM) introduction has contributed to a pivotal role in this shift, promoting effective communication, decision-making, and teamwork among crew

members. CRM training emphasizes the importance of recognizing and addressing errors collaboratively, fostering an environment where reporting and discussing mistakes are integral to safety (Arrubla, 2017; Carlson, 2014; Clark, 2011; Ford et al., 2014; Haynes, 1991; Wise, 2023).

For aviation professionals, a systems perspective is essential to understanding human errors. Among several models in the aviation human error topic is the Swiss Cheese Model, which illustrates how multiple layers of defense can be breached due to latent failures aligning with active errors. Further complementing this human error model is the SHELL model, which emphasizes the interactions between Software, Hardware, Environment, and Liveware (human elements), highlighting that errors often result from mismatches within these interfaces. The Human Factors Analysis and Classification System (HFACS) further categorizes human errors across four levels: unsafe acts, preconditions for unsafe acts, unsafe supervision, and organizational influences.

Discourse framing and sensemaking in aviation safety investigations are viewed not merely as technical analyses but also as discursive processes that shape the understanding of human error. The “meta-sensemaking” concept refers to how aviation personnel interpret and construct meaning around errors, often influenced by organizational narratives and cultural norms. During safety investigations, root cause identification and implementing safety measures are approached through discursive framing and sensemaking (Rankin et al., 2016).

A confluence of systemic models, organizational culture, training practices, and discursive framing shapes the understanding of human-induced errors among aviation personnel. Addressing these errors requires a holistic approach that encompasses not only technical solutions but also the social and cognitive dimensions of human performance. By fostering an environment that encourages open communication,

continuous learning, and vital reflection, the aviation industry can enhance its resilience and safety outcomes.

Understanding how aviation professionals navigate standards in aviation communicative practices through a concept of sense-making is an exploration of those dialogue practices aimed at error avoidance and safety compliance. Sensemaking refers to how researchers interpret and assign meaning to complex or unexpected events, thereby guiding their actions and decisions (Weick, 1995). In the high-stakes aviation environment, where safety is paramount, effective sensemaking can significantly contribute to interpreting and understanding the efficacy of communication and adherence to safety protocols (Rankin et al., 2016).

Sensemaking is an integral part of exploring the routine communicative practices of aviation professionals. Sensemaking enhances a researcher's understanding of error avoidance and safety compliance by facilitating shared understanding and adaptive responses to complex situations (Weick, 1995; Rankin et al., 2016). Through sense-making, a researcher may explore how an organization's supportive cultures and structured communication practices are better positioned to maintain high safety standards in aviation operations.

A sense-making approach to understanding human errors in safety investigations is particularly relevant in aviation, given the industry's complexity and the potential for unexpected situations. Weick's (1995) seminal work emphasizes that sensemaking is a continuous process where individuals construct meaning through social interactions and experiences. Additionally, sensemaking among aviation professionals enables them to interpret anomalies and adjust their behaviors accordingly in the aviation industry. For instance, during unforeseen events, pilots and crew members rely on collective sense-making to assess situations and make informed decisions (Weick, 1995).

Effective communication is a cornerstone of safety in aviation operations. Studies have shown that communication failures are a significant contributor to aviation incidents. For example, a study by the Dutch Aerospace Research Centre identified poor communication as one of the top factors leading to mistakes on the ramp (Chatzi et al., 2019). Sense-making among aviation professionals in routine communication, as an integral part of the communicative process, may mitigate such errors by fostering a shared understanding among team members, enhancing coordination, and reducing misunderstandings.

Routine communicative practices in aviation, such as standardized checklists and briefings, are designed to promote safety compliance. These practices are not merely procedural but are embedded within the sense-making framework. They provide structured opportunities for team members to align their understanding and expectations, which is crucial for maintaining situational awareness and ensuring that safety protocols are followed consistently (Battles et al., 2006).

The organizational culture within aviation entities influences how sense-making occurs. A culture that encourages open communication and continuous learning supports effective sense-making. Conversely, a culture that discourages questioning or reporting errors can hinder the sensemaking process, leading to potential safety risks. Implementing a “just culture” that balances accountability with a non-punitive approach to error reporting can enhance sensemaking and, consequently, safety outcomes (Reason, 1997; Dekker, 2007).

Aviation Professionals’ Interpretive Engagements

The interpretive engagement among aviation professionals in their safety communication dimensions involves a complex interplay of cognitive, social, and organizational factors, which enables aviation professionals to navigate the intricacies

of human performance and error within operational contexts (Malakis & Kontogiannis, 2013). Sensemaking is the process through which individuals interpret and construct meaning from complex or unexpected events (Weick, 1995). This process is essential in aviation, especially when standard procedures are disrupted. For instance, a study examining cockpit scenarios revealed that pilots often rely on collective sensemaking to address anomalies, such as autopilot disengagements or landing gear issues, by integrating inputs from crew members and maintenance personnel to formulate a coherent understanding of the situation (Mogford, 1997). Effective communication is paramount in aviation operations. Miscommunication between pilots and air traffic controllers has been identified as a significant contributor to aviation incidents. A study analyzing pilot-controller interactions found that communication errors, such as incorrect phraseology or misunderstandings, often lead to high-severity occurrences.

Aviation professionals navigate the complexities of human performance and error through a multifaceted engagement with safety systems. This engagement is shaped by sensemaking processes, effective communication, organizational culture, targeted training, and technological interfaces. Understanding and enhancing these elements are crucial for improving safety outcomes in aviation operations (Weick, 1995; Tuzkaya et al., 2011; Endsley, 1995).

Aviation professionals operate in high-stakes environments where safety-essential decisions must be made under conditions of uncertainty, time pressure, and complex system interactions. Their interpretive engagements involve how they make sense of, respond to, and communicate about emerging situations that are central to understanding human performance in aviation contexts. These engagements transcend mechanical adherence to standard operating procedures, encompassing instead a dynamic interplay of cognitive sensemaking, interpersonal communication, and organizational meaning systems (Weick, 1995; Malakis & Kontogiannis, 2013).

Sensemaking in aviation safety investigations serves as a foundational lens through which these investigators examine how aviation professionals interpret disruptions to normal operations. Weick (1995) describes sensemaking as a retrospective, social, and ongoing process by which individuals construct meaning from ambiguous or unexpected events. In the cockpit, this process is neither linear nor purely individual; it unfolds as a collaborative endeavor, often involving multiple actors such as pilots, air traffic controllers, maintenance crews, and dispatchers. Malakis and Kontogiannis (2013) emphasize that flight crews, when confronted with unanticipated anomalies, such as automation disconnections, conflicting instrument readings, or unstable approaches, rely on joint sensemaking practices to reframe the event, assess its operational significance, and determine an appropriate course of action. These practices are situated in real-time communication and shaped by shared experience, training, and cultural norms within the aviation profession. For example, empirical analyses of cockpit communication have revealed that flight crews actively construct situational understanding through verbal exchanges, drawing upon not only technical knowledge but also shared mental models of flight operations (Mogford, 1997). Such engagements are particularly evident during non-routine events, such as go-arounds or system malfunctions, where rapid re-interpretation of unfolding conditions is required. These moments illuminate how interpretive engagements in aviation are not merely responses to “errors,” but rather involve a continuous negotiation of meaning, where information, uncertainty, and risk are constantly recalibrated in light of operational priorities and social cues (Kanki et al., 2019).

Communication plays a significant role in structuring interpretive engagements. Effective communication facilitates shared situational awareness, which is essential for collaborative decision-making and error management. However, communication breakdowns remain a persistent hazard in aviation operations, and even minor

deviations from standard phraseology or delayed acknowledgments can escalate into safety-essential events when they obstruct mutual understanding. The interpretive challenge here lies not only in accurately transmitting information but also in ensuring that communicative intent is successfully decoded and integrated into operational cognition (Tuzkaya et al., 2011).

Organizational and technological contexts also influence this communicative dimension. For example, technological interfaces such as automation systems or flight management computers mediate human engagement by shaping what information is available, how it is presented, and how it is interpreted (Endsley, 1995). These systems can either support or inhibit sensemaking, depending on their design and the user's familiarity with their logic. A misunderstanding of automation logic has been implicated in pilots' failure to correctly interpret aircraft behavior, highlighting the importance of both technical literacy and communicative clarity in operational environments (Billings, 1997; Woods & Hollnagel, 2006). Aviation professionals' interpretive engagements are deeply embedded in organizational culture. The way safety is communicated and practiced, whether through formal briefings, post-incident debriefs, or safety reports, reflects broader organizational narratives about risk, responsibility, and learning (Dekker, 2011). Interpretive engagement, in this sense, includes not only how frontline professionals make sense of events in real-time but also how their sensemaking is subsequently represented, authorized, or silenced in official safety discourses. This discursive framing has implications for how human errors are constructed in investigation reports and for shaping future safety practices.

Professional training programs, such as Crew Resource Management (CRM), aim to cultivate communication, coordination, and decision-making skills that enhance collective sensemaking. However, such training is not merely technical; it is also performative, as it inculcates particular values and expectations about how aviation

professionals ought to speak, act, and interpret their roles (Helmreich & Merritt, 2001). These training programs become scripts that shape how individuals perceive and recount their experiences of disruption, both in the moment and in retrospective safety investigations. Thus, the interpretive engagements of aviation professionals are multifaceted and situated. They encompass moment-to-moment sensemaking in the cockpit, structured communication across professional domains, interactions with organizational and technological systems, and the broader discourses that shape how human error is understood. Understanding these engagements is not only vital for improving operational safety but also for interrogating how safety knowledge is constructed and communicated in the aviation system.

Discursive Value of Safety Reports in Aviation Accidents and Incidents

Safety reports are not merely technical documents; they are narratives constructed through specific linguistic and discursive choices. The unstructured nature and varied styles of writing safety reports can obscure vital information, making interpretation challenging. Additionally, the language used in these reports can reflect and reinforce certain cultural and organizational biases. For example, there is an emphasis on individual errors over elemental issues that may stem from narrative structures that favor linear causality and clear attribution of accountability (New & Wallace, 2025).

When considering safety reporting as a standard for maintaining a positive safety culture among aviation organizations, effective safety reporting systems are crucial for identifying and addressing human errors. Non-punitive reporting encourages personnel to share information about errors without fear of retribution, fostering a culture of transparency and continuous improvement (New & Wallace, 2025). However, challenges persist, such as underreporting due to fear of blame and

the normalization of deviance, where repeated exposure to minor deviations leads to their acceptance as standard practice (Kohn et al., 2000).

In the domain of aviation safety, formal accident and incident reports serve as both documentary and discursive artifacts. They do not merely catalogue operational failures or human errors; they also construct particular narratives of causality, accountability, and systemic vulnerability. Through a phenomenological lens, these texts can be understood not simply as objective repositories of data but as situated representations of lived experience, reconstructed and codified within institutional frameworks of meaning (New & Wallace, 2025).

Discursive analysis of safety reports reveals how language functions to mediate and shape the understanding of human error. The narratives embedded in these reports often employ structured formats – such as the sequence of events, analysis, findings, and probable cause – yet within these formats, subtle linguistic choices reflect underlying epistemologies about causation and responsibility. For instance, active versus passive voice ("the pilot failed to recognize" vs. "a recognition error occurred") signals differing orientations toward agency and culpability (Dekker, 2014).

Accident reports are not neutral repositories of facts but discursive constructions that shape collective sensemaking about error (Pupulidy, 2015). The linguistic framing of causes ("pilot deviation" vs "systemic drift") influences remediation priorities and professional identity work among investigators and line aviation professionals. Based on Weick's (1995) sensemaking theory, the argument was that report narratives reflect and reproduce regulatory logics, legitimizing particular safety meanings while marginalizing others. Empirical data on communicative factors in high-pressure environments, as captured in several cockpit voice recordings, suggest that stress resulting from high-stress operating conditions degrades syntax length, increases command modality, and narrows semantic range, patterns associated with

crew performance drops (Krivonos, 2007). The Flight Safety Foundation warns that most investigators still “lack the tools and training to analyze language-related factors,” leading to under-reporting of crucial discourse cues (Matthews, 2012).

From a phenomenological standpoint, such reports are reconstructions of actors’ sense-making processes under operational pressure. The investigator, functioning as both an analyst and narrator, engages in a second-order sense-making, interpreting how frontline operators made sense of a situation that eventually went awry. This layered reconstruction aligns with the phenomenological aim to explore how people experience, interpret, and assign meaning to phenomena as they unfold (van Manen, 2016).

Moreover, the process of generating a safety report entails institutional filtering, in which complex, emotionally charged, and ambiguous events are rendered into technical language. This raises vital questions about what aspects of lived experience are preserved, transformed, or lost in the transition from cockpit to report. Phenomenological inquiry thus invites a deeper reading of these documents, not only for what they say, but for how they say it, and what they leave unsaid. The act of discursively framing an accident also implicates organizational culture. Studies have shown that the language of safety reports reflects prevailing norms of risk perception, procedural adherence, and accountability (Bieder & Bourrier, 2013). A phenomenologically informed discursive analysis can therefore illuminate not just the cognitive errors of individuals but also the collective, culturally embedded sense-making systems that frame how safety is operationalized.

In essence, discursive analysis of aviation safety reports through a phenomenological lens reveals the interplay between narrative, cognition, and institutional meaning-making. It shifts the analytical focus from what happened to how what happened is made meaningful, enabling a richer understanding of human factors

not as isolated deviations, but as embedded in dynamic, communicative, and organizational lifeworlds (van Manen, 2016; Bieder & Bourrier, 2013).

Aviation safety reports are often perceived as technical documents designed to document occurrences, determine their causes, and issue recommendations. However, when carefully examined through a discursive and phenomenological lens, these documents emerge not simply as repositories of objective data but as textual performances, crafted narratives that construct meaning, impose order, and encode organizational sensemaking (Bieder & Bourrier, 2013; van Manen, 2016). The discursive value of these reports lies in their dual function: they serve both as institutional tools for risk management and as cultural artifacts that reflect and reproduce dominant epistemologies, linguistic conventions, and normative assumptions about human performance, accountability, and error.

Safety reports are fundamentally constructed narratives. Although framed in the language of evidence and causality, they are shaped by the report writers' interpretive frameworks, organizational affiliations, regulatory expectations, and cultural assumptions (New & Wallace, 2025). This narrative construction involves the selection, sequencing, and framing of events in ways that influence how causality is inferred and how responsibility is assigned. Often, the structure of these texts adheres to a linear logic, beginning with a disruption, followed by an investigation, leading to findings, and culminating in recommendations. Such linear causality may inadvertently privilege individual human actions as the proximate source of failure while marginalizing systemic, organizational, or technological contributory factors that do not easily fit into a sequential storyline (Dekker, 2011; Woods & Cook, 2002). This discursive bias becomes especially salient in the treatment of human error; the linguistic and rhetorical strategies employed in safety reports frequently foreground pilot or controller deviations as isolated nodes of failure. Terms such as "failed to," "did

not," or "neglected to" attribute error to individual action or inaction, obscuring the broader network of socio-technical interdependencies in which those actions are embedded (New & Wallace, 2025). This linguistic framing not only shapes institutional memory of incidents but also influences how future safety interventions are conceptualized, often emphasizing retraining or procedural reinforcement over more complex organizational reforms (Amalberti, 2001).

The unstructured or semi-structured styles of report writing can introduce interpretive ambiguity. The lack of standardized discourse conventions across different investigative bodies and jurisdictions means that similar incidents may be narrated in vastly different terms. As a result, comparative learning is hampered, and subtle but significant contextual cues may be lost or overlooked (Maurino, 2017). This discursive heterogeneity also allows for selective visibility, where some elements, such as organizational pressures, hierarchical communication breakdowns, or automation design flaws, are underemphasized or absent from the narrative, depending on the investigative framing and institutional ethos of the reporting agency (Bieder & Bourrier, 2013).

From a phenomenological perspective, the meaning of experience is not solely found in the act itself (Manen, 2016). However, in the telling, how experience is retrospectively constructed, made sense of, and inscribed into institutional discourse. Applying this insight to aviation safety reports, the focus shifts from merely cataloging what occurred to understanding how meaning is constructed around the event. This approach aligns with meta-sensemaking, where analysis probes the second-order interpretive structures that inform not only the events but also the linguistic, cultural, and epistemic practices through which those events are made intelligible. This also implicates the report's audience: regulators, safety managers, and line personnel, in a dialogical process of meaning-making, whereby institutional narratives shape not only

understanding but also future behavior and organizational identity (Czarniawska, 2004).

The discursive construction of safety reports is also a site of institutional power. What is said, unsaid, or left ambiguous can reflect deeper organizational anxieties and constraints. In some cases, investigative reports may exhibit communicative silences around politically sensitive topics such as managerial oversight, labor relations, or regulatory capture. These omissions are not random but are indicative of the discursive economy within which such reports are produced as an economy shaped by legal liability concerns, organizational reputation management, and inter-agency dynamics (Dekker, 2014). Thus, the language of safety reports must be read not only for its content but also for the contextual silences, absences, and the institutional forces they index. The discursive value of aviation safety reports extends beyond their function as technical documentation. They are deeply embedded in cultural, organizational, and epistemological frameworks that shape how accidents and incidents are understood, communicated, and addressed. By attending to the linguistic and narrative dimensions of these texts, researchers and practitioners can uncover the underlying logics that govern institutional responses to failure and reframe human error not as a discrete cause but as a discursive construct shaped by broader socio-organizational dynamics.

Chapter III

FRAMEWORK OF THE STUDY

My study is anchored on a framework that interrelates the constructs of human error, aviation communication, meta-sensemaking, and safety practices, all viewed through a phenomenological lens. Given the qualitative and interpretive nature of the inquiry, the framework is not based on a single overarching theory but rather integrates concepts drawn from safety science, communication studies, and phenomenology to illuminate the lived experiences of aviation professionals. Grounded through an interdisciplinary conceptual framework that integrates human factors theory, organizational sensemaking, and interpretive phenomenological analysis, this doctoral work examines civil aviation safety investigations and reports as discursive texts, exploring how human error is constructed, interpreted, and communicated within these documents. By adopting a meta-sensemaking approach, the research seeks to understand the phenomenon through which meaning is ascribed to aviation incidents and how these meanings influence safety practices and organizational learning.

The Framework of the Study

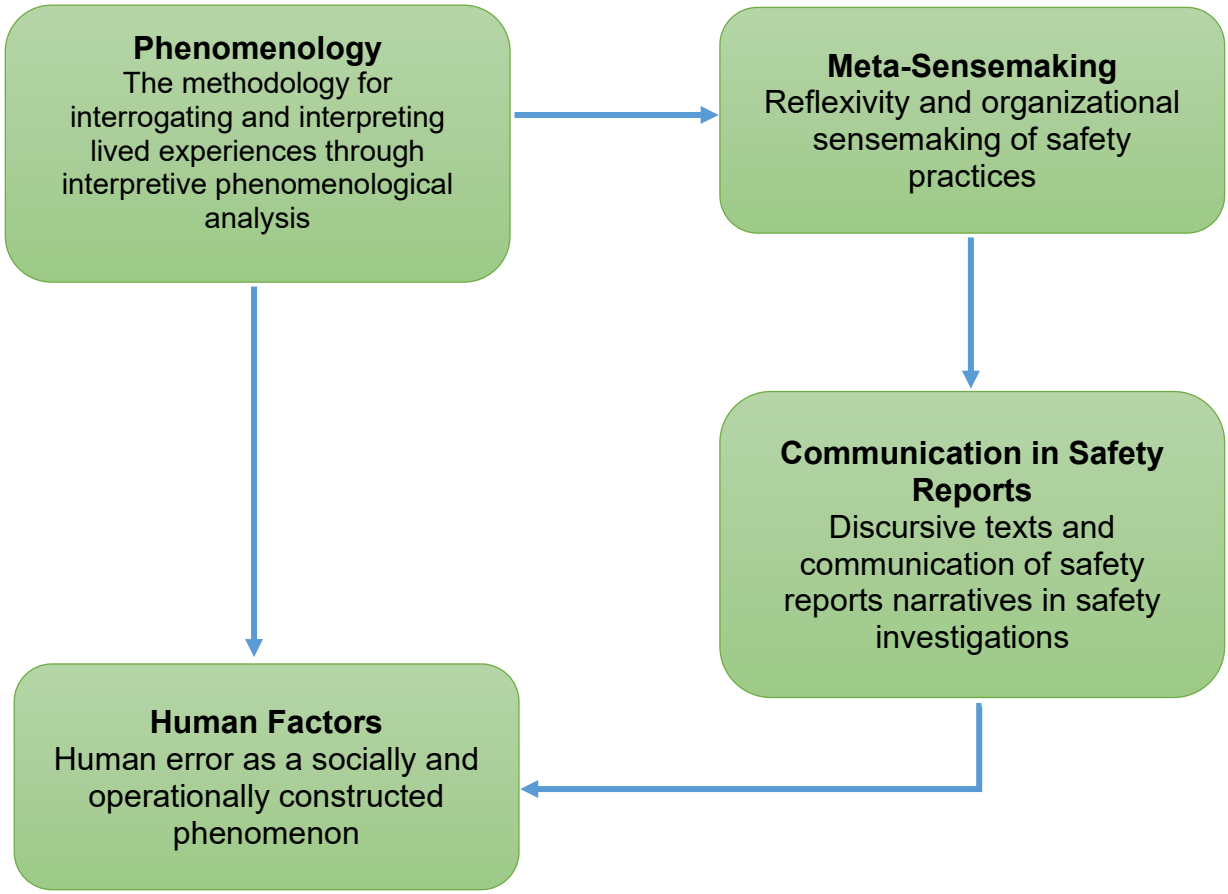
Human Factors: Human Error as a socially and operationally constructed phenomenon

Communication in Safety Reports: Discursive texts and communication of safety reports narratives in safety investigations.

Meta-Sensemaking: Reflexivity and Organizational Sensemaking of Safety Practices.

Phenomenology: the methodology for interrogating and interpreting lived experiences through interpretive phenomenological analysis.

Framework Diagram



Discourse of Understanding

My dissertation employs Interpretive Phenomenological Analysis (IPA) and meta-sensemaking to investigate and uncover the lived experiences and the communicative practices among aviation professionals, where the meaning of human errors is mutually constructed and interpreted. The communicative practices are not merely the transmission of information, but an interpretive act among the participants through making sense of their shared language and culture in aviation. The discourse of understanding produces knowledge among aviation professionals as they collaboratively construct meaning in their lived world, a process that dialogically exists as a co-production of shared meanings regarding aviation safety and human errors, which are institutionally shaped (Mumby, 1997).

Interpretive Phenomenological Analysis

My study employs an Interpretative Phenomenological Analysis (IPA) approach, through which I explored, by invoking and drawing from my shared understanding, how human errors are constructed, interpreted, and communicated within civil aviation safety investigations and reports. By examining these reports as discursive texts, the research aims to understand the lived experiences of aviation professionals and the processes through which meaning is ascribed to aviation incidents. The framework integrates concepts from human factors theory, organizational sensemaking, and interpretive phenomenological analysis to provide a comprehensive understanding of the phenomena under investigation. As a qualitative research approach that focuses on exploring how individuals make sense of their personal and social experiences, IPA is founded in phenomenology and hermeneutics, emphasizing the subjective experiences of individuals and the meanings they ascribe to those experiences (Smith, Flowers, & Larkin, 2009). In the context of my study, IPA facilitates an in-depth examination of how aviation professionals interpret and communicate human errors within safety reports.

IPA focuses on exploring how individuals perceive and make sense of their experiences. In aviation safety, this approach can be applied to analyze narratives from incident reports, interviews (captured from safety reports or actual), and investigations to uncover the underlying meanings and contexts of human error. By examining these accounts, I, as the researcher, can gain insights into the cognitive and emotional processes that influence decision-making and behavior in complex operational environments. For instance, analyzing pilot narratives can reveal how factors like stress, fatigue, and organizational culture impact performance. Such qualitative analyses can inform the development of interventions aimed at mitigating

human error by addressing the root causes embedded within the social and operational context.

The conceptualization of “Human Factors: Human Error as a Socially and Operationally Constructed Phenomenon” reflects a paradigm shift in aviation safety research. This perspective moves beyond viewing human error as isolated individual failings, instead recognizing it as a product of complex interactions within social and operational contexts. This approach aligns with the interpretive phenomenological analysis (IPA) framework, which seeks to understand how individuals make sense of their experiences within their specific environments. With meta-sensemaking, IPA may also provide a framework for exploring how individuals involved in safety investigations, such as pilots, air traffic controllers, and maintenance personnel, make sense of incidents. By examining personal narratives and experiences through the safety and investigation reports, I gain insights into the subjective meanings and contextual factors that influence behavior and decision-making. This approach acknowledges that human experiences are complex and shaped by various social, cultural, and organizational factors.

This integrative approach guides the formulation of research questions in my review of safety investigation reports and the interpretive analysis of narratives. My goal is to deepen an understanding of how aviation professionals make sense of and respond to human errors within communicative practices that are both constrained and enabled by the operational environment. In the context of my study, meta-sensemaking involves analyzing how safety reports themselves are products of sensemaking processes and how they, in turn, contribute to future interpretations and actions within the aviation industry.

Meta-Sensemaking of Aviation Safety Practices

Drawing on the theory of sense-making in organizations (Weick, 1995), my study situates safety not just as adherence to standard procedures, but as a continual process of interpreting unfolding events. Sense-making in high-risk environments, such as aviation, often occurs under time pressure and uncertainty. Sensemaking is triggered by unexpected or confusing events, prompting organizations to engage in meaning-making activities to restore order and understanding. In aviation, safety reports serve as formalized sensemaking artifacts, encapsulating the interpretations and conclusions drawn by investigators and stakeholders. Organizational sensemaking is an approach through which individuals and corporations interpret and construct meaning from ambiguous or complex situations. In the context of aviation safety investigations, sensemaking involves the retrospective interpretation of events to develop coherent narratives that explain incidents and inform future practices. This process is inherently social and discursive, shaped by organizational cultures, norms, and power dynamics. Understanding how aviation professionals interpret cues, communicate intent, and adapt in ambiguous situations is crucial for identifying the root causes of human error and the resilience of safety systems (Dekker, 2016).

Meta-sensemaking, in the context of my research, refers to the process by which I, as an aviation safety investigation professional, reflect upon and interpret the sensemaking activities through the safety investigation reports. Meta-sensemaking involves a higher-order analysis of how meaning is constructed, allowing for a deeper understanding of the underlying assumptions and frameworks that guide behavior and decision-making. Reflexivity, in this context, refers to the ability of individuals and organizations to critically examine their practices, beliefs, and assumptions, leading to more informed and adaptive actions.

Adopting the meta-sensemaking model among organizations as part of their process in interpreting and responding to complex, ambiguous, or unexpected events involves collective interpretation and the construction of shared meanings that guide organizational actions. In the context of my study, where an aviation safety report is examined, organizational sensemaking plays a crucial role in the development, implementation, and modification of safety practices. For example, when an incident occurs, the organization's response is shaped by how it interprets the event, the narratives constructed around it, and the lessons learned from it. Organizational culture, communication patterns, and existing safety frameworks influence this process. By engaging in organizational sensemaking, aviation entities can adapt their safety practices to address emerging challenges better and prevent future incidents.

The concept of meta-sensemaking extends the analysis to the processes through which organizations reflect on their sensemaking practices. This involves an examination of how safety narratives are constructed, the assumptions underlying these narratives, and the implications for organizational learning and change. Meta-sensemaking encourages reflexivity, prompting organizations to question their interpretive frameworks and to consider alternative perspectives. In the context of my study, meta-sensemaking involves analyzing how safety reports themselves are products of sensemaking processes and how they, in turn, influence future interpretations and actions within the aviation industry.

Integrating meta-sensemaking and reflexivity into organizational practices can lead to significant improvements in aviation safety. By fostering a culture of continuous reflection and examination, organizations can identify and address systemic issues, adapt to changing environments, and enhance their resilience to unexpected events.

In aviation safety, meta-sensemaking enables organizations to scrutinize their safety practices, communication protocols, and decision-making processes. By

engaging in reflexive practices, organizations can identify potential biases, systemic issues, and areas for improvement, thereby enhancing overall safety performance.

Human Factors: Socially and Operationally Constructed Phenomenon

Human Error as a socially and operationally constructed phenomenon is a key concern in aviation safety, often serving as a focal point in accident investigations. It remains a predominant contributing factor to incidents and accidents in civil aviation. It is no longer viewed solely as an individual's failure, but rather as a symptom of systemic vulnerabilities and latent conditions (Reason, 1997). Human error is approached not merely as an outcome to be mitigated but as a complex phenomenon embedded in communicative and operational contexts. The framework draws from Reason's (1997) "Swiss Cheese Model" to understand how organizational defenses and layers of safety may align in ways that allow errors to propagate into adverse events.

Traditional models often attribute accidents to individual mistakes, but contemporary research emphasizes the role of organizational culture and social dynamics in shaping human behavior. For instance, the Human Factors Analysis and Classification System (HFACS) identifies organizational influences, such as resource management and organizational climate, as foundational factors that can lead to unsafe acts (Wiegmann & Shappell, 2000). This perspective acknowledges that errors often stem from systemic issues rather than solely individual negligence. The Human Factors Analysis and Classification System (HFACS) provides a framework for identifying and analyzing human errors at multiple levels, including unsafe acts, preconditions for unsafe acts, supervisory factors, and organizational influences. HFACS is based on Reason's (1990) Swiss Cheese Model, which conceptualizes accidents as the result of multiple, latent failures aligning within an organization's defenses. The SHELL model further contextualizes human error by examining the

interactions between Software, Hardware, Environment, and Liveware (human elements) in aviation systems (Hawkins, 1993). This SHEL model emphasizes the importance of considering the complex interplay between various system components and human operators in understanding and mitigating errors. Operational factors, including technology, procedures, and environmental conditions, also play a crucial role in human error. The SHELL model (Software, Hardware, Environment, Liveware) illustrates how mismatches between human operators and system components can lead to errors (Edwards, 1972). For example, poorly designed interfaces or inadequate procedures can increase the likelihood of mistakes, highlighting the need for systems that accommodate human limitations. Also, latent conditions within an organization, such as inadequate training or flawed procedures, can create environments where errors are more likely to occur (Edwards, 1972; Hawkins, 1993; Reason, 1990). These latent errors may remain unnoticed until they contribute to an incident, emphasizing the importance of proactive safety management.

Furthermore, cultural factors significantly impact communication and decision-making in aviation. An element of high power distance in organizational cultures may discourage subordinates from questioning superiors, potentially leading to communication breakdowns (Helmreich & Merritt, 1998). Such cultural dynamics underscore the importance of understanding human error within its social context.

Understanding human error as both a social and operational construct necessitates a holistic approach to safety management. This involves considering the interplay between individual behaviors, organizational culture, and system design. Interventions should focus on creating environments that support open communication, continuous learning, and system designs that align with human capabilities. By adopting this integrated perspective, aviation organizations can move beyond reactive measures and develop proactive strategies that address the systemic

factors contributing to human error. This approach aligns with the principles of Safety Management Systems (SMS), which emphasize the importance of organizational culture and continuous improvement in enhancing safety performance. This comprehensive understanding of human error underscores the importance of considering both social and operational contexts in aviation safety. By employing interpretive phenomenological analysis, researchers and practitioners can gain deeper insights into the factors influencing human behavior, leading to more effective safety interventions.

Communication in Safety Reports

The Discursive texts and communication of safety reports narratives in safety investigations. Aviation communication, whether between flight crew, air traffic control, or maintenance personnel, is central to operational safety. Miscommunication or communication breakdowns are frequently implicated in safety lapses (Helmreich, Merritt, & Wilhelm, 1999). However, communication is not only a mechanism for transmitting information but also a sense-making process through which professionals interpret dynamic situations (Weick, 1995). My study, therefore, adopts a view of communication as both a functional and phenomenological phenomenon, where meaning, misunderstanding, and adaptive responses emerge in real time. The discourses and communication in safety reports provide a wealth of factual and verifiable information, which is constructed narratives reflecting particular perspectives, assumptions, and rhetorical strategies. By analyzing safety reports as discursive texts, my study explored how linguistic choices influence the portrayal of human error, the attribution of responsibility, and the recommendations for organizational change. This approach acknowledges that language plays a crucial role in shaping perceptions of safety and in facilitating or hindering learning from incidents.

Safety reports are not merely objective records; they are discursive texts that reflect the perspectives, assumptions, and cultural norms of their authors. The language used in these reports can influence how events are perceived and understood; the choice of words, narrative structure, and emphasis can shape interpretations of causality and responsibility. This discursive nature underscores the importance of analyzing safety reports not only for their content but also for their linguistic and rhetorical communicative characteristics. Effective communication is vital in safety investigations. Investigators must navigate complex information, often under demanding time constraints and subject to public scrutiny. When findings are communicated, both internally among investigation teams and externally to stakeholders and the public, they may impact the effectiveness of safety recommendations and the trust in investigative processes. Challenges such as language barriers, cultural differences, and varying levels of technical understanding can complicate these communications. Understanding safety reports as discursive texts and applying IPA may lead to uncovering nuanced insights into the human factors contributing to aviation incidents. This perspective encourages a shift from a purely technical analysis to one that considers the social and communicative contexts of safety events.

By integrating the analysis of communication within safety reports and employing interpretive phenomenological analysis, researchers and practitioners can develop a deeper understanding of the human factors in aviation safety. This holistic approach can lead to more effective interventions and a stronger safety culture within the aviation industry.

Chapter IV

METHODOLOGY

The meta-sensemaking of Human Errors in Civil Aviation Safety Investigations and Reports as Discursive Texts utilizes a qualitative, interpretivist approach centered on Interpretive Phenomenological Analysis (IPA) and introduces the concept of meta-sensemaking as an epistemological and analytical lens. My doctoral work involves my sensemaking on exploring how human error is experienced, interpreted, and represented within the institutional discourse of aviation safety investigation reports. My research is grounded in the methodological foundations of Interpretive Phenomenological Analysis (IPA) and supplemented with the conceptual innovation of meta-sensemaking of the safety investigation reports as discursive texts to explore and address the philosophical assumptions, data collection sources, analytical procedures, and strategies for ensuring research rigor. The philosophical foundation of my research was situated within a constructivist-interpretivist paradigm, acknowledging that knowledge is co-constructed by individuals situated within social and institutional frameworks. IPA's phenomenological roots draw heavily from a concept of 'being-in-the-world,' which views understanding as an interpretive process embedded in context (Heidegger, 1962; Dekkerall, 2005). This aligns with the study's goal of examining how pilots and institutional actors retrospectively make sense of high-risk events, such as aviation accidents. IPA is employed to explore how individuals construct meaning in response to significant life events (Smith, Flowers, & Larkin, 2009). In my study, IPA enables the exploration of how human error is experienced by pilots in real-time and how this experience is subsequently represented in official investigative narratives. This dual focus allows for an interpretive, idiographic, and phenomenologically grounded engagement with aviation safety documentation. Meta-sensemaking is introduced as a

second-order interpretive layer that examines how institutional texts make sense of pilots' sensemaking. It is grounded in the concept of sensemaking as a retrospective, identity-forming process, and extends it by analyzing how investigative institutions narratively frame cognition, error, and accountability (Weick, 1995; Czarniawska, 1997). This dual-layered analysis enables me, as the researcher, to interrogate the epistemological assumptions embedded in the NTSB report.

Case Study: Asiana Airlines Flight 214 Investigation Report

The contents and contexts of my study focused on the 2013 crash of Asiana Airlines Flight 214, as documented in NTSB Report AAR-14/01. This case presents a rich site for interpretive analysis, as it involves issues of automation, cross-aircraft experience, and complex pilot decision-making under stress. The investigation report's framing of error and causality serves as an exemplary instance for applying IPA and meta-sensemaking.

Data Analysis Approach and Table Labeling

The primary data comprises the NTSB's AAR-14/01, including narrative findings, technical appendices, and factual summaries. Supplementary documents include ICAO guidance, pilot interview transcripts, and procedural manuals. These texts are treated as discursive objects that perform epistemological work (Fairclough, 2013), meaning they actively shape how knowledge about safety and error is constructed and disseminated.

The data narratives were analyzed for the emergent themes to surface from those identified narratives, as data for my research, with the following steps:

1. Read the narratives from the safety investigation reports thoroughly and deeply, examining the narrative excerpts that capture the emotional intensity, depth, and richness of the narrative experiences.

2. Identify the descriptive codes by sensemaking of the report through my shared understanding of the descriptions in the data.

3. Draw the emergent themes from these data. For example, the rich Airbus experience of the Pilot Flying shaped his Boeing systems expectations (code), where the “legacy of prior aircraft experience” emerges as a theme.

4. Compare the construct of the safety reports on the pilots’ cognitions and their organizational contexts, and the institutional framing from the lived experience in the cockpit, to draw an interpretive insight for each emergent theme.

Furthermore, each of the emergent themes through the data analytical procedure for my research followed five iterative steps:

1. Reading and Re-reading

   Deep immersion in the text to identify emotional, linguistic, and technical nuances.

2. Initial Noting

   Identification of descriptive codes, linguistic features, and interpretive commentary.

3. Interpreting the discourse

   The discourses in the narratives (data) were descriptively interpreted from my shared understanding as an airline safety investigation officer.

4. Interpretive Insight

   Comparing institutional framings with interpretive insight from lived cockpit experiences.

5. Meta-sensemaking Layer

   Analysis of how the report constructs meaning about pilot cognition and organizational context.

From these analytical methods, the tables were generated as follows:

The table for the main emergent themes that were identified:

Narrative Excerpts	Descriptive Codes	Emergent Themes	Interpretive Insights

The analytical dimensions table for each emergent theme:

Narrative Excerpts	Descriptive Codes	Discursive Interpretation	Interpretive Insight	Meta-Sensemaking Layer

Contextual Sensitivity in IPA

In line with IPA's idiographic commitment, contextual sensitivity was prioritized. This included attention to the pilot's transition from multiple aircraft types, as well as cultural and organizational expectations, and training constraints. These contextual dimensions are essential in interpreting both the pilot's sensemaking and the institutional account of error.

In qualitative inquiry, particularly within Interpretive Phenomenological Analysis (IPA), contextual sensitivity refers to the methodological imperative to attend to the specific sociocultural, institutional, historical, and experiential circumstances in which meaning-making occurs (Weick, 1995; Czarniawska, 1997). For my study, which examined how pilots experience human error through safety reports and is subsequently constructed in official investigative narratives, contextual sensitivity is not only a philosophical stance but also a methodological necessity. It undergirds both the phenomenological depth and the discursive precision required in analyzing the meaning of aviation safety incidents, particularly in high-stakes, cross-cultural, and highly regulated domains such as civil aviation. IPA is rooted in the phenomenological tradition, particularly in a concept of being-in-the-world, which asserts that all human understanding is always situated; there is no experience outside of context (Weick, 1995;

Czarniawska, 1997). This concept is crucial for understanding how pilots perceive cockpit environments, particularly when navigating complex technological systems under stress. Because of this concept, IPA researchers must strive to understand participants' experiences within their unique contexts, encompassing the cultural, organizational, and technological structures that shape their perceptions and decisions (Smith, 2009).

In the case of Asiana Airlines Flight 214, contextual sensitivity involves acknowledging the transition of the pilot from different aircraft types, each with distinct automation philosophies. Thus, contextual sensitivity in IPA requires the researcher to consider not just the cognitive decisions made by the pilot but also the embodied and historical trajectory of his training, aircraft transitions, and the internalized logic of prior automation experiences. This goes beyond psychological or procedural analysis: it interrogates how the pilot's "sense of normal operation" was socially and technologically formed.

Contextual Sensitivity in Meta-Sensemaking

In this doctoral work's novel methodological extension, meta-sensemaking, contextual sensitivity is elevated to a second-order interpretive level. It is not only the participant's context that must be considered, but also the institutional context of the investigators who construct post-hoc narratives about the pilot's decisions. Investigation reports, such as those produced by the NTSB, are not neutral artifacts; they are embedded in epistemic cultures (Knorr-Cetina, 1999) that privilege certain forms of explanation, typically cognitive, technical, and procedural, over others, including embodied knowledge, organizational complexity, or cultural constraints. This institutional framing often creates discursive silences (Gee, 2011) in which crucial contextual elements are omitted or underemphasized. For example, while the report acknowledges that the PF had limited experience flying visual approaches with the auto throttle

disengaged, it does not fully explore the broader training environment, airline operational culture, or cognitive load from instructor oversight during the approach phase. As I apply meta-sensemaking as the researcher, I closely evaluate how the investigative report constructs its interpretive context and how that context shapes the framing of human error.

