Research paper on PPS

Version 101.0 x modified on 13Aug,2019 x original by Shigeru Fujii on 20Apr, 2017

PPS = **Proactive and Predictive System to mitigate/minimize/eliminate PICs fatal decision-making errors by Deep Learning AI**

PPS SLOGAN = “ Trap Human Errors with PPS “

① Help pilots trap errors that might occur.

② Do not let errors slip past the “filters” to protect you.

③ Verbalize threats to the rest of the crew.

《 I N D E X 》

4. My Goal of PPS

4.1 PPS outside Cockpit【Phase-1-A】

4.2 PPS inside Cockpit

4.2.1 PPS inside Cockpit with DARUMA【Phase-1-B】

4.2.2 PPS inside Cockpit with ULTRAMAN【Phase-2】

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1. Preface

PPS is “Proactive and Predictive System to mitigate/minimize/eliminate PICs fatal decision-making errors by Deep Learning AI”.

PIC is a captain who is ultimately responsible for his flying aircraft operation and safety during the flight.

“PICs fatal decision-making errors” are, naturally speaking, made by PICs. Therefore my focus is PICs actions, that is, how they operate an aircraft.

PPS’s ultimate goal to trap errors before they can become undesired consequences – if worst comes to the worst, the deadliest plane crash like TENERIFE – is to create GLOBAL ULTRA LINK, that is, all the “participants/elements” on Earth are liked globally, which will be realized much sooner than expected as “global village” is a hair’s breadth to us by making maximum use of Deep Learning AI.

Although so many people, areas of responsibility and things contribute to daily flight operations, all the “participants/elements” should be systematically linked – ULTRA LINK – in future so that any threats can be shared among all the “participants/elements” to mitigate them as soon as possible.
Under this system integration, Deep Learning AI will matter most to maximize the margin of aviation safety.

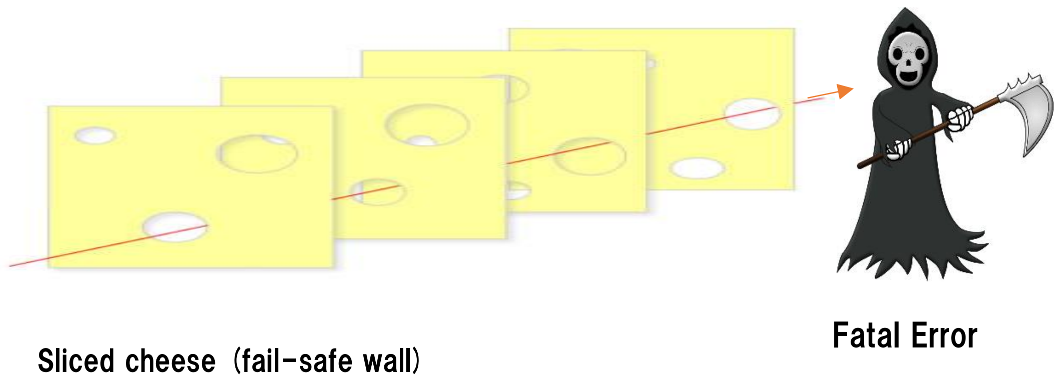
2. PARADIGM SHIFT

Paradigm shift from "Swiss Cheese" to "Japanese Rice Cracker"

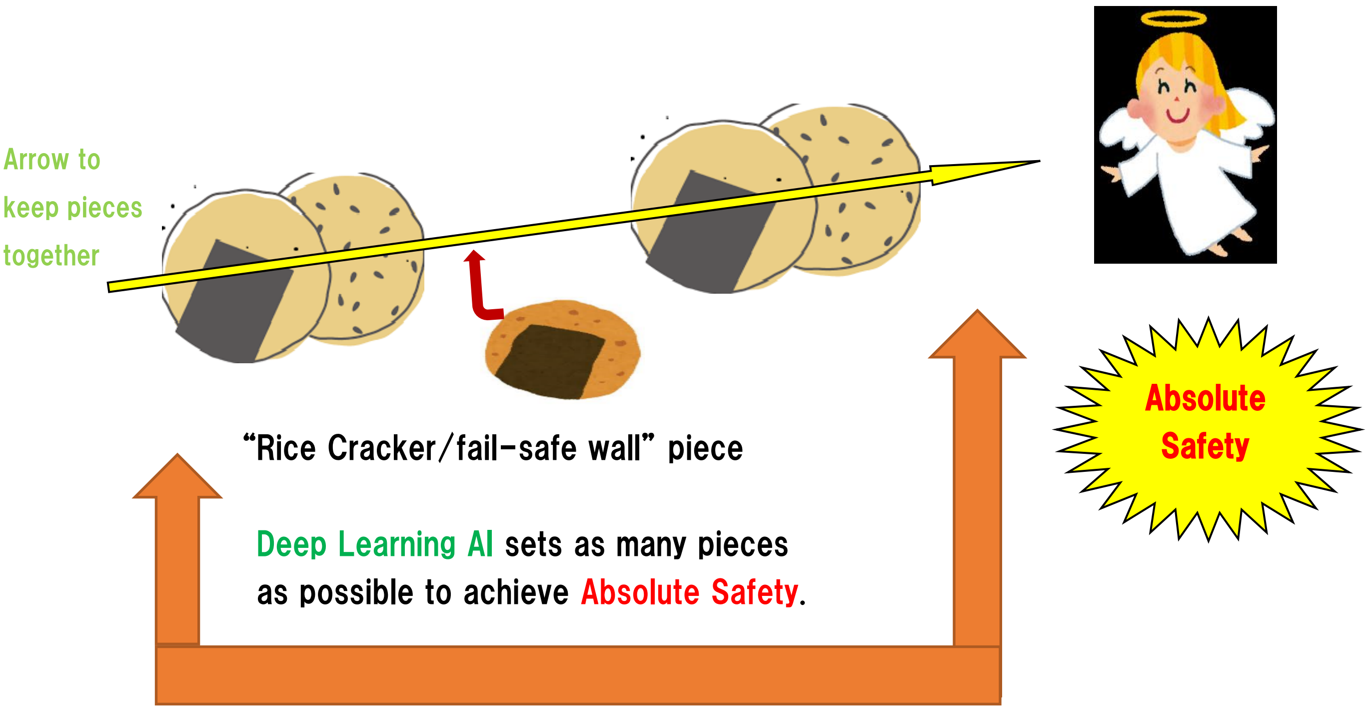
To think about the risk management focusing on PICs fatal decision-making errors, I'd like to create the world of aviation absolute safety with the help of Deep Learning AI, where we have made a Copernican revolutionary/fundamental change in our common sense that a PIC is possible to make fatal decision-making errors because he is a human being.

That is, "consequently speaking", with help of Deep Learning AI, we can eliminate PIC's fatal decision-making errors, where the shift from " James Reason's Swiss Cheese Model " to " Shigeru Fujii's Japanese Rice Cracker Model " is created.

(1) James Reason's Swiss Cheese Model ⇒ from bad to worst / negative spiral



(2) Shigeru Fujii's Japanese Rice Cracker Model ⇒ from good to best / positive spiral



Self-Learning ⇒ Self-Innovation

3. PPS

PPS consists of two parts.

Part-1 covers “On Deck” PICs actions, the scope which is from “show up for the coming duty flight” to “duty off”.

Specifically and sequentially speaking,
Part-1 covers
①show up⇒②block out⇒③takeoff⇒④landing⇒⑤block in⇒⑥duty off

Part-2 covers “Off Deck” PICs actions, the scope which is from “duty off” to “show up for next duty flight”.

Specifically and sequentially speaking,
Part-2 covers
①duty off⇒②rest in ⇒③rest out⇒④show up

1.2 PPS

PPS project consists of

(a) PPS concept　(GENERAL)

and

(b) PPS development　(PARTICULARS).

This document covers only【(a) PPS concept (GENERAL)】which is quite general, in other words, how to develop PPS【(b) PPS development (PARTICULARS)】depends on the organizations in the following three groups to do it like an airline, an IT company, a joint venture and so on.

《 (a) PPS concept (GENERAL) 》

Human errors can't be eliminated as long as pilots are human, which has been said for long time, but don't think so. There must be an effective strategy to "eliminate" them, which is my motto/belief.

To cope with "human error on deck" (pilots-caused-errors in an aircraft cockpit), the shift from the reactive way to the proactive and predictive one has to be created through the redundant system integration, the core of which is Deep Learning AI as soon as possible.

Suppose you are a staff in charge of "human error on deck" of **Global Airline (an imaginary airline)** of **USF (an imaginary country named "United States for Justice")** which has **CAA (Country Aviation Administration) like FAA of USA**.

When pilots make an error causing undesired consequences/aviation accidents, the following scenario is commonly expected, I think.