Contextual Detail and Idiographic Commitment

A hallmark of IPA is its idiographic orientation, which mandates detailed, case-specific analysis rather than broad generalization (Smith et al., 2009). Contextual sensitivity is therefore expressed through close textual and experiential engagement with individual cases. This means tracing how a pilot's identity, as a senior captain, a trainee in a new aircraft, a member of a Korean flight crew, and a human actor within a technocratic system, shapes and is shaped by the event. This idiographic stance is described as a worthy topic and rich in rigor in qualitative inquiry (Tracy, 2010). My responsibility as the researcher is to "stay with the trouble" of the case: to unpack its entangled social, technical, and linguistic dynamics without reducing it to universal cognitive errors or sanitized causal chains.

Contextual Sensitivity, Reflexivity, and Researcher Positionality

Contextual sensitivity in this methodology requires reflexivity on the part of the researcher. In both IPA and meta-sensemaking, I, as the researcher, am not a passive observer but an active co-constructor of meaning (Finlay, 2012). Acknowledging the interpretive lens through which one reads both the accident report and the pilot's experiences is essential. This includes recognizing one's own cultural assumptions, professional affiliations (e.g., in aviation safety), and methodological commitments. For

example, my training in safety investigation might initially align with procedural logics. However, I must remain open to alternative framings, such as viewing error as an emergent product of layered systems and cultural mismatches.

Contextual sensitivity is not a supplemental consideration in my study; it is central to the interpretive architecture of both IPA and meta-sensemaking. It requires attention to the embodied, institutional, cultural, and discursive contexts that shape human experience and its retrospective narration. By embracing this sensitivity, the study resists reductionist explanations and instead promotes a more nuanced, ethical, and epistemologically aware understanding of human error in aviation.

Meta-Sensemaking as a Second-Order Analysis

Meta-Sensemaking is introduced in my study as a second-order interpretive layer that examines how institutional texts, the safety investigation reports, make sense of aviation professionals' sensemaking. The meta-sensemaking, in conjunction with IPA, enables a meta-investigation, or an "investigation of an investigation," that interrogates the theoretical assumptions embedded in aviation safety reports. Developed as a methodological innovation that extends the interpretive capabilities of Interpretive Phenomenological Analysis (IPA), this approach is grounded in the concept of sensemaking as a retrospective, identity-forming process. It builds upon it by analyzing how investigative institutions narratively frame cognition, error, and accountability (Weick, 1995). This dual-layered analysis enables me, as the researcher, to interrogate the epistemological assumptions embedded in the NTSB report within the context of an interpretive phenomenological analysis.

While traditional IPA focuses on understanding how individuals make sense of their lived experiences, meta-sensemaking adds a second-order analytical lens to

investigate how those experiences, especially the processes of sensemaking themselves, are subsequently represented, interpreted, and institutionalized in formal discourse. This concept is crucial in aviation safety investigations, where post-hoc narratives frame human actions within specific epistemological and organizational contexts. Meta-sensemaking serves as a powerful analytical lens that extends the interpretive scope of IPA. It enables my research to move beyond first-order accounts of experience to examine how institutions interpret and reframe those accounts. This approach not only enhances methodological rigor but also highlights the complex discursive and epistemological dynamics that underpin aviation safety investigations.

Integrating meta-sensemaking with IPA requires attending not only to what is said about the lived experience, but also to how those descriptions are framed through institutional language. IPA's idiographic focus complements meta-sensemaking by enabling close, layered analysis of the textual representations of a singular, high-stakes incident. This dual-method approach allows for an exploration of both the micro-phenomenological aspects of pilot experience and the macro-discursive practices of institutional narrative production.

One key feature of meta-sensemaking is its ability to illuminate what is omitted or underemphasized in formal accounts. These discursive silences (Weick, 1995) often concern contextual factors, such as training systems, automation interface design, or cultural communication dynamics. Meta-sensemaking, therefore, functions as a hermeneutic of suspicion (Ricoeur, 1970), interrogating the text for what it chooses not to represent, or for how it frames human behavior in narrowly cognitive or technical terms.

The application of meta-sensemaking reveals the epistemological stakes involved in formal knowledge production in aviation safety. It highlights how knowledge about error, competence, and responsibility is stabilized through narrative form and institutional

authority. By analyzing these processes, my research contributed to broader critiques of safety epistemologies that privilege linear causality and decontextualized agency (Macrae, 2014).

In the context of aviation, safety investigations are structured around a need to produce coherent, causally linked narratives of events. These reports are not neutral; they reflect institutional values and epistemologies of safety (Dekker, 2016). Meta-sensemaking in this context reveals how these narratives assign responsibility, obscure systemic contributors, and reify normative assumptions about human error. By applying meta-sensemaking, I, as the researcher, identify how the Asiana Flight 214 accident report constructs a discourse around pilot behavior that reflects institutional priorities, such as adherence to procedure and technological fluency. By adopting an epistemological approach to safety, my study examined how safety is conceptualized, narrated, and policed within institutional texts. Safety is treated as a knowledge regime that stabilizes meaning through narrative structure and language (Dekker, 2016; Macrae, 2014). Meta-sensemaking unveils how these narratives promote particular norms while silencing others.

Trustworthiness, Rigor, and Ethical Considerations

The trustworthiness and rigor of the study were ensured through this methodology by employing the following strategies: (1) Achieving trustworthiness and credibility through thick description, prolonged engagement with the texts, and peer debriefing. (2) The dependability is achieved through documented methodological consistency. (3) The transferability was enabled through detailed contextual analysis. (4) The confirmability was enhanced through reflexive memoing and audit trails (Lincoln & Guba, 1985).

Although the study uses publicly available documents, ethical rigor was maintained by treating the actors represented in the documents with respect and avoiding deterministic interpretations. Interpretive humility was exercised in analyzing the pilot's cognitive processes, especially in high-stress and high-consequence scenarios.

Chapter V

RESULTS AND DISCUSSIONS

Data Presentation

The primary data for this dissertation came from the official investigative document issued by the National Transportation Safety Board (NTSB), specifically Accident Report No. NTSB/AAR-14/01, PB2014-105984, which was finalized and made publicly available on June 24, 2014. This report is titled Descent Below Visual Glide Path and Impact with Seawall: Asiana Airlines Flight 214, Boeing B777-200ER, HL7742, and pertains to the aviation accident that occurred on July 6, 2013, at San Francisco International Airport (SFO), California. The document is accessible through the NTSB's official online repository and has been utilized in this dissertation as a textual artifact for discursive and phenomenological analysis.

The selected report represents an official government document compiled and published by a federal investigative body responsible for enhancing transportation safety in the United States. As such, it constitutes a form of public domain data, freely accessible to the public and scholars alike, with no expectation of confidentiality, anonymity, or restricted access. This makes it particularly suitable for qualitative interpretive methodologies such as Interpretive Phenomenological Analysis (IPA) and discourse analysis, which emphasize the study of meaning-making through publicly available narratives (Smith, Flowers, & Larkin, 2009; Gill, 2014).

Public Nature of the Data

The NTSB operates under U.S. federal law, and its accident investigation reports are intentionally disseminated to promote transparency, accountability, and systemic learning. These reports are published in full detail, including cockpit voice recordings (transcripts), technical analysis, and findings, so that the broader aviation

community, including regulators, manufacturers, operators, and researchers, can benefit from the insights drawn. The public availability of such data serves a pedagogical and regulatory function, enabling critical examination of systemic weaknesses and human factors without compromising individual privacy (NTSB, 2013).

Unlike interviews or field observations, which may require informed consent due to the involvement of identifiable individuals in private settings, data sourced from government-issued accident investigation reports is already curated for public consumption. The identities of parties involved, when included, are either necessary for the report's factual integrity or are already part of the public record as a matter of law and aviation regulatory practice. Therefore, no breach of confidentiality or participant consent occurs in utilizing this data, aligning the research with ethical standards for the use of publicly accessible documents in social science research (British Psychological Society, 2021; American Psychological Association, 2020).

Aligning with Ethical Research Standards

My study adhered to prevailing ethical frameworks for research involving human subjects and textual data. According to the American Psychological Association's Ethical Principles of Psychologists and Code of Conduct (APA, 2020), the use of publicly available data that does not involve intervention or interaction with individuals, and where there is no reasonable expectation of privacy, does not constitute research involving "human subjects" in the traditional regulatory sense. Similarly, the British Psychological Society (2021) affirms that research using documents already in the public domain, especially those disseminated by governmental or official bodies, does not typically require ethics board review, provided the analysis is respectful. It does not misrepresent the data's original context or purpose.

Furthermore, the use of open-access archival material may be exempt from the ethics review, provided that such usage is grounded in scholarly inquiry and adheres to standards of citation and interpretive integrity (PHREB, 2022; UPLB, 2024)

Rationale for Research Use

The NTSB accident report was not analyzed solely for its technical or procedural content, but rather as a discursive text that encapsulates the institutional narration of human error, safety processes, and systemic causality. This aligns with the methodological framework of Interpretive Phenomenological Analysis in meta-sensemaking, which seeks to explore the constructed meanings and communicative practices embedded in institutional artifacts (Eatough & Smith, 2017). By treating the NTSB report as a reflexive document, both a representation of an event and a site of sensemaking, my research examined how human performance and communication are linguistically framed, evaluated, and memorialized within civil aviation safety narratives.

As such, the use of this data adheres not only to ethical guidelines but also enhances the depth and relevance of the phenomenological inquiry. It leverages publicly accountable institutional texts to interrogate the discursive constructions of error, silence, and safety in aviation investigations, without infringing on individual rights or requiring participant consent.

Data and Analysis

Demographics and Professional Background of the Key Flight Crew

Here are the demographic profiles, training histories, and aviation experience of the three principal crew members present in the flight deck during the final approach of Asiana Airlines Flight 214. The information was based on the official findings documented in the accident report issued by the National Transportation Safety Board (NTSB, 2013). The demographic and professional information presented establishes the background of each crew member who was present on the flight deck during the final phase of Flight 214. These profiles provide essential context for understanding the structure of roles, responsibilities, and qualifications as documented in the official accident report. Furthermore, these factual records establish the professional context in which each crew member was operating during the event.

Table No. 01: Flight Crew Members' Experience and Background

No	Crew Member – Function	Total Flight Hours	Aircraft Types Previously Flown
1	Pilot Flying (PF) – Captain (Trainee)	10,063 Hours (43 hours on the B777)	Airbus A320 SA Family, A330, and Boeing B737
2	Pilot Monitoring (PM)	12,387 Hours (3,200+ hours on B777)	Boeing 737, 747, 767
3	Relief First Officer	4,600 Hours (978 hours on B777)	Boeing 737, 747, 767

No	Crew Member – Function	Training Background
1	Pilot Flying (PF) – Captain (Trainee)	Recently completed ground school and simulator training for the B777 (On IOE during the accident).
2	Pilot Monitoring (PM)	Experienced instructor with recurrent training on the B777 and the CRM.
3	Relief First Officer	Completed type-rating training on the B777 and certified as a relief pilot.

Pilot Flying (PF): Captain Under Initial Operating Experience

The Pilot Flying (PF) at the time of the accident was serving as a trainee captain, undergoing Initial Operating Experience (IOE) for the Boeing 777-200ER. He had a total of 10,063 flight hours, with only 43 hours logged on the Boeing 777

platform. Prior to training on the B777, he had obtained type ratings and significant operational experience on multiple other aircraft, including the Airbus A320 family, Airbus A330, and Boeing 737.

Before the accident flight, the PF had completed the airline's required Boeing 777 ground school, full-motion simulator sessions, and associated technical proficiency evaluations. He was seated on the left side during the flight and was responsible for aircraft handling during the final visual approach to Runway 28L at San Francisco International Airport (SFO). His participation in this flight was part of the final stages of IOE, where trainee captains are paired with check airmen for line exposure in live operational environments.

Pilot Monitoring (PM): Line Instructor Captain

The Pilot Monitoring (PM) has held the position of instructor captain and was authorized to conduct IOE and proficiency checks for other flight crews. He possessed a total of 12,387 flight hours, with over 3,200 hours logged on the Boeing 777.

His flying career included extensive experience with various Boeing aircraft, including the Boeing 737, 747, 767, and 777. In addition to his line responsibilities, the PM had received recurrent training in instructional techniques, aircraft systems, crew resource management (CRM), and non-technical skills development, as part of his regulatory and organizational duties. On the day of the flight, he was seated in the right seat and designated as the Pilot Monitoring, while concurrently serving as the check airman supervising the PF's IOE progression.

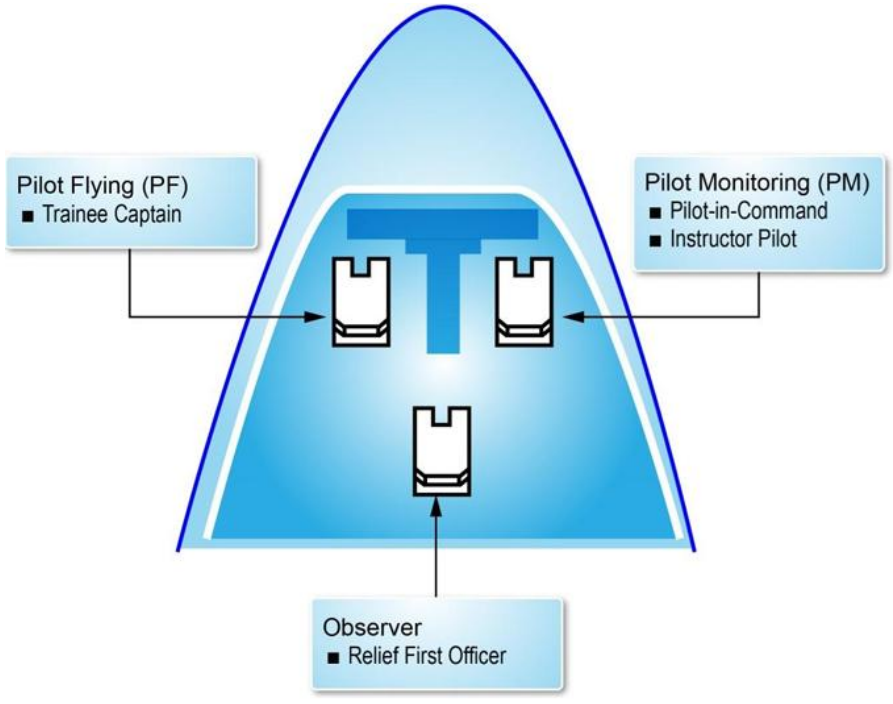
Relief First Officer (RFO): Jumpseat Occupant

The Relief First Officer (RFO) has held the appropriate qualifications to serve as a relief pilot on long-haul Boeing 777 operations. At the time of the event, his total

flight experience amounted to 4,600 hours, of which 978 hours were on the Boeing 777.

His aviation background included training and experience on various aircraft, particularly the Boeing 737, 747, and 767 series. On the day of the accident, he was seated in the cockpit jumpseat, not assigned any flight duty during the approach phase. He was not designated as one of the active flight crew members during the landing sequence, as his assigned role was to serve as a relief pilot during other segments of the trans-Pacific flight.

Illustration No.01: Flight Crew Cockpit Seating Locations (B777)
Figure Source: NTSB Accident Report/NTSB/AAR-14/01 PB2014-105984



Narrative Presentation of the Accident Data: Asiana Airlines Flight 214

On July 6, 2013, Asiana Airlines Flight 214, a scheduled international passenger service from Incheon International Airport (ICN), South Korea, to San Francisco International Airport (SFO), California, United States, experienced a catastrophic accident during final approach to runway 28L. The aircraft, a Boeing 777-200ER bearing registration HL7742, impacted the seawall located short of the runway threshold, resulting in extensive structural damage to the airframe, a post-crash fire, and the tragic loss of three passengers, with over 180 others sustaining injuries (National Transportation Safety Board [NTSB], 2014).

The investigation conducted by the National Transportation Safety Board (NTSB) culminated in the official report NTSB/AAR-14/01. This report presents a comprehensive, chronological, and causal reconstruction of the flight's final moments, examined from technical, operational, and human performance perspectives. Critically, the NTSB attributed the probable cause of the accident to the flight crew's mismanagement of the descent, inappropriate reliance on automation, and inadequate monitoring of airspeed, factors deeply embedded in communicative and cognitive coordination under high workload conditions.

The narrative arc presented in the report is structured through a multi-layered discourse: first, as an objective recounting of procedural deviations, and second, as an institutional account that frames error within a systemic context. This narrative includes statements from cockpit voice recordings, flight data analysis, crew interviews, and expert assessments. The report identifies a breakdown in crew resource management (CRM), a misinterpretation of the auto throttle mode logic, and delayed recognition of the critical loss in airspeed during the visual approach as core contributors to the mishap.

The captain, a highly experienced pilot transitioning to the Boeing 777 type, was receiving line-oriented flight training at the time of the accident. The presence of a training captain in the right seat, who was himself supervising the line training, adds complexity to the communication dynamics and authority gradients within the cockpit. According to the NTSB, the flying pilot (PF) believed the auto throttle would maintain the target approach speed, even though the automation had reverted to an inactive mode due to mode mismanagement, a crucial cognitive slip not detected by the monitoring pilot (PM). This scenario unfolded in the absence of precise and assertive verbal exchanges that could have mitigated the situation.

As the aircraft descended below the intended glide path, airspeed decayed dangerously low without timely corrective action. The pilot monitoring (PM) called for a go-around only at the final moments before impact, after which the tail of the aircraft struck the seawall, causing the fuselage to break apart upon runway contact. The final seconds of cockpit communication reveal fragmented efforts at recovery, characterized by abrupt, reactive verbal commands that came too late to avert the impact.

The final investigative report issued by the National Transportation Safety Board (NTSB/AAR-14/01) attributes the probable cause to the flight crew's mismanagement of the descent and airspeed during the final approach, their overreliance on automation, and the inadequate monitoring of critical flight parameters. However, beyond the procedural and technical findings, the report reveals a complex interplay of cognitive schemas, training paradigms, and communicative silences: elements that are central to this dissertation's focus on meta-sensemaking and discursive constructions of human error in civil aviation safety reports.

A particularly revealing discursive moment emerges in the analysis of the Pilot Flying's (PF) expectations regarding auto throttle behavior. During post-accident

interviews conducted by the NTSB, the PF expressed a belief that the auto throttle system was “protecting” the target airspeed and would “wake up” automatically as the aircraft slowed (NTSB, 2013). This belief appears inconsistent with Boeing’s auto throttle logic. It is not substantiated by any documented function of the 777’s automation modes under the configuration used at that time, namely, flight-level change (FLCH) mode with the auto throttle in hold. In this mode, the auto throttle does not automatically re-engage to maintain airspeed, and this behavioral characteristic of the automation was critical to the aircraft’s continued deceleration to a dangerously low airspeed.

This factual account is not merely a chronicle of technical failures; it reveals a deeper ontological terrain of miscommunication, cognitive overload, and organizational silence embedded in institutional learning systems. The accident narrative, while couched in the language of aeronautical logic and procedural analysis, simultaneously illustrates the phenomenology of confusion, misaligned expectations, and implicit assumptions between human actors and their technological interfaces.

The NTSB’s discursive construction of the report organizes causal links within a linear framework, linking antecedents, decisions, and outcomes, but it leaves open interpretive spaces in which meta-sensemaking can uncover latent dimensions of meaning. For instance, the pilots’ reliance on automation was not merely a technical misunderstanding but a reflection of deeply sedimented cultural practices and operational training norms that shaped their expectations about aircraft behavior. The report’s findings on CRM performance, monitoring failures, and automation mode awareness reflect communicative conditions that were structurally predisposed to error.

Moreover, the report’s presentation of pilot statements, though procedural, implicitly renders a phenomenological encounter with ambiguity, hesitation, and

unvoiced assumptions. The CVR transcript fragments provide a linguistic record of what was said, while also drawing attention to what was not said, what was misunderstood, and how time-bound decision-making unfolded under institutional constraints and experiential uncertainty.

By treating this report as both data and discourse, my study was situated within a second-order analytical frame, that of meta-sensemaking, which interrogates not only what happened but also how the meaning of what happened is constructed, disseminated, and implemented within the wider social and technical system of aviation safety management.

In this way, the NTSB/AAR-14/01 report becomes more than a technical source; it becomes a discursive site through which civil aviation safety is negotiated, narrated, and legitimized. It presents a textual opportunity for interpretive phenomenological analysis that aligns with the aims of this dissertation: to examine how human error is constructed, communicated, and reinforced in institutional texts, and to analyze how such constructions contribute to the organizational memory and culture of safety in civil aviation.

Illustration No.02: Accident of Asiana Flight 214
Figure Source: NTSB Accident Report/NTSB/AAR-14/01 PB2014-105984



Interpretive Phenomenological Analysis

Interpretive Phenomenological Analysis (IPA) was employed in my research to explore the lived, communicative, and meaning-making experiences as embedded in the narrative and structural composition of the NTSB's accident report on Asiana Airlines Flight 214. IPA's focus on understanding how individuals make sense of their experiences (Smith, Flowers, & Larkin, 2009) makes it well-suited for analyzing institutional texts that narrate human actions, intentions, and judgments in high-stakes environments such as commercial aviation.

Rather than treating the NTSB report as merely an objective factual record, this analysis approaches it as a discursive and phenomenological text, one that encodes fragments of cockpit life, operational reasoning, and social interaction within the institutional frame of aviation safety reporting. By identifying themes from this text, the IPA method enabled a second-order sensemaking process, the meta-sensemaking, to surface latent patterns of cognition, silence, expectation, and action that characterized the crew's experience and performance during the final approach phase of Flight 214.

Through IPA, a multi-layered interpretive account of how the crew of Flight 214 may have lived, perceived, and made sense of their roles, environment, and technologies during a critical flight phase. The emergent themes: automation disorientation, silence, authority ambiguity, experiential carryover, and temporal fragmentation, reveal not only operational conditions but the subjective texture of aviation performance under ambiguity.

The NTSB report, when approached as a discursive text, becomes a source of interpretive insight into how human actors navigate, assume, and communicate meaning within sociotechnical systems. This analysis contributes to the broader

project of this dissertation by uncovering the interpretive undercurrents embedded in institutional narratives of human error.

NTSB Replay Snapshots:

Illustration No.03: Above glide path (slope) Asiana Flight 214
Source: NTSB Video Animation / https://youtu.be/8MFPSfGoT1U?si=JDC44qsAjDv02beV

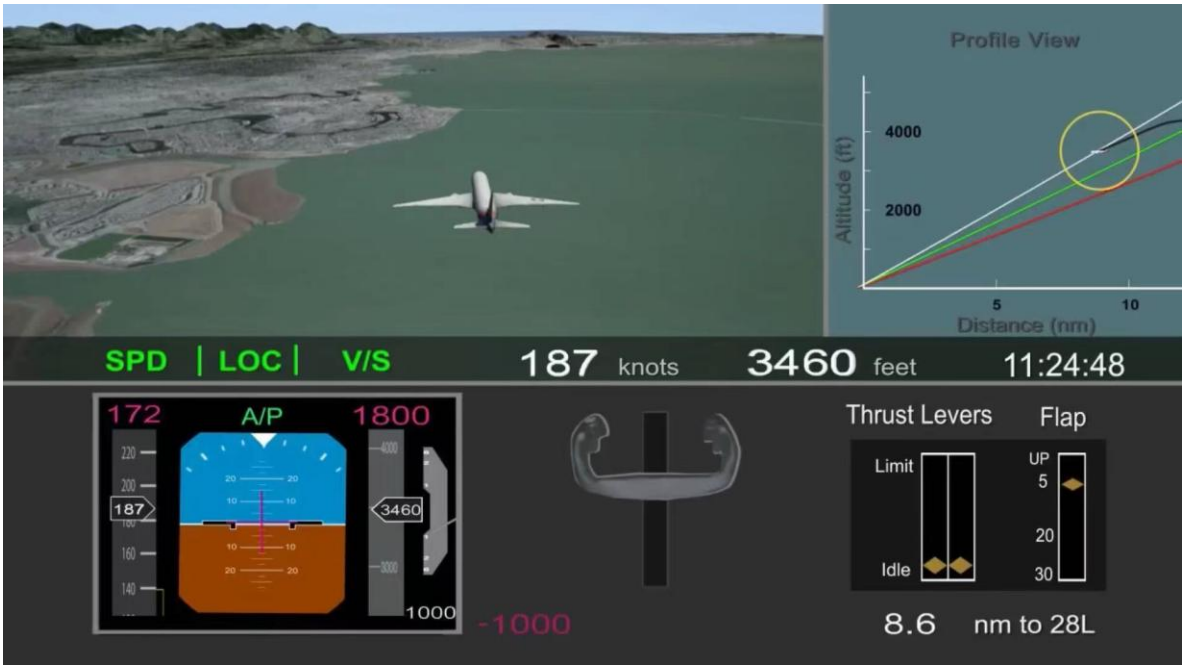
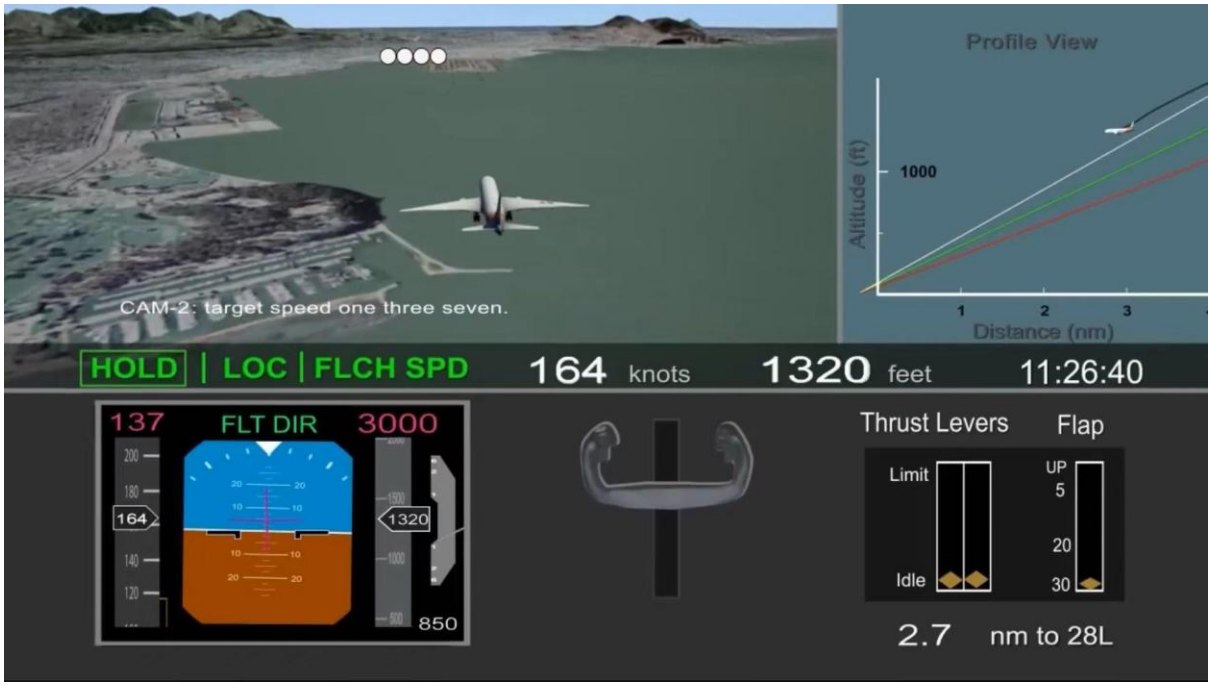


Illustration No. 04: Autopilot in HOLD MODE, Asiana Flight 214
Source: NTSB Video Animation / https://youtu.be/8MFPSfGoT1U?si=JDC44qsAjDv02beV



Emergent Themes Asiana Airlines Flight 214

Table No. 02: Emergent Themes on Asiana Flight 214

Theme No.	Narrative Excerpts	Descriptive Code	Emergent Theme	Interpretive Insight
1	*"The PF assumed that the auto throttle would maintain airspeed although it was in HOLD MODE." (NTSB Transcript, 2013, p. 208).* *"Some pilots expect the automation to do certain things, which the automation does not do because there are gaps and misconceptions about how the automation works." (NTSB Transcript, 2013, p. 171).* *"We identified vulnerabilities in that pilots sometimes rely too much on the automated systems and may be reluctant to intervene. We saw that autoflight mode confusion errors continue to occur." (NTSB Transcript, 2013, p. 152).*	Misunderstanding of the auto throttle engagement logic during descent	Disorientation in Automation Mode Awareness	An autopilot schema mismatch leading to reliance on non-existent system behavior.
2	Context: There was no discussion among the crew regarding the decaying airspeed until the final moments. *(NTSB Transcript, 2013, p. 25).*	Lack of challenge or inquiry during the abnormal approach configuration	Silence and Unspoken Assumptions in the cockpit	The "social silence" constrained all opportunities for proactive intervention and clarification.
3	Context: The instructor captain (PM) did not initially intervene because the trainee captain (PF) was managing the approach." *(NTSB, 2013, p. 100).* "How far can	Deference of PF to the PM: unclear supervisory interventions	Authority Gradient and Instructional Ambiguity	Instructional role ambiguity limited assertiveness and cognitive cross-checking.

	an instructor allow a trainee to deviate from the procedures?" (NTSB Transcript, 2013, p. 111).			
4	"The PF had extensive Airbus experience and referred to speed protection functions not present in the B777." *(NTSB Transcript, 2014, p.109, and 208).*	PF's Airbus experience shaping Boeing's System expectations	Legacy of Prior Aircraft Experience	Residual mental models from Airbus influenced situational expectations.
5	The PM initiated a go-around call at 200 feet above ground level (AGL), which was too late to avoid the impact to the ground *(NTSB Transcript, 2013, p.25). "I don't understand or I cannot tell how much stress the Captain received because he was such an experienced pilot" (NTSB Transcript, 2013, p. 110).*	Rapid succession of tasks dilutes the CRM's effectiveness	Temporal Pressure and Fragmented Monitoring	A degraded crew monitoring amid a high workload reflects diminished attention bandwidth.

Emergent Theme 1: Disorientation in Automation Mode Awareness

One of the most significant experiential motifs observed in the report is the disorientation in automation awareness expressed by the Pilot Flying (PF). During post-accident interviews, the PF stated that he believed the aircraft's auto throttle would maintain target approach speed during the descent. However, the Boeing 777's automation was in FLCH SPD mode with auto throttle in HOLD, a configuration that does not provide automatic speed protection (NTSB Transcript, 2013, p. 138, 152, 171, and 208). This reveals a misalignment between the PF's cognitive expectations and the aircraft's actual logic.

Through an interpretive lens, this theme highlights a phenomenology of automation expectation: the experience of assuming technological assistance where

none actually exists. While not directly verbalized during the approach, this internal assumption shaped the PF's engagement with the aircraft's behavior. The crew's experience here is marked by silent disorientation, an internalized misperception uncorrected by external dialogue.

Emergent Theme 1: Analytical Dimensions

Analytical Dimensions	Context
Narrative Excerpts	*"The PF assumed that the auto throttle would maintain airspeed although it was in HOLD MODE." (NTSB Transcript, 2013, p. 208).* *"Some pilots expect the automation to do certain things, which the automation does not do because there are gaps and misconceptions about how the automation works." (NTSB Transcript, 2013, p. 171).* *"We identified vulnerabilities in that pilots sometimes rely too much on the automated systems and may be reluctant to intervene. We saw that auto flight mode confusion errors continue to occur." (NTSB Transcript, 2013, p. 152).*
Descriptive Code	The misunderstanding of auto throttle engagement logic during descent.
Discursive Interpretation	Institutional discourse obscures the experiential tension of relying on automation.
Interpretive Insight	The autopilot system mismatch results in unverified expectations of system behavior.
Meta-Sensemaking Layer	Latent belief in automation protection reveals a second-order misalignment between perceived and actual aircraft behavior, shaped by prior training and cognitive carryover from Airbus systems.

Table No. 03: Emergent Theme No.1 Analytical Dimensions

Emergent theme no.1 underscores the dissertation's broader argument: that civil aviation safety investigations are not only about reconstructing causality but also about reconstructing meaning. The PF's automation disorientation illustrates how latent cognitive structures were formed through training, culture, and prior experience, and may shape lived performance in subtle yet consequential ways. It also demonstrates how the language of safety reports renders such experiences legible through a mixture of empirical data and institutional interpretation. This theme's analytical dimensions are presented as follows:

The theme of “Disorientation in Automation Mode Awareness” captures a central interpretive insight into the cognitive and communicative breakdowns that occurred in the final moments of Asiana Airlines Flight 214. Through the lens of Interpretive Phenomenological Analysis (Smith, Flowers, & Larkin, 2009), this theme reveals the lived disjuncture between the Pilot Flying’s (PF) internal mental model of auto throttle behavior and the actual functioning of the Boeing 777’s flight management system.

The NTSB report transcript (2013) presents a pivotal narrative moment in which the PF admitted that he believed the auto throttle system would automatically maintain the target airspeed during descent. Specifically, the PF assumed the auto throttle would “wake up” and resume speed protection, even though the system was in HOLD mode under FLCH SPD, a configuration in which speed is not protected (NTSB, 2013). This misunderstanding reflects not just a technical error, but a phenomenological experience of expectation, of technological reliability, that was silently carried into the cockpit environment.

Phenomenologically, this represents an instance of schema mismatch. In this situation, the pilot’s mental script of system behavior, likely influenced by prior Airbus experience, was incompatible with the actual operational logic of the Boeing system. This internal belief was not verbally tested or externally validated within the cockpit team. Thus, disorientation was not voiced but instead embodied, becoming a silent cognitive distortion that remained unchecked due to a lack of dialogic challenge or clarification.

Discursively, this error was structured within the report in procedural language, but beneath this institutional framing lies a rich interpretive field of lived assumptions and communicative silences. The PF’s belief in speed protection suggests an unexamined reliance on automation, a tacit trust in the system that displaced the

necessity for continuous manual vigilance. The report's institutional voice acknowledges the error, but it also reveals a deeper terrain of unvoiced expectations and deference, typical of high-risk organizations operating under time pressure and technological complexity (Dekker, 2014; Hollnagel, 2011).

From a meta-sensemaking perspective, this theme illustrates how the institutional text itself participates in shaping the meaning of error. By articulating the mismatch between expected and actual automation behavior, the report becomes a discursive site where aviation safety is negotiated, not merely through technical correction but through epistemic realignment, that is, a social and institutional process of constructing shared meanings. Aviation safety is not merely observed; it is constructed, framed, and stabilized through language in the safety report. The PF's error, then, is not simply operational; it is ontological, involving a misrecognition of the relationship between human and machine within a sociotechnical system.

Emergent Theme 2: Silence and Unspoken Assumptions in the Cockpit

The narrative reveals extended periods of communicative silence, particularly regarding the aircraft's decaying airspeed. There was no explicit cockpit conversation about airspeed deterioration until approximately seven seconds before impact, when a late go-around call was made (NTSB, 2013, p. 25). This silence reflects more than a failure of verbal protocol; it represents a lived experience of unvoiced uncertainty, where pilots' assumptions about monitoring roles and automation performance remained unchallenged.

From an IPA perspective, the absence of dialogue reflects a shared but unspoken mental model, wherein each crew member may have expected the others to detect and manage deviations. This situational ambiguity materialized in quiet

tension rather than verbal articulation, underscoring how ***communicative omissions shape the phenomenological texture of decision-making under pressure***.

Emergent Theme 2: Analytical Dimensions

Analytical Dimensions	Context
Narrative Excerpt	Context: There was no discussion among the crew regarding the decaying airspeed until the final moments. *(NTSB, 2013, p. 25).*
Descriptive Code	The lack of challenge during an abnormal approach configuration.
Discursive Interpretation	Discursive silence reflects latent expectations, social inhibition, and role ambiguity within CRM.
Interpretive Insight	An experience of shared but unspoken certainty when each crew member expected others to act.
Meta-Sensemaking Layer	A tacit mutual deference shaped by institutional norms, cockpit hierarchy, and non-verbal alignment, resulting in an interpretive inaction.

Table No. 04: Emergent Theme No.2 Analytical Dimensions

Emergent theme no. 2 presents the silence and unspoken assumptions that reaffirm one of the central arguments of this doctoral work: that aviation safety reports are not just technical archives but discursive texts, where meaning is constructed through both presence and absence. By analyzing the NTSB's account of Flight 214 through IPA and meta-sensemaking, silence emerges not as a gap but as a site of lived, embodied uncertainty that contributed to the accident's tragic trajectory. Emergent theme No. 2 analytical dimensions are presented as follows:

From the accident narrative of Asiana Airlines Flight 214, one of the most striking phenomenological features is the extended period of communicative silence among the flight crew during a time of escalating flight risk. This theme, Silence and Unspoken Assumptions in the Cockpit, emerges from both the transcript evidence and the absence of dialogue about the aircraft's decaying airspeed until the final seven seconds before impact (NTSB Transcript, 2013, p. 25). Unlike errors of commission, this theme revolves around what was not said, a profound space of communicative inaction that reflects shared yet unarticulated assumptions.

From an Interpretive Phenomenological Analysis (IPA) standpoint, silence in this context is not emptiness; it is experientially full. It suggests a horizon of mutual but unvoiced expectations: that someone else in the cockpit was monitoring, that the automation was functioning correctly, or that intervention was unnecessary. This shared silence implies that the crew may have been acting under a collectively assumed mental model, what Weick (1995) might call an “enacted environment,” in which each individual deferred to the other’s perceived awareness or judgment.

The CVR analysis and the NTSB’s report (2014) note that no challenge, inquiry, or collaborative questioning took place regarding the dangerous drop in airspeed. This lack of dialogue created a discursive vacuum; an interpretive blind spot where a breakdown in interpersonal coordination obscured the opportunity for timely action. The theme highlights a relational phenomenon: silence as a shared, embodied practice shaped by norms of cockpit hierarchy, training cultures, and cognitive workload.

Discursively, the silence operates as a structural absence in the report, which is a space where words might have redirected the course of action but never came. This mirrors what aviation linguists call “institutional silence” (Antaki et al., 2002), where the lack of challenge is not accidental but shaped by social expectations around deference, authority, and non-confrontation, especially in high power-distance cultures or hierarchical cockpit dynamics. In this way, silence becomes a performative act: the non-speech that signifies trust, restraint, uncertainty, or conflict avoidance.

From a meta-sensemaking perspective, the silence is not merely an operational lapse but a discursively significant event. It reflects the latent epistemologies of aviation safety culture: the norms, assumptions, and shared beliefs that shape how information is communicated, when speech is considered necessary, and how

authority is distributed across roles. Silence becomes the medium through which safety was negotiated, misinterpreted, and ultimately compromised.

Most importantly, the NTSB (2014) report does not portray this silence as negligence. Instead, it situates it within the broader communicative and cognitive conditions of the cockpit during a time-pressure, visually demanding manual approach. The absence of dialogue, in this reading, is not a failure but a phenomenological artifact of how lived experience unfolds in real time under ambiguity and expectation. The Interviews conducted by the NTSB indicated that each pilot assumed the other was aware and managing the situation. No explicit monitoring statements or corrective interventions were recorded until it was too late. My research recommends the term “reciprocal blind assurance” or RBA for this emergent theme. The reciprocal blind assurance connotes a phenomenological and epistemic communicative condition in which actors mutually mirror the same presumption, creating a sense of confidence or assurance that is masked by an underlying uncertainty. The term RBA in my study was epistemologically introduced as an “absence of explicit verification,” which conveys a tacit message of presumed alignment. In the lens of meta-communication, my study reframes systematic vulnerability, where communicative inaction may lead to, or produce, discursive blind spots within the narratives of aviation safety and investigation reports.

Emergent Theme 3: Authority Gradient and Instructional Ambiguity

During the final approach phase of Flight 214, the cockpit was occupied by three pilots: the trainee captain who was also assuming the PF role in the final phase of Initial Operating Experience (IOE), the senior captain acting as the instructor, and also assumed the pilot monitoring (PM) role, and the relief first officer occupying the jump seat.