They, both of captain and copilot are forced to get offline as soon as possible. Then veteran pilots in the related various departments/sections specializing in training such off-lined pilots have an urgent meeting to cope with the issue and decide the best remedy/training program for it, according to which supervising pilots will train the offline pilots by ground study, a simulator and a real ship.
If a CAA inspector checks the training record and gives the pilots the permission to fly again, the pilots can get online, that is, can fly again.

I have to say this is a reactive remedy which is a traditional accident investigation although I have to admit on the other hand that it has made a lot of accomplishments.

It is often said that such a reactive remedy that the investigation for causes and contributing factors is carried out after an accident is prerequisite but insufficient for SMS promoting "a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures" which ICAO implemented with its 190 contracting states.

They say that instead of blaming pilots, that is, instead of focusing on "who and what", the focus should be put on "why and how".

SMM（Safety Management Manual/ICAO Doc 9859）shows you how aviation safety concept has advanced.

https://www.icao.int/safety/fsix/Library/DOC_9859_FULL_EN.pdf

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2.2 THE EVOLUTION OF SAFETY

【SMM / Chapter 2 Safety Management Fundamentals】

The history of the progress in aviation safety can be divided into three eras.

1. The technical era

From the early 1900s until the late 1960s

Aviation emerged as a form of mass transportation in which identified safety deficiencies were initially related to technical factors and technological failures. The focus of safety endeavors was therefore placed on the investigation and improvement of technical factors.
By the 1950s, technological improvements led to a gradual decline in the frequency of accidents, and safety processes were broadened to encompass regulatory compliance and oversight.

2. The human factors era

From the early 1970s until the mid-1990s

In the early 1970s, the frequency of aviation accidents was significantly reduced due to major technological advances and enhancements to safety regulations. Aviation became a safer mode of transportation, and the focus of safety endeavours was extended to include human factors issues including the man/machine interface.
This led to a search for safety information beyond that which was generated by the earlier accident investigation process.
Despite the investment of resources in errors mitigation, human performance continued to be cited as a recurring factor in accidents（Figure 2-1）.
The application of human factors science tended to focus on the individual, without fully considering the operational and organizational context.
It was not until the early 1990s that it was first acknowledged that individuals operate in a complex environment, which includes multiple factors having the potential to affect behavior.

3. The organizational era

From the mid-1990s to the present day

During the organizational era safety began to be viewed from a systemic perspective, which was to encompass organizational factors in addition to human and technical factors.
As a result, the notion of the – organizational accident ‖ was introduced, considering the impact of organizational culture and policies on the effectiveness of safety risk controls.
Additionally, traditional data collection and analysis efforts, which had been limited to the use of data collected through investigation of accidents and serious incidents, were supplemented with a new proactive approach to safety.
This new approach is based on routine collection and analysis of data using proactive as well as reactive methodologies to monitor known safety risks and detect emerging safety issues.
These enhancements formulated the rationale for moving towards a safety management approach.

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The core of my strategy, my thesis to minimize/mitigate/eliminate PIC's fatal decision-making errors is to change the current reactive remedy to the proactive and predictive one trying to identify/trap a safety risk and have a PIC "awake" before an accident occurs by making most use of a system/machine.

As said "there is a great difference between word and deed",
I can think about the issue theoretically but find so difficult to solve it in actual pilots working path/circumstances.
But however hard it may be, we have to deal with it not only for aviation industry but for mankind, I'm convinced, which is my belief.

《 (b) PPS development (PARTICULARS) 》

This document covers only (a) PPS concept/GENERAL.

With regard to **(b) PPS development/PARTICULARS,**

how to develop PPS depends on an airline playing the leading role in the following three groups (On its own responsibility the airline is free to organize a development group including an IT company, a joint venture and so on.)

As I'm on an airline, my counterpart/negotiator must be an airline staff.

With regard to the organizations, I would like to divide the world into three groups, that is,

(a) Asia & Oceania group

(b) North & South America group

(c) Europe & Africa group

I will lead the (a) Asia & Oceania group.

Regarding (b) North & South America group and (c) Europe & Africa group, a challenging airline venturing to develop PPS is highly appreciated.

Active and frequent exchanges on the information to develop PPS among the airlines – even if they are immature and unskilled – are prerequisite to make PPS best.

When the following PONANZA AI shogi (a Japanese chess-like board game for two players) program was developed, the developer of PONANZA dared to make public even the source programs public to accelerate the development speed.

“A computer shogi program beat a professional player for the first time in 2013. The superiority of artificial intelligence over humans in the world of shogi became clear when the PONANZA program defeated Mr. Amahiko Sato, an eight-dan master, 2-0 in April and May.”

https://www.japantimes.co.jp/opinion/2017/06/29/editorials/shogi-prodigy-breathes-new-life-game/

2. Know where to look first

"Knowing where to look first" is most important before getting into details to research the cause of aviation accidents.

2.1 If you are given the following math questions on condition that you can use a calculator but have to solve all of them within 30 seconds. What would you do ?

Q1: 55 x 7 x 2 =

Q2: 25 x 36 =

Q3: 26 x 8 + 13 x 4 =

2.2 If without a calculator and within the same time？

Q1: $55 \times 7 \times 2 =$

Q2: $25 \times 36 =$

Q3: $26 \times 8 + 13 \times 4 =$

2.3 “First where to look” is most important.

Re Q1: $55 \times 7 \times 2 = 55 \times 2 \times 7 = 110 \times 7 = 770$ ⇒ 5 seconds

Re Q2: $25 \times 36 = 25 \times 4 \times 9 = 100 \times 9 = 900$ ⇒ 5 seconds

Re Q3: $26 \times 8 + 13 \times 4 = 26 \times 8 + 26 \times 2 = 26 \times 10 = 260$ ⇒ 5 seconds

If “where to look first” is perfect, you can make it easy.
If worst, terrible !

3. Case study/Data acquisition

Case study/Data acquisition to be categorized later to be used in the PPS system if I get so many cases in the not-too-distant future.

3.1 《Category: Wrong Runway Departures》

Comair Flight 5191 / 27Aug in 2006,
marketed as Delta Connection Flight 5191, from Lexington in Kentucky to Atlanta in Georgia, operated on behalf of Delta Connection by Comair

3.1.1 Overview of the accident

3.1.1.1 Comair 5191 / 27August, 2006

"Cockpit Voice Recorder Database" HP

https://www.tailstrike.com/270806.htm

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Comair Flight 191, marketed as Delta Connection Flight 5191, was a scheduled United States（US）domestic passenger flight from Lexington, Kentucky, to Atlanta, Georgia, operated on behalf of Delta Connection by Comair. On the morning of August 27, 2006, the Bombardier Canadair Regional Jet 100ER that was being used for the flight crashed while attempting to take off from Blue Grass Airport in Fayette County, Kentucky, four miles（6 kilometers）west of the central business district of the City of Lexington.

The aircraft was assigned the airport's Runway 22 for the takeoff, but used Runway 26 instead. Runway 26 was too short for a safe takeoff, causing the aircraft to overrun the end of the runway before it could become airborne. It crashed just past the end of the runway, killing all 47 passengers and two of the three crew. The flight's first officer was the only survivor. While not the pilot in command, according to the cockpit voice recorder transcript, the first officer was the pilot flying at the time of the accident.

Analysis of the cockpit voice recorder indicated the aircraft was cleared to take off from Runway 22, a 7,003 feet (2,135 m) strip used by most airline traffic at Lexington. Instead, after confirming "Runway two-two," Captain Jeffrey Clay taxied onto Runway 26, an unlit secondary runway only 3,500 feet (1,100 m) long and turned the controls over to First Officer James Polehinke for takeoff. The air traffic controller in the control tower was not required to maintain visual contact with the aircraft; after clearing the plane for takeoff, he turned to perform administrative duties and did not see the aircraft taxi to the runway.

Based upon an estimated takeoff weight of 49,087 pounds (22,265 kg), [8] the manufacturer calculated a speed of 138 knots (159 miles per hour or 256 kilometers per hour) and a distance of 3,744 feet (1,141 m) would have been needed for rotation (increasing nose-up pitch), with more runway needed to achieve lift-off. At a speed approaching 100 knots (120 mph), Polehinke remarked, "There is no lights" referring to the lack of lighting on Runway 26. ["Yeah," confirmed Clay, but the flight data recorder gave no indication either pilot tried to abort the takeoff as the aircraft accelerated to 137 knots (158 mph).

Clay called for rotation but the aircraft sped off the end of the runway before it could lift off. It then struck a berm, becoming momentarily airborne, [clipped the airport perimeter fence with its landing gear, and collided with trees, separating the fuselage and cockpit from the tail. The aircraft struck the ground about 1,000 feet (300 m) from the end of the runway. Forty-nine of the 50 people on board perished in the accident; most of them were killed instantly in the initial impact. A resulting fire destroyed the aircraft.