Each of the flight crew members plays a unique role in the cockpit. The PF role is the actual pilot flying the airplane in a flight leg. PF may be seated in either the left or right seat in a commercial airplane cockpit. The PM is the co-pilot sharing the workload with the PF. The shared tasks may include instrument monitoring, situational awareness support, cockpit callout, and communications with air traffic controllers, among others. The relief first officer acts as a relieving pilot for either the left or right seat. This position is the standard for flights that exceed eight hours.

The instructor captain, acting as Pilot Monitoring (PM), did not take assertive control during the visual approach despite signs of deteriorating flight performance. He later explained that he believed the PF was intentionally performing a delayed descent and that he did not want to interfere with the PF's judgment (NTSB, 2013, p. 110). This deference reveals a blurred boundary between instructional oversight and operational authority.

In IPA terms, this moment exemplifies the lived complexity of role duality, where the instructor's responsibility to evaluate intersects with the human inclination to trust a colleague's judgment. The PM's experience may have involved negotiating internal doubts against an institutional role that emphasizes mentorship and non-intrusion. This ambiguous zone of authority forms a horizon of interpretive uncertainty, shaping how actions, or inactions, were experienced and justified in the moment.

Emergent Theme 3: Analytical Dimensions

Analytical Dimensions	Context
Narrative Excerpt	"The PM likely did not see the need to provide the PF with continuous active coaching; the PM did not intervene or otherwise ensure that needed corrections were made to the airplane's vertical path (NTSB, 2013, p.100)."
Descriptive Code	Deference of PF to the PM: unclear supervisory interventions.
Discursive Interpretation	The safety report reflects how mentorship norms constrained assertiveness and muted vital oversight within the cockpit CRM.
Interpretive Insight	Lived ambiguity in role responsibility, where instructional and operational authority boundaries blurred.

Meta-Sensemaking Layer	A structural ambiguity in authority roles created a space where cognitive checks were withheld, shaped by institutional deference, and instructional hesitation.

Table No. 05: Emergent Theme No.3 Analytical Dimensions

The third emergent theme, *authority gradient and instructional ambiguity*, exposes a critical tension in cockpit interaction during the final moments of Asiana Airlines Flight 214. It centers on the dynamic between the Pilot Monitoring (PM), an instructor-captain, and the pilot flying (PF), a trainee-captain undergoing Initial Operating Experience (IOE). The PM's post-accident statement that he "did not initially intervene because he believed the trainee captain was managing the approach" (NTSB, 2013) reflects a more profound ambiguity in role authority and pedagogical boundaries.

Emergent Theme 3 invites an inquiry into the ways institutionalized hierarchies, evaluative scripts, and instructional cultures mediate the enactment of safety-essential decisions. This dissertation reinforces its broader argument: that safety is not merely about rule-following, *but about how meaning is negotiated under ambiguity, and how institutional texts, such as NTSB reports, both reflect and reproduce those negotiations through their construction of error*. The analytical dimensions of emergent theme No.3 are presented as follows:

From an Interpretive Phenomenological Analysis (IPA) perspective, this moment represents a lived complexity in which professional roles were layered, entangled, and internally negotiated. The PM occupied dual identities: as both an evaluator and a safeguard. The instructor's role demands oversight and non-interference, while the operational authority of a line captain expects decisive action when safety is threatened. The phenomenological experience here is marked by hesitation, a moment where the instinct to trust a colleague's judgment coexisted with latent cognitive dissonance about deteriorating flight parameters.

Discursively, this theme reveals how institutional expectations of mentorship and assessment may inhibit assertive intervention, particularly when instructional authority is socially mediated by deference, professional courtesy, and perceived trainee autonomy. The NTSB report renders this deference not as a singular error, but as part of a structural pattern within CRM and training cultures, where lines of authority become ambiguous in the presence of rank and instructional hierarchy.

This ambiguity becomes even more pronounced in the meta-sensemaking framework. At a second-order level, the failure to intervene becomes not simply a lapse in procedure but an artifact of organizational epistemology, how knowledge, authority, and safety responsibilities are distributed, interpreted, and normalized within civil aviation institutions. The instructor's restraint is not personal, it is patterned. It is shaped by pedagogical scripts, CRM doctrine, and institutional cues that constrain when and how mentorship crosses into command authority.

The authority gradient, in this context, is not a clear vertical divide. It is texturally nuanced, woven with normative expectations of how seniority, training, and safety intersect. The report subtly gestures to this gradient through its phrasing, implying that trust in the PF's perceived competence may have overridden early signs of automation mismanagement. However, by capturing this moment through a factual lens, the report inadvertently masks the interpretive burden of navigating unclear instructional boundaries in real-time.

From a meta-sensemaking lens, this theme also serves as a discursive signal of the invisible forces that govern cockpit culture, forces that are not found in SOPs or checklists, but instead in how aviation professionals are trained to interpret and respond to one another's behavior. Instructional ambiguity is thus both a phenomenological experience (lived confusion, evaluative restraint) and a discursive artifact (how the report rationalizes inaction through contextual framing).

Emergent Theme 4: Legacy of Prior Aircraft Experience

The pilot flying (PF) had accumulated extensive flight hours on Airbus aircraft before transitioning to the Boeing 777. In post-accident testimony, he referred to the aircraft "waking up" the auto throttle if speed decayed, a concept consistent with Airbus's Alpha Floor protection but not applicable to the Boeing 777's automation logic (NTSB, 2013, p. 68).

This statement brings forward the phenomenological sedimentation of prior experience, where past operational contexts shape present expectations. The PF's embodied familiarity with Airbus systems seemingly informed his interpretation of the Boeing cockpit interface. IPA allows us to consider how previous training and operational environments remain experientially active, even as pilots adapt to new aircraft, thus shaping their present-day sensemaking and interaction with automation.

Emergent Theme 4: Analytical Dimensions

Analytical Dimensions	Context
Narrative Excerpt	"The PF had extensive Airbus experience and referred to speed protection functions not present in the B777." *(NTSB Transcript, 2014, p.109, and 208; NTSB, 2013, p 14, 68, 93).*
Descriptive Code	PF's Airbus experience was shaping Boeing's system expectations.
Discursive Interpretation	The report presents an institutional framing of prior experience as a latent influence on automation misjudgment.
Interpretive Insight	Residual cognitive models from prior aircraft shaped moment-to-moment interpretations of the current system behavior
Meta-Sensemaking Layer	Pilot expectation formed by past familiarity with Airbus systems reveals how experiential carryover contributes to systemic ambiguity and reinforces organizational learning limits.

Table No. 06: Emergent Theme No.4 Analytical Dimensions

Emergent Theme 4 demonstrates that even within a culture of procedural precision, human engagement with machines remains deeply historical, contextual, and discursively mediated. This realization invites a broader epistemic humility: that aviation safety cannot simply rely on procedural compliance or retraining but must also engage with the phenomenology of technological familiarity and how (past) experience

silently shapes present cognition. A legacy of prior aircraft experience reveals how residual mental models, formed through previous operational contexts, can influence moment-to-moment interactions with automation in high-stakes environments. In the case of Asiana Airlines Flight 214, the Pilot Flying (PF) had logged extensive flight hours on Airbus aircraft before transitioning to the Boeing 777. During post-accident interviews, he referenced a belief that the auto throttle would automatically “wake up” and resume speed protection, an expectation consistent with Airbus Alpha Floor logic, but incompatible with Boeing’s FLCH SPD mode, where the auto throttle does not re-engage when in HOLD (NTSB, 2013, p. 136, 137). The analytical dimensions for emergent theme No.4 are presented as follows:

From an Interpretive Phenomenological Analysis (IPA) perspective, this incident reflects how embodied experience, accrued through thousands of hours in a different aircraft type, continues to live in the perceptual and cognitive frames of pilots even after retraining. This legacy is not simply technical; it is phenomenological. It shapes what is expected, what is attended to, and what is assumed to be “normal” in the interaction with complex automation systems. The PF’s belief in a non-existent protection mechanism is not an irrational error, but a situated assumption: an interpretive residue carried over from a previously habituated technological environment.

Discursively, the NTSB (2014) report presents this as a latent factor, noting the PF’s reliance on Airbus-based logic as a contextual contributor to his misinterpretation of Boeing automation. However, the language remains neutral, preserving a tone of objectivity that defers from assigning direct blame. What is notable here is the subtle institutional encoding of prior experience as a tacit risk factor; a framing that implies systemic gaps in transition training and organizational awareness, without overtly problematizing them.

This is where the meta-sensemaking lens adds critical depth. By interpreting the PF's cognitive dissonance as a function of experiential sedimentation, the analysis reveals how the temporal layering of aviation professional history continuously shapes aviation safety. The aircraft may change, but the pilot's sensemaking tools, expectations, muscle memory, and tacit trust in automation behavior are not immediately overwritten. The legacy of the Airbus ecosystem remained active within the Boeing context, creating a structural ambiguity in the pilot's operational mental model.

The report's treatment of this legacy experience becomes a discursive site where institutional learning is negotiated. Rather than confronting the full implications of training adaptation and cross-platform reorientation, the report frames this moment as a subtle misalignment. However, this subtlety itself is instructive, revealing how aviation institutions rationalize experiential interference without thoroughly interrogating how such interference is produced, reinforced, and potentially preventable.

Viewed through the conceptual framework of this dissertation, this theme highlights the importance of reflexivity in safety culture. Experiential legacy is not a "human error" in the traditional sense; it is a symptom of organizational myopia, a failure to recognize how deeply human sensemaking is embedded in past practice. In high-reliability systems, such sedimentation poses ongoing interpretive challenges, especially as pilots transition across different aircraft architectures with varying automation philosophies.

Emergent Theme 5: Temporal Compression and Fragmented Monitoring

During the final moments of flight, cockpit actions became increasingly compressed. The go-around call came at approximately 200 feet above ground level:

too late to execute and effect a successful escape maneuver (NTSB, 2013). The report shows that both PF and PM were engaged in other tasks, and the degradation of airspeed occurred without sustained monitoring.

This theme reflects the temporal narrowing often experienced under time-constrained, high-stakes conditions. From a phenomenological standpoint, this compression of time dilutes cognitive bandwidth and interpersonal attentiveness, leading to fragmented engagement with flight variables. The flight crew's lived experience was likely characterized by an intensifying perceptual overload, wherein attentional resources were pulled toward immediate tasks, eclipsing global monitoring.

Emergent Theme 5: Analytical Dimensions

Analytical Dimensions	Context
Narrative Excerpt	"The PM declared the go-around at 200 feet above ground level (AGL), which was too late to avoid the impact to the ground" *(NTSB, 2013, p. 98; NTSB Transcript, 2013, p.25).*
Descriptive Code	Rapid succession of tasks dilutes the CRM's effectiveness.
Discursive Interpretation	The safety report portrays temporal constraints as degrading team monitoring cohesion, without thoroughly interrogating institutional contributors to task saturation.
Interpretive Insight	Crew performance was characterized by perceptual narrowing, where the escalating workload led to fragmented situational awareness.
Meta-Sensemaking Layer	Time-compression created a horizon of urgency in which attentional resources collapsed, foregrounding moment-to-moment action while limiting vigilance and situational awareness.

Table No. 07: Emergent Theme No.5 Analytical Dimensions

Emergent theme No. 5 invites critical reflection on how aviation safety must contend with the phenomenology of time. High-tempo phases of flight create not only operational demands but also interpretive distortions, in which the crew's understanding of the situation is fragmented, delayed, or saturated. Safety, in this light, becomes not just a function of what is known, but of how much time is available to know it.

Temporal Compression and Fragmented Monitoring (emergent theme No.5) captures the experiential narrowing of cognitive and communicative capacity as the

flight crew of Asiana Airlines Flight 214 entered the final, critical seconds before impact. The NTSB report notes that the go-around call was initiated by the Pilot Monitoring (PM) at about 200 feet above ground level (AGL), a point far too late for effective execution (NTSB, 2013, p. 25). This moment epitomizes the lived consequences of escalating time pressure and attentional saturation. The analytical dimensions for the emergent theme No.5 are presented as follows:

From an Interpretive Phenomenological Analysis (IPA) perspective, this theme surfaces the embodied phenomenology of overload: the tightening of time horizons, the collapse of distributed awareness, and the reduction of complex environmental cues to immediate, fragmented stimuli. The crew's monitoring behavior did not fail in an absolute sense; rather, it was fragmented by task saturation, where too many cognitive demands competed for finite attentional resources. Each pilot, situated in their respective roles, responded to a field of rapidly evolving signals under conditions that discouraged holistic processing and prioritized reactive engagement.

Phenomenologically, this compression of time transforms the cockpit into a space of urgency, not just temporally, but epistemically. Decision-making becomes compressed into immediacy, rendering the broader situational picture secondary or even invisible. The crew's CRM breakdown in this moment is less about neglect than about cognitive bandwidth erosion, where procedural knowledge was present, but perceptually unreachable due to temporal intensity.

Discursively, the NTSB (2014) report conveys this urgency through neutral narration, a factual sequencing that outlines the timing of events without dramatization. However, this objectivity belies the affective and interpretive conditions under which those events were experienced. The report implies systemic strain but does not fully explore how institutional conditions, such as cockpit role configuration, training under time-constrained simulations, or workload design, contribute to temporal vulnerability.

In this way, the institutional voice normalizes urgency as an operational reality, rather than as a design flaw.

From a meta-sensemaking standpoint, this theme reveals the systemic limits of human interpretive capacity under compressed temporal frames. Time is not merely a backdrop but becomes an actor in the cockpit, one that actively shapes what is noticed, what is ignored, and what meanings are available to be constructed. When time compresses, interpretive clarity diminishes. Monitoring becomes reactive. Communication becomes reduced to late-stage commands, and intersubjective verification collapses.

This insight also reframes the notion of “human error” in institutional texts such as NTSB reports. The PM’s late go-around call is not just a delay; it is a discursive marker of compression, a symptom of deeper systemic forces that configure attention, decision thresholds, and error detection under high temporal stress. By documenting this moment, the report becomes a discursive crystallization of the limits of proceduralism: the idea that correct decisions can always emerge from training and standardization, even when lived time disrupts those assumptions.

Discussions

Emergent Theme 1: Disorientation in Automation Mode Awareness

The textual and phenomenological coding of cockpit dialogue and accident report findings reveal a recurrent pattern of confusion surrounding the operational status and logic of the Boeing 777-200ER’s auto throttle system. The Pilot Flying (PF), who was undergoing Initial Operating Experience (IOE) and had extensive experience with the Airbus A320-series, believed that the auto throttle system was engaged and would maintain the selected airspeed during the final approach. However, as the aircraft was in Flight Level Change (FLCH) mode with auto throttle in HOLD, the

system did not provide speed protection. This misunderstanding persisted until the aircraft was below 500 feet AGL, at which point airspeed had decayed significantly, and a go-around call was made too late to prevent impact (NTSB, 2013).

The data presents an apparent disconnect between the PF's mental model of automation behavior and the actual state logic of the Boeing automation suite. Verbal transcripts derived from crew interviews and post-event reflections all reflect a phenomenological disorientation, that is, a lived experience in which perceived aircraft status and expected behavior did not align with the technical reality.

Interpretive Insight: Lived Disorientation

From an Interpretive Phenomenological Analysis (IPA) perspective, this theme illuminates a pilot's lived experience of trust and expectation in automation, marked by a gradual realization that the aircraft's behavior deviates from internal expectations. The PF's reliance on automation to manage speed, while automation was functionally disengaged, reveals an experiential gap between knowing (procedural knowledge) and sensing (real-time perception of system states). This aligns with Merleau-Ponty's (Merleau-Ponty, 1962) description of the "body schema" becoming misaligned with environmental affordances, in this case, the embodied understanding of how the automation should behave based on prior Airbus experience.

The PF's decision not to verify airspeed manually, nor to verbalize his assumption about auto throttle behavior, suggests a suspension of manual vigilance in favor of assumed technological reliability. This state of disorientation was not abrupt but incremental and tacit, occurring over several minutes of descent as attention became fragmented and reactive.

Meta-Sensemaking Perspective: Epistemic Gaps in Automation Literacy

Within the meta-sensemaking framework (which is my study's second-order analytical lens), this disorientation is not merely a human-machine interaction problem, but an epistemic failure embedded in how safety, control, and responsibility are socially constructed in the cockpit. The PF's belief that "the auto throttle would wake up" reflects a cognitive carryover from Airbus's Alpha Floor protection logic, where speed management is retained under most flight modes. Boeing's FLCH mode, by contrast, requires continuous manual verification of speed unless specifically engaged.

Here, meta-sensemaking reveals how experiential residues from different aircraft logic architectures form part of the pilot's interpretive equipment. The auto throttle was not misunderstood in a vacuum; it was misunderstood through the lens of prior training, technological philosophy, and aircraft culture. The PF's sensemaking was shaped by a layered past, where automation systems had always prioritized speed, and thus vigilance was gradually trained out over time.

More critically, this disorientation was not challenged, neither by the Pilot Monitoring (PM), nor by the crew's checklists or standard operating procedures. This institutional silence suggests that automation disorientation is systemically under-articulated within training and operational cultures. The data in emergent theme no. 1 imply that disorientation was collectively constructed, silently reinforced, and only became visible after the event, through the investigative discourse.

Discursive Construction in the NTSB Report

The NTSB report plays a central role in shaping the public and institutional meaning of this error. The report phrases the PF's misunderstanding in objective terms, noting that "the PF believed the auto throttle would maintain speed even though it was in HOLD mode" (NTSB, 2013). However, this neutral language masks the

phenomenological distress and interpretive ambiguity that accompanied that assumption. The report presents the logical error as a fact but does not fully explore the discursive and affective conditions under which such assumptions are made and sustained in real time.

From this dissertation's standpoint, the report becomes a discursive site where aviation safety is negotiated, framed, and stabilized, not only through what is said, but through what remains unsaid. For example, the systemic design difference between Airbus and Boeing automation philosophies is noted but not problematized, despite being crucial to the PF's misunderstanding.

Implications for Training and Organizational Learning

The results point to a significant organizational blind spot in automation literacy and cross-platform training. Pilots are trained on procedures, but rarely on the cognitive implications of transitioning between different automation architectures. The PF's lived disorientation reflects a broader epistemological instability in modern airline operations: trust in automation is taught, but critical inquiry into its assumptions is not.

This theme, therefore, challenges the notion that human error is located solely at the individual level. Instead, error is co-produced by training systems, aircraft design, and institutional silence, creating conditions where interpretive disorientation becomes likely. The PF's confusion was not irrational; instead, it was narratively, cognitively, and culturally coherent within his experiential frame. That coherence, however, led to a tragic outcome when it misaligned with the aircraft's inherent design.

Emergent Theme 2: Silence and Unspoken Assumptions in the Cockpit

A textual analysis of the NTSB report (NTSB, 2013) reveals a recurrent communicative gap in the final approach phase of Flight 214: critical parameters, such as decaying airspeed, automation mode status, and flight path deviations, were not

explicitly discussed by the flight crew. The Pilot Flying (PF), a trainee undergoing Initial Operating Experience (IOE), and the Pilot Monitoring (PM), his instructor, were both present in the cockpit. Despite signs of deteriorating flight energy and deviations from the glide path, neither pilot verbalized awareness of the aircraft's dangerous energy state until seven seconds before impact, when the PM called for a go-around (NTSB, 2013).

Crew resource management (CRM) protocols typically emphasize active communication, cross-checking, and assertive monitoring. Nevertheless, a prolonged silence prevailed during a period of high vulnerability. Interviews conducted by the NTSB indicated that each pilot assumed the other was aware and managing the situation. However, no explicit monitoring statements or corrective interventions were recorded until it was too late.

Interpretive Insight: Silence as Lived Mutual Deference

From an Interpretive Phenomenological Analysis (IPA) standpoint, the silence among the crew is not merely an absence of words, but a presence of meaning, a rich, embodied experience shaped by deference, hierarchy, perceived role clarity, and social caution. The PF, new to the Boeing 777, appeared deferential to the PM's judgment and oversight. Meanwhile, the PM assumed the PF was exercising appropriate command authority and held back intervention to avoid undermining the trainee's confidence or autonomy (NTSB, 2013).

This communicative silence is thus not neutral. Instead, it is an active, relational, and emotionally loaded phenomenon. In phenomenological terms, the cockpit becomes a shared horizon of co-constructed ambiguity, where nonverbal assumptions take precedence over procedural explicitness. Silence here is filled with expectation, trust, and uncertainty, an "intercorporeal" state (Merleau-Ponty, 1962), where coordination is sought not through speech, but through implicit attunement.

Discursive Construction: Silence as Institutional Blind Spot

In the discursive construction of the NTSB report, this silence is presented neutrally, yet its implications are profound. The report documents the lack of airspeed discussion factually:

*"*There was no discussion among the crew regarding the decaying airspeed until the final moments. *(NTSB Transcript, 2013, p. 25)."*

"The PM also made several errors: not noticing the decay in airspeed between 500 and 200 ft, and not immediately ensuring a timely correction to thrust was made when he detected the low airspeed (NTSB, 2013, p. 86)."

However, this construction omits the interpretive and institutional forces that render silence both possible and meaningful. In a cockpit with formal CRM training, why would such critical silence persist?

The report refrains from deeply interrogating organizational culture, training doctrine, or social dynamics that enable this silence. In doing so, it reflects an epistemology of omission: privileging observable behavior while marginalizing intersubjective meaning-making. This meta-sensemaking perspective is precisely where meaning is negotiated, in the unsaid, the assumed, and the deferred.

Meta-Sensemaking Lens: Silence as a Site of Discursive Strain

Viewed through the meta-sensemaking lens, the crew's silence is not just a momentary oversight. It is a discursive event shaped by institutionalized communicative norms, cultural expectations, and role ambiguity.

This safety report reveals (among other things) that:

- The PF's silence reflects performance anxiety, cognitive overload, and habitual deference to automation and authority.

- The PM’s silence reflects instructional caution, hierarchical boundaries, and professional courtesy: norms that discourage direct correction unless failure is inevitable.

Together, these unspoken dimensions reveal a cockpit saturated with assumptions: that everything is fine, that someone else is watching, or that intervention is not warranted. These assumptions form a mutual interpretive field where communicative inaction is not only tolerated but also normalized.

This discursive normalization is reproduced in the report itself, which, while cataloging the facts of silence, does not fully explore how organizational communication cultures cultivate such silence. This is a form of structural silence: a tacit organizational value that privileges non-intervention, individual responsibility, and stoicism under pressure.

Implications for Safety Culture and Organizational Learning

The theme of unspoken assumptions invites a direct challenge to traditional CRM paradigms. While standard CRM emphasizes open communication, assertiveness, and mutual monitoring, the lived reality in Flight 214 reveals that these ideals can collapse under the pressures of culture, hierarchy, or emotion. Silence here is not a violation. Instead, it is a predictable output of an organizational habitus that underemphasizes the social negotiations of communication in high-power-distance or instructionally imbalanced crews.

Furthermore, the implications for organizational learning are significant. If safety systems rely on communication, then safety failures can emerge not from what is said, but from what cannot be said, due to discursive absences shaped by fear, confusion, or institutional norms. The analysis suggests that traditional investigations,

focused on spoken data, may overlook entire layers of communicative vulnerability unless interpretive and phenomenological methodologies are employed.

Emergent Theme 3: Authority Gradient and Instructional Ambiguity

During the final approach phase of Flight 214, the cockpit was occupied by three pilots: the Pilot Flying (PF), a trainee captain in the final phase of Initial Operating Experience (IOE); the Pilot Monitoring (PM), a senior captain acting as instructor; and a relief first officer occupying the jump seat. According to the NTSB (NTSB, 2013), although the approach was unstable, marked by a decaying airspeed and misconfigured automation, the instructor (PM) did not take over or instruct corrective action until the aircraft was critically low. The report states that "the PM likely did not see the need to provide the PF with continuous active coaching; the PM did not intervene or otherwise ensure that needed corrections were made to the airplane's vertical path (NTSB, 2013, p.100.)."

This statement, along with the absence of authoritative cockpit intervention during the unstable descent, formed the basis for identifying the emergent theme: a blurring of operational and instructional authority, which created ambiguity regarding who was ultimately responsible for safety-essential decisions in real-time.

Interpretive Insight: Lived Ambiguity in Role and Responsibility

From an Interpretive Phenomenological Analysis (IPA) perspective, this theme reveals a lived ambiguity, an inner conflict experienced by both PF and PM as they navigated dual identities: pilot-in-command and trainee, instructor and monitor, observer and intervener. For the PF, there was a reliance on the PM's oversight, possibly stemming from deference to seniority, compounded by the stress of completing IOE on a complex aircraft type. For the PM, there was a hesitation to

override or interfere, rooted in instructional restraint, an embedded cultural ethos of allowing the trainee to learn through performance.

This ambiguity creates a phenomenological field of uncertainty, where mutual assumptions about role boundaries suppress decisive communication and timely corrective action. Competing imperatives shaped each pilot's lived experience: the imperative to perform, to supervise, and to respect role boundaries. These imperatives fractured collective situational awareness and contributed to the erosion of command clarity.

The result is an environment where no one "clearly" acts, not because of incompetence or disregard, but because the interpretive expectations of authority are contested and unclear in the moment.

Discursive Construction: Authority Gradient Rendered Neutral

In the official NTSB report, the ambiguity of authority is described in clinically neutral language. The PM is noted to have believed the PF was in control, and the PF is described as having assumed auto throttle protection was active. However, what remains underexplored is how institutional language defers responsibility through discursive neutrality. By not explicitly problematizing the distribution of authority in IOE contexts, the report normalizes ambiguity rather than interrogating it as a systemic vulnerability.

Moreover, the discursive construction of the instructor's inaction as a rational pedagogical choice obscures the structural confusion inherent in blended instructional and operational roles. The instructor was not just a teacher. He was also the acting captain, holding the ultimate authority to intervene. However, the text positions him as primarily an evaluator, which subtly reframes the event as a training lapse rather than a breakdown in authority.

Meta-Sensemaking: Role Displacement as Organizational Blind Spot

Through a meta-sensemaking lens, the authority gradient in Flight 214 is not simply a cockpit dynamic. It reflects organizational learning failures. The ambiguity experienced by the crew is the product of an institutional structure that fails to reconcile evaluative detachment with real-time operational responsibility. Instructional programs prioritize non-interference to preserve learning, yet operational lines demand intervention to ensure safety.

This displacement of roles creates a discursive condition where sensemaking is suspended: the instructor hesitates, the trainee defers, and critical errors go uncorrected. The cockpit becomes a space where authority is fragmented across temporal and institutional dimensions: training systems, command expectations, automation literacy, and CRM doctrine all intersect, but without precise alignment.

This also exposes a deeper epistemological tension: when is an instructor a captain, and when are they merely observing? The NTSB report does not resolve this tension. Instead, it presents both roles as simultaneously present and unproblematized, preserving a dual-role fiction that leaves future crews vulnerable to similar confusion.

The theme thus demonstrates that instructional ambiguity is not just a human factor. Instead, it is a discursive artifact of organizational logic, training doctrine, and safety culture. This ambiguity only becomes visible after the accident, when the NTSB retrospectively tries to impose coherence onto a moment that was lived as confused, silent, and deflected.

Implications for Training, CRM, and Safety Culture

This theme raises essential questions for airline training systems, particularly regarding CRM authority structures during IOE flights. If instructors hold operational

authority, then training philosophy must not inhibit necessary assertiveness. If trainees are expected to command, then clear transitional thresholds must be defined where instructional oversight yields to safety preservation.

Thus, my research prescribed that CRM, as implemented, often reifies hierarchy and confuses leadership with ownership. The PF deferred, the PM observed, and no one challenged the degradation in airspeed and trajectory, despite multiple cues that the approach was unstable.

This disjunction between authority held and authority enacted must be critically examined in both pilot curricula and institutional discourse. A meta-sensemaking model of CRM would treat authority not as a fixed structural position, but as a fluid interpretive activity, constantly negotiated through language, context, and institutional framing.

Emergent Theme 4: Legacy of Prior Aircraft Experience

The NTSB investigation into the crash of Asiana Airlines Flight 214 revealed that the Pilot Flying (PF), while qualified to operate the Boeing 777, had substantial prior experience flying Airbus A320-series aircraft. During the accident sequence, the PF misinterpreted the behavior of the Boeing auto throttle system, believing it would maintain the selected airspeed automatically, despite being in HOLD mode and inactive at the time (NTSB, 2013).

According to the NTSB report:

“The PF had extensive experience flying Airbus A320 aircraft and may have expected the auto throttle to operate similarly to the Airbus auto-thrust system (NTSB, 2013, p. 14, 68).”

This assumption persisted until it was too late to recover. Despite the B777 and A320 having distinct automation philosophies, the PF’s mental model of automation appeared to be influenced by his Airbus training and long-term experience, forming

the core of this emergent theme: the residual influence of prior aircraft automation schemas on current performance in a different cockpit architecture.

"During post-accident interviews conducted by the NTSB, the PF expressed a belief that the auto throttle system was 'protecting' the target airspeed and would 'wake up' automatically as the aircraft slowed (NTSB, 2013, p. 83)."

This statement from the PF thus invites interpretive scrutiny. A closer phenomenological reading suggests that the PF may have been engaging in a form of automation transference—the unconscious application of mental models and operational expectations derived from previous experience with a different aircraft type. Notably, the PF had extensive experience flying Airbus aircraft, whose automation philosophy emphasizes more assertive protective features, including automatic thrust engagement to preserve airspeed in many phases of flight. In Airbus systems such as the A320 series, the Alpha Floor protection function automatically commands maximum thrust when a stall risk is detected, effectively overriding pilot inputs if necessary (Woods, 2010; Dekker, 2014). No such automatic protection exists in Boeing's FLCH mode with auto throttle hold engaged.

Interpretive Insight: Experience as Embodied Expectation

The PF of the Asiana Flight 214 accident has carried expectations from previous Airbus experiences into the present situation (cockpit automation) with the Boeing B777 airplane. Through IPA and meta-sensemaking, my research uncovered how a pilot's "embodied expectations," that is, an individual's reflexive and mentally rooted orientations on how events, systems, or interactions, unfolds in the present situations that may have been the sediment of their prior lived experiences (history) and spontaneously enacted without conscious evaluation of their current conditions. Thus, this PF's expectations may have been carried over into his present Boeing B777 situation (cockpit automation), not as a "mental cognition" but as "procedural memory"

as part of his professional experiences, a misplaced tacit assumption to respond and act towards current operational contexts (van Manen, 2016; Merleau-Ponty, 1962).

Through the lens of IPA, the PF's interaction with automation on the Boeing 777 was not merely procedural but deeply experiential. Having flown Airbus aircraft extensively, the PF brought to the Boeing cockpit a tacit expectation: the aircraft's auto throttle system would retain speed protection as a default safeguard, even during descent.

Phenomenologically, the PF's moment-by-moment experience was one of cognitive familiarity, shaped by past interactions with automation systems that function differently. This is not simply a case of faulty memory or inadequate training; it reflects how habituated interaction with technology creates perceptual patterns that endure across contexts. The expectation that automation would intervene to protect airspeed was not questioned because, in the PF's past flying experience, such questioning was rarely needed.

This "carryover cognition" from Airbus to Boeing resulted in misalignment between perception and reality. The PF experienced the cockpit not as a set of disjointed controls, but as a familiar rhythm of automation behavior; a rhythm that, in this case, did not exist.

Discursive Construction: Experience Framed as Latent Variable

In the NTSB's narrative, the PF's prior experience is described as a latent factor, rather than an active contributor to the accident. The report notes the PF's Airbus background and implies that this may have influenced his misunderstanding, but it stops short of problematizing this legacy in structural or institutional terms.

The PF's misinterpretation, therefore, may not have been a mere technical oversight, but a discursive trace of an internalized Airbus automation logic

projected onto the Boeing 777 flight deck. This projection, while not explicitly articulated in the NTSB report as a root cause, becomes legible through a phenomenological and meta-sensemaking lens as an epistemic remnant of prior experience. It reflects a form of embodied automation schema, which aviation psychologist David Woods (Woods, 2010) refers to as cognitive coupling with design logic, that shapes how pilots anticipate and interact with flight systems, especially under cognitive load.

Moreover, this aircraft transition context introduces a broader communicative tension between institutional training structures and situated operational performance. The PF was undergoing initial operating experience (IOE) on the B777 under the supervision of a training captain (PM), who did not effectively monitor airspeed or cross-check the PF's assumptions about automation state. The mutual silence and lack of critical inquiry in the cockpit during the descent phase suggest a breakdown in CRM, but also reflect how unspoken assumptions, shaped by prior training and aircraft familiarity, can become operationally consequential. The absence of explicit clarification or verification of automation modes becomes a silence that masks not only misunderstanding but the transposition of past knowledge into an incompatible present.

This discursive treatment is significant: it individualizes a systemic issue, locating the error in personal expectation rather than organizational training protocols, design philosophy, or the broader culture of automation transition. The phrase "may have expected" distances the analysis from institutional accountability. In doing so, the report frames prior aircraft experience as a background influence, rather than a structurally foreseeable challenge in training cross-qualified pilots.

Thus, while the safety investigation report acknowledges the legacy of prior experience, it renders this legacy epistemically invisible in the training discourse. The

issue becomes one of mistaken assumption rather than systemic cognitive inertia, a form of automation fluency that resists retraining.

Meta-Sensemaking Perspective: Automation Schema as Discursive Inheritance

Viewed through a meta-sensemaking lens, this theme reveals a deeper structure of discursive inheritance. The PF's assumption about the auto throttle was not a random mistake, but an institutionally conditioned belief; one shaped by repeated exposure to Airbus's design logic, reinforced by years of operational trust, and uncritically transferred into a different technological environment.

From this perspective, the misinterpretation was not solely a failure of training; it was a failure of discursive reflexivity within the organization. Airline systems often assume that once a pilot completes conversion training, previous experiences become irrelevant or subordinate. However, this ignores the durability of cognitive and perceptual schemas formed under operational stress in previous contexts.

The report becomes a discursive artifact that preserves this institutional oversight. It speaks of expectations and misunderstandings, but does not name the inter-system epistemic conflict that occurs when two aircraft manufacturers encode automation differently. Airbus promotes trust in automation and protective logics (e.g., Alpha Floor), whereas Boeing offers more manual latitude, requiring greater awareness of automation. These are not simply technical differences; they are philosophies of control and pilot agency.

By not addressing the incompatibility of these schemas in transition training, the institution creates an unstable interpretive space, a domain where pilots must navigate contradictions without support. The PF's interpretive failure was thus a symptom of epistemic displacement, where his sense of what is "normal" in one aircraft made him blind to what was critical in another.

The NTSB report reconstructs these events within a linear causal chain, tracing decision points and procedural deviations. However, when interpreted discursively, the narrative from the NTSB report offers more than error attribution; it becomes a site of meta-sensemaking, a space where pilots' communicative, cognitive, and embodied engagements with automation are rendered intelligible within the institutional memory of aviation safety. The PF's reference to expected automation behavior becomes not merely a factual error, but a linguistic and cognitive artifact of cross-aircraft operational experience, organizational training norms, and pilot cognition under ambiguity.

Thus, the NTSB/AAR-14/01 report serves as both data and discourse: a representation of factual chronology, and a reflexive text that narrates how safety, automation, and human error are constructed and remembered. Through the lens of this dissertation, the PF's referential slippage between Airbus and Boeing automation logic illustrates how deviations in communication are not only behavioral lapses but embodied discursive acts: acts that surface the complex interdependence between language, technology, training, and meaning-making in aviation operations.

Implications for Training, Design, and Safety Culture

This theme carries significant implications for how airlines train pilots transitioning between aircraft types. Transition training often focuses on procedural differences, but not on philosophical and cognitive dissonance. In this case, the PF did not merely miss a checklist item. He operated within a different epistemic world, one shaped by legacy experience and unspoken assumptions.

Training must address the interpretive gap between aircraft systems, not just the procedural one. It must help pilots both unlearn and learn, and explicitly surface the risks of schema transfer. Without this reflexive layer, transition training remains incomplete and potentially dangerous.

Moreover, flight deck designers must recognize that a new type rating does not erase mental models of automation. The human-machine interface must be robust enough to signal mismatches, especially during high workload or ambiguous automation states. In Flight 214, no alert system countered the PF's false assumption. The aircraft was silent. The cockpit was silent. Only the report speaks: after the fact.

Transition Training: Regulations and Procedures

Aircraft transition training in the context of civil aviation is a structured training procedure that covers ground and flight operations, aimed towards orienting an aviation professional's transition from prior aircraft knowledge to a new aircraft type. Although engineers and pilots share transition training as a regulatory mandate, the flight crew is provided more operational procedures on top of the aircraft system design differences (14 CFR Part 121, Subpart N, 1970). Generally, as pilots move to another aircraft category and class, these technical differences address aircraft performance, handling characteristics, and operational procedures. This transition training was a safety improvement obtained from years of accidents and incidents in the general aviation human factors, where it was said that aviation accidents involving pilots changing to fly another aircraft type take place between 50 to 100 flight hours in the absence of formal aircraft transition training, and the requirements for the syllabus must emphasize all differences in all operating systems procedures (avionics, engines, flight controls, fuels, automation systems, among others), technical performance characteristics (takeoff, climb, cruise, approach, landing, ground maneuvers, among others), and emergency procedures between aircraft types that concerns the pilot trainee on aircraft training transitions (flight examiner, n.d.; FAA safety briefing, 2022). Along with all the regulatory requirements on pilot training is the "Upset Prevention and Recovery Training (UPRT)" introduced by the FAA. The UPRT was developed as

part of all pilot training, including type transitions training, addressing loss-of-control in-flight accidents, and enabling recovery into normal, safe flight conditions. By principle, the UPRT seeks to address the limitations of simulation, provide comprehensive flight aerodynamics training, and develop skills in divergence from the flight path, upset prevention, and CRM on progressive intervention strategies during pilot monitoring (FAA, 2015).

Emergent Theme 5: Temporal Compression and Fragmented Monitoring

The NTSB report (NTSB, 2013) outlines a cascading sequence of breakdowns in situational awareness and monitoring by the flight crew in the final moments of Flight 214's approach into San Francisco International Airport. Specifically, the report documents that the auto throttle was inadvertently in HOLD mode, disengaging speed protection, and that airspeed deteriorated to critical levels without timely crew response. Despite cockpit resource management (CRM) protocols requiring active monitoring and cross-verification, the decaying airspeed was not detected or corrected until seven seconds before impact, when a go-around was initiated too late (NTSB, 2013).

The recorded data and pilot interviews indicate that the crew was experiencing high-task load, with simultaneous attention required for:

- Visual approach management under VFR conditions,
- Autopilot disconnection,
- Aircraft configuration and landing checklist tasks, and
- Coordination with air traffic control.

This combination of workload saturation and narrowing time led to fragmented attentional engagement, which this theme refers to as temporal compression, where the available time for cognition and communication becomes increasingly compressed, resulting in delayed detection and impaired judgment.

Interpretive Insight: The Experience of Time Running Out

From an Interpretive Phenomenological Analysis (IPA) lens, this theme captures the lived experience of time distortion in high-stakes aviation contexts. The pilots of Flight 214 were not unaware or indifferent; instead, they were experientially constrained by the rapid acceleration of perceptual demands, which led to attentional tunneling and an incomplete cognitive appraisal of critical flight parameters. Attention tunneling, in this context, is the narrowing of an individual's perception and attention so that a person with this state is narrowly focused within a limited subset of environmental and awareness, and unintentionally excludes other essential information that may have been important within a given situational context (Endsley, 1995; Wickens, 2008). From a phenomenological perspective, "attention tunneling" is not just a deficit of an individual's ability to process essential information. Rather, it becomes a lived constriction of one's perception where the experience of urgency shapes what is seen, while other vital information becomes unattended (van Manen, 2016).

This is more than the workload. It is a phenomenological compression in which each second carries more information than can be processed, and the perceived horizon of action becomes increasingly narrow. The crew's silence, misprioritized gaze behavior, and delayed communication indicate cognitive saturation: a state in which the inner experience is governed by reactive immediacy rather than reflective anticipation.