During the course of its investigation, the Federal Aviation Administration (FAA) discovered that tower staffing levels at Blue Grass Airport violated an internal policy as reflected in a November 16, 2005 memorandum requiring two controllers during the overnight shift: one in the tower working clearance, ground, and tower frequencies, and another, either in the tower or remotely at Indianapolis Center, working TRACON (radar). At the time of the accident, the single controller in the tower was performing both tower and radar duties. On August 30, 2006 the FAA announced that Lexington, as well as other airports with similar traffic levels, would be staffed with two controllers in the tower around the clock effective immediately.

The National Transportation Safety Board determines that the probable cause of this accident was the flight crew members' failure to use available cues and aids to identify the airplane's location on the airport surface during taxi and their failure to cross-check and verify that the airplane was on the correct runway before takeoff. Contributing to the accident were the flight crew's non pertinent conversations during taxi, which resulted in a loss of positional awareness and the Federal Aviation Administration's failure to require that all runway crossings be authorized only by specific air traffic control clearances.』

3.1.1.2 Wikipedia

https://en.wikipedia.org/wiki/Comair_Flight_5191

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Comair Flight 5191, marketed as Delta Connection Flight 5191, was a scheduled United States (US) domestic passenger flight from Lexington, Kentucky, to Atlanta, Georgia, operated on behalf of Delta Connection by Comair. On the morning of August 27, 2006, at around 06:07 EDT, the Bombardier Canadair Regional Jet 100ER that was being used for the flight crashed while attempting to take off from Blue Grass Airport in Fayette County, Kentucky, 4 miles (6.4 km) west of the central business district of the City of Lexington.

The aircraft was assigned the airport's runway 22 for the takeoff, but used runway 26 instead. Runway 26 was too short for a safe takeoff, causing the aircraft to overrun the end of the runway before it could become airborne. It crashed just past the end of the runway, killing all 47 passengers and two of the three crew. The flight's first officer was the only survivor.

Although not the pilot in command, according to the cockpit voice recorder transcript, the first officer was the pilot flying at the time of the accident. In the National Transportation Safety Board report on the crash, investigators concluded that the likely cause of the crash was pilot errors.

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3.1.2 Definition of a runway incursion

Manual on the Prevention of Runway Incursions（ICAO Doc/9870）

http://cfapp.icao.int/fsix/_Library/Runway%20Incursion%20Manual-final_full_fsix.pdf

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Chapter 1　INTRODUCTION

1.1 DEFINITION OF A RUNWAY INCURSION

The Procedures for Air Navigation Services – Air Traffic Management（PANS-ATM）defines a runway incursion as:

"Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft."

1.2 INTRODUCTION OF RUNWAY INCURSION PREVENTION

1.2.1 Runway incursions have sometimes led to serious accidents with significant loss of life. Although they are not a new problem, with increasing air traffic, runway incursion have been on the rise.

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3.1.3 Questions & Hypothesis

If I put forward the following hypothesis;

(a) Why did the captain only reply " yeah " although the first officer verbalized "no lights (dat is weird with no lights)" without trying to stop the aircraft, which was the last chance to trap the disastrous - causing death - errors of moving on the wrong runway ?

If a PIC pays no attention to the threats around them, his-company-given checklists, SOPs and even copilot's assertions can't keep the aircraft safe.

The most important cockpit voice recording
05:36:07.7 ⇒ Start of recording
06:06:16.3 ⇒ First Officer James Polehinke verbalized

"dat is weird with no lights." (dat=that)

06:06:18.0 ⇒ PIC/Captain Jeffrey Clay replied " yeah."

(b) If the PIC had have an iPad by which his company emails him in advance to warn him that an accident of moving on the wrong runway with no lights was possible to happen so be careful when he showed up at the dispatch counter to sign the show up list, what would have happened ?

PIC's "awakening" is core, especially in terms of the last chance to trap the errors causing fatal situation.

If a PIC is lost in a conversation/chat or thought, only his subconscious functions and his ability to control an aircraft/situational awareness decreases so much so that undesired consequences get induced, I think.
Although an aviation accident is caused by so many related people, related area and related things, first of all I should bring PIC's "awakening" into focus as I'm on how to mitigate/minimize/eliminate PIC's fatal decision-making errors.

If so, next we have to research the mechanism on how a PIC - a very smart, selected person - makes a fatal decision-making error.
In other words, what is the proactive and predictive way to mitigate/minimize/eliminate PIC's fatal decision-making errors by Deep Learning AI？

The prerequisite one of many tools we should rely on is a system, so why don't we pay attention first to the proactive and predictive system to mitigate/minimize/eliminate PIC's fatal decision making-errors by Deep Learning AI？

4. My Goal of PPS

Proactive and Predictive System to mitigate/minimize/eliminate PIC's fatal decision-making errors by Deep Learning Ai 【hereafter, PPS】

How can we take the precautions against the PIC's fatal decision making errors like Comair 5191/27Aug, 2006？

Praise the Lord, then we can see the Light, can't we？　I do hope so.

However complex the environment – including multiple factors with the potential to affect behaviors – is , PIC never fails to make a right decision with the help of PPS.

4.1 PPS outside Cockpit 【Phase-1-A】

4.2 PPS inside Cockpit

4.2.1 PPS inside Cockpit with DARUMA 【Phase-1-A】

4.2.2 PPS inside Cockpit with ULTRAMAN 【Phase-2】

4.3 IDEAL PPS 【Phase-3】

4.1 PPS outside Cockpit【Phase-1-A】

4.1.1 The core logic for Phase-1-A

Work Flow × Algorithm (Deep Learning AI) = Warning

"P P S outside Cockpit"【Phase-1-A】is on the assumption that pilots are outside a cockpit.

If we need to warn a PIC, PPS will send an email to his handy device like iPad to warn him at the departure dispatch counter before he gets on an aircraft.

If necessary, a manager in charge of rostering pilots on daily flight operations should get in touch with the PIC to make sure that the PIC can recognize the warning. If he is already in a cockpit, the manager should call a satellite phone in a cockpit.

Currently as a tool/device best for PIC, iPad is best as in Global Airline, all pilots have iPad so that they can see the LMS contents anywhere in the world through internet, 24 hours a day, 7 days a week.

4.1.2 Work Flow

4.1.2.1 Definition of Work Flow

My first project I have to put a focus on is Work Flow.

Work Flow is the name of the system to manage training records systematically – by which instructors on any training phases can grasp the training record of the targeted trainee/pilot instantly – in which the evaluation of each trainee/pilot on each training phase is recorded in terms of competency based grading consisting of skills, knowledge and attitudes as ICAO defines "competency is a combination of skills, knowledge, and attitude required to perform a task of prescribed standard".

4.1.2.2 Scope & Data Item of Work Flow

To think about Work Flow, "where to look first" is (a) scope and (b) data item.

(a) Regarding "scope",

★ My targeting scope as a first trial is only the recurrent training although the potential targeted one is as follows: ★

Phase-1 Entrance exam for "our" company

Phase-2 GS (Ground Study)

Phasa-3 FBS (Fixed Based Training)

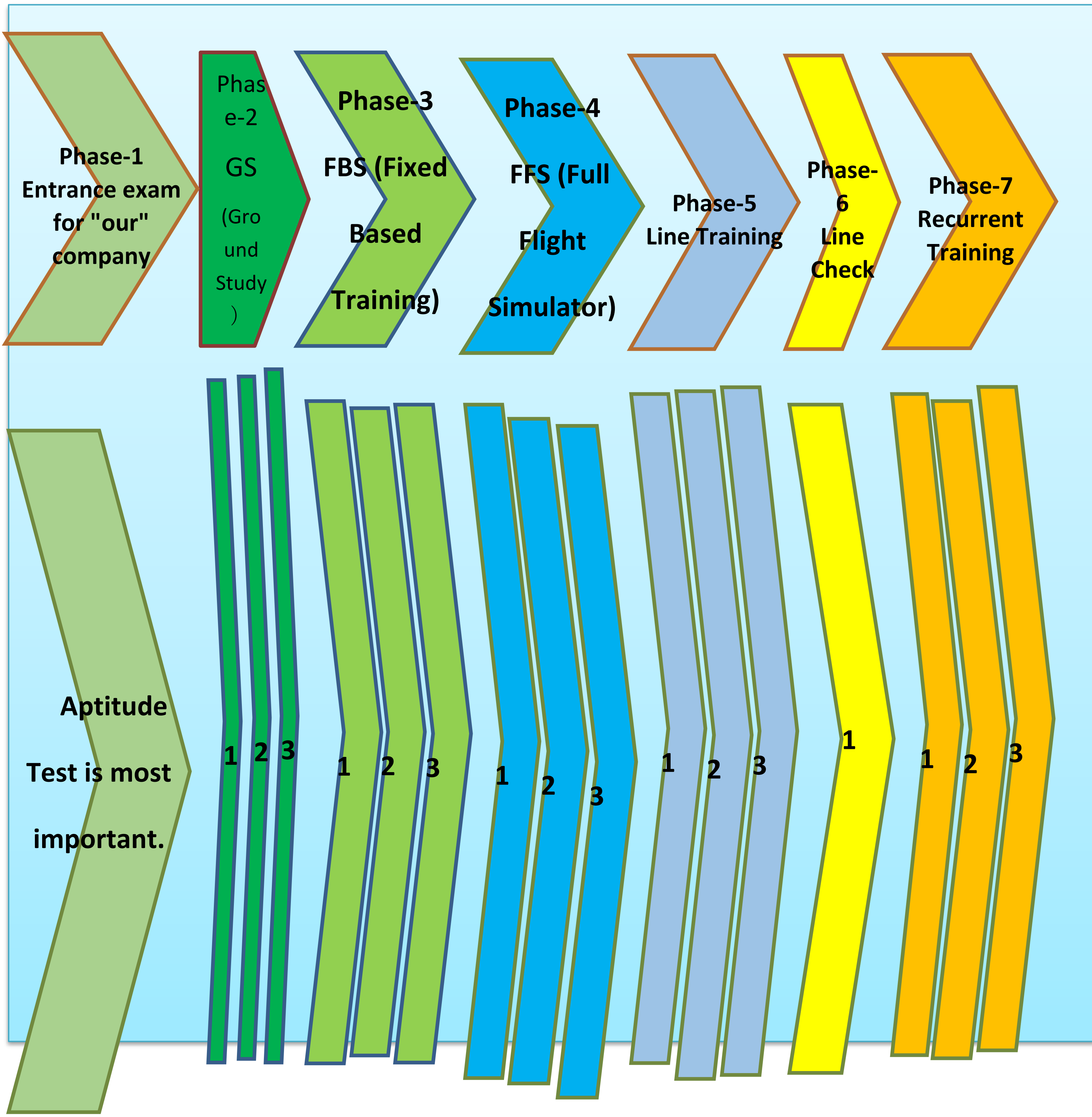
Phase-4 FFS (Full Flight Simulator)

Phase-5 Line Training

Phase-6 Line Check

Phase-7 Recurrent Training

◆ Bird 's-eye View of Phase 1～7 ◆



(b) Regarding “evaluation data items”,

In addition to Global Airline’s evaluation items to use KSA【knowledge, skill, attitude】on recurrent training, some more evaluation data items oriented toward PPS will be needed.

★ I'll decide the evaluation data items to be used for the algorithm (program) after negotiating with flying instructors/pilots. ★

Review on an important technical term “KSA”【knowledge, skill, attitude】etc. used in “Manual of Evidence-based Training” (ICAO Doc9995 First Edition/2013)

https://www.icao.int/SAM/Documents/2014-AQP/EBT%20ICAO%20Manual%20Doc%209995.en.pdf

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① Competency = A combination of knowledge, skills and attitudes required to perform a task to the prescribed standard【Manual of Evidence-based Training /GLOSSARY】

② Facilitation technique = An active training method, which uses effective questioning, listening and a non-judgmental approach and is particularly effective in developing skills and attitudes, assisting trainees to develop insight and their own solutions and resulting in better understanding, retention and commitment【. GLOSSARY】

③ KSA = knowledge, skills and attitudes【ABBREVIATIONS & ACRONYMS】

④ The core competencies identified in EBT encompass what was previously known as both technical and non-technical knowledge, skills and attitudes, aligning the training content with the actual competencies necessary in the context of contemporary aviation.【Chap 1. BACKGROUND 1.4】

⑤ The first component in the development of the EBT concept is a set of competencies contained in Appendix 1 to PartⅡ. This is a complete framework of competencies, competency descriptions and related behavioral indicators, encompassing the technical and non-technical knowledge, skills and attitudes to operate safely, effectively and efficiently in a commercial air transport environment. The competencies contained Appendix 1 to PartⅡ were used to develop the Baseline EBT program. However, operators are encouraged to develop their own competency system, which should list observable behavioral indicators, meeting their specific needs and including a comprehensive set of technical and non-technical knowledge, skills and attitudes.【Chap 3. PRINCIPLES & PROGRAMME PHILOSOPHY 3.2 COMPETENCIES】

⑥ To be competent in any job, a person requires a certain amount of knowledge, an adequate level of skills, and a particular set of attitudes. This is true for doctors, hotel receptionists, lawyers, footballers, soldiers, artists and of course flight crew members. The role of a trainer in any discipline is to help people develop their knowledge, skills and attitudes so that they are able to do their job well. In many professions the formal training emphasis is often on developing knowledge and skills, with the examination of competence almost exclusively concerned with measuring knowledge and skills against a set of standards.【Chap 7. CONDUCT OF EBT 7.8.5.1】

⑦ To be competent, a pilot requires capabilities across a range of knowledge, skills and attitudes（KSA）. The role of the instructor is to help trainees develop their KSA using appropriate techniques including facilitation. The facilitation technique is not just for the poor performer or for the development of attitude but can be equally used to reinforce effective behavior because it gives trainees an understanding of why they are good, which encourages their continued development.【Chap 7. CONDUCT OF EBT 7.8.5.4】

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At least I can say that not negative but positive evaluation must be in terms of traditional harsh but fair “training discipline” not to provoke a revolt by a labor union etc. against a company.

Taking an example, instead of setting a check item to judge and evaluate such and such a trainee is “arrogant”– negative evaluation, we should set one for “modesty” – positive evaluation.

Then if a certain trainee has no “modesty” point, the algorithm will suspect he has a potentiality/tendency to be arrogant by way of interpreting by contraries.

4.1.3 Fatigue（Rest time)

Pilots have to work longer than before as their companies/airlines have been struggling to reduce costs and at the same time enhance new routes and will be.

The very fact will surely be a contributing factor for fatigue which is a symptom of reduced bodily function usually caused by the result of insufficient quantity and/or quality of sleep.

“Physical, Mental and Emotional”, three forms, in which fatigue can present itself.

Where to look first is “physical” fatigue which is usually brought about by insufficient rest time usually consisting of insufficient quality and/or quality of sleep.

Physical fatigue is usually caused by lack of rest so let’s think about rest time！

Before researching rest time in detail, I’d like to refer to the following report in brief.

Asleep at the Wheel（at the wheel = when you fly/control an

Points of the report “FLIGH SAFETY FONDATION/AERO SAFETY WORLD/SEPTEMBER 2009 aircraft Page25）

https://flightsafety.org/asw/sept09/asw_sept09_p24-28.pdf

are as follows;

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(a) A search of the U.S. National Aeronautics and Space Administration（NASA)

Aviation Safety Reporting System database for 1995 through 2007 revealed 17 reports in which crewmembers on U.S. Federal Aviation Regulations Part 121 flights said that they had inadvertently fallen asleep during flight. Of the17reports, five described events in which both pilots had fallen asleep.

(b) A1999 NASA survey of regional airline pilots found that 80 percent said that they had "nodded off" during a flight, and respondents said that multiple flight segments and "scheduling considerations" contributed to their fatigue.

(c) The NTSB (The U.S. National Transportation Safety Board) said that a survey published in 2007 determined that 15 to 24 percent of civilian pilots could be classified as obese.

(d) at least one regional transit agency is conducting a test project to screen operators for obstructive sleep apnea and other sleep disorders. The FAA also should develop this type of guidance, the NTSB said.

(e) The NTSB said. "Because [obstructive sleep apnea] is associated with excessive daytime fatigue, leads to an increased risk of accidents and cognitive impairment, substantially increases the likelihood of critical errors and of actually falling asleep during flight, and because many individuals who have the disorder do not know they have it, the NTSB concludes that efforts to identify and treat the disorder in commercial pilots could improve the safety of the traveling public."

(f)NTSB safety recommendations called on the FAA to modify the application for a pilot medical certificate to include questions about whether the applicant had ever been diagnosed with obstructive sleep apnea and whether he or she had risk factors for the disorder.

(g) The FAA also should implement a program to "identify pilots at high risk for obstructive sleep apnea and require that those pilots provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated … before being granted unrestricted medical certification," the NTSB said.

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To begin with, let' s focus on the rest time before the flight !

I show you the following imaginary story:

The OM (Operation Manual) of GAL (Global Airlines/airline) in the USJ (United States for Justice/country) has the following article on pilots' duty time, specifically speaking, FDP (Flight Duty time Period), rest time and so on.

Article-1【One-consecutive-flight-pattern】

One-consecutive-flight-pattern consists of one leg,or,several legs in which there is no more than 12 hours rest time between the legs except the base as at the base more than 15 hours rest time is needed.

Artcle-2【FDP: Flight Duty time Period】

(1) FDP is,

if one leg, the time between show-up-time and block-in-time.

If more than two legs, the time between show-up-time of the first leg and block-in time of the last leg.