Such phenomenology resonates with the experience of "being out of time," where future-oriented planning is supplanted by moment-to-moment coping. As the situation became increasingly urgent, the possibility of comprehensive monitoring diminished, giving way to fragmented checking, hesitations, and missed cues.

Discursive Construction: Flattening of Urgency in the Report

The NTSB report, while noting the absence of airspeed callouts and delay in initiating a go-around, constructs these events as procedural deviations rather than affective or interpretive phenomena. For instance, it states:

"The PF did not call out any concern regarding the decreasing airspeed, and the PM did not monitor airspeed closely during the approach (NTSB, 2013, p. 83)."

However, the discursive tone flattens the urgency of the cockpit experience. It presents the monitoring failure as a binary lapse (observed/not observed), neglecting the subjective compression of time and decision space. The linearity of report writing, that is, sequencing actions after the fact, obscures the non-linear, multidirectional perception of time experienced in crisis. In the final moments of Asiana Flight 214, the altitude loss and time before the impact discursively create the immediacy and intensity of the event, which is the rising temporal compression where the pilots' perceptual narrowing results in fragmented monitoring, which carries "phenomenological density" and should have been afforded proportional "urgency" and weight. These communicative events that were unfolding present a tangible acceleration, the lived temporal horizon, that has shaped the perception, communication, and decision-making of the flight crew. The investigation report "flattened" this immediacy or "urgency" that was neutralized, which gave minimal engagement with the cognitive atmosphere that was taking place in the cockpit of Asiana Flight 214 and presented them instead as equal in narrative weight to the earlier phases (less intense) of the flight. The narratives of the safety and investigation report maintained their institutionalized procedural logics that prioritized the causal reconstruction of the events and lessened the phenomenological communicative substance.

Through this dissertation's meta-sensemaking lens, the report is presented as a retrospective narrative that overwrites the lived temporality of breakdown, rendering urgent ambiguity as linear error. It prioritizes technocratic chronology over phenomenological entanglement, thereby masking the complex struggles of meaning-making that unfolded as time "ran out."

Meta-Sensemaking: Monitoring as a Distributed and Fragile Practice

Through the framework of meta-sensemaking, this theme reframes fragmented monitoring not as a personal deficit but as a systemic vulnerability in how attention, responsibility, and information are distributed across time and crew roles. Monitoring is typically construed as an individual act: checking instruments and verifying status, but in reality, it is a socially constructed and temporally dynamic process.

In the final 90 seconds of Flight 214's descent, the cockpit functioned as a disrupted sensemaking system. Visual cues were misinterpreted. The automation logic was misunderstood. Attention was absorbed in non-critical tasks (e.g., glidepath anticipation), while collective situational awareness disintegrated. Monitoring did not fail in isolation. Instead, it was overwhelmed by competing signals, ambiguous role assumptions, and latent trust in automation.

The crew's delayed recognition of speed decay is not simply a procedural error. It is a manifestation of system-wide informational drift, where the collapse of interpretive structure over time eroded the capacity to recognize, discuss, and act upon critical cues. Time itself becomes a discursive actor, reshaping what is sayable, noticeable, and knowable.

Temporal Compression as a Structural Reality

Crucially, the theme also implicates the organizational and cultural conditions that normalize time-compressed decision spaces. Airline operations, by design, maximize efficiency and throughput, training pilots to operate under time pressure.

CRM training often emphasizes teamwork and communication, but rarely trains real-time temporal self-awareness, that is, how to recognize when cognitive time is shrinking, and when silence masks fragmentation.

Temporal compression is a consequential phenomenon in the cockpit because of the sequencing of tasks that exist and take place in aviation operations, a "structured" production of institutionally sequenced timeframes that comes from standardized operations, such as the control of the aircraft in the terminal managed area by air traffic control, the complexity of flight automation modes, and airplane configurations: an implicit structuring of the timeline that produces *"how much time is allocated"* for every cockpit tasks. Additionally, temporal compression is a "cultural artifact" in the aviation community, particularly in the airline industry, where operational efficiency, tight turnaround times, and the need to "keep it going" during periods of high operational demand (Helmreich & Merritt, 2001). In the last moment before the impact of Asiana Flight 214, it can be perceived that the PF's reluctance to verbalize his uncertainty in the "HOLD mode" control of the airspeed stems from culturally mediated hesitation to disrupt the ongoing flight descent during the final approach.

From a meta-sensemaking perspective, temporal compression is institutionalized and accepted as an occupational hazard rather than being addressed as a safety-critical variable. The NTSB report, while describing the time-sequenced breakdown, does not critique this structural issue. The report *"documents it but does not problematize it."*

Boeing 777 Automatic Flight System in Thrust and Speed Management

In modern civil aviation, the interface between pilots and automation is not merely a technological interaction, it is a communicative event that reveals how human intention is negotiated, deferred, or occluded through machine logic. The Boeing 777,

introduced as a technologically advanced wide-body aircraft, exemplifies this epistemic shift wherein flight path management and energy state control are increasingly mediated through layers of automation. Within this frame, the automatic flight system (AFS), including the Autopilot Flight Director System (AFDS) and Auto throttle (A/T), serves as a critical medium of pilot-machine discourse.

The Boeing 777 AFS comprises two main subsystems (B777 FCOM, 2023; B777 AMM-SDS, 2025):

1. Autopilot Flight Director System (AFDS): Manages lateral and vertical navigation.
2. Thrust Management Control System (TMCS), where the Auto throttle (A/T) is an integral part of this subsystem. The A/T controls thrust to maintain speed or thrust targets, depending on the mode selections.

These components are deeply interlinked, coordinated via the Mode Control Panel (MCP) and Flight Management Computer (FMC), forming a systemic feedback loop of inputs and outputs across automation layers.

The Boeing 777 auto throttle system, by logic and operation, was designed to modulate engine thrust and manage either speed or thrust targets, depending on the selected flight mode. It functions in several distinct modes, including SPD (Speed), THR REF (Thrust Reference), IDLE, and HOLD.

The SPD mode maintains a target airspeed by automatically adjusting thrust. Conversely, the THR REF mode commands the engines to deliver climb or cruise thrust as defined by FMC thrust limits, decoupling speed management from direct auto throttle authority.

The HOLD mode, which played a significant role in the Asiana Flight 214 accident, is uniquely distinct. In HOLD mode, the auto throttle system disengages servo control of the thrust levers, allowing pilots to manually set the thrust. However,

unlike fully disengaged auto throttle systems, HOLD mode can still influence re-engagement logic and speed protection functions. Thus, while the thrust levers are physically “free,” the system remains conceptually “live,” a subtlety often misunderstood by flight crews.

During final approach, HOLD mode introduces a shift from automated to manual control, though not a complete epistemic handover. In the Asiana 214 case, the auto throttle entered HOLD mode during descent because the flight mode annunciator (FMA) displayed a vertical mode, FLCH (Flight Level Change), which disengaged auto throttle speed targeting. In FLCH, the auto throttle commands IDLE thrust, and upon reaching a capture altitude or certain thresholds, it transitions to HOLD.

In this state, the thrust levers remain at idle unless manually advanced by the crew. Crucially, if the pilot assumes that speed control is still active, the HOLD mode can become a silent communicative rupture. As evidenced in the Asiana case, the PF (pilot flying) expected that the auto throttle would “wake up” to maintain approach speed. This expectation, unfulfilled, contributed to the aircraft’s decay below target airspeed, resulting in an impact short of the runway threshold.

The Asiana 214 accident reveals a breakdown not only in situational awareness but also in the meta-communication between pilot and automation. As discussed in the analysis of emergent theme number one (1), the cognitive framing of automation is co-constructed discursively, in the way the system “speaks” through mode transitions, annunciations, and the absence of physical feedback.

The ambiguity of the HOLD mode, wherein the auto throttle is technically “available” but operationally disengaged, exemplifies a liminal state of communication. This liminality is exacerbated by a lack of tactile resistance, inconsistent annunciation

salience, and asymmetries between Boeing and Airbus logic models, a significant factor given the captain's background in Airbus aircraft (NTSB, 2013).

The Boeing 777 AFS thus functions not only as a control interface but as a site of communicative deviation. The shift between active and passive system roles (e.g., SPD to HOLD) creates epistemic gaps, zones where the pilot must re-interpret or reassert authority. When such reinterpretation is hampered by training gaps, inconsistent mental models, or cultural deference to automation, it fails meta-sensemaking.

Moreover, the flight mode annunciator (FMA), the primary means of communicating automation status, is cognitively overloaded, presenting multiple modes simultaneously in a small visual space. The transition into HOLD is often silent; no aural cue or physical alert is provided, placing the onus entirely on pilot interpretation. In this regard, mode confusion is less a procedural error and more a discursive failure of the interface.

The Boeing 777's auto throttle system, particularly its HOLD mode, illustrates the core argument of this dissertation: human errors emerge not solely from individual failures, but from discursive ruptures between human and system, embedded in automation design and operational expectations.

As shown in the case of Asiana 214, the misalignment between pilot mental models and auto throttle logic led to catastrophic results. The HOLD mode, as both a mechanical state and a semiotic phenomenon, failed to communicate its operational implications transparently. This dissonance between system logic and pilot sensemaking constitutes a communicative deviation: an epistemic event that this dissertation seeks to surface through interpretive phenomenological analysis.

Automation Logic in Cross-Aircraft Type Transitions

The critical communicative breakdown involving the Boeing 777's auto throttle HOLD mode, as seen in the Asiana Airlines Flight 214 accident, must be situated within the broader epistemic backdrop of a legacy of prior aircraft experience. Pilots transitioning between aircraft types do not arrive as tabula rasa; rather, they bring with them cognitive schemas, operational expectations, and embodied knowledge derived from previous flight decks, especially in highly automated platforms such as the Airbus A320 family.

In this specific case, the PF's extensive background flying Airbus aircraft introduced a conflicting automation philosophy into the Boeing 777 cockpit. Airbus systems are characterized by envelope-protection logic, full-time autothrust, and automation authority that resists manual override unless explicitly disengaged (Woods & Sarter, 2000). The Airbus autothrust system does not contain an equivalent to the Boeing "HOLD" mode; it remains engaged in active speed management throughout all flight phases unless manually disconnected. Consequently, for a pilot habituated to Airbus systems, the 777's transition into a passive HOLD mode, where the auto throttle disengages servo control while remaining "armed," can be unintuitive and dangerously silent.

This phenomenon, illustrated in this dissertation, is framed as meta-sensemaking failure: the pilot's interpretive frame, shaped by prior experience, did not align with the actual operational behavior of the current aircraft. The mismatch resulted not from a lack of technical knowledge but from misapplied experiential schemata. In the NTSB's analysis, this legacy bias was directly linked to the flight crew's expectation that speed would be automatically maintained during final approach, even after engaging Flight Level Change (FLCH) mode, despite the auto throttle having entered HOLD (NTSB, 2013).

This automation-schema mismatch is not a purely cognitive or individual-level issue; it is an organizational and systemic concern. The FAA's 2013 Human Factors report on flight crew interfaces emphasized that "automation surprises" often stem from embedded legacy knowledge, which, when unaddressed in transition training, becomes a latent condition for error (FAA, 2013). Thus, this theme reinforces the need to treat pilot knowledge not as isolated procedural competence but as a discursive repertoire shaped by experience, expectation, and embodied practice.

Automation as a Cognitive Divestment

In parallel, the Asiana Flight 214 accident also reflects how temporal compression and fragmented monitoring co-evolve under conditions of high automation and degraded mode awareness. The crew's engagement in non-linear monitoring behavior, particularly during the approach phase, is emblematic of a cognitive system strained by time pressure, task switching, and diminished workload sharing.

As the auto throttle entered HOLD mode during FLCH descent, thrust levers were idle, yet no one explicitly verified airspeed decay for over 30 seconds. This lapse cannot merely be explained by inattentiveness; it illustrates a deeper temporal disorganization of monitoring patterns, aggravated by:

1. Reduced mutual cross-checking;
2. Increased head-down time manipulating the Flight Management Computer (FMC);
3. Compressed task sequencing during a late runway change at San Francisco International Airport;
4. Notably, overreliance on automation to self-regulate energy states is a significant concern.

These factors culminated in a perceptual narrowing described by Endsley (1995) as “loss of situational awareness due to cognitive overload and expectation bias.” In the Asiana case, expectation bias was reinforced by previous aircraft experience (Theme 4), which shaped assumptions that the auto throttle would remain engaged and protective. This led to fragmented monitoring, where neither the Pilot Flying (PF) nor Pilot Monitoring (PM) maintained consistent speed awareness despite multiple cues, including:

1. The decaying speed tape on the PFD.
2. The idle thrust lever position.
3. The absence of expected auto throttle re-engagement.

The phenomenological implication here is profound: time and attention were not simply mismanaged; they were misconstructed. Under the veil of “normal” automation engagement, monitoring became episodic and reactionary rather than anticipatory and integrated. This fragmentation of temporal awareness, coupled with misaligned automation assumptions, reflects what Weick (1995) might frame as a collapse of enacted sensemaking, where the crew’s understanding of the present situation was governed more by past cognitive scripts than by live interpretive feedback loops.

Integrative Perspective: Discursive Failures in the Flight Deck Ecosystem

By synthesizing these two emergent themes, the Asiana 214 case exemplifies how aviation automation is not merely technical but deeply discursive. Automation, particularly auto throttle logic, “speaks” through modes, annunciators, tactile cues, and silence. When that language is misinterpreted due to legacy aircraft experience or overlooked under fragmented monitoring pressure, communicative failures manifest, not just between humans, but also between humans and machines.

Furthermore, these emergent phenomena should not be interpreted as isolated lapses but as structural distortions in cockpit epistemology. The fact that the Boeing 777's auto throttle system does not offer active aural or visual feedback upon entering HOLD mode, a critical transition with significant operational implications, means that the system's discursive footprint is incomplete, placing the interpretive burden squarely on the pilot (Sarter & Woods, 1995).

Thus, what unfolded in the final seconds of Asiana 214's approach was not just a failure of automation or vigilance, but a multi-layered communicative event, in which automation ambiguity, legacy schemata, and temporal disintegration coalesced into a fatal silence.

Toward Reflexive Flight Deck Design and Communicative Training

The intersection of legacy experience and fragmented temporal cognition compels a new orientation toward flight safety. Training programs must go beyond system familiarization to cultivate reflexive, interpretive competencies. These capabilities help pilots interrogate not just what the system is doing, but how and why they are making sense of it in the ways they do.

Moreover, the implications for this dissertation's broader framework are clear: accident reports and are not just narratives of failure; they are transcripts of communicative breakdowns within socio-technical ecologies. Through the lens of meta-sensemaking, we uncover how pilots navigate a shifting terrain of prior knowledge, temporal uncertainty, and automation opacity, revealing that human error is neither singular nor spontaneous, but the residue of communicative drift in high-reliability systems.

The Invisible Communication of Automation

The auto throttle HOLD mode in the Boeing 777, as demonstrated in the Asiana Airlines Flight 214 accident, represents not just a technical state of system

disengagement but a discursive silence; a moment when the aircraft ceases to communicate thrust control intent in a way that is perceptible, confirmable, or interruptible by the crew.

In the emergent theme on “silence and unspoken assumptions,” the cockpit is seen not only as a space of verbal exchange but as a semiotic environment, where meaning is constructed through actions, glances, and absences. The auto throttle’s transition to HOLD mode, lacking aural cues or conspicuous annunciations, constitutes such a silent event: a shift that should prompt inquiry or confirmation but often does not.

In the case of Asiana 214, neither the Pilot Flying (PF) nor the Pilot Monitoring (PM) explicitly verbalized or cross-checked the thrust mode status during final approach. Despite visible deceleration on the primary flight display (PFD) and the thrust levers at idle, there was no cockpit discussion of energy state deterioration. This reveals a communication vacuum grounded in unspoken assumptions, most notably, the belief that auto throttle would protect airspeed by design (NTSB, 2013).

These assumptions were structurally inherited from prior automation experience (mainly Airbus, as previously discussed) and remained unchallenged due to cockpit norms that subtly disincentivize interruptive questioning. The phenomenological texture of this silence is crucial: it was not the absence of communication, but the failure to render communicatively salient what needed to be questioned, a distinction critical in sensemaking theory (Weick, 1995). What was left unspoken became epistemically dominant, shaping decisions as much as any verbal command.

The Discursive Boundaries of Deference

The absence of spoken verification of automation state and energy management must also be situated within the broader context of authority gradient

and instructional ambiguity, particularly within multicultural flight crews and training environments where instructional roles blur during line operations.

As recorded by the NTSB (2013), the captain was undergoing initial operating experience (IOE) training on the 777, with a training captain seated in the right seat. Despite the instructional setup, there was no effective override or assertive intervention during the critical moments of deceleration. The instructor, likely balancing his dual role as trainer and co-pilot, may have deferred to the captain's perceived authority, even as airspeed declined below threshold.

This speaks directly to the emergent theme, "authority gradient and instructional ambiguity." The problematic tension between formal authority, training status, and actual operational command. In civil aviation, instructional ambiguity manifests when the hierarchy of command becomes flattened or reversed through the instructional relationship. When the instructor acts as PM (Pilot Monitoring), but is also the ultimate safety authority, the boundaries of authority become discursively unstable (Helmreich et al., 1999).

Cultural dynamics compounded this instability. Research on Crew Resource Management (CRM) in East Asian flight crews (e.g., Chidester et al., 2001) has highlighted that high power-distance cultures may resist vocal challenge, especially in training contexts. In this case, the PF, although less experienced in type, was a senior captain, while the PM was in a subordinate instructional position. The result: a muted cockpit climate, where the necessary reassertion of control, either verbally ("Check your airspeed!") or physically (advancing the thrust levers), was inhibited by discursive ambiguity and deference.

Furthermore, the aircraft itself failed to intervene. No aural warnings or mode reversions are activated until it is too late. The automation's silence became complicit in the authority ambiguity. While the auto throttle was "armed," it was not "active," a

distinction requiring manual interpretation. The Flight Mode Annunciator (FMA) displayed HOLD, but HOLD was not self-explanatory. This semantic opacity forced the crew to “read” the automation’s intent, a form of communicative labor which, under stress, is frequently bypassed or misinterpreted (Sarter & Woods, 1995).

Automation as an Actor in Cockpit Discourse

From a meta-sensemaking lens, both emergent themes converge to reveal automation as an active participant in cockpit discourse. The auto throttle, through its design logic and communicative (non-)features, shaped not just aircraft behavior but also crew interactions. In this view, HOLD mode becomes a site of discursive disempowerment: the aircraft silently relinquishes speed control, while the crew, fragmented by instructional ambiguity and cultural deference, fails to fill the communicative void.

Importantly, this is not to suggest individual culpability, but rather to surface the socio-technical entanglements that make such silence and authority drift possible. The auto throttle system’s failure to audibly alert the crew that it was no longer protecting airspeed is not a technical oversight; it is a semiotic deficiency. The silence is not neutral; it is loaded with meaning, or more dangerously, with assumed meaning.

Toward Discursive Reflexivity in High-Reliability Flight Environments

The Asiana 214 tragedy highlights the importance of conceptualizing aviation safety not only in terms of technical competence or CRM adherence, but also as a discursive system where meaning is co-constructed by humans and automation. The combined effects of unspoken assumptions (Theme 2) and instructional authority ambiguity (Theme 3) formed a layered communicative breakdown, one that was neither dramatic nor explosive, but incremental and silent.

The contribution of this dissertation lies in highlighting how cockpit communication is not merely verbal but phenomenological and semiotic, suffused with historical expectations, authority tensions, and the opaque logics of automation. In this light, auto throttle HOLD mode serves as a case study in discursive deviation, where the aircraft's silence and the crew's assumptions merged into a fatal epistemic error.

This warrants a reconsideration of how training, interface design, and cockpit culture align or misalign in high-pressure scenarios. A reflexive cockpit is not just one that communicates, but one that continually interrogates what is left unsaid, whether by human or machine.

Chapter VI

CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

This dissertation theorizes that aviation safety investigation reports provide more than technical reports of accidents and incidents from a fact-finding committee, but as an interrogation of the communicative dimensions of human-induced errors in civil aviation, which lay down the discursive texts in theorizing and co-constructing the meanings of those human errors in the context of accountability and aviation safety.

Understanding Human Errors through IPA and Meta-Sensemaking

Through Interpretive Phenomenological Analysis (IPA) and the methodological approach of meta-sensemaking, the aviation accident case of Asiana Airlines Flight 214 (NTSB, 2013) gives the empirical anchor for interpreting how aviation professionals experience, enact, and reflect on safety-related communication.

Deviations in communicative practices in civil aviation are presented in the findings of my research as not merely procedural lapses, as generally seen among aviation professionals, but rather as phenomenological communicative experiences that coexist among the actors within the interconnection of socio-technical systems. The focus of the aviation safety report in my study, the Asiana Flight 214 accident, illustrates the misinterpretations that comprise the elements of the auto throttle modes, framed not merely as operational shortcomings, but as interpretive breakdowns rooted in pilot-preconceived expectations, prior aircraft experience, and the opaqueness of automation technology (NTSB, 2013). Through a meta-sensemaking of the aviation safety investigation, such deviations in communicative practice are the discursive moments where epistemic misalignments (e.g., between perceived and actual system behavior) “creep in” unnoticed because of systemic silences and inherited cognitive scripts (Dekker, 2014; Weick, 1995).

Through the lens of meta-sensemaking, the sensemaking of the investigation and safety report in the case of Asiana Flight 214 reveals a deviation in aviation communication that illuminates how human errors in aviation are often connected to the cognitive disorientation of pilots' automation behavior.

This phenomenon is a manifestation of communicative assumptions, not merely the lapses in operational procedures, where automation of airplane flight management and control is framed as somewhat predictable and self-correcting. The PF in the case of Asiana Flight 214 believes, in error, that the B777 auto throttle was engaged even when the "HOLD" mode was presented to the flight crew in the primary instruments, and as such, will continue to maintain the target speed. In the context of this airplane's automation, when the auto throttle is in "HOLD" mode, speed management is placed in a dormant condition. This misperception by the PF went uncorrected due to a breakdown in shared cockpit awareness, verbal clarification, and confirmations (NTSB, 2013).

The pilots' disorientation to this airplane's operating system design reality mirrors the meta-sensemaking of the failure to correct their misinterpretation of their auto throttle "HOLD" mode understanding, and that the flight crew neither confirmed nor questioned this actual mode because of an implicit trust in the airplane's logic of the auto flight system, particularly the automatic air speed management, and cognitive reliance on previously held familiar operating patterns. Thus, this trust ushered in the discursive silence in the cockpit in the face of a decaying airspeed. Such silence appears to be symptomatic of a much wider deviation in the flight crews' communicative behavior that is embedded in the human-to-machine interaction after thousands of hours of professional flying career in a similar aircraft type. The absence of active verification and dialogue is illustrative of mode status confusion becoming

more than a failure to observe technical reality, but a failure in communication that is present in the subject flight accident (Sarter & Woods, 1995).

In a communicative sense, the pilots' disorientation in automation is an inherent discursive problem where the flight crews' assumptions about an airplane system's characteristics were left unspoken, unchallenged, and the eventful situation remains unrectified. A meta-sensemaking analysis revealed in my research has shown that aviation professionals do not simply react to automation. Instead, they interpret, narrate, and sometimes silence their uncertainties based on past interactions with similar systems, grounded in identity. It appears that pilots derive meaning not only from instrumentation but also through communicative patterns that may be shaped by organizational culture, prior training, and accumulated flying experience.

The pilots' failure to verbalize the uncertainties revealed in my research's case of Asiana Flight 214, with the absence of monitoring callouts and the assumed engagement of certain automation features, is not merely an isolated procedural omission. Instead, they reflect shared narratives in flight automation, familiarity, and invulnerability that may resist interruptions unless there is a perceived need to contest actively. The variability of human performance in speaking up or staying silent is a resource for safety, or a precursor to safety failure (Hollnagel, 2014).

What is left unsaid? What is assumed to be known? In essence, the emergence and understanding of human errors are already bound in the narrative ecology of the cockpit. As such, deviations in aviation communicative practices are not merely explicit miscommunications, but rather the emergence of unexamined "dangerous" alignments in shared misconceptions. It is therefore essential for aviation professionals to learn beyond the characteristics of automation systems, but also to question, narrate, and reframe these characteristics in the event of ambiguity.

Deviations in communicative practice in the cockpit, marked by silence, ambiguity, and misaligned expectations, stem from ontological disruptions in the perception of safety in aviation that are enacted in real-time. The case of Asiana Flight 214 is a clear illustration of how the misinterpretation of the auto throttle's HOLD mode stemmed from the pilot's silent assumptions, rooted in legacy Airbus experience. These assumptions remained uninterrogated and unchallenged by the PM, which may have stemmed from instructional ambiguity and authority gradients that reinforced the communicative vacuum among the crew (Helmreich & Merritt, 2001; Weick, 1995). In meta-sensemaking, these communicative breakdowns become interpretive events that reveal epistemic limitations in aviation safety systems, which are co-produced by the risk of silence and the opacity of flight automation (Dekker, 2014).

Approaching the subject of safety investigation as a discursive text from a meta-sensemaking perspective, those discursively inherited mental models rooted in previous aircraft systems may silently alter interpretive and communicative processes among aviation professionals. The PF's cognitive schema from the Airbus systems led him to expect that the automatic speed protection (the Alpha Floor) was available even in degraded thrust mode: this time in a Boeing aircraft. With the PF's assumptions from his cognitive schema in the Airbus systems, although not articulated in the flight, were formed into an internal assumption by the PF alongside his non-verbalized sense of situational normalcy: an assumption that remained unchallenged that has become part of the contributing factor to the airplane's dangerous condition throughout the final approach (NTSB, 2013).

The legacy of prior aircraft experience, the emergent four (4) in this dissertation's analysis, presents how deviation in communication in the cockpit is not always constituted by overt speech actions (such as callouts or readbacks). Instead, these communicative deviations are characterized by an unspoken yet epistemically

active persistence of prior aircraft operational logics, even when engaged in a new and entirely different system context. A non-trivial epistemic residue that has shaped what the pilot mentally attends to and is assumed to be true, collectively organizing the crew's monitoring capacity (van Manen, 2016; Woods & Hollnagel, 2006). A communication deviation beyond mere verbal omission, but rather, a disguised routine misunderstanding coming from the pilot's cognitive misalignment.

The meta-sensemaking of the case, as presented in the investigation report of Asiana Flight 214, offers insight that reorients traditional perspectives on aviation human error, moving beyond explanations based on human behavior or procedures. The PF's failure to maintain situational awareness and recover from a decaying airspeed on final approach may be viewed beyond the lens of negligence or flight monitoring lapses. Instead, part of this shortcoming stems from a discursively inherited misinterpretation of the Boeing 777's automation logics, resulting from the pilot's entrenchment in years of Airbus training and experience (Dekker, 2014). The PF thought the system (auto throttle) would "wake up" to provide continuous airspeed protection, which reflects the pilot's sensemaking breakdown that results from the transfer of an automation schema.

This deviation in communication in the cockpit remains unchallenged by the PM or the first officer, the observer: a lack of dialogue on auto throttle mode status and thrust lever position underscores a communicative omission, reinforced by an assumption of technical parity across aircraft platforms, which is seen here to propagate the human error in the cockpit. These communication omissions are evident in the form of communicative disagreements, which encode the limits of the regulatory-mandated training and transitions.

Thus, the pilot's legacy of prior aircraft experience exemplifies human errors in the cockpit that are not merely momentary slips or lapses, but errors that emerge from

a systematic cognitive misalignment between past knowledge and present conditions or reality, which remains invisible due to the absence of discursive challenge. The meta-sensemaking of this safety investigation report on the case of Asiana Flight 214 exposes communicative deviations in aviation that are sustained through institutional and legacy assumptions that remain uninterrogated among the flight crew in the accident flight; embedded within the horizon of sense that pilots bring into the cockpit (Weick, 1995; Reason, 1997; Smith, Flowers, & Larkin, 2009).

Communicative Deviations During Ambiguity and Stressful Conditions

As discussed in the previous chapter of this dissertation, temporal compression leads to fragmented monitoring. Through the IPA and meta-sensemaking lens, it reveals that time pressure erodes an individual's attention capacity and shared situational understanding. At the final moments of the landing phase in the case of Asiana Flight 214, the pilots' fragmented monitoring is beyond deviations from standards or procedural lapses. Instead, what the flight crew experienced was a phenomenological narrowing of temporal and cognitive space, that is, a lived sense of "being out of time" (van Manen, 2016; NTSB, 2013).

Through IPA and meta-sensemaking, my research captured what appears to be an erosion of collective communicative routines, such as cross-verifications, cross-checks, and callouts, that enable cockpit collaborative decision-making during escalating task demands. The "go-around" command was declared at a mere 200 feet above ground level: far too late for a flight error recovery. The PF and the PM were together, soaked in their present demanding tasks of visual approach alignment, landing configurations, checklist execution, and active verbal communication with the ATC, thus leaving the most critical task of flight monitoring unattended.

The pilots' disintegration of communicative coherence reveals the relationship between safety and human error, that is, not merely enacted from procedural failures, but emerges from a progressive loss of intersubjective awareness. Thus, fragmented monitoring among the pilots during the landing phase happened as a breakdown in the crews' capability to enact safety in their communicative interplay, not from a lack of training, but coming from cognitive saturation and perceptual tunneling accompanied by high-stakes temporal compressions (Endsley, 1995; Malakis & Kontogiannis, 2013).

The cruciality of the temporal compression encountered by the pilots, however, should not be construed as a disappearance of communication. Instead, the transformation of their communicative practice in the aviation safety context was evident. Verbal communication between the crew was significantly delayed, fragmented, or reduced to reactive utterances, causing them to bypass possible opportunities for anticipatory interventions; an epistemic collapse in the crew members' co-construction of the shared meaning of the risks unfolding during the event that was then unfolding through the lack of timely callouts and cross-verifications.

This dissertation highlights the institutional and structural conditions that contributed to the degradation of communication among pilots during their final approach. Although the safety investigation report of Asiana Flight 214 documented the cockpit monitoring failures, it does not interrogate the discursive and cultural normalization of urgency that exists in airline operations. The report reveals the tangible presence of Crew Resource Management; however, during the moment of temporal compression, it was temporarily diluted. The narrowing of time disrupted the rhythm of communicative coordination and limited the enactment of safety despite training and knowledge remaining intact.

Through a meta-sensemaking approach, we interrogate the safety investigation report and reveal that under pressure, ambiguity compresses interpretive frameworks, forcing actors to engage in micro-level coping rather than macro-level reflection (Weick, 1995). Under these conditions, communicative practices shift from dialogue to fragmented monologue, and from collaborative sensemaking to individual cognitive survival.

Approaching the safety investigation report through meta-sensemaking in my research repositioned human error from mere discrete act, into a situated communicative phenomenon, that is, the gradual loss of meaning-making capacity when faced with cognitive overload, perceptual fragmentation, and institutional silence about the phenomenology of urgency (Dekker, 2014; Smith, Flowers, & Larkin, 2009). In high-pressure cockpit situations, the crews' communicative practices were shaped beyond the doctrines of CRM. However, the lived temporality of cockpit crises is an experiential environment where every moment carries more weighty information than an individual can process or verbalize.

During high-pressure cockpit situations, it reveals that the meaning-making of aviation safety and human error is not an abstract construction, but a moment-by-moment enactment through communicative capacities that display vulnerability to temporal compression. When under stress, it is likely that aviation professionals shift from shared understanding to fragmented engagements. This demonstrates that the cockpit is not merely a technical site, but a dynamic discursive environment. It is thus important to consider the necessity of temporal phenomenology in future CRM training, procedures, and the aviation safety reporting frameworks.

Sedimented Cognitive Structures in Temporal Disintegration

This doctoral work, which examines the case of Asiana Flight 214 through the safety investigation report, utilizes both IPA and meta-sensemaking to reveal the intersection between sedimented cognitive structures among aviation professionals, particularly pilots, in their communicative engagement with safety systems under time-constrained conditions and ambiguity. By forming a recursive and co-constitutive structure, a pilot's legacy of prior aircraft experience and knowledge lays down an epistemic framework that, during a moment of temporal compression, makes this framework adaptive or perilous.

The persistence of legacy automation schemas exposes aviation professionals to sedimented cognitive structures from their previous aircraft platforms, which are then presented in a new and different environment. The PF in the accident of Asiana Flight 214 had accrued extensive operational experience on the Airbus aircraft, especially the Airbus A320, where the automation design philosophy is based on the robustness of its envelope of protection, among those protection in the Alpha Floor that actively intervenes in the Airbus aircraft's autothrust management in maintaining the minimum airspeed during the most crucial phases of the flight, especially during final approach phase (Woods & Sarter, 2000; NTSB, 2013).

By shaping a tacit expectation through prior aircraft experiences, the pilot expects that the auto throttle system of the Boeing 777 will remain engaged and active even when the airplane decelerates towards a lower safe threshold while the system is in the "HOLD" mode. This carryover of expectations, though seemingly plausible, is procedurally incorrect. However, this PF's assumption persisted and remained unchallenged due to communicative silence and a lack of cross-verification, a failure that extended beyond CRM but one with discursive reflexivity (Dekker, 2014; Weick, 1995).

Through IPA and meta-sensemaking, my research illuminated a moment of lived misrecognition: the filtering of a pilot's (operational) perception through a legacy schema that no longer corresponded with the actual system logic. This is beyond a knowledge gap. Instead, it is an ontological dissonance between "what is" and "what is expected," shaped by embodied histories, not just technical manuals (van Manen, 2016).

The Collapse of Monitoring Under Pressure

The collapse of cockpit monitoring under pressure reveals how temporal and perceptual breakdowns emerge when cognitive load exceeds human capacity, as observed during the final approach phase of Asiana Flight 214. As the NTSB reports, both PF and PM failed to detect the dangerous decay in the airspeed at the final leg of the landing phase, until it was too late to make any corrections, so that the go-around call was decided only above two hundred (200) feet AGL. This was a human error (indeed), but not because either is ignorant, but one that may be attributed to "attentional tunneling."

The temporal compression and fragmented monitoring, by contrast, reveal the temporal and perceptual breakdown that emerges when cognitive load exceeds capacity, particularly during the final approach phase. The NTSB (2014) reported that both PF and PM failed to detect the dangerously low airspeed until it was too late, with the go-around call initiated only at 200 feet above ground level. This failure was not due to ignorance but to attentional tunneling under compressed time horizons, which fragmented the crew's monitoring and eroded their ability to construct shared situational awareness (Endsley, 1995).

These conditions reveal that under time pressure, monitoring becomes episodic rather than continuous, and communication devolves from collaborative dialogue to

disjointed, reactive utterances. The contraction of one's cognitive bandwidth, the space for questioning assumptions or verifying automation modes, disappears. Time, in this case, is also an actor in the scenario that alters the crews' discursive re-evaluation and, as a result, allows legacy judgment errors to persist unchallenged (Weick, 1995; Smith et al., 2009).

When Time Compression Shields Error from Challenge

The relationship between interactions and diminished monitoring is evident in the pilot's misinterpretation of the auto throttle's HOLD mode, a design characteristic that has slipped interrogation due to the temporal constraints of the approach, limiting both time and attention.

This reveals that legacy knowledge was not questioned because there was no time to question it. Aligning with the interpretive insight that in high-reliability operating domains such as aviation, professionals operate within enacted environments, the contexts are shaped not just by procedures but by "how things usually go" (Weick, 1995). When an intensity in time compression is present, actors default to heuristics drawn from experience, particularly those that have historically "worked." Thus, the PF's expectation of automatic speed protection, which was an echo of the Airbus automation logic, persisted without being reexamined because the unfolding urgency structurally favored assumption over interrogation. Also, the PM, who may have served as a corrective factor to the PF's misaligned cognitive frame, was consumed by the same fragmented monitoring responsibilities. This is an evident failure in CRM, not due to training, but rather from temporal disarticulation, where attention and communication were pulled in divergent directions, precluding the dialogic verification that may have surfaced the misunderstanding in the present environment (Malakis & Kontogiannis, 2013).

From a meta-sensemaking perspective, this interrelation reveals a systemic blind spot in how aviation safety institutions conceptualize error. Traditional training regimes emphasize knowledge acquisition and procedural compliance, but they underemphasize epistemic reflexivity; the capacity to interrogate one's assumptions, particularly under pressure (Reason, 1997; Hollnagel, 2014). The legacy of prior aircraft experience suggests that cross-aircraft automation logic is rarely scrutinized. In contrast, during temporal compression, it becomes apparent that even when failure becomes imminent, time constraints prevent this interrogation from occurring in real-time.

The safety investigation in this dissertation further reinforced this blind spot by framing errors in technical or procedural terms, rather than as communicative or epistemological breakdowns. As such, the legacy of prior experience and the temporal compression present in the accident flight point to a deeper discursive failure: the system's inability to support, or even recognize, the interpretive labor required to navigate uncertainty across complex operational environments.

My study revealed a recursive loop between legacy aircraft experience and temporal compression and fragmented monitoring, mutually reinforcing one another. The legacy of prior aircraft experience creates a hidden epistemic vulnerability, while temporal compression creates the conditions under which that vulnerability remains undetected and unmitigated. Together, they form a recursive risk loop: legacy expectations distort perception, and compressed time blocks correction. This loop underscores a key argument of this dissertation: that human error in civil aviation is not merely a deviation from procedure, but a deviation in communication, temporality, and meaning-making.

Recommendations

The recommendations derived from the output of my research were based on the plausibility of the interpretations derived from the interpretive phenomenology and meta-sensemaking of civil aviation communication deviations, primarily aimed at advancing aviation safety practices by moving beyond procedural conformity to reflexivity and epistemic transparency. From IPA and meta-sensemaking framing that responds to the communicative and epistemic vulnerabilities that exposed the flight crew of Asiana Flight 214, focusing on aviation safety systems, training designs, organizational learning, and regulations.

Cross-Aircraft Automation Reflexivity in Training Aviation Professionals

Aviation training systems should consider reconceptualizing the cognitive continuity among aviation professionals, particularly pilots, in terms of their previous aircraft knowledge and experiences. The misinterpretation of the Boeing B777's automation by the PF of Asiana Flight 214, who had an extensive working background in Airbus automation, reinforces an epistemic hazard where legacy aircraft schemas remain unexamined. The PF persistently assumed that the Boeing B777's auto throttle characteristics have similar characteristics to those of the Airbus' Alpha Floor protection. This is a clear reflection that the structural oversight in aircraft type transition and recurrent training has overlooked the need to address potential cognitive dissonance across platforms. Therefore, aircraft type transitions and recurrent training programs should integrate cross-aircraft automation differences in their modules. Pilots should be provided with the training means to actively compare and interrogate system logics between their previous aircraft experience and their transition towards a new aircraft type. Training modules must employ real-world scenarios that allow pilots to reflect on and challenge their entrenched expectations, thereby reinforcing

their epistemic awareness (Woods & Sarter, 2000). In doing this training approach, it should help reduce a pilot's reliance on prior aircraft knowledge.

This may be accomplished through structured debriefings, simulations, or training programs that can interrogate the differences in automation logics across aircraft types. In the safety investigation report on Asiana Flight 214, it was evident that the legacy mental models from the Airbus systems were tacitly carried over to the Boeing airplane, thus causing the misinterpretations of the B777's auto throttle operating characteristics. Training should shift from mere systems knowledge toward reflexive epistemology, that is, aiding pilots to recognize and interrogate themselves and the situational context about their prior automation schemas, and preventing prior aircraft experience from being applied to a new and different aircraft type. It is essential to consider the comparative automation logics in the training modules in conjunction with the auto flight system's contrast, as their exercises enable them to "unpack" all previous assumptions.

Meta-Communicative Prompts in High Workload Scenarios

The CRM on cockpit communication strategizes communication and task distribution, enabling the flight crew to share the workload effectively during critical phases of a flight, such as takeoff and landing procedures. However, these communicative activities may fall short of protocols that surface unspoken assumptions when either or both pilots are stressed or under pressure. Meta-communication should aim to prompt pilots with embedded cues that will ensure verification of essential automation and aircraft conditions during takeoff, landing, or non-precision and go-around procedures. For example, "verify speed protection active?" or "HOLD mode verify?" These meta-communication phrases are highlighted

to confirm that the expectations of the PF align with the current aircraft mode and should be included in the checklist flows.

The CRM is a well-established cornerstone in aviation safety and is recognized as a standard for both cabin and cockpit crews in aviation operations. CRM provides the essential resources that facilitate effective communication, define clear role delineation, and efficiently distribute workload in a manageable manner, which becomes so crucial in high-stakes flight phases such as takeoff and landings (Kanki et al., 2019). CRM frameworks, SOPs, and briefing protocols effectively address the exchange of information in a timely, accurate, and unambiguous manner, thereby helping to alleviate cognitive overload among crews (Helmreich & Merritt, 2001).

What has been demonstrated in the accident of Asiana Flight 214 was the possibility for communicative strategies to fail when a meta-level communication is not addressed, that is, a communicative environment where “unspoken assumptions” were not surfaced and reconciled, particularly on the current aircraft state about the automation characteristic modes and actual expectations during the time of increased workloads and stressful situations (NTSB, 2013).

The role of meta-communicative prompts functions as an intentional and purposeful cue within cockpit dialogues, explicitly verifying and aligning current mental models among the cockpit crew in the context of automatic flight conditions and essential aircraft parameters. The existing cockpit callout practices were designed to convey the factual airplane status, such as “airspeed…check,” “gears…retract,” among others. The function of meta-communication extends beyond simply calling out the actual airplane status. Instead, it attempts to address the interpretive layer of specific flight conditions, that is, “challenging” the current airplane system’s or automation state if they match both crews' collective expectations. This meta-communication in the cockpit communicative practices serves to (1) validate the

shared understanding between the pilots, and (2) allow an opportunity to identify and correct any divergence in the pilot's mental model (Weick, 1995; Smith, Flowers, & Larkin, 2009).

A practical means to strategically deploy meta-communication in the cockpit is to include this as part of the cockpit checklist flows, particularly those that require transitioning between manual flying and automation. Making meta-communication as part of the cockpit standard operational practice creates an institutionalized "cockpit safety interventions" that reduces reliance on mere spontaneous recall and the pilot's judgment during stressful and demanding conditions in the cockpit. Verbalizing these meta-communicative checklists reinforces shared situational awareness and, at the same time, creates a discursive atmosphere among the flight crew where potential errors or discrepancies are simultaneously addressed, thus mitigating the risk of "silent error" slipping in during high workload scenarios in the cockpit (Dekker, 2014; Reason, 1997).

Implications for Further Study

This doctoral research demonstrates how IPA and meta-sensemaking can uncover the lived experiences and communicative-interpretive processes among aviation professionals, as mediated by aviation safety investigation reports. As an extension of my study, broader data sets of aviation communicative practices and human factors in aviation may reveal more emergent themes, particularly in the context of initial and recurrent training for aircraft types, and the CRM as a co-constituted theory and concept in safety among aviation professionals. Thus, contributing to rich resources that may strengthen knowledge in aviation safety studies (Smith et al., 2009; van Manen, 2016).

This dissertation may suggest a need for further studies that explore possible methodological approaches and orientations. These are: first-order sensemaking that encapsulates the meaning-making of pilots in a cockpit's communicative practices (through direct interviews with the subject-pilots), and second-order meta-sensemaking to interrogate and interpret how safety officers retrospectively reconstruct safety events (beyond the cockpit) through the safety investigation reports. Furthermore, a third-order analysis from a critical communication lens, where interpretations are conceived as asymmetrical (Mumby, 1997), reveals that they function within power-communicative structures that privilege certain voices, such as technical expertise and regulatory authority, while marginalizing communicative silences and embodied experiences, among others (Weick, 1995; Dekker, 2014).

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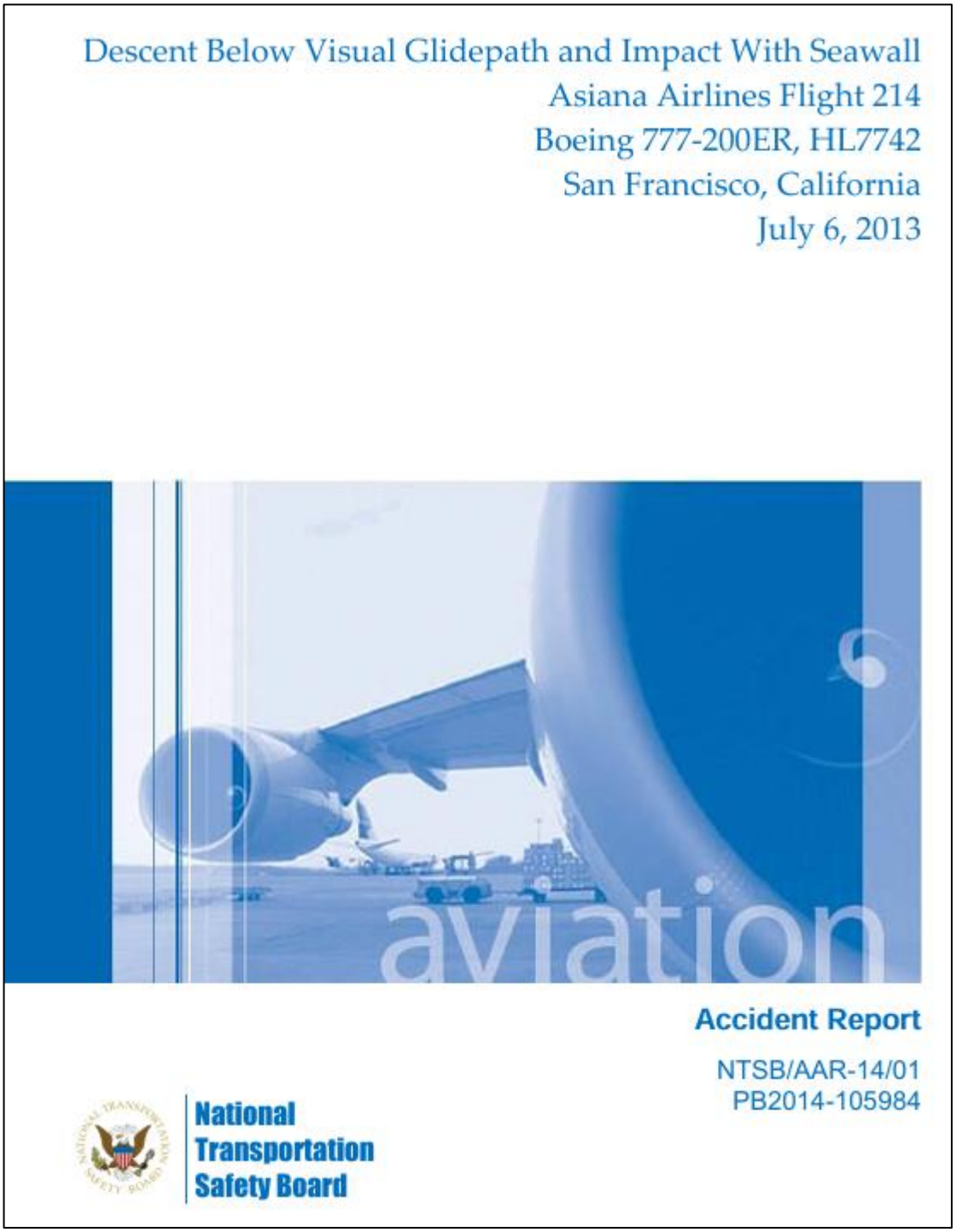
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ANNEXES

Annex 1: The NTSB Accident Report, 2013 (NTSB/AAR-14/01) with Recommendations



(static) tensile load until ultimate failure. Three tests were performed in the inboard direction, and three were performed in the downward direction. The ultimate loads at failure during these tests varied between 1465 and 1781 lbs, which were three to four times higher than certification loads. In all six tests, the release mechanism experienced a failure (tearing) of the release shaft in the area of tang engagement similar to the damage on the release mechanisms for the 2R, 3R, and 4R slide/rafts on the airplane.

The NTSB also contracted with a research company to perform sled acceleration tests of six exemplar 777 slide/raft packs. Complete slide/raft packs were affixed to a test rig in a vertical orientation to apply inboard lateral loads, a horizontal orientation to apply downward loads, or a 45° orientation to apply a combined downward and inboard load. The packs were then subjected to test runs with increasing *g* loads until ultimate failure. The two slide/rafts subjected to inboard loads released at loads of 14.2*g* and 14.4*g*; however, there was no damage to the release shafts of the release mechanisms. The two slide/rafts that were subjected to downward loads released at loads of 12.7*g* and 13.5*g*, and the damage to the release shafts was similar to those from the 2R, 3R, and 4R slide/rafts on the airplane. The two slide/rafts that were subjected to combined inboard and downward (45°) loads released at loads of 12.4*g* and 12.9*g*, and again, the damage to the release shafts was similar to those from the 2R, 3R, and 4R slide/rafts on the airplane.

1.17 Organizational and Management Information

Asiana Airlines is a major Korean domestic and international airline based in Seoul, Korea. The company was established in 1988 and, at the time of the accident, provided passenger service to 23 countries and cargo service to 14 countries. Asiana had a fleet of 81 airplanes,[86] including 12 Boeing 777 aircraft, and employed 1,349 pilots, including 136 Boeing 777 captains and 129 Boeing 777 FOs.

1.17.1 Pilot Standard Operating Procedures

Asiana provided procedural guidance to its flight crews in several documents. The Asiana Flight Operations Manual (FOM) established general procedures and provided instructions and guidance for use by flight operations personnel in the performance of their duties. Flight crew procedures specific to the 777 were found in the Asiana 777 Pilot Operations Manual (POM).

Additional guidance was found in the Asiana 777 FCOM, which was prepared by Boeing for Asiana and included operating limitations, procedures, performance, and systems information. With the FCOM, Boeing also provided a 777 QRH that listed normal and nonnormal procedures in a checklist format. Further information and recommendations on maneuvers and techniques were found in Boeing's 777 Flight Crew Training Manual (FCTM).

Flight crews were expected to follow POM guidance where it was more restrictive than other guidance, such as that in the FOM, FCOM, or FCTM.

[86] At the time of the accident, Asiana's fleet was composed of 10 Airbus A320, 24 Airbus A321, 13 Airbus A330, 14 Boeing 747, 8 Boeing 767, and 12 Boeing 777 airplanes.

1.17.1.1 Use of Automation

The 777 POM, chapter 2, "Supplementary [Normal Procedures] NP," paragraph 2.1.6, "AFCS Procedures," provided general guidance to pilots on the proper use of the AFDS and A/T. Subparagraph 2.1.6.1, "General," stated that the flight crew must always monitor airplane course, vertical path, and speed; verify manually selected or automatic AFDS changes; and when selecting a value on the MCP, verify that the respective value changes on the flight instruments. Further, the subparagraph stated that the flight crew should use the FMA to verify mode changes for the A/P, F/D, and A/T and that to "call out loudly and clearly to the changes on the FMA and thrust mode display when they occur are a good CRM practice."

Subparagraph 2.1.6.2, "AFCS guideline," stated that "operations by A/P and A/T have preference to improve safety, to reduce workload and to enhance operational capability." It stated that when "operating within terminal areas where air traffic congestion could be expected, the PF and the PM [should] make full use of A/P and A/T." It further stated that the flight crew should use the A/P and A/T together and recommended use of A/T during all phases of flight, including manual flight.

Subparagraph 2.1.6.4, "A/P and A/T Disengage (Disconnect) Procedure," stated that the PF should notify the PM when disengaging or disconnecting the A/P and/or A/T. The subparagraph included a note stating that the PF should call out "manual flight" upon disconnecting the A/P and "A/T disconnect" upon disconnecting A/T; the PM should verify that the change is indicated by a change in AFDS status or mode annunciation on the FMA and then call out the change.

Further guidance regarding AFDS and A/T mode selections and related callouts was found in paragraph 2.1.4, "Crew duties," which stated that manipulating the controls and switches on the MCP is the PF's responsibility, but when flying manually, the PF should direct the PM to make changes on the MCP. Also, paragraph 2.1.7, "Standard Callouts & Response Procedures," stated that the pilot who is in charge of "flight mode change" must call out accomplishment of a mode change, and the other pilot must respond with a confirmation. This paragraph also stated that the PM should call out every FMA change.

Regarding the use of FLCH SPD mode, the 777 FCTM, page 5.26, stated, "Non-ILS approaches are normally flown using VNAV, V/S, or [flightpath angle] FPA pitch modes. The use of FLCH is not recommended after the FAF."

The Asiana 777 chief pilot stated in an interview that the airline recommended using as much automation as possible. He agreed with the statement that Asiana pilots obtained most of their manual flying practice during approaches below 1,000 ft agl. He stated it was permissible for Asiana pilots to disengage the A/P above 1,000 ft, but turning the A/P off at 8 nm from the airport and at 2,800 ft, for example, would not be recommended. When asked if Asiana had a policy regarding when FLCH SPD could be used during an approach, he stated that there was no requirement but that it was not recommended on final approach. He stated that when executing a manually flown visual approach, it was mandatory to have the A/T on for final approach.

Other Asiana pilots interviewed agreed that it was standard practice to disengage the A/P about 1,000 ft agl on a manually flown approach. Two Asiana captains with prior flight experience at other airlines stated that most Asiana FOs preferred to make automated landings or to leave the A/P engaged to 1,000 ft agl or lower before taking over and landing manually. An Asiana contract simulator instructor stated that manual flying was a "big scare for everybody," and he believed that pilots avoided flying manually because of concern that they might do something wrong and the company would blame them if they performed a go-around or had a hard landing that was captured by onboard flight data monitoring devices. He further stated that manual flying training that included the approximate power settings and pitch attitudes required to achieve a 3° glidepath was not in the training syllabus.

Asiana provided landing statistics for the year 2012 indicating that on the 777, 77.7% of the landings were made manually and 17.1% were automated landings.[87] The statistics also showed that 36% of all 777 landings in 2012 were made by the FO.

1.17.1.2 Descent Procedures

The FOM, paragraph 7.8.9, "Maximum Descent Rate," stated that to avoid controlled flight into terrain, the maximum descent rate is 3,300 fpm for altitudes between 5,000 and 2,000 ft agl and 1,500 fpm for altitudes between 2,000 and 1,000 ft agl. Below 1,000 ft agl, the pilot should follow the stabilized approach criteria (see section 1.17.1.4).

The 777 POM, subparagraph 2.12.9.7, "Use of Speedbrakes," stated that to avoid buffeting, the use of speedbrakes should be avoided at flap settings higher than 5°. It also stated that speedbrakes should be retracted before reaching 1,000 ft agl.

According to the 777 FCTM, page 4.21, "Descent Rates," when operating at idle thrust and an airspeed of about 210 knots, the descent rate can be increased from 1,000 fpm to about 2,300 fpm with the use of speedbrakes.

1.17.1.3 Visual Approach

The 777 POM, section 2.18, "Visual Approach," provided guidance to pilots for visual approaches. The section described how to set up downwind, base, and final legs using the FMC arrival page and how to use distance from the runway end and timing techniques to fly the visual traffic pattern. Subparagraph 2.18.1.4, "Final Approach," stated that the recommended approach path angle was 2.5° to 3°; an altitude of about 300 ft above the airport elevation for each mile from the runway would provide a normal approach profile; and the airplane should be stabilized on the selected approach speed with a rate of descent of 700 to 900 fpm. It further stated that descent rates greater than 1,000 fpm should be avoided; however, rates a "little over 1,000 fpm" were acceptable and should be included in the approach briefing.

[87] For the other 5.2% of 777 landings in 2012, the type of landing was not reported.

In the same simulator that was used for the pilot-in-the-loop simulations described in section 1.16.1.2, an Asiana training captain demonstrated the technique pilots were taught for performing a visual approach involving a standard traffic pattern. His demonstration, including the use of the FMC, timing to determine when to make turns, use of the VPI, and use of the A/P until about 1,000 ft agl on final approach, were consistent with the guidance in the Asiana 777 POM.

1.17.1.4 Stabilized Approach and Go-Around

The 777 POM, paragraph 2.13.6, "Stabilized Approach," addressed stabilized approach procedures and criteria. It stated, "every flight crewmember must confirm and monitor a stabilized approach, and "if a stabilized approach is not established, go-around." The paragraph also included a note that stated "deciding to make Go-Around does not mean that the procedure has been done wrong, but it means that crews follow[ed] the company safety policy and executed safety procedure normally."

Subparagraph 2.13.6.5, "Stabilized Approach Criteria," stated, in part, the following:

a. All approaches should be stabilized by 1,000 ft above airport elevation in [instrument meteorological conditions] IMC and 500 ft above airport elevation in VMC. An approach is considered stabilized when all of the following criteria are met:

1) the airplane is on the correct flightpath
2) only small changes in heading and pitch are required to maintain the correct flightpath
3) Speed: Max Target speed +10 knots, Min Target speed - 5 knots (Target speed = V_{ref} + Wind Correction)
4) the airplane is in the correct landing configuration
5) sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted
6) thrust setting is appropriate for the airplane configuration
7) all briefings and checklists have been conducted.

The subparagraph included a note that stated, in part, "an approach that becomes unstabilized below 1,000 feet [above field elevation] AFE in IMC or below 500 feet AFE in VMC requires an immediate go around."

The 777 POM, subparagraph 2.13.6.8, "Standard Callout & Response," stated that the PM should call out "five hundred" at 500 ft AFE; the PF should respond "stabilized" or "go-around;" and a go-around should be made if the approach was not stabilized.

In a postaccident interview, the PF stated that at 500 ft AFE, the airplane should be stabilized, and for a visual approach, the airplane should be stabilized by 300 ft AFE. For an unstable condition, he said a go-around should be performed. The PF stated that only the PIC, in

this case the PM, had the authority to decide to go around. He said this was company policy resulting from a tailstrike event that had occurred when an FO had initiated a go around.

In a postaccident interview, the PM stated that "the PF was supposed to be the one calling out the go-around." However, he also stated that when he discussed executing a go-around with the PF during the flight, he said that if performance requirements were not met, he (the PM) would say "I have control."

The FOM, paragraph 7.10.2, "Decision to Land," subparagraph 7.10.2.1, "Responsibility," stated that the "captain has authority and responsibility to make a landing or missed approach (go-around) considering actual weather condition and stabilized approach condition."

The 777 POM, section 2.19, "Missed Approach (Go-around) Procedure," subparagraph 2.19.1.1, "Decision and Control," stated that "the decision to make a missed approach rests with the Captain. However, when the Co-pilot (F/O) flies the aircraft as PF, Co-pilot (F/O) can make a missed approach." Subparagraph 2.19.1.3, "Missed approach during Manual Instrument Approach or Visual Approach," stated that if a missed approach is required following a visual approach, the PF should "push either TO/GA switch, call for flaps 20, check go-around thrust set, and rotate smoothly toward 15 [degree] pitch attitude."

The Asiana 777 chief pilot stated in an interview that the first responsibility for conducting a go-around rested with the PIC but the PF could decide to perform a go-around at any time, and anyone in the cockpit could call for a go-around. He said he thought all Asiana captains would agree that an FO could initiate a go-around. Interviews with several Asiana pilots and instructors yielded similar interpretations of Asiana policy in this area. For example, an IP who conducted OE with the PF for flight 214 was asked specifically if it was acceptable for a captain in the left seat who was being instructed to make the decision to go around, and he responded that it was acceptable.

1.17.1.5 Flight Crew Duties During Approach

The 777 POM, section 2.13, "Approach Procedure," paragraph 2.13.1, "PF/PM's Duties," stated that for all approaches, the PF's duties were the following:

1. Maintain aircraft control and conduct the approach briefing
2. Follow published approach procedures
3. Cross check all flight instruments
4. When using the AFDS, the PIC should be ready for manual flight before passing the final approach fix.

The PM's duties for all approaches were the following:

1. Make active standard callouts
2. Cross check all primary instruments and raw data

3. Monitor any display of warning/caution flags or deviation from the intended flightpath and callout to the PF
4. Monitor speed and descent rate until touchdown
5. After landing, advise runway and taxiway to PF
6. When aircraft is unstabilized or safe landing is not assured, advise the PF to make a missed approach.

Subparagraph 2.13.2.2, "Deviation Callout," stated that when airspeed, glideslope, localizer, sink rate, thrust, or visual guidance is out of approach limitation, the PM should call it out clearly.

Paragraph 2.13.5, "Scan Policy," addressed the division of flight deck workload for instrument scan and acquisition of visual cues during landing. It stated that for a visual approach below 1,000 ft agl, after visual contact was made with the airport, both the PF and the PM should be scanning both inside and outside the airplane. It stated that the PM should monitor airspeed and sink rate through the touchdown, and when there was an additional pilot in the cockpit, he or she should perform backup duty for the PM during the approach.

1.17.1.6 Expected Pitch and Power on Final Approach

The 777 FCOM, chapter PI, "Performance Inflight," pages PI.10.30-31, provided a chart listing approximate values for pitch attitude and power setting for various phases of flight. For flight on final approach (1,500 ft agl), gear down, thrust set to maintain a 3° glidepath, flaps 30, and speed V_{ref} plus 10 knots (142 knots for flight 214), at a landing weight of 450,000 lbs, the chart showed an expected pitch attitude of 0° and 57.9% N_1 speed. For a landing weight of 350,000 lbs, the chart showed an expected pitch attitude of -0.5° and 51.2% N_1 speed.

1.17.1.7 Evacuation

The 777 POM, chapter 4, "Non-Normal Procedures," paragraph 4.1.4, "Authority and Responsibility in Emergency," stated, "in an emergency situation that requires immediate action for the safety of passengers, crew and aircraft, the captain may deviate from prescribed operation procedures and aviation regulations. At that time the captain shall notify appropriate ATC facilities immediately [of] the deviated situation."

Subparagraph 4.10.2.5, "After Landing or Rejected Takeoff," addressed evacuation policy. It indicated that the captain should determine if an evacuation is necessary, and if so, to perform the QRH evacuation procedure; the evacuation procedure was located on the back page of the 777 QRH. The procedure required the parking brake to be set, the outflow valves to be opened, and the engine to be shut down before advising the cabin to evacuate.

A contract simulator instructor stated that if pilots missed a step on the evacuation checklist in training it would be a failure, and he did not think Asiana pilots would deviate from the evacuation checklist. He was asked if there was a step in the evacuation training that involved calling the tower before evacuating. He replied yes. He stated that it was not in the checklist, but in a situation where the crew was not sure about the condition of the airplane, the

pilots would want to confirm with the tower whether a fire was visible. If the flight crewmembers were sure about the airplane's condition, they would have to immediately evacuate.

1.17.2 Flight Crew Training

Asiana Airlines provided its pilots with all training at its headquarters, including initial, recurrent, upgrade and transition ground training, simulator training, testing, and checks. Asiana employed contract instructors to conduct the full flight simulator portion of 777 training. All training curriculum, procedures, and standards were developed by the Asiana flight crew training team under the direction of the general manager of flight crew training.

The Asiana Airlines Flight Crew Training Regulation established operational standards and procedures for flight crew training and evaluation. For 777 pilot training, Asiana Airlines also used Boeing's 777 FCTM. The introductory section of the FCTM stated that procedures and restrictions published in the FCOM, QRH, and other documents took precedence over the FCTM.

1.17.2.1 Autothrottle Function Training

The PF's Asiana 777 transition training included detailed overviews of the 777 autoflight system presented during two instructor-led training modules, a 4-hour slideshow on the "Automatic Flight System," and a 2-hour slideshow titled "B777 Flight Controls – Recurrent Training." According to Asiana, the slides were based on screen captures of computer-based training lessons purchased from Boeing to which Asiana instructors added descriptions and references from the Asiana POM, Asiana FCOM, and the Boeing FCTM.

The "Automatic Flight System" training module described A/T function during FLCH descent and stated that the A/T activates in THR mode and transitions to HOLD mode if the thrust levers reach idle. This module also included information about the forms of flight envelope protection provided by the A/P, which included stall protection. One of the module's slides included the statement:

> DOES THE AUTOPILOT NEED TO BE ENGAGED TO HAVE FLIGHT ENVELOPE PROTECTION? NO
> (Demo in SIM[ULATOR])

The "B777 Flight Controls – Recurrent Training" training module contained the following additional information about stall protection:

> Stall Protection Feature
> - Reduces the possibility of reaching stick shaker
> - No trim below minimum maneuvering speed
> - Slow speed requires continuous back pressure
> - Autothrottle engaged automatically (if armed)

The "Automatic Flight System" transition training module and the "B777 Flight Controls – Recurrent Training" module did not indicate that the low speed protection function provided by the A/T would not activate if the A/T was in HOLD mode.

In a written statement, an Asiana 777 ground school instructor indicated that although the information was not included on any slides, he explained during a 777 ground school class attended by the PF that the A/T would sometimes remain in HOLD mode after the A/P was disconnected and airspeed could drop. He described this as an "anomaly in the Boeing 777's autothrottle functioning" that he had personally experienced on three separate occasions. He said he advised students that this could occur during a high energy descent in FLCH mode and that if they encountered this situation, they should change the AFDS pitch mode to V/S or VNAV. An Asiana pilot who was in this instructor's class with the PF reviewed his class notes and confirmed that the instructor had provided this information. The same student stated that another instructor had provided similar information during another 777 ground school class attended by the PF and advised students that they should not use FLCH to descend after crossing the FAF.

1.17.2.2 Asiana Pilots' Statements about A/T Function

The PF stated that the 777 A/T system would always maintain the selected airspeed as long as the A/T was on. He said that if a pilot overrode the thrust levers manually, the A/T would resume controlling airspeed when the pilot released the thrust levers. He stated that it was irrelevant whether he had pushed the FLCH button immediately before disconnecting the A/P during the accident approach because he was in manual flight and the A/T was always working. He thought the A/T should have automatically advanced the thrust levers upon reaching the MCP-selected airspeed during the accident approach, and he did not understand why that did not occur. Furthermore, he thought the A/T system should have automatically transitioned to TO/GA when the airplane reached minimum airspeed. In that respect, he believed that the 777 A/T functionality was similar to alpha floor protection on the Airbus A320/321.[88] Asked how confident he was in his understanding of the 777 AFCS, he said he had followed the Asiana training program but was not confident in his understanding, and he thought he needed to study more.

An Asiana 777 OE instructor captain who had conducted an OE instructor check flight with the PM was asked to predict how the 777 A/T system would behave if the FLCH pushbutton was selected while descending through 2,000 ft msl in V/S mode with the A/P on and the MCP altitude set to 3,000 ft msl. He said that the thrust levers would advance, and the airplane would try to climb. When asked what mode the A/T would be in if the pilot manually pulled the thrust levers back, he said that the A/T would remain in SPD mode, and the thrust levers would advance after the pilot released them. Three additional Asiana pilots were asked what would happen in this same scenario if a pilot pulled the thrust levers back manually and then disconnected the A/P. Another 777 OE instructor captain who had conducted an OE training

[88] Alpha floor protection is a low speed protection feature of the Airbus autothrust system. When activated, it provides TO/GA thrust. As an Airbus airplane decelerates into the alpha (angle of attack) protection range, alpha floor protection is activated, even if the autothrust is disengaged. Alpha floor protection is inhibited below 100 ft RA, if autothrust is unserviceable, following a double engine failure on the four-engine A340 or a single engine failure on twin-engine models, and above Mach 0.53.

flight with the PM said he did not know what thrust mode the A/T would be in after this sequence of actions. Two 777 OE instructor captains who had conducted OE training flights with the PF said that the A/T would transition to HOLD mode and remain there until a different A/P pitch mode was selected by the pilot.

The Asiana 777 chief pilot was asked if there were any conditions in which the 777 A/T system would not provide low speed protection, and he said it would not provide low speed protection in HOLD mode. He said this information was not included in Asiana's 777 pilot training curriculum but was contained in the 777 FCOM, and he thought Asiana 777 pilots were aware of it. When the same question was posed to three OE training captains (two of whom had conducted OE training flights with the PM and one of whom had conducted an OE flight with the PF), they said that the A/T system did not provide low speed protection in HOLD mode; however, one said he had only learned that after the accident. A fourth OE instructor was asked the same question and said that the A/T system would not provide low speed protection if the A/P and A/T both failed. A contract simulator instructor (who had been providing 777 simulator training to Asiana pilots since 2006) was asked if he thought most pilots understood that the 777 A/T system did not provide low speed protection in HOLD mode, and he said he was not aware of that himself until Boeing provided an update to the 777 FCOM in 2012.[89]

1.17.2.3 Stall Protection Demonstration

The 777 FCTM, page 7.11, "Stall Protection Demonstration," described a demonstration to be used in 777 training to familiarize pilots with stall warning and the correct recovery technique for conditions approaching a stall, with and without the A/P engaged. In a series of three approaches to stall from level flight, the first maneuver demonstrated the A/T "wake up" feature, the second demonstrated nose-up trim inhibit and increased column force below minimum maneuver speed, and the third demonstrated A/P commanded descent at slightly above minimum maneuver speed when the A/T is disarmed.

Asiana adopted the FCTM stall protection demonstration in its 777 simulator training, and the pilots had observed the demonstration. During the demonstration, A/P and A/T were disengaged, thrust levers were retarded to idle, command speed was reduced below minimum speed on the speed tape, and the airplane was allowed to decelerate into the amber band on the airspeed tape (below minimum maneuvering speed). With no pilot intervention, the A/T system's "wake up" feature activated, and the system engaged in SPD mode and returned the airplane to minimum maneuver speed. The PF stated that when he saw the demonstration, he was "astonished" that the airplane would recover by itself from an approach to stall.

1.17.2.4 Flight Director Use During Visual and Circling Approaches

The FCTM, page 5.60-61, "Visual Approach –General," addressed procedures for flying a visual approach. No reference was made in this section to the use of F/Ds. The FCTM,

[89] According to Boeing, this 2012 update relocated a discussion of the A/T's automatic activation feature from section 9.20, where it had been part of a larger discussion of stall protection features, to section 4.20, where it was included in a description of the A/T.

page 5.54, "Circling Approach – General," did address the use of F/Ds during a circling approach, stating the following:

> When intercepting the visual profile, disengage the autopilot and continue the approach manually. At this point in the approach, the pilot's attention should be focused on flying the visual profile rather than attempting to set the MCP or FMC to allow continued use of the autopilot. After intercepting the visual profile, cycle both F/D to OFF, and select the PM F/D to ON. This eliminates unwanted commands for the PF and allows continued F/D guidance for the PM in the event of a go-around when pitch or roll mode is changed. Complete the landing.
>
> Note: If a go-around is selected with either flight director switch in the OFF position, the flight director pitch or roll command bar on the corresponding side will disappear when the first pitch or roll mode is selected or engaged.

1.17.2.5 Instructor Pilot Training

A review of Asiana's 777 flight instructor training guide showed that instruction techniques were taught, as well as execution of normal and nonnormal procedures. The simulator training included several scenarios in which the instructor trainee had to identify poor or dangerous performance by the pilot in the left seat and take action to recover the airplane safely. For example, in one scenario, the instructor trainee had to take control of the flight from the left seat pilot because of a takeoff overrotation, and in another scenario, the instructor trainee had to take over because of no flare during landing at 30 ft above the runway. The final stage of instructor training consisted of two flight legs of OE instruction and two flight legs of a check in the airplane. On the training flights and check flights, the instructor trainee flew the airplane from the right seat but gave no instruction.

1.17.3 Regulatory Oversight

Regulatory oversight of Asiana in the Republic of Korea is the responsibility of the KOCA. Regulatory oversight of Asiana in the United States is the responsibility of the FAA.

Within the KOCA, oversight of Asiana is conducted by the Air Operations Safety Division. According to the principal operations inspector (POI), he was responsible for approving the entire Asiana training manual, including all changes, and FOM special limitations. The POI stated that the KOCA only conducted pilot checkrides of upgrading captains, and he did about 10 flight examinations per year but did not conduct type rating checkrides.

To operate into the United States, foreign carriers must obtain a permit issued by the US Department of Transportation and obtain operations specifications issued by the FAA. Operations of foreign air carriers are regulated by the FAA under 14 CFR Part 129,[90] which

[90] According to the FAA, as of July 2013, there were 482 foreign air carriers certified under Part 129.

specifies that each carrier must meet the safety standards contained in International Civil Aviation Organization (ICAO) Annex 6.[91]

In 1992, the FAA established the International Aviation Safety Assessments Program under which the FAA assesses whether another country's oversight of its air carriers operating into the United States complies with ICAO safety standards; as of July 2013, the Republic of Korea was determined to be in compliance.

The POI assigned to provide FAA oversight of Asiana Airlines in the United States explained that as a Part 129 POI, his activities focused on maintaining the operations specifications of each carrier he was responsible for, reviewing each carrier's performance, and generating recommendations for the work program. He stated that the only type of inspection the FAA was authorized to perform on Asiana was a ramp inspection. The POI stated that the FAA was not authorized to ride a foreign carrier jumpseat or to conduct cockpit or cabin en route inspections. He stated that the FAA did not approve operations manuals or crew training programs and had no oversight of these items.

A review of 140 entries in the FAA's program tracking and reporting subsystem regarding Asiana since October 2011 showed that most entries were related to ramp inspections or operations specifications revisions. A total of 118 ramp inspections were conducted at 11 US airports served by Asiana. One possible flight violation was noted, which was referred to and resolved by Asiana Airlines.[92]

1.18 Additional Information

1.18.1 Postaccident Safety Action

1.18.1.1 Asiana Airlines

In December 2013, Asiana Airlines provided NTSB investigators with a list of the company's postaccident actions, which included the following:

(1) Enhanced flight crew training and evaluation for all flight crewmembers:
- Increased hours for basic, initial, and transition training
- Increased training focus on automation logic and the capabilities of the A/T stall protection system

[91] Annex 6 addresses the standards and recommended practices for the operation of aircraft.

[92] According to the FAA, during an approach to Seattle-Tacoma International Airport, an Asiana flight was cleared by ATC to track inbound on the localizer and maintain 5,000 ft. However, the flight started descending on the ILS glideslope before receiving clearance for the descent. According to the FAA, Asiana took immediate corrective actions including briefing and training the incident flight crew and informing other Asiana pilots of the circumstances of the event.

- Increased training focus on visual approaches and enhanced evaluation of visual approach performance
- Additional evaluation for captain upgrade

(2) Strengthened flight instructor training
- Enhanced flight instructor screening and selection process
- Increase in required training hours for ground school, simulator, and OE flight instructor training
- Increased focus on special airports, visual and nonprecision approach, unstabilized approach, monitoring, and standard callouts

(3) Enhanced CRM training
- Implementation of new advanced communications and CRM courses
- Special training focusing on monitoring, workload management, and threat and error management

(4) Revamped safety management structure
- New senior executive-level position to oversee safety operations
- Additional staff devoted to internal safety audits, flight crew training support and development, and CRM instruction

(5) Other measures
- Revision of safety management system program and company procedures and manuals to provide more detailed guidance on key issues

2. Analysis

2.1 General

The flight crewmembers were properly certificated and qualified in accordance with Korean regulations and 14 CFR Part 129. The investigation found no evidence that the flight crews' performance was affected by any behavioral or medical condition or by the use of alcohol or drugs.

The airplane was loaded within weight and CG limits and was equipped, certified, and maintained in accordance with KOCA regulations and 14 CFR Part 129. The investigation found no evidence of any preimpact structural, engine, or system failures, including no indications of problems with the airplane's AFCS.

Weather conditions at the time of the accident were suitable for a visual approach. Air traffic controllers vectored flight 214 toward the extended centerline of runway 28L and, after the pilots reported the airport in sight, issued a clearance for the visual approach at a position and altitude that allowed for a normal descent and approach to the runway. The speed restriction issued on approach was in accordance with FAA procedures, and the flight crew accepted the speed assignment. The MSAW system was configured within FAA standards and performed as expected; it would not have activated based on the airplane's proximity to the runway.

The NTSB concludes that the following were not factors in the accident: flight crew certification and qualification; flight crew behavioral or medical conditions or the use of alcohol or drugs; airplane certification and maintenance; preimpact structural, engine, or system failures; or the air traffic controllers' handling of the flight.

A NOTAM had been published indicating that the ILS glideslope for runway 28L was out of service due to a construction project, and the flight crew was aware of the outage. While the electronic vertical guidance provided by a glideslope is required for approaches in certain low visibility conditions and can be a useful aid in all weather conditions, a glideslope is not required for a visual approach. The flight crew had numerous other cues to assist in planning and flying an appropriate vertical flightpath to the runway. Flight crews routinely plan descents based on speed and distance from airports or navigational fixes and published crossing altitudes on approach charts. Aids such as the ND's green altitude range arc and VNAV features were available to guide the pilots in the initial portion of the descent. As the airplane neared the runway, the PAPI lights and the visual aspect of the runway surface provided additional cues. The NTSB concludes that although the ILS glideslope was out of service, the lack of a glideslope should not have precluded the pilots' successful completion of a visual approach.

The following analysis describes the accident sequence and examines the safety issues associated with the flight crew's performance and the operation of the airplane's systems during the approach.

2.2 Accident Sequence

2.2.1 Approach from 14 to 5 nm from the Runway

The airplane intercepted the final approach course for runway 28L about 14.1 nm from the runway threshold and 4,800 ft msl, which was close to the desired glidepath and set up the flight crew for a straight-in visual approach. However, after the flight crew accepted the ATC instruction to maintain 180 knots to 5 nm from the runway, the crew made inputs to the AFCS that reduced the airplane's descent rate and caused it to diverge well above the desired 3° glidepath.

The PF decreased the MCP-selected speed from 210 knots to 180 knots and commanded flaps 5. While these selections at this time were appropriate, leaving the AFDS in FLCH SPD pitch mode without using the speedbrake to ensure an adequate rate of descent was not effective because the A/P was controlling airspeed with elevator inputs and the reduction in selected speed caused the airplane to pitch up and the descent rate to decrease. As a result, the airplane started to drift above the desired glidepath. In addition, the PF did not appear to promptly recognize that the airplane was drifting above the desired glidepath after he had selected a lower airspeed in FLCH SPD.

A cue available to the flight crew indicating the airplane's position relative to the desired glidepath was the green altitude range arc on the ND's map display. After they were cleared for the approach, the flight crewmembers had selected an MCP altitude of 1,800 ft because it is the crossing altitude for the DUYET waypoint, located 5.4 nm from the runway. The FMC used the airplane's vertical speed and groundspeed to calculate and display an arc showing where the airplane was expected to reach the MCP-selected altitude. Throughout the initial part of the approach, the green arc would have shown that the airplane would not arrive at 1,800 ft until well past the DUYET waypoint.

When the airplane was about 11.5 nm from the runway, descending through 4,300 ft msl, the PF changed the A/P pitch mode from FLCH SPD to V/S and adjusted the vertical speed to -1,000 fpm; there was a corresponding automatic change in the A/T mode from HOLD to SPD. The airplane's vertical speed began to increase toward the target value; however, a descent rate of 1,000 fpm was not high enough to maintain, let alone recapture, the desired glidepath, so the airplane continued to drift above it.

When the airplane was about 8.5 miles from the runway threshold, descending through 3,400 ft msl at an airspeed of 188 knots, the PF commanded landing gear down. Gear extension added drag and made it easier to decelerate. Although he did not do so, the PF could also have commanded flaps 20 at this time, adding additional drag, because the airspeed was 7 knots below the flaps 20 limit speed of 195 knots. The airplane was about 900 ft above the desired glidepath, and a higher flap setting would have allowed the flight crew to descend the airplane at a steeper angle while maintaining the assigned airspeed and would have saved time later when the flight crew needed to establish a landing configuration and decelerate to final approach speed.

After moving the gear handle to the down position, the PM commented on the airplane's position above the desired glidepath, stating, "this seems a little high." The PF agreed. The PM continued, "this should be a bit high." After a few seconds, the PF queried, "do you mean it's too high?" The PM made an unintelligible response, and the PF stated, "I will descend more," then decreased the selected vertical speed to -1,500 fpm. This exchange was followed by 21 seconds of no communication between the pilots as the airplane's descent rate increased and the airplane drew closer to the desired glidepath.