(2) FDP must be less than 13 hours if a single pilots combination (cap&cop).

Artcle-3【Rest time】

(1) Rest time is the time,

if one leg, between duty off time (block-in-time + one hour) and show-up-time of the next leg,

if more than two legs, between duty-off-time (block-in-time + one hour) of the former leg and show-up-time of the next leg.

(2) If rest time is over 3 hours, half of the rest time must be deducted from FDP

If rest time is over 12 hours, the pattern should be divided, that is,

after 12 hours rest from the duty off time of the former pattern, a “new” one-consecutive-flight-pattern begins (duty off time⇒12hours⇒ show-up-time).

(3) If FDP is less than 10 hours, rest time after the last leg must be 10 hours.

If FDP is over 10 hours, rest time must be same as much as the FDP.

(4) If the time difference between the base and the destination is over 5 hours, the half of the time difference should be added to the rest time.
But if the block-in-time of the last leg is delayed, the time-difference-originated-rest can be deducted.

On the assumption that GAL123 left the base/Eve (place name) for the destination/Adam (place name) under one-consecutive-flight-pattern,

If GAL123's

FDP = 12 hours

time difference = 8 hours,

rest time in Adam = 12 + (8÷2=) 4 = 16 hours ･･･ expected rest time,

then,

as the flight delayed and arrived at Adam 4 hours later than the original,

the rest time can be reduced to 12 hours.

The reduced rest information as above should be integrated into PPS systematically as the decreased rest is possible to cause fatigue which has a significant impact on errors rates. In other words, we have to integrate Fatigue Management theory into PPS.

4.1.4 Algorithm (Deep Learning AI)

Deep Learning AI will find the linkage between a "potential element" and a PIC's fatal errors, which is the goal.

To achieve that goal, we never fail to get "Big Data" – huge amount of data – which are given by Work Flow and the records of aircraft accidents caused by PIC's fatal decision-making errors so that Deep Learning AI can find the linkage of "cause and effect".

The first "potential element" to be researched is the evaluation data defined in 4.1.1.2.2 Scope & Data Item of Work Flow/ (b) Regarding evaluation data items".

The second "potential element" to be researched is fatigue (rest time) defined in the next "4.1.1.3 Fatigue (Rest time)".

4.2 PPS inside Cockpit 【Phase-1-B】&【Phase-2】

"PPS inside Cockpit" is on the assumption that pilots are maneuvering an aircraft inside a cockpit.

Two robots emerge in this chapter, that is,

① DARUMA of " 4.2.1 P P S inside Cockpit with DARUMA 【Phase-1-B】 "

② ULTRAMAN of " 4.2.2 P P S inside Cockpit with ULTRAMAN 【Phase-2】"

ULTRAMAN is the advanced version of DARUMA, which has the physical ability to move like a human being.

4.2.1 PPS inside Cockpit with DARUMA【Phase-1-B】

Do you know DARUMA ？

DARUMA is a Japanese traditional doll.

OR

BUILT-IN SPEAKER

A robot be put between a captain and a first officer, a little behind them, in a cockpit.
The robot which is integrated with Deep-Leaning AI has a self-learning, self-study function.
That is, the robot can get as much the flying ability/technique as pilots have if we continue to have the robot see and record how pilots maneuver an aircraft, which is going to be big data（teachers’ data）for Deep-Leaning AI.
I’ll name the robot DARUMA.

Though DARUMA is a robot having as much the flying ability/skill as pilots, if the shape is not proper in terms of public approval, the function can be integrated into the built-in device like a speaker.

4.2.1.1 The roles of DARUMA – Ideal Image

Then, I would like to have DARUMA play the following roles when pilots face in future the situation like Comair Flight 5191/27Aug/2006 which I referred to in "3.1.1 Overview of the accident".

4.2.1.1.1 If the pilots (they, hereafter) chat so much,

DARUMA says loud and clear
" You're against aviation law ! Focus on flying ! "

4.2.1.1.2 When they try to do a wrong runway incursion,

DARUMA says loud and clear
" Wrong runway ! Watch the heading indicator "

Currently a controller usually says to pilots "Follow the green", then, the pilots move the ship according to the green line which the controller manually sets/turns on.

Stop ! Let's consider for a while !

If the green line light gets properly turned on systematically after the runway to fly is decided and the aircraft is made to follow the green light systematically, a wrong run way incursion errors will never happen.

4.2.1.1.3 When they dare to go on a wrong runway after disregarding/unnoticing " Wrong runway ! " warning,

,

DARUMA makes the ship stop so that they can not move the ship.

4.2.1.1.4 If they both take a nap as follows ;

http://edition.cnn.com/2009/US/08/03/sleepy.pilots.apnea/index.html?eref=rss_us

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The pilot and co-pilot of a Go! Airlines jet failed to respond to calls from air traffic controllers for 18 minutes during the February 2008 flight from Honolulu to Hilo and awoke to find they had overshot their destination by about 30 miles, the National Transportation Safety Board reported. The plane landed safely once the pilots awoke and resumed contact with controllers. The 53-year-old pilot was later diagnosed with obstructive sleep apnea, which can cause daytime sleepiness.

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DARUMA says loud and clear “ Wake up ! “

4.2.1.1.5 If they both faint, say, due to sudden decompression after the takeoff,

DARUMA can handle the ship and even land at the destination airport for himself or by remote control like Predator（American remotely piloted aircraft）

Regarding Predator,

https://en.wikipedia.org/wiki/General_Atomics_MQ-1_Predator

4.2.1.2 Deep Learning AI

Deep-Learning AI has a self-learning, self-study function, that is, it can get as much the flying ability/technique as pilots have if we continue to have it see how pilots maneuver an aircraft.

https://en.wikipedia.org/wiki/Deep_learning

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Deep learning (also known as deep structured learning or hierarchical learning) is the application to learning tasks of artificial neural networks (ANNs) that contain more than one hidden layer. Deep learning is part of a broader family of machine learning methods based on learning data representations, as opposed to task specific algorithms. Learning can be supervised, partially supervised or unsupervised.

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4.2.1.3 System development

After surveying several Japanese big companies specializing in AI, we will select the most distinguished one meeting our needs and trust the system development to it.

4.2.1.4 Big data【Learning/Teachers' data】

4.2.1.4.1 from our own training

Experimentally we use Boeing 787 as the first ship to try.

B787 has originally has a camera and the recorder in its cockpit as its genuine parts. So we use the recorded data as learning/teachers' data.

4.2.1.4.2 from Aircraft manufacturers

If we can get the same kind of data from the aircraft manufacturers, we will use them as learning/teachers' data.

4.2.1.4.3 from Simulator companies

In addition to the data acquired by B787 real ship, if we can get the same kind of data from the simulator companies, we will use them as learning/teachers' data.

4.2.2 PPS inside Cockpit with ULTRAMAN【Phase-2】

Do you know ULRTRAMAN ？

ULTRAMAN was a Japanese TV superhero who fought giant aliens invading the earth. I loved the TV program about 50 years ago so I named a robot with deep-learning AI and the ability to move like a human being "ULRTRAMAN".

ULRTRAMAN will sit between a captain and a first officer, a little behind them, in a cockpit.

Integrated with deep-learning AI, a robot has a self-learning, self-study function. That is, the robot can get as much the flying ability/technique as pilots have if pilots continue to have the robot see how pilots maneuver an aircraft.

Although DARUMA cannot move physically, ULTRAMAN can move like HONDA's ASIMO, a super robot, which can move and grasp things like a human being.

https://m.youtube.com/watch?v=zfFgy8lhpks

4.2.2.1 The roles of ULTRAMAN （Ideal Image）

Then, I would like to have ULTRAMAN play the following roles when pilots face in future the situation like Comair Flight 5191/27Aug/2006 which I referred to in “3.1.1 Overview of the accident”.

4.2.2.1.1 The pilots (they, hereafter) chat so much,

ULTRAMAN says loud and clear
“ You' re against aviation law !　Focus on flying ! “

4.2.2.1.2 When they try to do a wrong runway incursion,

ULTRAMAN says loud and clear
“ Wrong runway !　Watch the heading indicator “

Currently a controller usually says to pilots “Follow the green”, then, the pilots move the ship according to the green line which the controller manually sets/turns on.

Stop !　Let' s consider for a while !

If the green line gets properly turned on systematically after the runway to fly is decided and the aircraft is made to follow the green light systematically, a wrong run way incursion errors will never happen.

4.2.2.1.3 When they dare to go on a wrong runway after disregarding/unnoticing “ Wrong runway ! “ warning,

,

ULTRAMAN repeats loud and clear “ Wrong runway !　Watch the heading indicator “ and makes the ship stop so that they can not move the aircraft.

4.2.2.1.4 If they both take a nap as follows ;

http://edition.cnn.com/2009/US/08/03/sleepy.pilots.apnea/index.html?eref=rss_us

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*

The pilot and co-pilot of a Go! Airlines jet failed to respond to calls from air traffic controllers for 18 minutes during the February 2008 flight from Honolulu to Hilo and awoke to find they had overshot their destination by about 30 miles, the National Transportation Safety Board reported. The plane landed safely once the pilots awoke and resumed contact with controllers. The 53-year-old pilot was later diagnosed with obstructive sleep apnea, which can cause daytime sleepiness.

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ULTRAMAN says loud and clear " Wake up ! "

If they don't awake, **ULTRAMAN** pushes their shoulder.

4.2.2.1.5 If they have to cope with the in-flight fire case like Swissair Flight 111/02Sep/1998,

https://en.wikipedia.org/wiki/Swissair_Flight_111

ULTRAMAN can move like a human being so he can extinguish a fire for himself or by remote control. (Ideal model)

4.2.2.1.6 If **ULTRAMAN** gets advanced to the co-pilot level, **ULTRAMAN** sits in a co-pilot seat/right seat and a co-pilot sits in a **ULTRAMAN**' s seat.
When **ULTRAMAN** gets to this level in a simulator training, **ULTRAMAN** can sit in a co-pilot seat/right seat, which means **ULTRAMAN** can do what we call "co-pilot" duty in a simulator training, contributing to save co-pilot human resources that can be used for live flights. (Ideal model)

4.2.2.1.7 If terrorists try to invade a cockpit, **ULTRAMAN** fights them to protect pilots. (Ideal model)

4.2.2.1.8 If they both faint, say, due to sudden decompression after the takeoff,

ULTRAMAN can handle the ship and even land at the destination airport for himself or by remote control like Predator (American remotely piloted aircraft) (Utmost Ideal model)

Regarding Predator,

https://en.wikipedia.org/wiki/General_Atomics_MQ-1_Predator

4.2.2.2 Deep Learning AI

Same as written in “4.2.1 P P S inside Cockpit with DARUMA【Phase-1-A】“

4.2.2.3 System development

Same as written in “4.2.1 P P S inside Cockpit with DARUMA【Phase-1-A】“

4.2.3.4 Big data【Learning/Teachers’ data】

Same as written in “4.2.1 P P S inside Cockpit with DARUMA【Phase-1-A】“

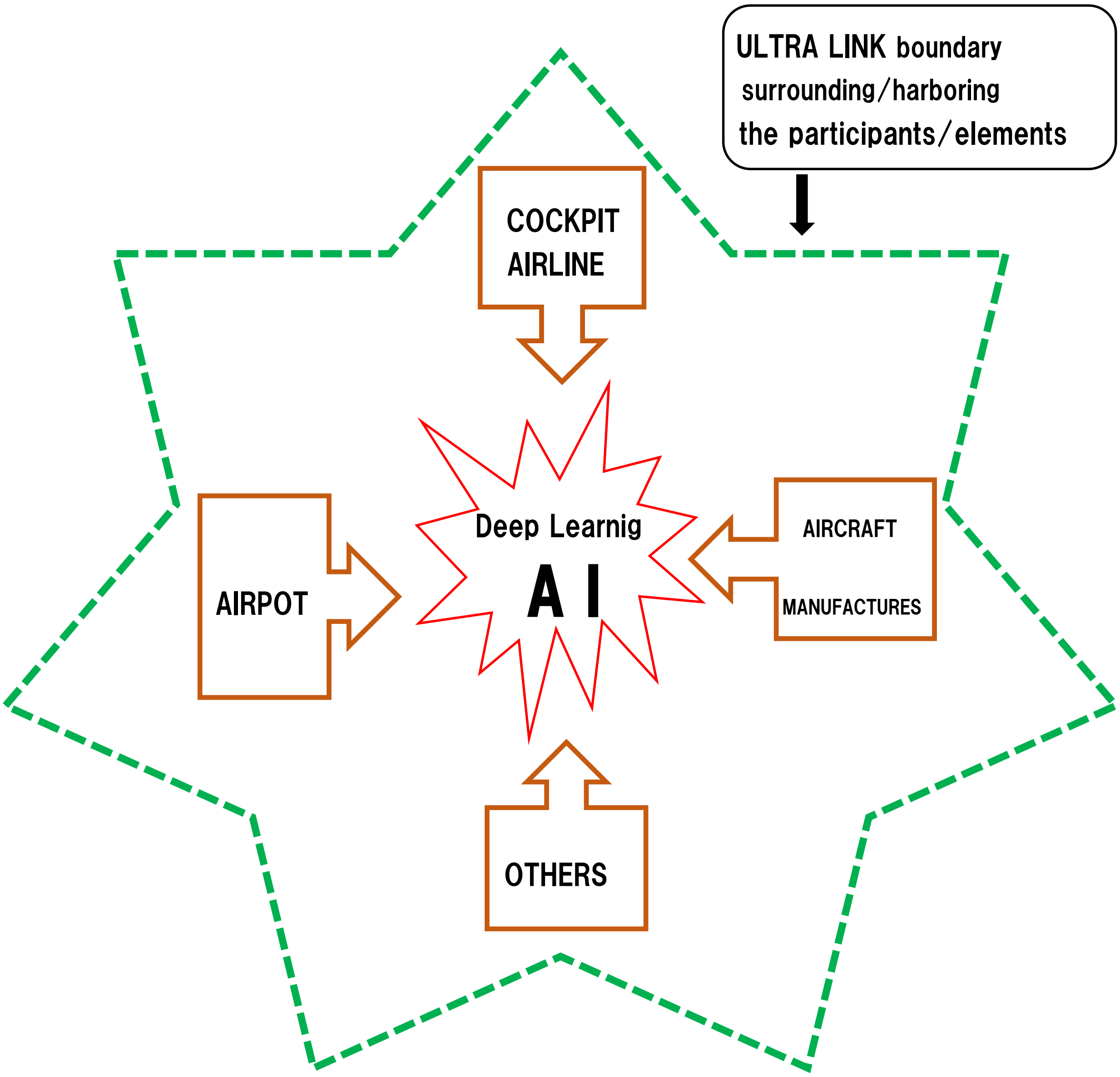
4.3 IDEAL PPS【PPS' s Ultimate Goal】⇒【Phase-3】

4.3.1 ULTRA LINK

PPS' s ultimate goal to trap errors before they can become undesired consequences – if worst comes to the worst, the deadliest plane crash like TENERIFE – is to create GLOBAL ULTRA LINK, that is, all the "participants/elements" on Earth are liked globally, which will be realized much sooner than expected as "global village" is a hair' s breadth to us by making maximum use of Deep Learning AI.

Although so many people, areas of responsibility and things contribute to daily flight operations, all the "participants/elements" should be systematically linked – ULTRA LINK – in future so that any threats can be shared among all the "participants/elements" to mitigate them as soon as possible.
Under this system integration, Deep Learning AI will matter most to maximize the margin of aviation safety.

ULTRA LINK image of systematically-linked-package of all the participants/elements



4.3.1.1 AIRPORT

Controllers will be on ULTRA LINK.

4.3.1.2 COCKPIT

Cockpit has a captain and a first officer and a ULTRAMAN having the same flying ability/technique as pilots have.
ULTRAMAN can help pilots fly safely as shown in "4.2.1 ULTRAMAN".

4.3.1.3 AIRLINE

Airlines will be on ULTRA LINK.

4.3.1.4 FLIGHT PATH

Flight paths will be on ULTRA LINK.

4.3.1.5 OTHERS

All other "participants/elements" on daily flight operations will be on ULTRA LINK.

4.3.2 "What if ?" on Comair 5191

What would have happened if the controller had precisely noticed the errors of Comair 5191 and called the crew to abort the takeoff ?

We have to remind that the controller told the crew of Comair 5191
" fly runway heading, cleared for takeoff x that heading work for you. "

Actually there was a lucky case that the tower controller recognized the errors and told the PIC to abort the takeoff as follows.
And the PIC made it !