When the airplane was about 6.3 nm from the runway at about 2,600 ft msl and an airspeed of 178 knots, the selected vertical speed was changed back to -1,000 fpm. By examining the altitude and distance to the runway, both of which were displayed on the instrument panel, and applying the well known rule of thumb that a 3° glidepath requires about 300 ft of altitude loss per nm, the pilots could have quickly estimated that they were still several hundred feet high. Changing the vertical speed back to -1,000 fpm at that time was, therefore, inappropriate because the airplane was still well above the desired glidepath, and the flight crew needed to continue descending the airplane at more than 1,000 fpm to return to the desired glidepath. The crew's action indicated a lack of awareness of the airplane's position relative to the desired glidepath and of cues in the cockpit that could have alerted them to this. As a result of this lack of awareness and their early reversion to a descent rate of 1,000 fpm, the airplane remained high.

When the airplane reached the 5 nm point, it was about 400 ft above the desired glidepath, descending through 2,085 ft msl, at an airspeed of about 174 knots. As a result, the PF needed to slow the airplane below the flaps 30 limit speed of 170 knots, while also losing the excess altitude. When test pilots from Boeing and the FAA attempted to fly a stabilized approach in a flight simulator beginning from this starting point, they found it difficult to achieve a stabilized approach by 500 ft agl. In fact, they found it impossible to do so without exceeding maximum descent rates published in Asiana's FOM. However, when the starting point was changed to an on-desired-glidepath altitude (1,650 ft msl) with the same airspeed, the test pilots were consistently able to achieve a stabilized approach by 500 ft agl, and they did so without exceeding Asiana's maximum descent rates. Clearly, the airplane's excess altitude increased the difficulty of achieving a stabilized approach. The NTSB concludes that the flight crew mismanaged the airplane's vertical profile during the initial approach, which resulted in the airplane being well above the desired glidepath when it reached the 5 nm point, and this increased the difficulty of achieving a stabilized approach.

2.2.2 Approach from 5 nm to the Runway

The flight crew's difficulty in managing the airplane's vertical path continued as the approach progressed. The PF was aware of the need to lose excess altitude and attempted to do so using FLCH SPD pitch mode, which initiated a sequence of events that had the unintended consequence of deactivating automatic airspeed control. The changes on the FMA that occurred during the airplane's descent from 1,850 to 1,330 ft msl, when it was between about 4.5 and 3.0 nm from the runway threshold, are shown in figure 14 and discussed below.

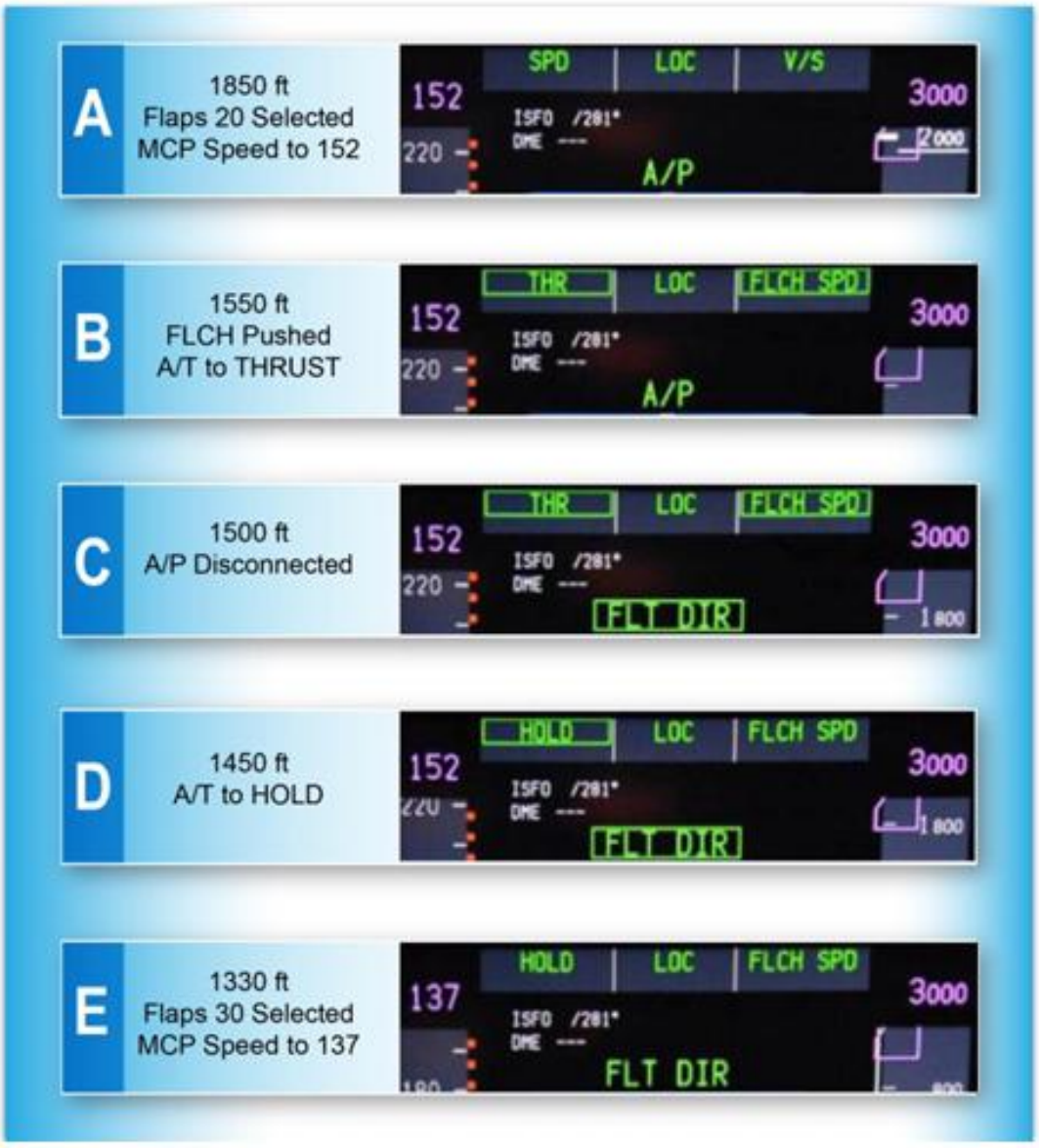


Figure 14. Automation sequence from 1,850 to 1,330 ft msl.

After passing the DUYET waypoint, the PF called out and set the MCP altitude to 3,000 ft, the planned altitude in the event of a go-around. After passing the 5 nm point, the PF commanded flaps 20; the PM moved the flap lever to the flaps 20 position; and the PF set the MCP speed to 152 knots (panel A of figure 14), the target speed for flaps 20.[93] The PF then commanded flaps 30, but the PM delayed setting them to the flaps 30 position because the airspeed had not yet slowed to below the flaps 30 limit speed.

[93] The PF correctly determined the target speed for flaps 20 by following the procedure as described in the 777 FCOM of adding 20 knots to V_{ref} (132 + 20 = 152 knots).

About 13 seconds after the PF commanded flaps 30 and 3 seconds before the PM set flaps 30, the AFDS pitch mode changed from V/S to FLCH SPD. By design, the A/T mode simultaneously changed from SPD to THR. Because the MCP-selected speed of 152 knots was less than the airplane's current airspeed of 172 knots (and in FLCH SPD, the AFDS controls speed via elevator pitch commands), the AFDS responded to this mode change by increasing pitch to slow the airplane. Also, the F/D command bars displayed an increase in target pitch. Because the MCP-selected altitude of 3,000 ft was above the airplane's current altitude of about 1,550 ft msl (and in THR mode, the A/T applies thrust appropriate to attain the selected altitude), the thrust levers began to advance to initiate a climb. About three seconds later, the PF disconnected the A/P and manually countered the forward motion of the thrust levers, moving them to the idle position. He then decreased the pitch by pushing the control column forward. As a result of the PF's manual override of the A/T, the A/T mode switched to HOLD, a mode in which the A/T would not move the thrust levers and was not controlling thrust or airspeed.

During a postaccident interview, the PF volunteered that he considered selecting FLCH SPD while descending in V/S mode because the airplane was high and he thought FLCH SPD would cause the thrust levers to move to the idle position and stay there, facilitating a more rapid descent than he could achieve in V/S mode. He added that he was not sure whether he selected FLCH SPD. During a follow-up interview, when informed that FLCH SPD had been selected, he initially reiterated his uncertainty but stated that it did not matter because selecting FLCH SPD would not have affected the functioning of the A/T and its automatic control of the selected airspeed.[94] When questioned further, he stated that he did not believe he had selected FLCH SPD.

Postaccident testing of the MCP and A/T components revealed no system faults that could have caused the transition to FLCH SPD without deliberate pilot action via the MCP. Based on the fact that the PF was flying the airplane and responsible for manipulating the MCP at the time of the mode transition, his recollection that he considered selecting FLCH SPD, and the fact that immediately after FLCH SPD was engaged, the PF disconnected the A/P and counteracted the climb inputs that had just been initiated by the autoflight system, it is likely that the PF selected FLCH SPD. Further, it is likely that he reconsidered his decision when he realized the AFCS was initiating a climb, disconnected the A/P, and then unintentionally put the A/T in HOLD mode by manually resisting the advance of the thrust levers.

When the PF selected FLCH SPD mode on the MCP, he did not announce doing so, as required by the Asiana 777 POM. By design, when the FLCH SPD mode was selected, the following visual changes occurred: the green light on the FLCH push-button switch illuminated, the MCP V/S window dropped the -1,000 fpm value that previously had been selected (because the AFDS mode was no longer V/S), and, as shown in panel B of figure 14, the FMA displayed boxed indications of THR in the A/T position and FLCH SPD in the pitch position. These MCP and FMA indications were important cues to the PM and the observer about the AFDS and A/T mode changes, but neither reported noticing these indications. Another visible cue indicating that

[94] It was apparent from the PF's interview statements that he did not understand the implications of the A/T mode transitions that occurred as a result of his selecting FLCH SPD. See section 2.4.1 for discussion of the training the pilots received on the A/T system.

the AFDS mode had changed was the increase in target pitch of the F/D command bars, but according to the PM and the observer, they also did not notice this indication.

Because the PM moved the flap lever to the flaps 30 position about 3 seconds after the PF selected FLCH SPD on the MCP, it is likely that at that time, the PM was monitoring the airspeed in preparation for changing the flap setting, which may have been why he missed the cues indicating the AFDS and A/T mode changes. At the same time as the PM selected flaps 30, the PF disconnected the A/P by double-clicking the wheel switch, which prevented the A/P disconnect aural alarm from sounding. The PF did not make the required "manual flight" callout when he disconnected the A/P. However, the disconnection of the A/P was apparently noticed by the PM because he called out "flight director," indicating the change to the AFDS status displayed on the PFDs (panel C of figure 14). About 1.5 seconds later, the PF responded, "check." Between these two callouts, the A/T mode changed from THR to HOLD. Neither pilot called out the change in the A/T mode, which would have been visible as a boxed HOLD annunciation (see panel D of figure 14). In postaccident interviews, no flight crewmember recalled noticing the A/T transition to the HOLD mode. This is not surprising in light of human factors research demonstrating that pilots frequently do not notice mode changes on the FMA, especially those that are unexpected (Sarter et al. 2007, 347-357).

The process of decelerating and configuring for landing would have been much easier, the pace of activities slower, and the workload less if it was not necessary for the PF and PM to both lose excess altitude and slow down after reaching the 5 nm point. Because they had to do both, they encountered a period of increased workload when they were engaged in parallel tasks for an extended period of time during a critical portion of the approach. This, in addition to the PF's failure to make a callout when he selected FLCH SPD pitch mode on the MCP, reduced their ability to effectively crosscheck each other's actions and monitor changes in the status of the autoflight system. The NTSB concludes that the flight crew's mismanagement of the airplane's vertical profile during the initial approach led to a period of increased workload that reduced the PM's awareness of the PF's actions around the time of the unintended deactivation of automatic airspeed control.

After setting the target approach speed of 137 knots in the MCP, the PF commanded, "flight director off." It was Asiana's informal practice to fly visual approaches with the PF's F/D turned off and the PM's F/D turned on, but only after turning both F/D switches off first.[95] In postaccident interviews, the PF and PM stated that the PM followed this practice. However, QAR data indicated that the PM turned off the PF's F/D switch but did not turn off his F/D switch. If both F/Ds had been in the off position at the same time, this would have cleared the AFDS modes and caused the A/T to transition to the SPD mode and resume automatic control of airspeed. However, the AFDS remained active and continued to display the FLCH SPD guidance that the PF had commanded. The PF's and PM's FMAs continued to display A/T HOLD mode, LOC roll mode, and FLCH SPD pitch mode (see panel E of figure 14). The PM's F/D command

[95] As further discussed in section 2.6.1, the purpose of having the PM's F/D on during a circling approach was to ensure that it would be active in the event of a missed approach. Asiana had an informal practice of also following this procedure on visual approaches.

bars were providing guidance to stay on the localizer and pitch to maintain the commanded 137-knot speed. The PF's F/D command bars were removed.

When the PF's F/D switch was turned off, the airplane's descent rate was about 1,000 fpm. About 2 seconds later, the PM stated "it's high," and the PF responded by pitching the airplane down and increasing the descent rate to capture the desired glidepath. Over the next 8 seconds, the descent rate increased to about 1,500 fpm. When the flight passed 1,000 ft, the PAPI would have been showing a too-high indication of four white lights, and over the next few seconds, the PF increased the descent rate to as much as about 1,800 fpm. The observer called out "sink rate, sir" three times in the next 9 seconds; he later stated this was because the Asiana FOM states that the descent rate must be 1,000 fpm or less below 1,000 ft agl. He further stated that the PF and PM were slow to respond to his sink rate callouts but they did respond, and the sink rate decreased, so he stopped making sink rate callouts.

As the airplane reached 500 ft, the descent rate diminished to about 1,200 fpm. At that time, the PAPI indication was three white lights and one red light showing the airplane was slightly high but approaching the desired glidepath. The thrust levers were still at idle, with N_1 speed about 23%. The airspeed, which had been decreasing rapidly, reached the proper approach speed of 137 knots. The decreasing trend in airspeed then slowed, and the airspeed remained about 135 knots for about the next 4 seconds. Review of recorded flight data showed that about 5 seconds after it descended through 500 ft, the airplane finally attained, but passed through, a 3° glidepath.

Although, at 500 ft, the airplane met some of Asiana's stabilized approach criteria as listed in the 777 POM (including being on target airspeed, in the landing configuration, and on the correct flightpath), it failed to satisfy other criteria. It was descending at greater than 1,000 fpm, and the thrust setting was not appropriate (it should have been about 56% N_1 speed). Because the approach was not stabilized at 500 ft agl, the flight crew should have conducted a go-around. Either the pilots did not notice that these parameters exceeded stabilized approach criteria[96] or they believed that the deviations were minor and could easily be corrected. In either case, the crew's decision to press ahead was not unusual, as industry statistics indicate about 97% of unstable approaches are continued to landing (Burin 2011).

Asiana's POM guidance for visual approaches stated that the PM should call out "five hundred" at 500 ft above the touchdown height, and the PF should respond "stabilized," or "go around." The PM did not make a 500-ft callout, and the PF did not say "stabilized" or "go around." However, about 5 seconds after passing through 500 ft, when the airplane finally attained the desired glidepath and the PAPI was giving an on-path indication of two white and two red lights, the PM made a callout, stating "on glidepath," and the PF replied "check." Thus, the flight crew did not make standard callouts for the mandatory stabilized approach check.

About 5 seconds after the PAPI on-path indication, the airplane descended through about 330 ft, and the PAPI indication changed to three red lights and one white light, meaning the

[96] See section 2.3.3 for a discussion of the flight crew's monitoring performance.

airplane was now slightly below the PAPI glidepath. All three flight crewmembers later stated in interviews that they were aware of the PAPI indication changing to three red lights but for the 12 seconds between the PM stating "on glidepath" and his next remark, "it's low," none of the pilots remarked about the changing glidepath. The PM's remark of "it's low" (made as the airplane passed 180 ft, about 17 seconds from impact) could have applied to either the airspeed (which was about 118 knots) or the glidepath since, about 2 or 3 seconds earlier, the PAPI indication had changed to four red lights, showing that the airplane was significantly below glidepath. Both the airspeed indication, which was more than 5 knots below target approach speed, and a PAPI indication of four red lights required a go-around, but the flight crew continued the increasingly unstabilized approach.

In a postaccident interview, the PF stated that he never saw four red PAPI lights. However, FDR data indicate that immediately after the change to four red PAPI lights and the PM's comment "it's low," the PF increased the pitch from 5° to 7.5° by pulling back on the control column. This suggests that the PF interpreted the PM's comment as referring to low glidepath, that the PF was aware of the low glidepath, and that he attempted to correct the low glidepath by pulling back on the control column.[97]

In a postaccident interview, the PM recalled that he first noticed the airspeed was low (120 knots) about 200 ft and thought at that time that the A/T was not working. FDR data are consistent with his recollection that the airspeed was 120 knots at 200 ft. The observer also recalled noticing that airspeed was low and seeing that the red hatch marks at the bottom of the airspeed tape (the barber pole) were moving up around 200 ft. He estimated that this was 5 or 10 seconds before impact (the airplane reached 200 ft about 18 seconds before impact). The observer did not recall a specific airspeed value at 200 ft.

In a postaccident interview, the PF said he was briefly "blinded" by a bright light similar to a glare or reflection outside the airplane between 500 and 200 ft, and when he looked down, he noticed the low airspeed and the EICAS "airspeed low" caution alert. However, the PF also stated that the bright light was visible only momentarily, that it did not subsequently affect his vision, and that its only effect was to cause him to look at the instrument panel shortly after the quadruple chime sounded. In addition, neither of the other pilots reported seeing a bright light or having it interfere with the performance of their duties. Thus, the visual phenomenon described by the PF seems to have had little effect on the performance of the flight crew, aside from possibly causing the PF to look at the instrument panel. As further discussed below, it is also possible that the PF's attention was drawn to the instrument panel by the low airspeed alert's quadruple chime or master caution light.

About 8 seconds after the PAPI indication changed to four red and 7 seconds after the PM recalled seeing the airspeed at 120 knots, the quadruple chime caution aural alert sounded, and the master caution light illuminated. The airplane was about 11 seconds from impact at an

[97] The PF's reaction at this point would be consistent with his reaction to the PM's earlier comment "it's high" at 11:26:44, after which the PF pitched the airplane down to increase descent rate because they were well above the glidepath (as indicated by four white lights on the PAPI).

altitude of 124 ft and a speed of 114 knots. According to the performance study, after this point, the airplane likely no longer had performance capability to accomplish a go-around.

The PF and PM recalled seeing the accompanying "airspeed low" message on the EICAS. Their attention was likely drawn to the EICAS as a result of the quadruple chime caution aural alert and/or master caution light. The PF and PM also recalled seeing low airspeed indications on the PFD at that time. About 4 seconds after the quadruple chime sounded and 7 seconds before impact, when the airplane was at an altitude of 90 ft and a speed of 110 knots, the PM said, "speed," and added go-around thrust. Shortly thereafter, the control column reached the full aft position, and the stall warning stick shaker activated. Pitch attitude increased to 12°, and, passing 30 feet, the PM called out "go-around." Seconds later, the airplane struck the seawall.

The observer recalled that he first noticed airspeed was low when the airplane was about 200 ft but could not recall what speed was displayed at that time. He said he did not advise the other pilots about the low airspeed because the PF was already reacting. He thought this happened about 5 or 10 seconds before impact. However, it was the PM who pushed the throttle levers forward, and he did so about 11 seconds after the airplane passed through 200 ft. In addition, the airplane passed through 200 ft about 18 seconds before impact. Therefore, it is uncertain when the observer first became aware of the low airspeed, but it was probably sometime between 200 ft and the point where the PM moved the throttle levers forward (86 ft). The NTSB concludes that about 200 ft, one or more flight crewmembers became aware of the low airspeed and low path conditions but the flight crew did not initiate a go-around until the airplane was below 100 ft, at which point the airplane did not have the performance capability to accomplish a go-around.

2.3 Flight Crew Performance

2.3.1 Fatigue

The NTSB evaluated a number of criteria, including recent sleep, sleep quality, circadian factors, and time awake to determine whether the flight crewmembers were experiencing fatigue at the time of the accident. There is no evidence that any of the pilots began their duty period with a preexisting sleep debt or fatigue.

In the 24 hours before the accident, the PF, the PM, and the observer obtained about 5.5 hours, 8 hours, and 10.5 hours of sleep, respectively, as compared to their self-reported sleep needs of about 7.5 hours, 7 hours, and 7.5 hours. Thus, the PF received less sleep than normal in the 24 hours before the accident.

The hours of sleep reportedly obtained by each pilot during the 24 hours before the accident occurred in multiple sleep periods. Nonconsolidated sleep is less restorative than consolidated sleep. Thus, although the PM and observer reported obtaining enough total sleep, their recent sleep was fragmented, reducing its restorative value.

performance of the primary flight crew during the approach, enhancing the flight crew's monitoring capability. However, despite these countermeasures, the scheduling of the accident flight was likely to result in some fatigue.

The NTSB acknowledges that it would be very difficult, if not impossible, to completely eliminate flight crew fatigue in the operation of all long-distance transmeridian flights. However, it is possible for an airline to collect data on pilot fatigue during line operations and make small adjustments in scheduling and other factors to maximize pilot rest and minimize the occurrence of fatigue during high-workload safety-critical phases of flight. Such an approach is advocated in ICAO guidance materials on the development of fatigue risk management systems (FRMS) (ICAO 2012). At the time of the accident, Asiana was at the preliminary planning stage of developing an FRMS. The NTSB believes that, once developed and implemented, an FRMS could potentially reduce flight crew fatigue during Asiana's long-range transmeridian flights and encourages Asiana to expedite the development of its FRMS.

Encouraging flight crew compliance to operator SOPs, enhancing flight crew training, and improving flight crew interface design might also help to mitigate the effects of fatigue on long-range flight operations. Improvements in each of these areas are recommended in other sections of this report.

2.3.2 Flight Crew Communication

The PF, PM, and observer reported that they had normal crew interactions, callouts, responses, and actions during the accident approach. A review of CVR recordings revealed a relaxed but professional cockpit atmosphere. However, CVR recordings also indicated that the PF did not tell the PM that he was stressed about performing the approach without the benefit of an electronic glideslope to aid him in managing the airplane's vertical path. If the PF had expressed his concern, the PM might have discussed the availability of cues like the altitude range arc or VPI or suggested alternate methods for conducting the approach, such as flying a VNAV approach that would have provided precise vertical guidance via the F/D. The PF was likely reluctant to acknowledge his lack of confidence in this area, and, as a result, the flight crew missed an opportunity to discuss ways that they could have effectively managed the airplane's vertical path.

An evaluation of flight crew communications during the approach also revealed that the flight crew did not consistently adhere to Asiana's SOPs in the area of MCP selections and related callouts.

When the A/P was on, the PF was supposed to make selections on the MCP and accompany these selections with a callout. The PM was supposed to respond "check" and call out every mode change displayed on the FMA. Throughout the approach, the pilots sometimes adhered to this procedure but did not consistently do so. For example, at 1121:12, the PM called "heading select" with no preceding callout from the PF. At 1123:51, one of the pilots selected an MCP speed of 172 knots, but there was no callout from the PF. At 1123:58, the PM called "V/S" with no preceding callout by the PF. At 1125:31, the PM called "one thousand," referring to the

MCP-selected vertical speed, with no preceding callout from the PF. At 1126:32, the PM called "flight director" with no preceding callout by the PF. All of these callouts were accompanied by changes to the MCP. These communications indicate that the PF was not consistently performing both the selection and the accompanying callout when the A/P was on, per Asiana's SOPs.

The pattern of nonadherence to standard procedure involving selections and callouts pertaining to the MCP is likely the reason the PF did not call out "flight level change" when he pushed the FLCH button at 1,550 ft. As a result, and for other reasons discussed earlier, the PM did not notice that FLCH SPD was engaged at 1,550 ft.

A possible reason for the PF's and PM's lack of adherence to procedures may have been a lack of clarity concerning their roles. Confusion about their pilot roles may have been due, in part, to the fact that the PF and the PM were both captains, and the PF was performing the role of captain while the PM was the PIC and the PF's OE instructor for the flight. This may have caused the PF to be more deferential towards the PM than he would have been to an FO, for example, waiting for guidance from the PM before initiating actions and following his lead regarding the initiation of changes to the AFCS and performance of related callouts. In addition, this was the PM's first flight as an OE instructor, so he was new to the role of instructing another captain on the line. His job was to serve as the PIC and coach the PF as needed in terms of how to fly the aircraft while respecting the airline's policies and procedures pertaining to the prescribed roles of the PF and PM during the flight. The PM's inexperience in managing these multiple roles may have made it difficult for him to balance his multiple responsibilities. The NTSB concludes that nonstandard communication and coordination between the PF and the PM when making selections on the MCP to control the AFDS and A/T likely resulted, at least in part, from role confusion and subsequently degraded their awareness of the AFDS and A/T modes.

A review of Asiana's procedures for dealing with MCP selections and related callouts indicated that they would have been adequate if followed. Adherence to SOPs involving communication and coordination can be improved through training. Therefore, the NTSB recommends that Asiana reinforce, through its pilot training programs, flight crew adherence to SOPs involving making inputs to the operation of autoflight system controls on the Boeing 777 MCP and the performance of related callouts.

2.3.3 Flight Crew Monitoring

The flight crew did not adequately monitor airspeed between 500 and 200 ft. This likely resulted from a combination of workload, expectancy, and a coincidence of timing. When the PF inadvertently disabled automatic airspeed control about 1,500 ft, he pulled the thrust levers to idle to counteract the momentary increase in thrust that resulted from the airplane trying to climb to the MCP altitude of 3,000 ft. He incorrectly believed that the A/T would use thrust to target the selected airspeed of 137 knots thereafter, which would have required the thrust levers to remain at or near the idle position for a significant period of time as the airplane slowed from 168 to 137 knots. Therefore, the lack of thrust lever movement between 1,500 and 500 ft was in line with the PF's expectations and likely reinforced his incorrect understanding that the A/T system was controlling airspeed. At the 500-ft stable approach gate for the visual approach, the

PM checked the airspeed and saw that (by coincidence) it was within a couple knots of the target approach speed. The decreasing trend even halted for a few seconds at 134 knots (although the airspeed trend arrow predicted a continued decrease). The fact that airspeed was very close to the target airspeed at 500 ft and stabilized briefly at 134 knots likely confirmed the PM's expectation that airspeed was being controlled automatically.

If the PM had continued monitoring airspeed and thrust, he would have noticed that the airplane was not truly stabilized at the target approach speed. However, the PM's stable approach check occurred between multiple "sink rate" callouts from the observer (which resulted from the PF trying to descend rapidly to attain the desired glidepath by 500 ft), the PM's radio exchanges with ATC obtaining landing clearance, the PM's execution of the landing checklist, and his monitoring of the PF's rapid interception of the glidepath (as indicated by the PAPI). The need to perform these multiple concurrent tasks in a short period of time would have required the PM to perform the stable approach check very quickly, which increased the probability of an error like the one he made. Thus, the quality of the PM's monitoring of airspeed during the stable approach check and his failure to recognize that airspeed was not truly stabilized at the desired approach speed likely resulted from a period of increased workload involving multiple concurrent tasks. This increased workload was created, in part, by task compression resulting from the flight crew's ineffective management of vertical path earlier in the approach.

Below 500 ft, the airplane was getting close to the runway, and it was important to control the airplane precisely and promptly correct any flightpath deviations to ensure that the airplane would be in a position to land safely. Asiana SOPs stated that both pilots were supposed to alternate their visual attention inside and outside the airplane on final approach. Below 500 ft, however, the airplane began to sink below the desired glidepath. Although it was primarily the PF's task to control these parameters, the PM knew that the PF was new to the airplane and likely felt that it was important to closely monitor the PF's performance in these areas. Consequently, both the PF and PM recalled focusing their visual attention outside the airplane (on the runway environment and PAPI) between about 500 and 200 ft. As a result of their focus outside the airplane, they did not notice the continued decrease in airspeed that occurred below 500 ft. The PF appears not to have monitored the airspeed indicator for at least 24 seconds after the airplane descended below 500 ft (until the low airspeed alert activated), and the PM appears not to have monitored the airspeed indicator for about 17 seconds after the airplane descended below 500 ft (until the airplane was about 200 ft).

The observer also demonstrated a delayed recognition of the decaying airspeed in that he did not recognize that airspeed had decreased below target speed until 200 ft or lower. The observer made several sink rate callouts between 1,000 and 500 ft, indicating that he was closely monitoring vertical speed during at least part of the approach. Effective monitoring would have required the observer to frequently alternate his visual attention between vertical speed and airspeed (as well as other sources of information) and mentally compare the values he perceived to desired targets. The observer's delayed recognition of low airspeed indicates deficiencies in his visual scan and/or attention during the approach.

The observer's monitoring performance could have been adversely affected by the same increased workload that affected the PF and PM below 1,000 ft; however, because he was not required to perform many of the activities that they were assigned, his task load was less than theirs. The observer's postaccident interview and investigator observations in the 777 simulator indicated that the observer's view of the instrument panel was partially obscured by materials affixed to the PF's and PM's control wheel clipboards. From his position seated on the center jumpseat, the observer would likely have been able to see only the right half of the PF's PFD (showing altitude and vertical speed) and the left half of the PM's PFD (showing airspeed). This vantage point would not have prevented him from monitoring all necessary sources of information but would have increased the amount of effort required to effectively monitor. It is possible that the observer was fixated on the vertical speed information shown on the PF's PFD as a result of the high descent rates he had previously observed. It is also possible that his monitoring performance, and that of the other flight crewmembers, was degraded by fatigue, which is known to influence attention and increase vigilance errors (Van Dongen et al. 2003, 117-126).

Human factors research has demonstrated that system operators often become complacent about monitoring highly reliable automated systems when they develop a high degree of trust in those systems and when manual tasks compete with automated tasks for operator attention. This phenomenon occurs in both beginner and expert operators and cannot easily be overcome through practice (Parasuraman and Manzey 2010, 381-410). Attentional resources are limited, so shifting them away from automated tasks and toward manually controlled tasks during periods of increased workload can be viewed as adaptive because one of the functions of automation is to ease operator workload. However, the use of such systems has predictable adverse consequences on human performance. Specifically, it reduces monitoring and decreases the likelihood that a human operator will detect signs of anomalous or unexpected system behavior involving the processes under automatic control. In this case, the PF, PM, and observer believed the A/T system was controlling speed with thrust, they had a high degree of trust in the automated system, and they did not closely monitor these parameters during a period of elevated workload. Thus, the flight crew's inadequate monitoring of airspeed and thrust indications appears to fit this pattern involving automation reliance. The NTSB concludes that insufficient flight crew monitoring of airspeed indications during the approach likely resulted from expectancy, increased workload, fatigue, and automation reliance.

2.3.4 Go-Around Decision-Making

As stated earlier, the pilots did not initiate a go-around until reaching an altitude of 90 ft, which was about 7 seconds before the impact. This delay prevented a successful go-around because the airplane was not able to develop the power necessary to climb out in the time available before impact. As shown during testing, a go-around that was initiated 11 seconds before the impact (at an altitude of 124 ft) likely would not have resulted in the ground impact. In fact, the go-around should have been initiated well before that point: when the airplane reached 500 ft and the approach was unstabilized. The previous section discussed the role of insufficient monitoring in the flight crewmembers' failure to execute a go-around between 500 and 200 ft. This section will discuss the possible reasons for their delay in executing the go-around below 200 ft.

Either the glidepath-too-low indication of four red PAPI lights or the airspeed exceeding the low tolerance criterion for a stable approach should have prompted an immediate go-around. The PF indicated that he never saw a PAPI indication of four red lights and that he first noticed the airspeed was low when the "airspeed low" caution alert appeared on the EICAS display. The PM said that he first noticed four red lights and the low airspeed when the airplane was about 200 ft. However, he did not push the thrust levers forward to initiate a go-around until about 11 seconds after the airplane descended through 200 ft. The observer said that he was unable to see the PAPI due to a high deck angle and that he first noticed that the airspeed was low about 200 ft or just before the time when the PM pushed the thrust levers forward.

Available evidence does not support the PF's report that he did not see a PAPI indication of four red lights. Despite his statement that he never noticed the PAPI indication change to four red lights, he also stated that he was looking at the runway environment, noticed the change to one white and three red, and was very concerned about a change to four red because he believed that would cause him to "fail" his OE training flight. As a result, the PF would likely have been monitoring the PAPI lights very closely. In addition, the PAPI changes from two white/two red to one white/three red then to four red were followed immediately by step-wise increases in the airplane's pitch. These pitch increases resulted from the PF's control inputs, suggesting the PF saw and reacted to both changes. It is likely, therefore, that the PF saw the PAPI indication change to four red lights within 1 or 2 seconds after it occurred (at 1127:31 and 219 ft). Thus, he saw the PAPI indication change to four red lights about 11 to 12 seconds before the PM initiated the go-around.

No evidence contradicts the PF's statement that he was unaware of the low airspeed until the "airspeed low" caution alert message appeared on the EICAS. It is likely that his visual attention was focused primarily outside the airplane below 500 ft because he was manually flying the airplane and attempting to correct a vertical deviation that developed during this period. Therefore, the PF's statement about his lack of awareness of low airspeed until after the chiming of the low airspeed caution alert is the best available evidence about his awareness of airspeed during that period.

Accordingly, it is likely that the PF and PM were aware of unacceptably low PAPI indications for about 11 seconds, and the PM was aware of an unacceptably low airspeed indication for about 11 seconds before a go-around was initiated. The flight crew's delay likely resulted from a combination of surprise, nonstandard communication, and role confusion. Both the PF and the PM were under the impression that the A/T had been controlling airspeed for them, and they were surprised and confused when they realized it was not.

Human factors research indicates that reaction time is longer for unexpected than for expected events. When a flight crew is confronted with a sudden, abnormal event, responses are more likely to be delayed or inappropriate. In one study, for example, pilots who encountered an expected low-altitude aerodynamic stall during simulator training responded rather uniformly and quickly (an average of 1.33 seconds), but those who encountered an unexpected stall took much longer to respond (an average of 8.36 seconds). Moreover, there was a broad range of

response times to the unexpected stall (from 1.9 to 18.2 seconds) (Casner et al. 2013, 477-485). Thus, the PF's and PM's surprise likely contributed to their delayed reaction.

About a second after the PM noticed the PAPI was displaying four red lights and that airspeed was 120 knots, the CVR recorded the PM saying, "it's low" and the PF responding "yeah."[99] Per Asiana SOPs, the PM should have called out "low glidepath" and "low speed" or simply "go around," so his statement "it's low" was nonstandard. As previously stated, the PF seemed to interpret the PM's callout as referring to the airplane being low on the glidepath because he attempted to correct the situation by pulling back on the control column. Although this would have been an effective solution if power was also added, neither the PF nor the A/T was managing thrust and airspeed; therefore, the application of pitch alone was insufficient to achieve the desired glidepath.

As discussed earlier, the PF was likely aware that the PAPI was indicating four red lights when the PM said "it's low." He would have known that this indication required an immediate go-around. He may have continued the approach because he believed he could correct the vertical path deviation, because he did not want to acknowledge the error and "fail" his OE training flight, or because he was deferring to the PM (a more senior crewmember).

The PF appears to have remained unaware of low airspeed for at least another 7 seconds, until the quadruple chime sounded. Postaccident interviews indicate that at this point, both pilots' eyes were drawn down to the EICAS display where they read the "airspeed low" message. Both then inspected airspeed indications and recognized the urgent necessity of a go-around. At this point, the PF recalled thinking about increasing thrust, but the PM acted first.

The PF said he believed that only the PIC, in this case the PM, could call for a go-around. He said this was company policy resulting from a tail strike event that had occurred when an FO had initiated a go-around. This statement contrasted with Asiana's written policy in the 777 POM, which stated, "The decision to make a missed approach rests with the captain. However, when the co-pilot (F/O) flies the aircraft as PF, the co-pilot (F/O) can make a missed approach." In addition, multiple Asiana managers and pilots said there was no company policy preventing junior crewmembers from initiating a go-around. However, the Asiana FOM states only that the captain has the "authority and responsibility to make a landing or missed approach (go-around)"; it does not address the authority of the FO to initiate a go-around.

The PF's uncertainty about whether he had the authority to make a go-around decision could have stemmed from confusion due to the inconsistent written policy in this area. In either case, the PF's deference to authority likely played some role in the fact that he did not initiate a go-around. The PM, on the other hand, said he believed that the PF was responsible for initiating a go-around. Thus, the PF and PM had differing understandings about whose role it was to initiate a go-around in the event that one was required. The NTSB concludes that the delayed initiation of a go-around by the PF and the PM after they became aware of the airplane's low

[99] The PM recalled telling the PF they were "slightly low" and applying a little backpressure on the control column when the airplane was on short final approach; however, he recalled that this occurred about 500 ft.

path and airspeed likely resulted from a combination of surprise, nonstandard communication, and role confusion.

2.4 Autoflight System Training and Design

In postaccident interviews, the PF made several statements that indicated he had an inaccurate understanding of some aspects of the airplane's autoflight system. He said that although the A/T could be manually overridden by the flight crew, the A/T system was always working. He stated that pilots normally left the A/T engaged but it was not important whether the A/T system was engaged because the A/T moved the thrust levers automatically to maintain the selected speed. He stated that when the A/T was disconnected, the A/T would move the thrust levers to maintain airspeed. Asked whether the A/T would resume control of airspeed after a manual pilot override in FLCH SPD mode, he said the A/T would resume controlling speed. He said that if the 777 A/T system was turned off and airspeed became very low, the A/T would transition to TO/GA mode, and he believed that the airplane's functionality in this respect was similar to that of the Airbus A320. These statements indicate that the PF had an inaccurate understanding of how the AFDS and A/T interact to control speed in FLCH SPD mode, what happens when the A/T is overridden and the throttles transition to HOLD in a FLCH SPD descent, and how the A/T automatic engagement feature operates.

The complexity of autoflight systems can contribute to faulty mental models of automation logic. The systems installed on airplanes like the 777, for example, contain multiple subsystems. Each of these subsystems has various modes of operation, and these subsystems are intercoupled in various ways. Human factors research involving pilots suggests that they have difficulty comprehending the subtleties of the interconnections between various autoflight subsystems (Billings 1999). These difficulties lead to gaps in pilots' mental models that can be particularly problematic in highly dynamic and/or nonroutine situations (Sarter and Woods 1997, 553-569). The problem of faulty pilot mental models of complex autoflight systems can be alleviated by improving systems training and reducing design complexity.

2.4.1 Autoflight System Training

The PF's Asiana 777 transition training included two instructor-led ground school lessons totaling 6 hours that addressed the 777 autoflight system. The presentations given in these lessons used slides based on screen captures of computer-based training lessons purchased from Boeing. Use of the AFDS and A/T systems was also covered in other ground and simulator lessons. Despite having completed all classroom and simulator training, the PF said he was not confident in his understanding of the system.

Other Asiana pilots and instructors who were interviewed by investigators after the accident also appeared to have inaccurate mental models of AFDS and A/T system functionality in some of the same areas as the PF. A review of the Asiana 777 transition training slides revealed that they did not provide a complete picture of AFDS and A/T system design logic involving the functioning of the A/T in HOLD mode or the availability of minimum speed protection when the A/T was in HOLD mode. For example, a training slide labeled "stall

protection features" made the unqualified statement that "autothrottles engage automatically (if armed)." No description was provided of the circumstances when the A/T will not automatically engage. These circumstances, which were listed in the 777 FCOM, include when the AFDS pitch mode is FLCH SPD (as it was during the accident flight) or TO/GA, or the airplane is below 400 ft above the airport on takeoff or below 100 ft RA on approach.

Further, the Boeing 777 FCTM, upon which Asiana based much of its training, did not explain the conditions under which the A/T would not automatically engage. The FCTM recommended A/T use during all phases of flight, including manual flight, and presented a stall protection demonstration that did not include situations when the A/T would not automatically activate. Asiana adopted the FCTM stall protection demonstration in its 777 simulator training, and the PF had observed the demonstration.

During the demonstration, A/P and A/T were disengaged, thrust levers were retarded to idle, MCP-selected speed was reduced below minimum speed on the speed tape, and the airplane was allowed to decelerate into the amber band on the airspeed tape (below minimum maneuvering speed). With no pilot intervention, the A/T system "woke up," engaged in SPD mode, and returned the airplane to minimum maneuvering speed. The PF stated that when he saw the demonstration, he was "astonished" that the airplane would recover by itself from an approach to stall. Because the training the PF received did not adequately describe the circumstances in which the A/T would not automatically engage or expose him to such circumstances, this demonstration likely gave him false confidence that the A/T would provide speed protection at all times.