FAA Aviation Safety Information Analysis and Sharing
Wrong Runway Departures x July 2007 x page-8

http://www.cast-safety.org/pdf/asias_wrong_rwy_report_2007.pdf

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Cleveland Hopkins International Airport (CLE)
The following is a summary of an event described in a report from Cleveland Hopkins International Airport submitted to the ASRS database following an event in 1993. Because of confusion at the intersection of runways 23L and 23R and 28 at the approach end of the runways, we initiated a takeoff on the wrong runway for which we had been cleared. We had been cleared for takeoff on runway 23L. Because of the short distance between the terminal and the runways, we had a very short taxi time. Just as we reached the hold short lines, we had completed our taxi checklist and were immediately cleared for takeoff on 23L. As the Captain taxied out to line us up (he has the nose steering on his side only), I ran my line-up checklist and he said "Hello" to the passengers over the PA system. Lined up on the wrong runway. I took the throttles and we proceeded down the wrong runway. The tower controller called us to tell us we were taking off on the wrong runway. We were at about 35 knots and so I aborted. 』

Backing to Comair 5191 accident,

"Cockpit Voice Recorder Database"HP

https://www.tailstrike.com/270806.htm

shows that

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the air traffic controller in the control tower was not required to maintain visual contact with the aircraft; after clearing the plane for takeoff, he turned to perform administrative duties and did not see the aircraft taxi to the runway."
And
"during the course of its investigation, the Federal Aviation Administration (FAA) discovered that tower staffing levels at Blue Grass Airport violated an internal policy as reflected in a November 16, 2005 memorandum requiring two controllers during the overnight shift: one in the tower working clearance, ground, and tower frequencies, and another, either in the tower or remotely at Indianapolis Center, working TRACON (radar).
At the time of the accident, the single controller in the tower was performing both tower and radar duties.
On August 30, 2006 the FAA announced that Lexington, as well as other airports with similar traffic levels, would be staffed with two controllers in the tower around the clock effective immediately.

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If there is a comprehensive system where any organizations on the airport including airlines, a control tower and so son are systematically linked to ensure the safest possible airport environment – which surely passes any important safety information to each PIC of any aircrafts at the airport,
the system gives a warning each PIC that now a control tower has only one controller although two is better,
then,
PIC will be much more careful in moving the aircraft and pay much more attention

the situational awareness on the runway, I think.

Therefore, we have to think about this matter, that is a PIC’ s fatal decision-making errors as a “package”.

In other words, the “should be” safety/risk management system should include all the “participants” on daily flight operations.
And we need the comprehensive system to monitor/support their activities to mitigate/minimize/eliminate PIC’ s fatal decision-making errors by Deep Learning Ai, which seems quite a long way to go, but actually not so long, quite near future, I’ m convinced.

4.3.3 What is the aviation strategy of FAA（USA）？

https://www.faa.gov/tv/?mediaId=1437

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NextGen Flight 101 – The Passenger Experience
November 17, 2016 | Running time 6:34
"Take off" on NextGen Flight 101 to see firsthand how the FAA has optimized communications, operations, and performance to deliver direct benefits to airlines, airport operations and the flying public.
From ground operations to in flight communications, this NextGen Experience will illustrate how the FAA and its partners are changing the way we fly.

《Narration》
Welcome to NextGen Flight 101.
We' re getting ready to push back from out gate on time and on schedule.
As you settle in, our pilot is talking to air traffic and making sure our flight plan is filed.
It looks like a possible storm ahead may change our original route.
With previous standard voice communication, there was only one way to receive a new route; Air Traffic Control would contact our pilot, advise them of the new route to avoid the weather, the pilot would then read back the long complicated new clearance.
Next, the pilot would contact our Airline Operations Center and review the same information before calling back to Air Traffic Control again to accept the new path.
If in this lengthy process, the weather shifted, the whole process would need to start all over again.
Thankfully our flight is enabled with digital communications.
Air Traffic control is sending a digital message and communicating with the pilot and Airline Operations Center simultaneously in real time.
Our pilot accepts the new flight path and loads it into the onboard computer.
It is time to push back and we are going to use collaborative communication tool that will give us a smoother transition from push back to wheels up！
This means that while our aircraft is still at the gate it has already been assigned a

spot in the queue for takeoff.
This new virtual queue reduces the amount of time that our flight will have to wait with our engines running, saving fuel and reducing emissions.
We don’t want to push back then wait in line - instead we get our designated push back time and proceed directly toward departure.
By improving how we time our place in line we reduce traffic congestion on the airport surface and improve traffic flows.
So we have a digital change to our flight plan and have gotten in line for take-off before we have even left the gate.
NextGen flight 101 is ready to roll toward departure.
We’ve received our digital clearance gotten in line without even leaving the gate and are now rolling toward the runway for an on-time departure.
While we are preparing the flight for departure, Air Traffic Control is orchestrating the movement of very large and not so nimble aircraft on small and often constricted surface.
New surface communication tools allow Air traffic and Airline operations efficiently safely time pushback and departures to avoid bottlenecks and congestion on taxiways and runways.
Just like highway traffic uses an onramp to enter the freeway, aircraft use the runway to enter the overhead stream and head toward their destinations.
Flowing traffic efficiently off the runway keeps the entire system working.
Because Air Traffic Control is sending us on a precise and predictable path, we can use an additional departure path from our runway.
The buffers needed when using conventional ground-based navigation tools are eliminated, and brand new on ramps become available to us.
Currently in use at Atlanta Hartsfield-Jackson International Airport this new departure method can accommodate 8 to 12 more departures per hour.
An improvement in efficiency at the world’s busiest airport has a positive impact on the entire national airspace system.
We are wheels up and on our way to our destination！
Let’s see what additional improvements are impacting NextGen flight 101！

This is your captain speaking.
I’m happy you’ve chosen to fly NextGen.
We are now cruising at 35 thousand feet with favorable winds.
While your in-flight beverage service is being provided we are using the new air

traffic control system to find the most direct path or an alternate route and avoid weather systems.
Our air traffic control centers are using a new system to process more data from radar and are tracking almost twice as many aircraft.
This common vision allows the air traffic controller hundreds of miles away from our destination to see that weather is slowing down operations at our final destination.
Instead of letting us proceed at full speed toward a congested airspace – we are getting a small adjustment to our speed to ensure we arrive after the traffic has cleared and can proceed directly to the runway.

We are going to ask that you go ahead and return to your seat and fasten your seat belt as we begin our initial approach.
Our aircraft is being tracked through a combination of NextGen and GPS technology.
Conventional radar works by emitting and receiving radio waves; our flight is being tracked in real time and is "seeing" our flight from the top down – incorporating elements like weather, terrain and other aircraft and giving me a much more precise and predictable view of what's ahead.

The captain has asked that you return to your seat – we are arriving at our destination.
(4:39)
We will arrive today using a direct path that starts from hundreds of miles away and more than 20,000 feet.
Instead of **slowly approaching our destination by repeatedly descending and leveling off in a stair steps method**, our new satellite arrival procedures enable our pilot to pull back the throttle and descend at near idle

This burns a fraction of the fuel and dramatically reduces aircraft exhaust emissions and noise.
We can begin to descend higher, travel on a predictable path, and get you to your destination on time.
Air traffic control has our flight sequenced to land in just a few minutes, on time and on schedule.
Speed, weight and wingspan impact the strength of the wake – or turbulence – an aircraft creates, and its reaction to the wake of an aircraft in front of it.

The longer the required distance, the fewer aircraft can take off and land.
We’re coming in safely behind another flight, a process made possible after the FAA determined it was safe to decrease distance between aircraft.
Newer jets leave less wake, and the FAA has recategorized the separation standards improving aircraft capacity and efficiency.
In Memphis alone, these new procedures boosted capacity 20 percent, allowing 22 more arrivals per hour.
With the tools and technology provided by the FAA, air and ground personnel can communicate collaboratively in anticipation of your arrival.
If your flight lands early, you won’t have to sit on the tarmac waiting for a gate; all parties are communicating in real time to ensure the efficiencies and optimization delivered by NextGen not only benefit the airspace, but enhance your traveling experience as well.
We want to thank you for flying with us today on NextGen Flight 101！
We know you have many choices when you fly and we are glad you have chosen to fly with us in our modernized airspace system！

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5. Appendix

5.1 Aircraft manufactures strategy on runway incursion

5.1.1 Boeing runway safety strategy

① Runway Situation Awareness Tools as of 2017

https://www.icao.int/Meetings/GRSS-2/Documents/Panel%207/P7.3_RSAT%202017%20Updates%20with%20RAAS.pdf

② Improving Runway Safety with Flight Deck Enhancements as of 2011

http://www.boeing.com/commercial/aeromagazine/articles/2011_q1/2/

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To reduce runway excursion events, Boeing's flight deck design strategy is to improve flight crew awareness of predicted and actual takeoff, approach, and landing performance …… Solutions are designed to provide flight crews with information and awareness to prevent runway incursion, confusion, and excursion.

《New technologies improve runway safety》
A Commercial Aviation Safety Team assessment of runway incursions evaluated multiple ways to improve situational awareness, including two key technologies: airport moving map (AMM) with own ship (own airplane) position and a runway awareness and advisory system (RAAS).
AMMs depict runways, taxiways, and other airport features. Global positioning system technology is used to display airplane (own ship) position on the map.
RAAS is a software option in the enhanced ground proximity warning system (EGPWS). The EGPWS is standard equipment on all current Boeing models. RAAS provides voice callouts for pilot awareness when approaching, entering, or on a

runway, and voice and visual alerts for taxiway takeoffs and short runways.