Additionally, the PF was exposed to some informal, partially accurate information about the interrelationship between the FLCH SPD pitch mode and the HOLD A/T mode during his 777 transition training. An Asiana 777 ground school instructor stated that he had, on three occasions, experienced an "anomaly" in the behavior of the A/T in that it did not automatically engage while in FLCH SPD mode, and he personally explained this experience to pilots in his ground school classes. He stated that the PF had been in a class that had been given this explanation. Apparently, the PF was not able to recognize and apply this knowledge during the accident flight. The instructor's description of these experiences as "anomalies" rather than a result of the system's design logic and the fact that the instructor's comments were not incorporated into Asiana's 777 formal training curriculum indicate that this aspect of AFDS and A/T functionality was not accurately described or adequately emphasized.

The NTSB concludes that, as a result of complexities in the 777 AFCS and inadequacies in related training and documentation, the PF had an inaccurate understanding of how the AFDS and A/T interacted to control airspeed, which led to his inadvertent deactivation of automatic airspeed control.

As previously mentioned, interviews with other Asiana pilots and instructors indicated that they also lacked understanding of AFDS and A/T system functionality in some of the same areas as the PF. Further, the training materials that Asiana was using, including ground school materials and the FCTM, were supplied by Boeing, and these materials are not unique to Asiana

but are used by numerous other airlines. Therefore, the NTSB recommends that the FAA require Boeing to develop enhanced 777 training that will improve flight crew understanding of A/T modes and automatic activation system logic through improved documentation, courseware, and instructor training. Further, the NTSB recommends that once the enhanced Boeing 777 training has been developed, as requested in Safety Recommendation A-14-37, the FAA require operators and training providers to provide this training to 777 pilots.

The NTSB also recommends that the FAA require Boeing to revise its 777 FCTM stall protection demonstration to include an explanation and demonstration of the circumstances in which the A/T does not provide low speed protection. Further, the NTSB recommends that once the revision to the Boeing 777 FCTM has been completed, as requested in Safety Recommendation A-14-39, the FAA require operators and training providers to incorporate the revised stall protection demonstration in their training.

It is unlikely that deficiencies in pilot training addressing the underlying logic and operational use of autoflight systems are limited to the 777. A 2012 study conducted by Boeing, the International Air Transport Association, and the International Federation of Airline Pilots Associations surveyed airline transport pilots across multiple regions, airlines, and airplane types. The findings of this survey suggest that incomplete mental models stemming from deficiencies in training are common among pilots transitioning to a new airplane type (Holder 2012). Forty-two percent of respondents reported that autoflight system training was minimal or inadequate. Few (23%) felt comfortable with autoflight system operation during their initial line flight in a new airplane type, and the majority (62%) did not feel comfortable until after they had operated on the line for 3 months or more. Respondents estimated that 42% of their autoflight system learning occurred during line flying, rather than during classroom training or self-study.[100]

In its 2013 study of flight deck automation, the FAA also recommended training enhancements to "improve pilot knowledge and skills for successful flightpath management" (FAA 2013). This report stated that regulatory guidance and requirements determining the content and duration for training and certification should include the following considerations:

- Management and use of automated systems, including achieving and maintaining mode awareness;
- Handling known automated system anomalies or situations known to cause crew difficulties in line operations or in training;
- The decision-making process concerning the selection for applicable modes.

Pilot training could be improved across airplane types to support better pilot understanding of automated systems for flightpath management and their use in operational

[100] In addition, most pilots surveyed thought autoflight system training could be improved through more attention to automation surprises (57%) and hands-on use of automation in operational situations (52%). A third (33%) thought training could be improved through greater attention to transitions between modes, and slightly more than a quarter (27%) thought training could be improved through greater emphasis on basic knowledge of the system.

situations. Therefore, the NTSB recommends that the FAA convene an expert panel (including members with expertise in human factors, training, and flight operations) to evaluate methods for training flight crews to understand the functionality of automated systems for flightpath management, identify the most effective training methods, and revise training guidance for operators in this area.

2.4.2 Autoflight System Design

As previously mentioned, reducing design complexity is another method by which faulty pilot mental models of complex autoflight systems can be alleviated. Human performance researchers have identified mode awareness as a significant and continuing area of concern in aviation safety (FAA 1996 and 2013). Lack of mode awareness can lead to automation surprise when an automated system causes an airplane to behave contrary to flight crew expectation, and late detection of this behavior can lead to undesirable system behavior. Three factors have been found to contribute to a lack of mode awareness: poor mental models, low system observability, and highly dynamic and/or nonroutine situations (Sarter and Woods 1997, 557-569). All three factors were present in this accident.

The FAA has also highlighted problems involving pilot mode awareness. In its 2013 automation study, the FAA concluded that although current flight deck designs have incorporated many useful safety and operational improvements through new systems and technologies, the highly integrated nature of current flight decks has also increased flight crew knowledge requirements and introduced complexity that can lead to pilot confusion and error (FAA 2013). According to the FAA, short-term strategies for mitigating this problem include enhanced flight crew training, and long-term strategies should involve changes to equipment design.

The 787 and the 777 share a common type rating and have very similar if not identical AFCS logic. Although the FAA accepted the design logic of this system when the 777 was certified in 1995, the FAA and EASA identified the potential need for a design modification during the 787 flight test certification program in 2010. Both organizations expressed concern that the system did not provide minimum speed protection when the AFCS was in FLCH SPD or VNAV SPD pitch mode with the A/T in HOLD mode. They expressed concern about the intuitiveness of this design from a pilot's perspective and argued that safety would be enhanced by avoiding these exceptions in the design logic. Boeing did not modify the logic of the 787 AFCS as a result of these concerns. Instead, a note was added to the 787 AFM that stated, "During a descent in FLCH mode or VNAV SPD mode, the A/T may activate in HOLD mode. When in HOLD mode, the A/T will not wake up even during large deviations from target speed and does not support stall protection." The FAA accepted this outcome. Similar information addressing these aspects of A/T automatic activation logic is not included in the 777 AFM but is included in the 777 FCOM. However, the information in the 777 FCOM must be carefully pieced together by the reader because it is provided in two different notes with dissimilar wording that could be interpreted as describing different issues.

The PF's statements indicate that he did not have an accurate understanding of the context in which the A/T would transition to and remain in HOLD mode as a result of manual thrust lever override. Interviews with other Asiana pilots, including some instructors, indicated that they also had inaccurate mental models of system design logic in these areas. Although this was likely due, in part, to inadequate training and documentation, it was also likely due, in part, to the complexity of the design logic and a lack of intuitiveness from a pilot's perspective.

On the accident approach, if the A/T automatic engagement feature had been available, it would have engaged the A/T about 1 second after the airspeed reached 124 knots, which occurred about 21 seconds before impact. The NTSB concludes that if the A/T automatic engagement function ("wakeup"), or a system with similar functionality, had been available during the final approach, it would likely have activated and increased power about 20 seconds before impact, which may have prevented the accident.

System observability is another aspect of design that can influence the likelihood of mode confusion. Observability has been described as "the degree to which events, changes, and anomalies in the monitored process are effectively communicated to the operator through the interface" (Nikolic and Sarter 2007, 553-565). The 777 AFCS communicates AFDS and A/T mode status and changes to the pilot primarily through indications on the FMA. However, as discussed earlier in this report, pilots frequently do not notice mode changes that are presented in this fashion, especially when they are busy with other visual tasks or do not expect a mode change to occur. Although it can be argued that pilots could eventually become aware of such changes by noticing changes to flight parameters that are a result of undetected mode changes, flight crew monitoring of parameters they believe to be under the control of highly reliable automatic systems is imperfect.

Due to the limitations of human attention and monitoring capabilities, modern flight deck systems have been designed to provide flight crews with alerts that draw their attention to critical changes. The 777 flight deck, for example, provides an aural warning alert when the A/P is disconnected. Unless this warning is canceled in advance by double clicking the A/P disconnect button, this alert actively informs the crew that the airplane is no longer controlling pitch and roll, and the flight crew needs to manually manage these parameters or reengage the A/P. Similarly, an aural caution alert sounds if the A/T is disconnected, informing the flight crew that the A/T is no longer controlling thrust. However, the A/T disconnect alert only sounds when the A/T is turned "off." It does not sound when the A/T transitions, either autonomously or as a result of pilot action, to a mode where it is no longer controlling airspeed.

This is potentially problematic when, as occurred in the accident, the A/T transitions to HOLD at a time when the pilot does not expect it to do so. The risk of this occurring is increased by faulty mental models of system logic and by system design characteristics that cause the same pilot inputs to have differing effects depending on the operating mode. For example, manually overriding the throttle levers in V/S pitch mode and SPD A/T mode has no effect on the A/T operating mode, but manually overriding the throttle levers during a climb in FLCH SPD pitch mode changes the A/T operating mode from THR to HOLD. This inconsistency increases the opportunity for pilot error, especially in situations that are nonroutine. The surprise of the

accident pilot and the FAA's 787 test pilot regarding A/T response to manual override in FLCH SPD suggests that a pilot's manual intervention during a descent in FLCH SPD does not occur very often. Thus, flaws in a pilot's mental model of system functioning in this particular context may remain undetected for some period of time until the pilot encounters this aspect of the system's functionality. Such encounters are more likely to occur during dynamic, nonroutine situations, like a traffic collision avoidance system advisory during a FLCH SPD descent or a pilot's unintentional initiation of a FLCH SPD climb. During such situations, a flight crew faces increased workload and operational distractions that can reduce systematic scanning of the FMA and flight instruments, thereby reducing the likelihood that such a change will be detected.

This problem might be ameliorated by eliminating the inconsistency of the A/T's behavior when the pilot's manual throttle override occurs in different pitch modes. However, the HOLD mode is so thoroughly integrated into the 777 AFCS that removing this inconsistency might be impractical because it would require a fundamental redesign of the 777 and 787 AFCS. Another possibility would be to provide an alert to the pilot every time the A/T transitions to HOLD mode so that the pilot is more likely to notice that the A/T is no longer automatically controlling airspeed. However, the A/T normally enters HOLD mode many times during a flight, and providing an aural alert every time the HOLD mode activates would reduce the attention-getting property of the alert.

Since the 777 was designed in the mid-1990s, much has been learned about human-centered design of automated systems, and it is possible that a review of lessons learned from this accident and other operational data could provide insights that could lead to improvements in the design of the 777 and 787 AFCS systems, as well as the autoflight systems featured in future flight deck designs. The NTSB concludes that a review of the design of the 777 AFCS, with special attention given to the issues identified in this accident investigation and the issues identified by the FAA and EASA during the 787 certification program, could yield insights about how to improve the intuitiveness of the 777 and 787 flight crew interfaces as well as those incorporated into future designs. The FAA has a process for postcertification evaluations known as a special certification review, which is described in FAA Order 8110.4. The order describes a special certification review as a way to evaluate potentially unsafe design features on previously approved products and includes a list of potential safety problem areas for which a special certification review may be appropriate that includes complex or unique design features and complicated interrelationships and unusual features. Therefore, the NTSB recommends that the FAA convene a special certification design review of how the Boeing 777 AFCS controls airspeed and use the results of that evaluation to develop guidance that will help manufacturers improve the intuitiveness of existing and future interfaces between flight crews and autoflight systems.

2.5 Pilot Training

2.5.1 Visual Approach Training

To conduct a visual approach in a fast-paced busy terminal environment without an ILS glideslope, a flight crew must be able to plan an appropriate vertical profile, select an appropriate

control strategy (manual flight or some combination of autoflight modes), and adapt this plan in real time to satisfy externally imposed constraints, such as airspeed restrictions. There are many acceptable strategies for executing such approaches, but all require a flight crew to be able to effectively manage thrust, drag, and pitch to control airspeed and vertical speed, which in turn allow the flight crew to manage energy and remain on a desirable glidepath. Managing drag in such scenarios often requires strategically adjusting the timing of configuration changes, and this must be done while simultaneously respecting the airplane's operating limitations, the airline's operational policies, and ATC clearances. Success requires in-depth knowledge and a broad array of skills. Pilots acquire the requisite knowledge and skills through training, operational experience, and informal exchange of information among other pilots. However, the FAA's 2013 automation study indicated that pilots "often lack sufficient in-depth knowledge and skills to most efficiently and effectively accomplish the desired flightpath management related tasks" (FAA 2013). This accident reflects such a lack of knowledge and skills on the part of the PF.

The PF was an Asiana captain who was transitioning from the A320 to the 777. He was about halfway through OE, which was the final portion of his training before being released to fly the 777 as PIC. The accident flight was the first time he had flown a visual approach without an ILS glideslope in the 777 outside the simulator. During a postaccident interview, the PF expressed a lack of confidence in his ability to fly a stabilized approach without an ILS glideslope, saying he was "stressed" about having to do so.

The accident took place on a clear day with good visibility, and the pilots saw the airport early in the descent. The PF expected to be vectored by ATC to arrive both higher and faster than normal. However, the only ATC restriction the flight received applied to speed, and the flight was given ample distance to become established on an appropriate glidepath. As discussed earlier in this report, the PF did not descend rapidly enough early in the approach, which left the airplane significantly above the desired glidepath as he began the final portion of the approach.

Additionally, once past the 5 nm point, the PF continued to have difficulty achieving the desired glidepath and did not properly use the airplane's AFCS and the FMC's VNAV function to help manage the airplane's glidepath. In fact, his attempt to facilitate a more rapid descent by selecting FLCH SPD pitch mode when the MCP-selected altitude was above the airplane's altitude led to the unintentional deactivation of automatic airspeed control. (When the PF responded to the resulting climb by disconnecting the A/P and manually retarding the thrust levers, the A/T transitioned to HOLD mode.)

Further, because the FMC had been programmed with the LOC 28L procedure, the airplane's VNAV system had computed a 3° glidepath from DUYET to the runway threshold, and a VPI was displayed on both pilots' NDs. Once the airplane crossed DUYET (5.4 nm), the VPI showed the airplane's distance above or below this computed 3° glidepath for the remainder of the approach. However, when asked about the VPI, the PF said he did not make use of it during the approach. These deficiencies suggest that the PF's training in conducting visual approaches without an ILS glideslope was inadequate.

All approaches the PF had flown during his OE training before the accident flight were ILS approaches. During the full flight simulator portion of the PF's 777 transition training, he completed six visual approaches and landings. However, these approaches were accomplished in a standard traffic pattern using timed turns, computed guidance, visual displays, and A/P engagement until the simulator was positioned on final approach about 3 nm from the runway threshold. During one simulator period, the instructor reviewed a "high-energy landing technique" with the PF. Although it was unclear from the training record if a high-energy approach was flown or just discussed, it is unlikely it was flown because the 777 captain transition training syllabus in use at the time did not require a high-energy approach.

As noted above, to fly a visual approach, a pilot must possess a broad array of skills, including the ability to accurately judge the airplane's height, speed, and distance from the runway; anticipate the airplane's altitude and speed changes in response to configuration changes; and make the necessary adjustments to remain stable. However, these skills can atrophy through lack of practice. Throughout his training, the PF used the A/P regularly and typically relied on the ILS glideslope as a cue to proper altitude and flightpath. Thus, he did not have an opportunity to practice the skills necessary to anticipate and control the airplane's flightpath while making a straight-in speed-restricted approach with no ILS glideslope.

The PF's lack of exposure in 777 transition training to straight-in speed-restricted visual approaches played a role in the flight crew's mismanagement of the airplane's vertical profile. Following the accident, Asiana added straight-in speed-restricted approaches to its 777 transition training syllabus.

2.5.2 Instructor Pilot Training

The PM was an experienced 777 captain who was on his first flight as an IP. He had never flown with the PF but observed him fly the takeoff, climb, and cruise from ICN proficiently, and he noted the PF communicated well, confirmed his actions, and made effective callouts and responses. As a result, the PM likely did not see the need to provide the PF with continuous active coaching.

The PF made several errors during the initial part of the approach that should have alerted the PM that more active coaching was needed. After the flight was cleared for the visual approach and given the speed restriction, the PF did not descend aggressively enough. As the airplane remained high on profile, the PM said, "this seems a little high," and the PF, who did not recognize he was not on the proper glidepath, said, "do you mean it's too high?" The PM did not suggest a descent rate or ensure that the PF stayed on the desired glidepath, brief the PF about the need to decelerate and configure for landing as soon as the airplane reached the 5 nm point, or ensure that the subsequently selected vertical speed of -1,500 fpm was used long enough to recapture the desired glidepath. Even though the PF was demonstrating poor awareness of altitude and airspeed, the PM did not intervene or otherwise ensure that needed corrections were made to the airplane's vertical path.

Asiana 777 IP training included ground school, simulator instructor panel operation training, flight instructor training while operating in the right seat, and OE; examinations or checks were also performed for each of these phases of training. A review of the PM's training records and interviews with his OE instructors showed he performed well during training.

A review of the instructor training syllabus showed instruction techniques were taught, as well as execution of normal and nonnormal procedures. The syllabus included several events in which the instructor trainee had to identify poor or dangerous performance by the pilot in the left seat and take action to recover the airplane safely. For example, on two simulator training sessions, the instructor trainee had to take control of the flight from the left seat pilot because of a takeoff overrotation, and on another session, the instructor trainee had to take over because of no flare during landing at 30 ft above the runway. This training should have been adequate to prepare the PM to recognize and recover from the unstabilized accident approach. However, it took place in the structured environment of a flight simulator where the problems were known in advance.

The final stage of instructor training consisted of two flight legs of OE instruction and two flight legs of a check in the aircraft. On the training flights and the check flights, the PM flew the airplane from the right seat but gave no instruction. The PM did not have the opportunity during his OE instructor training to supervise and instruct a trainee while being observed by an experienced instructor. Having the opportunity to supervise a trainee on an actual flight would have improved the PM's awareness of the dynamic and often unpredictable challenges that he would encounter as an OE instructor.

The NTSB concludes that if the PM had supervised a trainee pilot in operational service during his instructor training, he would likely have been better prepared to promptly intervene when needed to ensure effective management of the airplane's flightpath. Therefore, the NTSB recommends that Asiana revise its flight instructor OE qualification criteria to ensure that all instructor candidates are supervised and observed by a more experienced instructor during OE or line training until the new instructor demonstrates proficiency in the instructor role.

2.6 Operations Issues

2.6.1 Cycling of Flight Director Switches

In interviews, four Asiana flight instructors verified that it was Asiana's informal practice, after the A/P was disconnected, to turn both F/Ds off and then turn the PM's F/D back on when conducting a visual approach and that this was taught in training. However, in Asiana's 777 POM guidance on visual approaches and Boeing's 777 FCTM guidance on visual approaches, the subject of F/D switch position was not mentioned.

The FCTM did contain guidance on the conduct of circling approaches, which included F/D switch cycling. It stated that turning both F/Ds off and then turning the PM's F/D back on "allows continued FD guidance for the PM in the event of a go-around when pitch or roll mode is changed." If a circling approach cannot be completed, the flight crew is expected to follow the

published missed approach procedure, and F/D guidance can be beneficial. However, there is no instrument missed approach segment following a visual approach. A go-around from a visual approach must be done using visual references until specific instructions are received from ATC.

F/D use is appropriate on both instrument and visual approaches when it provides valid navigational guidance. However, F/Ds cannot provide guidance when the underlying navigational signal or data is not available and should not be displayed when the pilot does not intend to follow it. During a visual approach, when F/D pitch and roll guidance is not needed, it can be a distraction. The FAA's *Airplane Flying Handbook*, page 12-6, "Flight Director/Autopilot," states that when an airplane is being hand-flown, if the F/D is not being used at any particular moment, it should be off so that the command bars are pulled from view.

During the accident flight, after the A/P was disconnected, the PM loosely followed Asiana's informal practice. However, because the two F/D switches were not both in the off position at the same time, the AFDS remained active with the pitch mode FLCH SPD, and the F/D command bars on the PM's PFD provided unneeded pitch guidance. Also, the A/T remained in the HOLD mode. If the PM had turned both F/D switches off, the F/D command bars would have been removed from his PFD, and the A/T mode would have changed to SPD mode and maintained the MCP-selected speed of 137 knots.

A review of the 777 FCOM and FCTM did not identify a specific statement that when the A/P is off and both F/D switches are turned off, the A/T mode goes to SPD and maintains the MCP-selected speed. Although this information can be inferred from FCOM information, it is critical for flight crews to have a complete understanding of the system functionality (as discussed above) and the effects of changes that they can make, particularly during critical phases of flight.

The NTSB concludes that if Asiana had not allowed an informal practice of keeping the PM's F/D on during a visual approach, the PM would likely have switched off both F/Ds, which would have corrected the unintended deactivation of automatic airspeed control. Therefore, the NTSB recommends that Asiana Airlines issue guidance in the Boeing 777 POM that after disconnecting the A/P on a visual approach, if F/D guidance is not being followed, both F/D switches should be turned off. The NTSB further recommends that Boeing revise the Boeing 777 FCOM to include a specific statement that when the A/P is off and both F/D switches are turned off, the A/T mode goes to SPD mode and maintains the MCP-selected speed.

2.6.2 Manual Flight

Asiana's automation policy, as stated in the POM, and interviews with Asiana pilots indicated that the company emphasized the full use of all automation and did not encourage manual flight during line operations. The Asiana POM stated that the PF and PM should make full use of the A/P and the A/T, and the A/T should be used even in manual flight. When interviewed, the Asiana 777 chief pilot supported the statement in the POM, stating that the airline recommended using as much automation as possible. He also agreed with the statement that Asiana pilots obtained most of their manual flying practice during approaches below 1,000 ft

agl. Other Asiana pilots interviewed agreed that it was standard practice to leave the A/P on to about 1,000 ft on final approach before disengaging it to complete a manually flown approach. An Asiana contract simulator instructor stated that he believed that pilots avoided flying manually because of concern that they would do something wrong. He stated that manual flying training that included the approximate power settings and pitch attitudes required to achieve a 3° glidepath was not in the training syllabus.

The maneuvering needed to place an airplane on the final approach course and stabilized at the appropriate altitudes prescribed by policy is highly variable and depends on a number of factors, including terrain, traffic, and flight crew interaction with ATC. Autoflight systems are very useful in minimizing crew workload during this maneuvering but function best when preprogrammed with the anticipated course and approach procedure. A change in ATC clearance can significantly revise the planned flightpath, changing the assumptions the crew made and requiring a rapid reassessment of the flight's needed path and energy. A turn toward the airport sooner than anticipated, for example, can make the flight higher and faster than planned, requiring an adjustment in speed, descent rate, and drag required. Such an adjustment can often be made most easily by manually flying the airplane. Manual corrections to flight controls can be made more quickly than A/P inputs, and manual movement of the thrust levers can be made directly and without automatic control input, simplifying the pilot's tasks.

Not all approaches can be flown or completed using automation. For example, some runways have offset LOC approaches, which require that the A/P be disconnected and the airplane aligned with the runway manually. Occasionally, partial runway closures displace runway thresholds by significant amounts, as much as 3,000 to 4,000 ft, requiring A/P disconnect and manual landing. Certain charted visual approaches, such as the Parkway Visual Approach to runways 13L/R at New York's John F. Kennedy International Airport or the River Visual Approach to runway 19 at Ronald Reagan Washington National Airport, require manual flight. Additionally, normal instrument approach navigational signals may experience failures or anomalies requiring the flight crew to disconnect the A/P and continue manually. Pilots must have both training and recent experience in manually manipulating the controls so as to have the skill and confidence to perform manual flight maneuvers safely.

As the airplane slowed after the PF disconnected the A/P (about 81 seconds before impact), the amount of backpressure required to maintain a positive pitch attitude increased due to the airplane being below its trim reference speed of 170 knots, which was due to the PF not using any pitch trim after disconnecting the A/P. Normally, a 777 pilot would use pitch trim to relieve such control forces, but the PF did not do so. Instead, he gradually increased backpressure to maintain pitch. He did not recognize this important tactile cue that the airplane was out of trim. If he had trimmed the airplane when it reached approach speed, the increasing force on the control wheel would have been an unambiguous cue indicating that the airplane was getting slow. Additional practice in manual flight would have prepared him to trim the airplane at approach speed and add power to correct any low airspeed condition he detected as a result of changes in force feel. Had he had more opportunity to manually fly the airplane during training and line operations, he would most likely have used trim, recognized this tactile cue, and corrected the airspeed using power.

Both SAFO 13002 and the FAA's amendment to 14 CFR Part 121 addressed the lack of proficiency in manual flight that has developed as a result of pilot reliance on increasingly sophisticated, highly automated airplanes such as the 777. In this accident, the PF, an experienced pilot who had 9,684 hours of flight time, a background as an instructor for Asiana, and a record of successful completion of ground school and simulator training in the 777, lacked critical manual flying skills. This demonstrates that without greater opportunity for pilots to manually fly the airplane, their airplane handling skills degrade.

Asiana provided statistical data that showed that in 2012, 77.7% of Asiana 777 landings were made manually. However, the data did not indicate at what point the A/P had been disengaged before the manual landing. Based on the interviews referred to above, it seems likely that most flight crews making manual landings did not perform manual airplane handling and maneuvering above 1,000 ft.

By 1,000 ft on final approach, the airplane is typically already stabilized in its landing attitude, configuration, speed, and power setting, and usually only minor adjustments must be made to the flight controls until the flare. Under normal conditions, the flare only requires a 2° to 3° pitch change and thrust reduction. In the case of the 777, even the thrust reduction is performed for the pilot by the A/T. By manually flying only the last 1,000 ft of an approach, pilots do not get to experience the necessary control inputs and feedback performance of the airplane that takes place in climbs, descents, turns, accelerations, decelerations, and configuration changes and do not develop or maintain an ability to "stay ahead" of the airplane, meaning the ability to anticipate the airplane's performance. The NTSB concludes that by encouraging flight crews to manually fly the airplane before the last 1,000 ft of the approach, Asiana would improve its pilots' abilities to cope with maneuvering changes commonly experienced at major airports and would allow them to be more proficient in establishing stabilized approaches under demanding conditions; in this accident, the PF may have better used pitch trim, recognized that the airspeed was decaying, and taken the appropriate corrective action of adding power. Therefore, the NTSB recommends that Asiana Airlines modify its automation policy to provide for more manual flight, both in training and in line operations, to improve pilot proficiency.

2.7 Low Energy Alert

The 777 was equipped with a low airspeed alerting system that was first certified on the 747-400 in 1996 and then certified for the 777-200B in 1997. This system, developed as a result of a safety-related incident reported by a customer airline in 1995,[101] was designed to alert flight crews of decreasing airspeed to avoid imminent stalls. The system, which activates when airspeed decreases 30% into the amber band, was not designed to alert crews that their airspeed had fallen below V_{ref} during approach. According to Boeing, the triggering threshold for the low airspeed alert was selected to avoid nuisance alerts during normal operations and to minimize them during intentional operations at low airspeeds. Minimizing nuisance alerts is an important

[101] According to Boeing, this incident involved a slow, unintended deceleration during cruise, followed by stick shaker activation and the loss of several thousand ft of altitude during recovery.

consideration in the design of alerts because too many false alerts can increase flight crew response times or cause crews to ignore alerts altogether.

In this accident, the low airspeed alert triggered about 11 seconds before impact, and the PM advanced the thrust levers about 4 seconds later. However, the attempted go-around was not successful because there was not enough time for the engines to develop sufficient power to arrest the airplane's descent before impact. The only way for an alert to facilitate a successful recovery in such a situation would be for the alert to activate at a higher airspeed, so kinetic energy (airspeed) could be traded for potential energy (altitude) until thrust increased, and/or at a higher altitude, so potential energy (altitude) could be traded for kinetic energy (airspeed) until thrust increased.

Boeing classified the low airspeed alert as a "caution" rather than a "warning" alert. In accordance with the 777 centralized crew alerting system, the low airspeed caution alert was designed to sound a master caution alert (the quadruple chime) to draw the flight crew's attention to the EICAS screen, where an "airspeed low" message would be displayed. Boeing expected that this type of alert presentation would result in a flight crew response time of about 4 seconds. (As stated above, in this accident, the PM did respond in about 4 seconds.) Boeing also expected that the low airspeed alert would activate at least 10 seconds before the onset of stall warning for common high-altitude stall scenarios and, therefore, concluded that an expected flight crew response time of about 4 seconds was sufficient to give the flight crew advance indication of the low airspeed condition and reduce the likelihood of a startle response. When the low airspeed alert activated in this accident, however, there was no question that immediate flight crew action was required due to low speed and low altitude. For the accident scenario, therefore, a warning level alert would have been more appropriate in order to reduce flight crew response time. However, even if the alert had been a warning that required immediate flight crew response, it likely would not have prevented this accident. The warning still would have occurred about 11 seconds before impact, and additional time would have been required for the flight crew to take corrective action. By this time, the airplane was in a very low energy condition (low airspeed, low altitude, and low thrust) and, based on the performance study, likely did not have the performance capability to accomplish a go-around. Nevertheless, this accident provides information that can be used as part of ongoing efforts to develop requirements for low airspeed alerting systems during all phases of flight.

The NTSB has long recognized the need for low airspeed alerting systems, having issued recommendations in this area following the investigations of a 2002 accident involving a Raytheon (Beechcraft) King Air A100 (NTSB 2003) and a 2009 accident involving a Bombardier DHC-8-400 (NTSB 2010). Safety Recommendations A-03-53 and -54 asked the FAA to convene a panel of experts to determine whether a requirement for the installation of low airspeed alert systems in airplanes engaged in commercial operations under 14 CFR Parts 121 and 135 would be feasible, submit a report of the panel's findings, and, if feasible, establish requirements for such systems. These recommendations were superseded by Safety Recommendation A-10-12, which urged the FAA to require, for all airplanes engaged in commercial operations under 14 CFR Parts 121, 135, and 91 Subpart K, the installation of low airspeed alert systems that provide pilots with redundant aural and visual warning of an impending hazardous low airspeed condition.

The FAA responded by tasking the Aviation Rulemaking Advisory Committee (ARAC) with developing recommendations for requirements to address low airspeed alerting systems. In February 2013, the FAA received the ARAC report that addressed scenarios for retrofitting low airspeed alerting systems in 14 CFR Part 25 airplanes operating under 14 CFR Part 121. The FAA has completed its evaluation of the ARAC recommendations and determined that low speed alerts are a highly effective safety enhancement for airplanes operating under 14 CFR Parts 121 and 129. On May 9, 2014, the FAA informed the NTSB that it was conducting a cost and effectiveness review for implementing low airspeed alerts, which it expected to complete by December 2014, and that it might pursue rulemaking pending this review. The FAA also said that it would continue to evaluate retrofit requirements for 14 CFR Part 25 airplanes operated under 14 CFR Parts 135 and 91 Subpart K.

The 777's low airspeed alerting system provided both an aural and a visual alert. However, this accident demonstrates that existing low airspeed alert systems that are designed to provide pilots with redundant aural and visual warning of an impending hazard due to low airspeed may not be adequately tailored to alert pilots to an impending hazard due to a combination of conditions (i.e., low airspeed combined with low altitude). During the approach phase of flight, an alert may need to be designed so that its activation threshold takes airspeed (kinetic energy), altitude (potential energy), and engine response time into account. In addition, the alert should take into account expected flight crew response time to an unexpected, critical event, based on the alert's method of presentation. A context-dependent low energy alert system would take all of these variables into account to determine the most appropriate activation threshold and method of presentation.

The terms "low airspeed" and "low energy" are sometimes used interchangeably, and indeed, both terms appear in the ARAC's final report. However, both terms are ultimately linked to situations in which the airplane's angle of attack is approaching or has exceeded a predetermined threshold and therefore are primarily concerned with the airplane's proximity to stall warning and stall. Neither term in the ARAC final report refers specifically to an alert that includes either the airplane's altitude above the ground or thrust setting in the logic that governs the triggering of the alert. Nonetheless, in general the term "energy," when referring to the total energy of the airplane, encompasses both airspeed (kinetic energy) and altitude (potential energy). Furthermore, the engine power level will govern the rate of total energy increase or loss. Therefore, the NTSB will refer to an alert that considers airspeed, altitude, engine power level, and flight crew response time in its alerting logic as a "low energy alert." The NTSB concludes that a context-dependent low energy alert would help pilots successfully recover from unexpected low energy situations like the situation encountered by the accident pilots.

The complexity of a context-dependent low energy alerting system means that the development of such a system needs to carefully balance the requirement for timely alerts in different phases of flight with the requirement to avoid nuisance alerts in all phases of flight. These competing requirements need to be assessed to determine whether the development of such systems is feasible. The FAA's Avionics Systems Harmonization Working Group (ASHWG) was tasked with evaluating the technical feasibility of low airspeed alerting systems. Doing so required the participation of human factors, aviation operations, and aircraft design specialists. Consideration of technological challenges and requirements for low energy alerting

systems would require a collaboration across the same specialties. In addition, due to its past work, the ASHWG would likely have a high degree of familiarity with issues related to the development of low energy alerting systems. Therefore, the NTSB recommends that the FAA task a panel of human factors, aviation operations, and aircraft design specialists, such as the ASHWG, to develop design requirements for context-dependent low energy alerting systems for airplanes engaged in commercial operations. Further, the NTSB recommends that Boeing, using the guidance developed by the low energy alerting system panel created in accordance with Safety Recommendation A-14-43, develop and evaluate a modification to Boeing wide-body automatic flight control systems to help ensure that the aircraft energy state remains at or above the minimum desired energy condition during any portion of the flight.

2.8 Survival Aspects

2.8.1 Accident Survivability

2.8.1.1 Evacuation

According to the PM and the cabin manager, after the airplane came to a stop, the cabin manager came forward to the cockpit and asked if the flight attendants should evacuate the airplane, and the PM told her to wait. The PM's outside view was obscured by dust, and he did not fully realize the extent of damage to the airplane. In accordance with Asiana procedures, the PM contacted the ATCT (about 20 seconds after the airplane came to rest). The PM recalled that once he understood that emergency vehicles were responding, he completed the initial steps of the QRH checklist and issued the evacuation order.

By this time, flight attendant L2A had already commanded the evacuation after observing fire outside door 2R. Upon hearing his command, the cabin manager opened door 1L and also began commanding passengers to evacuate. Review of video footage indicated that doors 1L and 2L were opened nearly simultaneously about 1 minute 33 seconds after the airplane came to a stop. Such a lengthy delay was not reported by any of the crewmembers in their statements; however, it is not unusual for human perceptions of time to be erroneous, especially when in disorienting, highly stressful events. The NTSB concludes that the flight attendants acted appropriately when they initiated an emergency evacuation upon determining there was a fire outside door 2R. Further, the delay of about 90 seconds in initiating an evacuation was likely due partly to the PM's command not to begin an immediate evacuation, as well as disorientation and confusion.

The flight attendants who opened doors 1L and 2L reported no problems with their doors or slide/rafts, and both were used during the evacuation. However, the slide/rafts on doors 1R and 2R inflated inside the airplane during the airplane's final impact, injuring and temporarily trapping two flight attendants and rendering the doors unusable during the evacuation.[102] The 1R slide/raft inflated into the forward galley area, which was forward of all passenger seats; because A-zone passengers on the right side of the airplane could cross through the seat rows to evacuate

[102] For further information about why these slide/rafts inflated, see section 2.8.2.

3. Conclusions

3.1 Findings

1. The following were not factors in the accident: flight crew certification and qualification; flight crew behavioral or medical conditions or the use of alcohol or drugs; airplane certification and maintenance; preimpact structural, engine, or system failures; or the air traffic controllers' handling of the flight.

2. Although the instrument landing system glideslope was out of service, the lack of a glideslope should not have precluded the pilots' successful completion of a visual approach.

3. The flight crew mismanaged the airplane's vertical profile during the initial approach, which resulted in the airplane being well above the desired glidepath when it reached the 5 nautical mile point, and this increased the difficulty of achieving a stabilized approach.

4. The flight crew's mismanagement of the airplane's vertical profile during the initial approach led to a period of increased workload that reduced the pilot monitoring's awareness of the pilot flying's actions around the time of the unintended deactivation of automatic airspeed control.

5. About 200 ft, one or more flight crewmembers became aware of the low airspeed and low path conditions, but the flight crew did not initiate a go-around until the airplane was below 100 ft, at which point the airplane did not have the performance capability to accomplish a go-around.

6. The flight crew was experiencing fatigue, which likely degraded their performance during the approach.

7. Nonstandard communication and coordination between the pilot flying and the pilot monitoring when making selections on the mode control panel to control the autopilot flight director system (AFDS) and autothrottle (A/T) likely resulted, at least in part, from role confusion and subsequently degraded their awareness of the AFDS and A/T modes.

8. Insufficient flight crew monitoring of airspeed indications during the approach likely resulted from expectancy, increased workload, fatigue, and automation reliance.

9. The delayed initiation of a go-around by the pilot flying and the pilot monitoring after they became aware of the airplane's low path and airspeed likely resulted from a combination of surprise, nonstandard communication, and role confusion.

10. As a result of complexities in the 777 automatic flight control system and inadequacies in related training and documentation, the pilot flying had an inaccurate understanding of how the autopilot flight director system and autothrottle interacted to control airspeed, which led to his inadvertent deactivation of automatic airspeed control.

11. If the autothrottle automatic engagement function ("wakeup"), or a system with similar functionality, had been available during the final approach, it would likely have activated and increased power about 20 seconds before impact, which may have prevented the accident.

12. A review of the design of the 777 automatic flight control system, with special attention given to the issues identified in this accident investigation and the issues identified by the Federal Aviation Administration and European Aviation Safety Agency during the 787 certification program, could yield insights about how to improve the intuitiveness of the 777 and 787 flight crew interfaces as well as those incorporated into future designs.

13. If the pilot monitoring had supervised a trainee pilot in operational service during his instructor training, he would likely have been better prepared to promptly intervene when needed to ensure effective management of the airplane's flightpath.

14. If Asiana Airlines had not allowed an informal practice of keeping the pilot monitoring's (PM) flight director (F/D) on during a visual approach, the PM would likely have switched off both F/Ds, which would have corrected the unintended deactivation of automatic airspeed control.

15. By encouraging flight crews to manually fly the airplane before the last 1,000 ft of the approach, Asiana Airlines would improve its pilots' abilities to cope with maneuvering changes commonly experienced at major airports and would allow them to be more proficient in establishing stabilized approaches under demanding conditions; in this accident, the pilot flying may have better used pitch trim, recognized that the airspeed was decaying, and taken the appropriate corrective action of adding power.

16. A context-dependent low energy alert would help pilots successfully recover from unexpected low energy situations like the situation encountered by the accident pilots.

17. The flight attendants acted appropriately when they initiated an emergency evacuation upon determining there was a fire outside door 2R. Further, the delay of about 90 seconds in initiating an evacuation was likely due partly to the pilot monitoring's command not to begin an immediate evacuation, as well as disorientation and confusion.

18. Passengers 41B and 41E were unrestrained for landing and ejected through the ruptured tail of the airplane at different times during the impact sequence. It is likely that these passengers would have remained in the cabin and survived if they had been wearing their seatbelts.

29. Although some of the communications difficulties encountered during the emergency response, including the lack of radio interoperability, have been remedied, others, such as the breakdown in communications between the airport and city dispatch centers, should be addressed.

30. The Alert 3 sections of San Francisco International Airport's 2008 and 2012 emergency procedures manuals were not sufficiently robust to anticipate and prevent the problems that occurred in the accident response.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the flight crew's mismanagement of the airplane's descent during the visual approach, the pilot flying's unintended deactivation of automatic airspeed control, the flight crew's inadequate monitoring of airspeed, and the flight crew's delayed execution of a go-around after they became aware that the airplane was below acceptable glidepath and airspeed tolerances. Contributing to the accident were (1) the complexities of the autothrottle and autopilot flight director systems that were inadequately described in Boeing's documentation and Asiana's pilot training, which increased the likelihood of mode error; (2) the flight crew's nonstandard communication and coordination regarding the use of the autothrottle and autopilot flight director systems; (3) the pilot flying's inadequate training on the planning and executing of visual approaches; (4) the pilot monitoring/instructor pilot's inadequate supervision of the pilot flying; and (5) flight crew fatigue, which likely degraded their performance.

Docket No. SA-537

Exhibit No. 2-L

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Operations Group Chairman Factual Report

Simulator Photo of FMA in HOLD

(2 Pages)

Attachment 11

To Operations Group Factual Report

DCA13MA120

Simulator Photo of FMA in HOLD


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Safety Recommendation A-14-037

TO THE FEDERAL AVIATION ADMINISTRATION: Require Boeing to develop enhanced 777 training that will improve flight crew understanding of autothrottle modes and automatic activation system logic through improved documentation, courseware, and instructor training.

Recommendation Details

Original recommendation transmittal letter

Overall status	Closed - Acceptable Alternate Action
Mode	Aviation
Priority level	Non-urgent
Times reiterated	0
Is hazmat	No
Is NPRM	No
SR coding	Personnel, Training / proficiency / check
Date issued	07/16/2014
Overall date closed	06/14/2023

Event Details - DCA13MA120

This report discusses the July 6, 2013, accident involving a Boeing 777-200ER, Korean registration HL7742, operating as Asiana Airlines flight 214, which was on approach to runway 28L when it struck a seawall at San Francisco International Airport (SFO), San Francisco, California. Three of the 291 passengers were fatally injured; 40 passengers, 8 of the 12 flight attendants, and 1 of the 4 flight crewmembers received serious injuries. The other 248 passengers, 4 flight attendants, and 3 flight crewmembers received minor injuries or were not injured. The airplane was destroyed. Safety issues relate to the need for Asiana pilots to adhere to standard operating procedures regarding callouts; reduced design complexity and enhanced training on the airplane's autoflight system; opportunity at Asiana for new instructors to supervise trainee pilots in operational service during instructor training; guidance for Asiana pilots on use of flight directors during a visual approach; more manual flight for Asiana pilots; a context-dependent low energy alert; research that examines the injury potential from significant lateral forces in airplane crashes and the mechanism that produces high thoracic spinal injuries; evaluation of the adequacy of slide/raft inertia load certification testing; aircraft rescue and firefighting (ARFF) training for officers in command of an

aircraft accident response; guidance on when to use a skin-piercing nozzle on a burning airplane fuselage; integration of the medical supply buses at SFO into the airport's preparation drills; guidance or protocols for ensuring the safety of passengers and crew at risk of a vehicle strike during ARFF operations; requirements for ARFF staffing; improvements in SFO emergency communications; and increased Federal Aviation Administration (FAA) oversight of SFO's emergency procedures manual. Safety recommendations are addressed to the FAA, Asiana Airlines, Boeing, the ARFF Working Group, and the City of San Francisco.

Location	San Francisco, CA
Event date	07/06/2013
NTSB #	DCA13MA120
Report #	AAR-14-01

Addressee Details

FAA - Closed - Acceptable Alternate Action - 06/14/2023

Safety Recommendation A-14-040

TO THE FEDERAL AVIATION ADMINISTRATION: Once the revision to the Boeing 777 Flight Crew Training Manual has been completed, as requested in Safety Recommendation A-14-39, require operators and training providers to incorporate the revised stall protection demonstration in their training.

Recommendation Details

Original recommendation transmittal letter

Overall status	Closed - Acceptable Alternate Action
Mode	Aviation
Priority level	Non-urgent
Times reiterated	0
Is hazmat	No
Is NPRM	No
SR coding	Procedures / Regulations, Aircraft operations
Date issued	07/16/2014
Overall date closed	11/04/2024

Event Details - DCA13MA120

This report discusses the July 6, 2013, accident involving a Boeing 777-200ER, Korean registration HL7742, operating as Asiana Airlines flight 214, which was on approach to runway 28L when it struck a seawall at San Francisco International Airport (SFO), San Francisco, California. Three of the 291 passengers were fatally injured; 40 passengers, 8 of the 12 flight attendants, and 1 of the 4 flight crewmembers received serious injuries. The other 248 passengers, 4 flight attendants, and 3 flight crewmembers received minor injuries or were not injured. The airplane was destroyed. Safety issues relate to the need for Asiana pilots to adhere to standard operating procedures regarding callouts; reduced design complexity and enhanced training on the airplane's autoflight system; opportunity at Asiana for new instructors to supervise trainee pilots in operational service during instructor training; guidance for Asiana pilots on use of flight directors during a visual approach; more manual flight for Asiana pilots; a context-dependent low energy alert; research that examines the injury potential from significant lateral forces in airplane crashes and the mechanism that produces high thoracic spinal injuries; evaluation of the adequacy of slide/raft inertia load

certification testing; aircraft rescue and firefighting (ARFF) training for officers in command of an aircraft accident response; guidance on when to use a skin-piercing nozzle on a burning airplane fuselage; integration of the medical supply buses at SFO into the airport's preparation drills; guidance or protocols for ensuring the safety of passengers and crew at risk of a vehicle strike during ARFF operations; requirements for ARFF staffing; improvements in SFO emergency communications; and increased Federal Aviation Administration (FAA) oversight of SFO's emergency procedures manual. Safety recommendations are addressed to the FAA, Asiana Airlines, Boeing, the ARFF Working Group, and the City of San Francisco.

Location	San Francisco, CA
Event date	07/06/2013
NTSB #	DCA13MA120
Report #	AAR-14-01

Addressee Details

FAA - Closed - Acceptable Alternate Action - 11/04/2024

Safety Recommendation A-14-041

TO THE FEDERAL AVIATION ADMINISTRATION: Convene an expert panel (including members with expertise in human factors, training, and flight operations) to evaluate methods for training flight crews to understand the functionality of automated systems for flightpath management, identify the most effective training methods, and revise training guidance for operators in this area.

Recommendation Details

Original recommendation transmittal letter

Overall status	Closed - Acceptable Action
Mode	Aviation
Priority level	Non-urgent
Times reiterated	0
Is hazmat	No
Is NPRM	No
SR coding	Personnel, Training / proficiency / check Quality / Safety Management, Safety assurance
Date issued	07/16/2014
Overall date closed	06/14/2023

Event Details - DCA13MA120

This report discusses the July 6, 2013, accident involving a Boeing 777-200ER, Korean registration HL7742, operating as Asiana Airlines flight 214, which was on approach to runway 28L when it struck a seawall at San Francisco International Airport (SFO), San Francisco, California. Three of the 291 passengers were fatally injured; 40 passengers, 8 of the 12 flight attendants, and 1 of the 4 flight crewmembers received serious injuries. The other 248 passengers, 4 flight attendants, and 3 flight crewmembers received minor injuries or were not injured. The airplane was destroyed. Safety issues relate to the need for Asiana pilots to adhere to standard operating procedures regarding callouts; reduced design complexity and enhanced training on the airplane's autoflight system; opportunity at Asiana for new instructors to supervise trainee pilots in operational service during instructor training; guidance for Asiana pilots on use of flight directors during a visual approach; more manual flight for Asiana pilots; a context-dependent low energy alert; research that examines the injury potential from significant lateral forces in airplane crashes and the mechanism

that produces high thoracic spinal injuries; evaluation of the adequacy of slide/raft inertia load certification testing; aircraft rescue and firefighting (ARFF) training for officers in command of an aircraft accident response; guidance on when to use a skin-piercing nozzle on a burning airplane fuselage; integration of the medical supply buses at SFO into the airport's preparation drills; guidance or protocols for ensuring the safety of passengers and crew at risk of a vehicle strike during ARFF operations; requirements for ARFF staffing; improvements in SFO emergency communications; and increased Federal Aviation Administration (FAA) oversight of SFO's emergency procedures manual. Safety recommendations are addressed to the FAA, Asiana Airlines, Boeing, the ARFF Working Group, and the City of San Francisco.

Location	San Francisco, CA
Event date	07/06/2013
NTSB #	DCA13MA120
Report #	AAR-14-01

Addressee Details

FAA - Closed - Acceptable Action - 06/14/2023

Safety Recommendation A-14-042

TO THE FEDERAL AVIATION ADMINISTRATION: Convene a special certification design review of how the Boeing 777 automatic flight control system controls airspeed and use the results of that evaluation to develop guidance that will help manufacturers improve the intuitiveness of existing and future interfaces between flight crews and autoflight systems.

Recommendation Details

Original recommendation transmittal letter

Overall status	Open Acceptable Alternate Response
Mode	Aviation
Priority level	Non-urgent
Times reiterated	0
Is hazmat	No
Is NPRM	No
SR coding	Procedures / Regulations, Aircraft certification Quality / Safety Management, Safety risk management
Date issued	07/16/2014
Overall date closed	

Event Details - DCA13MA120

This report discusses the July 6, 2013, accident involving a Boeing 777-200ER, Korean registration HL7742, operating as Asiana Airlines flight 214, which was on approach to runway 28L when it struck a seawall at San Francisco International Airport (SFO), San Francisco, California. Three of the 291 passengers were fatally injured; 40 passengers, 8 of the 12 flight attendants, and 1 of the 4 flight crewmembers received serious injuries. The other 248 passengers, 4 flight attendants, and 3 flight crewmembers received minor injuries or were not injured. The airplane was destroyed. Safety issues relate to the need for Asiana pilots to adhere to standard operating procedures regarding callouts; reduced design complexity and enhanced training on the airplane's autoflight system; opportunity at Asiana for new instructors to supervise trainee pilots in operational service during instructor training; guidance for Asiana pilots on use of flight directors during a visual approach; more manual flight for Asiana pilots; a context-dependent low energy alert; research that examines the injury potential from significant lateral forces in airplane crashes and the mechanism

Safety Recommendation A-14-043

TO THE FEDERAL AVIATION ADMINISTRATION: Task a panel of human factors, aviation operations, and aircraft design specialists, such as the Avionics Systems Harmonization Working Group, to develop design requirements for context-dependent low energy alerting systems for airplanes engaged in commercial operations.

Recommendation Details

Original recommendation transmittal letter

Overall status	Open - Acceptable Response
Mode	Aviation
Priority level	Non-urgent
Times reiterated	0
Is hazmat	No
Is NPRM	No
SR coding	Procedures / Regulations, Aircraft certification
Date issued	07/16/2014
Overall date closed	

Event Details - DCA13MA120

This report discusses the July 6, 2013, accident involving a Boeing 777-200ER, Korean registration HL7742, operating as Asiana Airlines flight 214, which was on approach to runway 28L when it struck a seawall at San Francisco International Airport (SFO), San Francisco, California. Three of the 291 passengers were fatally injured; 40 passengers, 8 of the 12 flight attendants, and 1 of the 4 flight crewmembers received serious injuries. The other 248 passengers, 4 flight attendants, and 3 flight crewmembers received minor injuries or were not injured. The airplane was destroyed.

Safety issues relate to the need for Asiana pilots to adhere to standard operating procedures regarding callouts; reduced design complexity and enhanced training on the airplane's autoflight system; opportunity at Asiana for new instructors to supervise trainee pilots in operational service during instructor training; guidance for Asiana pilots on use of flight directors during a visual approach; more manual flight for Asiana pilots; a context-dependent low energy alert; research that examines the injury potential from significant lateral forces in airplane crashes and the mechanism that produces high thoracic spinal injuries; evaluation of the adequacy of slide/raft inertia load certification testing; aircraft rescue and firefighting (ARFF) training for officers in command of an aircraft accident response; guidance on when to use a skin-piercing nozzle on a burning airplane fuselage; integration of the medical supply buses at SFO into the airport's preparation drills; guidance or protocols for ensuring the safety of passengers and crew at risk of a vehicle strike during ARFF operations; requirements for ARFF staffing; improvements in SFO emergency communications; and increased Federal

Aviation Administration (FAA) oversight of SFO's emergency procedures manual. Safety recommendations are addressed to the FAA, Asiana Airlines, Boeing, the ARFF Working Group, and the City of San Francisco.

Location	San Francisco, CA
Event date	07/06/2013
NTSB #	DCA13MA120
Report #	AAR-14-01

Addressee Details

FAA - Open - Acceptable Response

Name	FAA
Acronym	FAA
Category	Federal Government
Addressee status	Open - Acceptable Response

From	NTSB
To	FAA
Date	11/04/2024
Type	Official Correspondence
Response	

We note that, based on the Low Energy Alerting Recommendations Report from the Aviation Rulemaking Advisory Committee's ASHWG, you determined that Context-Dependent Low Energy Alerting System (CDLEAS) standards are needed. On August 2, 2024, your staff informed us that RTCA Special Committee (SC) 231, Terrain Awareness Warning System (TAWS), is working to incorporate a low-energy alerting mode in the TAWS Minimum Operational Performance Standards (MOPS) and that the updated TAWS MOPS are expected by June 2025. We also note that, in February 2023, you completed FAA-sponsored research that assessed the performance of various technologies to prevent and manage low energy. Your staff informed us that none of the technologies were effective in preventing stalls, but that you intend to work with RTCA SC-231 to evaluate additional CDLEAS technologies and will continue to sponsor research and development on automatic ground collision avoidance systems (aGCAS). Pending completion of your research, Safety Recommendation A-14-43 remains classified OPEN– ACCEPTABLE RESPONSE.

From	FAA
To	NTSB
Date	08/30/2023
Type	Official Correspondence
Response	

-From Kathryn B. Thomson, Deputy Administrator: The Federal Aviation Administration (FAA) is evaluating the resulting data from its sponsored research study on assessing the performance of

various methods to prevent and manage low energy, completed in February 2023. Based on the Low Energy Alerting Recommendations Report from the Aviation Rulemaking Advisory Committee's Avionics Systems Harmonization Working Group (ASHWG), which recommends a new design standard for low energy alerting, alone or in combination with low energy protection, for the normal landing configuration, we determined that it is appropriate to develop context-dependent low energy alerting systems (CDLEAS) standards.

The FAA also has plans to request that RTCA Special Committee 231, Terrain Awareness Warning System (TAWS), develop design standards for associated controlled flight into terrain/loss of control mitigations. The CDLEAS design standards will be based in part on the recently completed FAA-sponsored research on low speed/low energy systems. The intent is to incorporate the CDLEAS functionality as a uniquely defined enhanced ground proximity warning system alert mode.

Additionally, we will continue ongoing FAA-sponsored research and development efforts on automatic ground collision avoidance systems (aGCAS), with aGCAS systems providing a last line of defense against controlled flight into terrain and low airspeed/low energy accidents, and will determine implementation options for transport category airplanes based on the work of the ASHWG.

I will keep the Board informed of the FAA's progress on Safety Recommendation A-14-43 and anticipate providing an update by July 31, 2024.

From NTSB
To FAA
Date 06/30/2022
Type Official Correspondence
Response

We note that, on March 18, 2021, the Aviation Rulemaking Advisory Committee accepted the ASHWG's report on low energy, which recommends revising Part 25 to include a new requirement for low-energy alerting, alone or in combination with low energy protection, for the normal landing configuration. We also note that you are evaluating the ASHWG report and sponsoring research to assess various methods to prevent and manage low energy. Pending completion of your research, Safety Recommendation A-14-43 remains classified OPEN– ACCEPTABLE RESPONSE.

From FAA
To NTSB
Date 04/18/2022
Type Official Correspondence
Response

-From Billy Nolen, Acting Administrator: On March 19, 2021, the Federal Aviation Administration (FAA) received the Low Energy Alerting recommendations report from the Aviation Rulemaking

Advisory Committee's Avionics Systems Harmonization Working Group. This report is available on the following website: https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/committee/browse/committeeID/1

We are evaluating the report's recommendations, in combination with ongoing FAA-sponsored research that is looking into the potential for additional low energy management and prevention, to assess the performance of various methods to prevent and manage low energy. We expect to conclude our research by December 31, 2022, and will subsequently begin a review of appropriate implementation options for transport category aircraft.

I will keep the Board informed of the FAA's progress on Safety Recommendation A-14-43 and provide an update by March 31, 2023.

From NTSB
To FAA
Date 07/02/2020
Type Official Correspondence
Response

We note that, in January 2018, you asked the Aviation Rulemaking Advisory Committee (ARAC) to develop and recommend design requirements for the Context-Dependent Low Energy Alerting Systems (CDLEAS) for airplanes used in commercial operations. You reported that the ARAC has assigned this task to the ASHWG, which is developing recommendations for the CDLEAS. We also note that you are sponsoring research that is considering the factors that should influence CDLEAS requirements. Pending our review of the working group's recommendations and completion of the recommended action, Safety Recommendation A-14-43 remains classified OPEN–ACCEPTABLE RESPONSE.

From FAA
To NTSB
Date 02/11/2020
Type Official Correspondence
Response

-From Steve Dickson, Administrator: In January 2018, the FAA tasked the Aviation Rulemaking Advisory Committee (ARAC) to develop and recommend design requirements for the Context-Dependent Low Energy Alerting Systems (CDLEAS), for airplanes engaged in commercial operations. The ARAC assigned this task to the Avionics Systems Harmonization Working Group (ASHWG), which held their first meeting to discuss CD LEAS November 13-14, 2018. We expect to receive recommendations for the CD LEAS from the ASHWG in late 2021. We also note that the FAA is sponsoring research with industry to characterize what factors should influence CDLEAS requirements. We will provide the results of this research to the ASHWG for their consideration in formulating recommendations.

I will keep the Board informed of the FAA's progress on these recommendations and anticipate providing an update by December 2020.

From NTSB
To FAA
Date 12/12/2014
Type Official Correspondence
Response

We note that, since March 2013, you have been reviewing the findings and recommendations of your Avionics Systems Harmonization Working Group (ASHWG) related to low-airspeed alerting systems, and that, as a result, you are considering rulemaking. The work of the ASHWG was done in response to Safety Recommendations A-03-53 and -54, which were superseded by Safety Recommendation A-10-12. In our investigation of the Asiana Airlines flight 214 accident, we found that the Boeing 777 was equipped with a low airspeed alerting system that provided both an aural and a visual alert, which would have satisfied our previous recommendations on low airspeed alerting systems. However, the Asiana Airlines flight 214 accident demonstrated that existing low airspeed alert systems may not be adequately tailored to alert pilots to an impending hazard caused by a combination of conditions such as low airspeed and low altitude. We issued Safety Recommendation A-14-43 because our investigation had found that alerting systems based on a low energy state were needed in addition to, or instead of, a low airspeed alerting system.

We are encouraged that you will evaluate the effectiveness of the potential rule change to determine whether additional work is needed to address a context-dependent low energy alerting systems for airplanes engaged in commercial operations. Pending completion of the recommended action, Safety Recommendation A-14-43 is classified OPEN—ACCEPTABLE RESPONSE.

From FAA
To NTSB
Date 10/09/2014
Type Official Correspondence
Response

-From Michael P. Huerta, Administrator: In March 2013, the Avionics Systems Harmonization Working Group (ASHWG) submitted the Low Airspeed Alerting findings and recommendations to the FAA. To address the ASHWG recommendations, we are considering rulemaking for parts 121 and 129.

We will evaluate the effectiveness of the potential rule change to determine whether additional work will be needed to address context-dependent low energy alerting systems for airplanes engaged in commercial operations.

The FAA will also work with Boeing to review the design and examine the various means by which the Boeing 777 automatic flight control system controls airspeed. We will evaluate the results of our review and determine the appropriate course of action regarding flightcrew interfaces with autoflight systems.

further changes are made and to better show the precision approach path indicator, or PAPI, light graphic by the runway.

The pitch attitude steadily increased as the pilot applied back pressure to the column to attempt to maintain the glide path per the PAPI indicators, but there was no mention of the decaying speed on the cockpit voice recorder at this time. Thrust levers remained at idle as the airplane continued to lose airspeed and sink below the glide path.

Twenty-four seconds from impact, the airplane was about .9 miles from the runway and 300 feet altitude. The airplane continued to descend well below the PAPI glide path, as indicated by the four red lights, decelerating through 120 knots and at a pitch attitude of about 7 degrees nose up.

About 11 seconds prior to impact, an audible alert consistent with the low airspeed caution was recorded. Three seconds later, just below 100 feet above the water, the throttle levers were moved fully forward to initiate a go-around, followed 4 to 5 seconds later by stick shaker activation and a verbal call to go around. But the action was too late and the main gear and underside of the aft fuselage struck the seawall.

The lowest recorded airspeed was 103 knots, which was about 34 knots below the desired airspeed.

Due to the potentially disturbing nature of the surveillance video we are about to show, we will pause for a moment to let attendees exit the room if they choose.

CAPT. COX: Okay. We talked a little bit about how Boeing pilots transition from one airplane to another earlier, but I'm interested now in any special requirements that the FSB may have put on pilots transitioning from non-Boeing airplanes with perhaps different handling, such as an Airbus. Is there any requirement by the FSB to have that kind of training done?

MR. EITEL: So an Airbus pilot transitioning to a Boeing 777 would require a full transition course, which would be the 21-day course. He'd have to meet the E and F requirements of trainer checking and then any special items we may have identified in the FSB report, and that would be tach on/tach off, full speed awareness, those types of things. But basically it's pretty much the basic airplane course.

MR. MYERS: Absolutely. So when we design the airplane, we assume that aircrews are very good at monitoring when it's a critical phase of flight, when it's a relatively short duration, when it's an area of high interest, and we designed the airplane to assume that the pilots will fly the airplane when they haven't actually asked the airplane to fly.

So in the case of a final approach, we assume that is an area where the crew is actively monitoring the critical flight parameters, and there's no more critical flight parameters than glide path and airspeed. So we definitely expect that a crew flying final approach, whether it's an autoland or whether it's a manual flight visual descent, whatever -- or visual approach, we would expect them to be actively monitoring airspeed, glide path

MEMBER SUMWALT: Thank you. I'd like to ask that for the record you submit any data that Boeing may have used in the assumption, like you said this morning, that we assume that pilots are very good at monitoring. Any data that you may have to support that, we'd like to have please. Thank you.

MEMBER WEENER: I find the discussion about monitoring to be very interesting. There's really a couple of monitoring tasks going on in this particular situation. There's one task of monitoring another pilot, and then a lot of the discussion so far has been monitoring systems. And the point's been brought out that there's a hazard with automation that works right almost all the time because you get surprised when it doesn't work properly.

And I think I'll address this to Dr. Sarter. Could you

The other question is how do we measure success? We need to really address that, and what I mean by that is right now I see a lot of training to exposure. We expose a pilot to something, and we say they're trained. We assume that they understand it. But going back to what I just said, if in that simulator I give them two or three scenarios that are realistic from what I would get on the line, and then I see if they really understood the knowledge and skills that I taught them, did they really get it, because that's the only true test, not just show them once and assume that they got it.

The assumption of skills. A lot of our training programs, and I heard that word this morning several times, we assume that the pilot has skills, but how do we know they have them? And the key there would be that again we evaluate that somehow. And so we have to figure out how we do that.

And finally with the difference in the automation policies is, in our paper -- in our study, there's a lot of confusion with automation policies and what we do, and the biggest thing I think that was an eye opener for me when we went through the studies and we saw a couple of air carriers doing it, is the separation of guidance and control when we're talking about

But what I can say is that, again, another one of the exceptions or what we're not training is we train CRM and then we

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assume that the pilots can transfer that to their flight operations. And as an industry, I think we can make heavy strides in the safety industry if we figure out a way to integrate the CRM skills, decision making, crew coordination, communication, all those things, while we're doing the maneuvers, while we're

Number three, Capt. Byeong-geoun Yoo from Asiana Airlines, confirm whether or not the training slide with the highlighted area was pre- or post-impact, and you can do that by just providing an e-mail to me.

Then fourth, Mr. Myers, data to support the statement that Boeing assumes pilots are good at monitoring. That will be Exhibit 2Z, as in zulu.

Regarding that, we have a clear training model and clear training programs. The instructor pilots put their first and top priority on the safety through various training procedures and also they put emphasis on improving the proficiency or ability of the trainees, and to this end, we have various courses in place.

So during the flight training, if there is a deviation for the first time, the trainee will get some notice and warning from the instructor saying that there's a deviation. And if this deviation happens more than twice, then the instructor will actually take over due to the safety issue.

Annex 2: B777 FCOM



777-200

Flight Crew Operations Manual

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Document Number D632W001-ZEV

Revision Number: 3

Revision Date: December 15, 2023

- IDLE – displays while the autothrottle moves thrust levers to idle; IDLE mode is followed by HOLD mode
- HOLD – thrust lever autothrottle servos are inhibited. The pilot can set thrust levers manually
- SPD – autothrottle maintains command speed. Speed can be set using the MCP IAS/MACH selector or by the FMC, as displayed on the CDU CLIMB, CRUISE, or DESCENT page.

Note: In SPD mode, the autothrottle will not exceed the operating speed limits for the airplane configuration or the referenced thrust limits displayed on the EICAS.

Note: If only one thrust lever is active, "L" or "R" displays in front of SPD for the active thrust lever.

Autothrottle System

The autothrottle system provides thrust control from takeoff through landing. Autothrottle operation is controlled from the MCP and CDUs. The MCP provides mode and speed selection. The CDUs enable FMC reference thrust limit selection. When VNAV is active, the FMC selects autothrottle modes and target thrust values. Refer to Chapter 11, Flight Management, Navigation, for FMS and CDU operation. Refer to Chapter 10, Flight Instruments, Displays, for PFD indications.

The autothrottle is either off, armed, or active. The autothrottle is off when the A/T ARM switches are OFF. The autothrottle is armed when the A/T ARM switches are on and the autothrottle mode is blank. The autothrottle is active when the A/T ARM switches are on and there is an autothrottle mode shown. The active autothrottle modes are: IDLE, HOLD, THR, THR REF, and SPD.

Automatic Activation

The autothrottle can automatically activate to provide stall protection when armed and not active (A/T mode is blank).

With the autothrottle armed and not active, the autothrottle automatically activates when the pitch mode is ALT, V/S, FPA, VNAV ALT, VNAV PTH, VNAV SPD, FLCH SPD, G/S, TOGA or there is no active pitch mode, and:

- speed is less than an FMC calculated value for one second, and
- thrust is below reference thrust limit, and
- airplane barometric altitude is 400 feet above the airport on takeoff or airplane altitude is above 100 feet RA on approach.

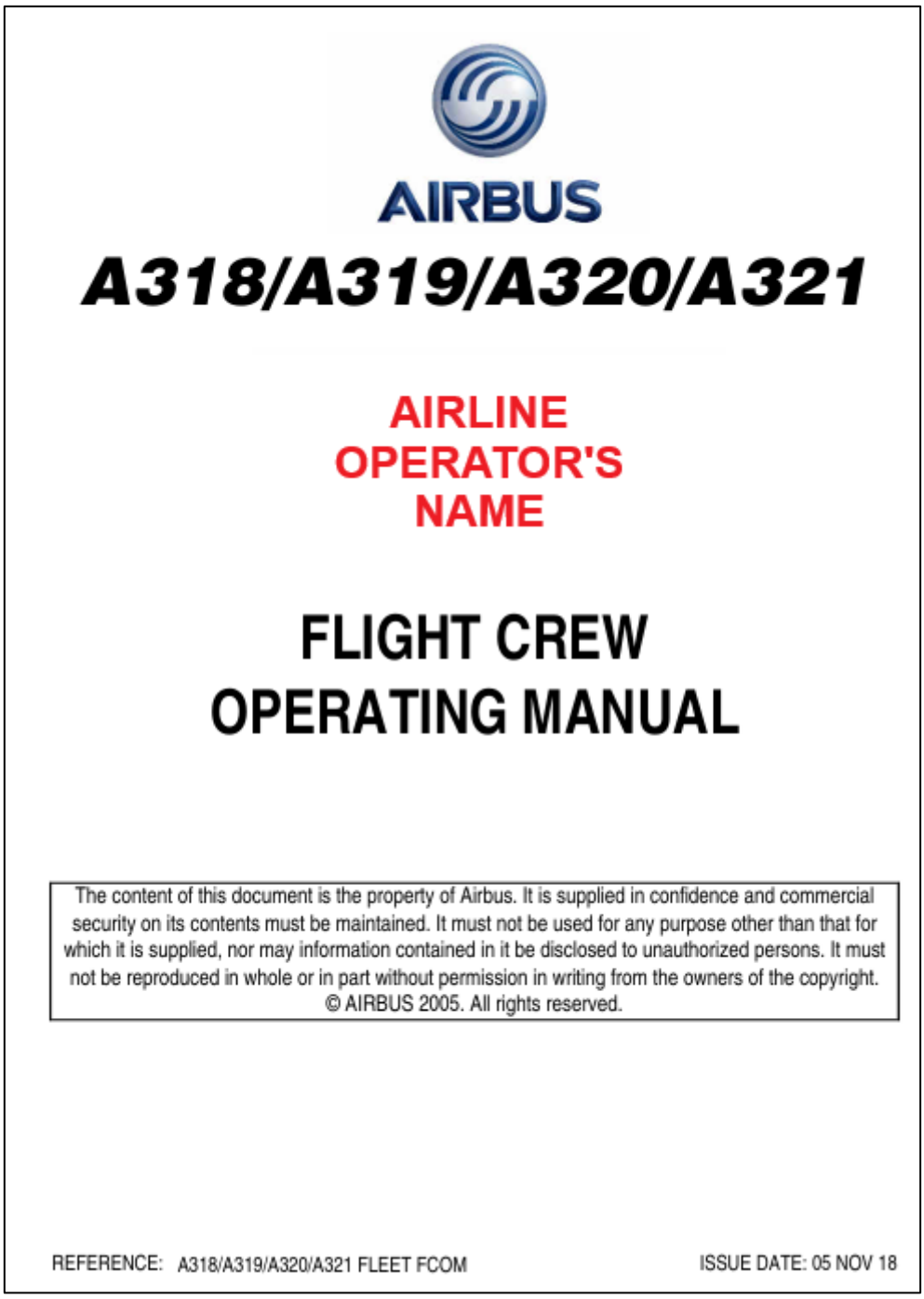
Autothrottle Thrust Lever Operation

The autothrottle system moves either or both thrust levers to provide speed or thrust control, depending on the active mode.

Thrust levers can be manually positioned without disconnecting the autothrottle. After manual positioning, the autothrottle system repositions thrust levers to comply with the active mode. The autothrottle system does not reposition thrust levers while in HOLD mode.

Note: When the pitch flight mode annunciation is FLCH SPD, the autothrottle can enter the HOLD mode. This occurs if the pilot overrides thrust levers; or, in a descent, when thrust levers retard to IDLE. When in HOLD mode, thrust lever servos are inhibited and the autothrottle does not control thrust or speed. Thrust levers can be manually advanced.

Annex 3: Airbus A320 FCOM



AIRBUS

A318/A319/A320/A321

AIRLINE
OPERATOR'S
NAME

FLIGHT CREW
OPERATING MANUAL

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REFERENCE: A318/A319/A320/A321 FLEET FCOM

ISSUE DATE: 05 NOV 18

GENERAL

Ident.: DSC-22_40-10-00000840.0001001 / 24 FEB 15
Applicable to: ALL

The aircraft has two flight augmentation computers (FACs) that perform four main functions:

- Yaw function
  - Yaw damping and turn coordination
  - Rudder trim
  - Rudder travel limitation
- Flight envelope function
  - PFD speed scale management
    - ■ Minimum/maximum speed computation
    - ■ Maneuvering speed computation
  - Alpha-floor protection
- Low-Energy Aural Alert function

Activate W
Go to Settings

In performing these functions the FAC uses independent channels :
Yaw damper
Rudder trim
Rudder travel limit
Flight envelope

Each FAC interfaces with the elevator aileron computers (ELACs) when the APs are disengaged, or with the FMGS when at least one AP is engaged.
Both FACs engage automatically at power-up.
The pilot can disengage or reset each FAC (in case of failure) by means of a pushbutton on the flight control overhead panel.
When a FAC is disengaged (FAC pushbutton set off) but still valid, the flight envelope function of the FAC remains active.
If both FACs are valid, FAC1 controls the yaw damper, turn coordination, rudder trim, and rudder travel limit, and FAC2 is in standby.
FAC1 keeps the aircraft within the flight envelope through FD1 ; FAC2 performs this function through

GENERAL

Ident.: DSC-22_40-30-00000859.0001001 / 09 DEC 09
Applicable to: ALL

As long as one Flight Augmentation Computer (FAC) is valid, it governs the flight envelope function, the rudder position display, and the rudder trim indication regardless of what the flight crew does with the FAC pushbutton.

PFD SPEED SCALE MANAGEMENT

Ident.: DSC-22_40-30-00000860.0001001 / 24 JAN 11

The FAC controls the speed scale on the PFD (*Refer to DSC-31-40 Attitude Data*).
When both FACs are operative, FAC1 supplies data to PFD1 and FAC2 supplies it to PFD2.

The FAC computes:
- The minimum and maximum speeds:
  - VSW (stall warning)
  - VLS
  - VFE and VFE for the next configuration
  - VLE
  - VMO/MMO
- The maneuvering speeds:
  - Green Dot Speed
  - S speed
  - F speed

  (*Refer to PRO-SUP-10 Characteristic Speeds* for speed definition).

The FAC also computes the speed trend and displays it as an arrow on the PFD speed scale.
The PFD displays these various speeds as appropriate, and they also go to the FMGC to be used as

Note: *The principle of the speed computation is as follows:*

- *First, the FAC computes VS1G (stall speed). From VS1G it computes the Gross Weight (GW) which is also sent to the Elevator Aileron computers:*
  - *When the aircraft is below 14 500 ft and 250 kt, it computes this from current angle of attack, speed/Mach, altitude, thrust, and CG.*
  - *When the aircraft is above 14 500 ft or 250 kt, it computes this out of the GW, which it has memorized and updated with a fuel consumption model set in the FAC.*
- *Finally the FAC computes the various minimum and maneuvering speeds, Vα prot and Vsw.*
- *The accuracies of the various minimum and maximum speeds are functions of the accuracy with which the FAC computes aircraft gross weight. Normal accuracy for VLS in CONFIG FULL is about ± 3 kt.*

A320/A321
FLIGHT CREW
OPERATING MANUAL

AIRCRAFT SYSTEMS
AUTO FLIGHT - FLIGHT AUGMENTATION
FLIGHT ENVELOPE FUNCTION

Note: *The FAC computes the operating speeds based on the FMS gross weight. This allows to have consistent and accurate operating speeds between the PFD and the MCDU. In parallel, the FAC also computes its own GW and CG, based on aerodynamic data, which is used by the ELAC and the FMS for gross weight crosscheck ("CHECK GW" MCDU message), and as a backup for speeds computation in case of dual FMS failure. The principle of the FAC GW/CG computation based on aerodynamic data is as follows :*

- *First, the FAC computes VS1G (stall speed). From VS1G it computes the FAC gross weight which is also sent to the ELAC:*
  - *When the aircraft is below 14 500 ft and 250 kt, it computes this from current angle of attack, speed/Mach, altitude, thrust, and CG.*
  - *When the aircraft is above 14 500 ft or 250 kt, it computes this out of the GW, which it has memorized and updated with a fuel consumption model set in the FAC.*

ALPHA-FLOOR PROTECTION

Ident.: DSC-22_40-30-00006198.0015001 / 22 APR 16

Alpha-floor protection automatically sets the thrust at TOGA thrust, when the aircraft reaches a very high angle of attack.
The Flight Augmentation Computer (FAC) generates the signal that triggers the alpha-floor mode. This, in turn, sets TOGA thrust on the engines, regardless of the thrust lever positions (*Refer to DSC-22_30-90 A/THR Modes - General*).

The FAC sends this signal when:
- The angle of attack is above a predetermined threshold, that is a function of the configuration.
- In CONF 3 and CONF FULL, this threshold decreases as a function of the aircraft deceleration rate (down to – 3 °).

Alpha-floor is available from lift-off until the aircraft reaches 100 ft RA in approach.
Alpha-floor is inhibited above M 0.6.

Activate Windo

LOW - ENERGY AURAL ALERT

Ident.: DSC-22_40-30-00006197.0001001 / 24 FEB 15
Applicable to: ALL

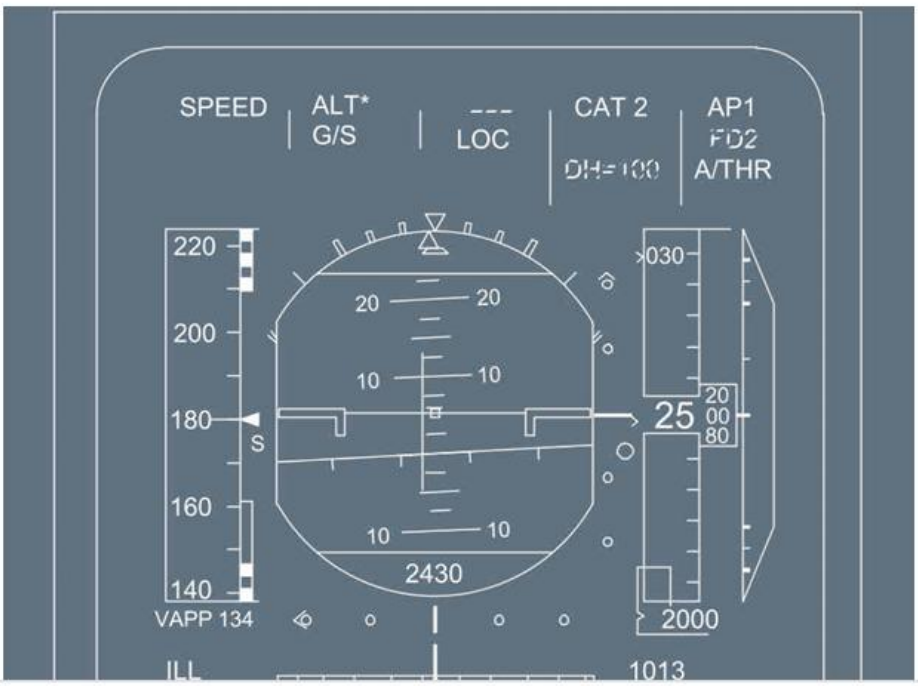
An aural low-energy “SPEED SPEED SPEED” alert, repeated every 5 s, warns the pilot that the aircraft’s energy level is going below a threshold under which he has to increase thrust, in order to regain a positive flight path angle through pitch control.

It is available in Configuration 2, 3, and FULL. The FAC computes the energy level with the following inputs:
- Aircraft configuration
- Horizontal deceleration rate
- Flight path angle.

MANAGED SPEED

CHECK that managed speed is active: MONITOR the target speed.

During the approach, the autothrust limits the speed of the current configuration. (GD, S, F, VAPP).



AUTOLAND

CHECK that the FMA displays the aircraft capability (CAT 2 or CAT 3) for the intended ILS approach.
MONITOR the radio automatic callout.

- **At 350 ft RA:**

  CHECK that "LAND" is displayed on the FMA.

  CHECK ILS course.

  If LAND is not displayed or if the ILS course is not correct, do not perform an autoland. The flight crew should perform a go-around, if visual references are not sufficient.

- **Between 50 and 40 ft RA:**

  CHECK that "FLARE" is displayed on the FMA.

- **At approximately 30 ft RA:**

  CHECK that "IDLE" is displayed on the FMA, and that autothrust starts to reduce thrust toward IDLE.

- **At 10 ft, "RETARD" callout comes up:**

  MOVE the thrust levers to IDLE.

  Autothrust disconnects.

- **At touchdown:**

  CHECK that "ROLL OUT" appears on the FMA.

- **At the end of the Rollout:**

  Disconnect the autopilot.

  If the flight crew does not disconnect the AP at the end of the rollout, and uses the nosewheel steering handwheel to taxi the aircraft off the runway, the following will occur:

  - *The AP will try to steer the aircraft back to the runway centerline, if the nosewheel steering handwheel is released and the aircraft heading is less than 20 ° off the runway centerline.*
  - *The AP will automatically disconnect, if the aircraft heading is 20 ° or more off the runway centerline.*

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Ident.: PRO-NOR-SRP-01-70-A-00004021.0001001 / 17 MAR 11
Applicable to: ALL

MANUAL LANDING

- **At DH:**
  DISCONNECT the APs. SPEED mode remains engaged.
- **At 20 ft "RETARD" automatic call out comes up:**
  MOVE the thrust levers to IDLE if they are not there already. (The A/THR disconnects).
- **At touch down:**
  "ROLL OUT" appears on the FMA and the yaw bar comes up on the PFD.

  Note: The retard call out is only a reminder when a manual landing is performed.