5.2 James Reason's 12 Principles of Errors Management

http://aerossurance.com/helicopters/james-reasons-12-principles-errors-management/

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James Reason, Professor Emeritus, University of Manchester, set out 12 systemic human factors centric principles of errors management in his book Managing Maintenance Errors: A Practical Guide (co-written with Alan Hobbs and published in 2003). These principles are valid beyond aviation maintenance and are well worth re-visiting:

1. Human errors is both universal & inevitable: Human fallibility can be moderated but it can never be eliminated.

As I wrote in "5.2 Shigeru Fujii's Japanese Senbei(rice cracker) Model", human fallibility can be eliminated with the help of redundancy of the system like PPS, I think.

2. Errors are not intrinsically bad: Success and failure spring from the same psychological roots. Without them we could neither learn nor acquire the skills that are essential to safe and efficient work.

3. You cannot change the human condition, but you can change the conditions in which humans' work: Situations vary enormously in their capacity for provoking unwanted actions. Identifying these errors traps and recognizing their characteristics are essential preliminaries to effective errors management.

4. The best people can make the worst mistakes: No one is immune. The best people often occupy the most responsible positions so that their errors can have

the greatest impact…

5. People cannot easily avoid those actions they did not intend to commit: **Blaming people for their errors is emotionally satisfying but remedially useless. We should not, however, confuse blame with accountability. Everyone ought to be accountable for his or her errors [and] acknowledge the errors and strive to be mindful to avoid recurrence.**

6. Errors are consequences not causes: …errors have a history. Discovering an error is the beginning of a search for causes, not the end. Only be understanding the circumstances…can we hope to limit the chances of their recurrence.

7. Many errors fall into recurrent patters: Targeting those recurrent errors types is the most effective way of deploying limited Errors Management resources.

8. Safety significant errors can occur at all levels of the system: Making errors is not the monopoly of those who get their hands dirty. …the higher up an organization an individual is, the more dangerous are his or her errors. Errors management techniques need to be applied across the whole system.

9. Errors management is about managing the manageable: Situations and even systems are manageable if we are mindful. Human nature – in the broadest sense – is not. Most of the enduring solutions…involve technical, procedural and organizational measures rather than purely psychological ones.

10. Errors management is about making good people excellent: Excellent performers routinely prepare themselves for potentially challenging activities by mentally rehearsing their responses to a variety of imagines situations. Improving the skills of errors detection is at least as important as making people aware of how errors arise in the first place.

11. There is no one best way: Different types of human factors problem occur at different levels of the organization and require different management techniques. Different organizational cultures require different 'mixing and matching'….of techniques. People are more likely to buy-in to home grown measures…

12. Effective errors management aims as continuous reform not local fixes:　There is always a strong temptation to focus upon the last few errors …but trying to prevent individual errors is like swatting mosquitos…the only way to solve the mosquito problem is drain the swamps in which they breed.　Reform of the system as a whole must be a continuous process whose aim is to contain whole groups of errors rather than single blunders.

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5.3 Full transcript of Cockpit Voice Recorder of Comair 5191/27Aug,2006

from "Cockpit Voice Recorder Database" HP

https://www.tailstrike.com/270806.htm

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05:36:07.7

START of RECORDING
05:36:18.4
CAM [sound of rustling similar to someone entering the cockpit]
05:36:50.2
CAM-3 *** well, I reported at five-thirty *****.
05:37:26.9
CAM-1 *** differed.
05:37:50.9
CAM-1 everything else is good.
05:37:52.7
CAM [sound similar to crewmember testing oxygen mask]
05:38:03.4
HOT-? [sound similar to crewmember conducting hot microphone test]
05:38:04.3
CAM-1 circuit breakers, checked, nose wheel steering is off, hydraulic pumps, all off, landing gear lever, down, spoiler lever, lever, retracted, flaps lever, set to flaps twenty, radar, off, AHRS, mag, landing gear manual release, ADG manual release, battery master, on, fire protection, checked, nav lights, on, external ** A/C, no APU, hydraulic pump 3A is on, nosewheel door, closed, aircraft/ crew docs, on board, flight compartment safety inspection is

complete.
05:38:28.4
CAM [sound similar to crewmember checking an oxygen mask]
05:38:40.9
HOT [three tones similar to CVR test tone]
05:38:53.0
CAM-? [sound of person whistling]
05:38:55.7
CAM [sound of hi-lo chime]
05:39:07.6
CAM-4 [sound of chimes similar to fire protection fire test signal] smoke.
05:39:13.3
CAM-1 smoke.
05:39:20.8
CAM-4 [sound of triple chime] bleed air duct.
05:39:24.9
CAM-1 I was talking to another guy I flew with yesterday. he was uh, had put his, bid in for uh, JFK captain. he wasn't real happy about it but......
05:39:35.4
CAM-2 First Officer?
05:39:36.3
CAM-1 yeah.
05:39:37.9
CAM-3 would you turn the smoking-seatbelt sign on for me?
05:39:40.2
CAM [sound of chime]
05:39:41.0
CAM-1 you got it. here come the lights.
05:39:43.5
CAM-2 why wasn't he too happy about it? he can always change it.
05:39:46.8
CAM-1 yeah, you know he just uh, he's just not really looking forward to reserves, that's all. but he feels like you know and I think he's right if he wants to get out of here. that's his decision he wants to do but. he's gotta get that PIC....

05:40:01.1
CAM-2 exactly.
05:40:01.9
CAM-1 ...you gotta bite the bullet sometimes but, I mean, nobody wants to do reserve there.
05:40:08.5
CAM-2 nope, not here. not the way they do it. they just they have.....
05:40:11.0
CAM [sound of chime]
05:40:12.9
CAM-2 ...no clue. they don't utilize....
05:40:14.3
CAM-? it's time.
05:40:14.4
CAM-4 all right.
05:40:16.5
CAM-2 ... the people effectively.
05:40:17.3
CAM [sound of chime]
05:40:21.9
CAM-2 you know, you're on for six days and you might fly eight hours 'cause they *.
05:40:27.1
CAM-1 it's amazing though right now, they are using everybody pretty efficiently. um, just shows you what they can do. like I mean I don't have more than ten hours in a hotel, any of these days that I've been on....
05:40:38.2
CAM-2 really.
05:40:38.7
CAM-1 ...and it's been that way for all month. now September rolls around and I'll guarantee you it'll be a different story.
05:40:47.4
CAM [sound of chime]
05:40:50.3
CAM-2 because I know Cincinnati base, they have a lot of reserves. but I

understand.
05:40:55.8
CAM-1 *.
05:40:56.0
CAM-1 then, they send them all to New York.
05:40:57.1
CAM-2 right, exactly.
05:40:58.4
CAM-1 yeah.
05:40:59.9
CAM [sound similar to stick shaker test]
05:41:04.6
CAM-4 glideslope whoop whoop, pull up, wind shear, wind shear, wind shear, terrain, terrain, whoop whoop, pull up. [sound of chime]
05:41:09.4
CAM-? [sound of person whistling]
05:41:22.6
CAM-4 [sound of triple chime] gear bay overheat.
05:41:45.7
CAM-4 TCAS system tests okay.
05:41:50.1
INT-1 test, test.
05:41:52.4
CAM [sound of three hi-lo chimes]
05:42:10.8
CAM-1 funny you were talking about @ I mean, I, I, I flew with a guy who was, he said he filled out the application process, he filled out the application and went through the background checks. actually I did my uh, my MV/LOE with him uh, about three or four weeks ago and uh, he was telling me all about it.
05:42:33.3
CAM-2 well that might do all that stuff prior to actually, giving you, the interview date.
05:42:38.5
CAM-1 uh huh.
05:42:39.3

CAM-2 but you are by no means guaranteed anything….
05:42:42.2
CAM-1 yeah.
05:42:44.4
CAM-2 but.
05:42:45.1
CAM-1 I just talked to my wife about it, we looked at, we looked at it on line. you know and I was looking at the pay scales and uh, yeah I know they provide a place ta, for you to live and things like that and was at four thousand, I don't know, forty-four hundred dollars.
05:43:01.8
CAM-2 fifty-two, fifty-two twelve, a month for the first * month tax free.
05:43:07.9
CAM-? how is it?
05:43:08.4
CAM-2 yeah.
05:43:09.4
CAM-1 yeah the last time I looked at it or it was like forty-five or something and but. I talked to a guy who was in the military, he said he was, he said it's really pretty for a desert, you know it's….
05:43:22.8
CAM-2 yeah well there's a guy, a military guy, up uh, a first officer, in Kennedy, he's like I think you're doing the right thing. he says if not to visit, maybe to be an ex-patriot and live there is not a good thing.
05:43:40.9
CAM-1 yeah, what I heard, you know you can't buy land uum, they'll let you buy a condo, like on a high rise or something, thank you, but you can't buy property…. here they come Kelly.
05:44:04.9
CAM-2 yeah howdy, like yeah, yeah * and then I kept thinking about it…. I guess, when I'm, I'm deciding on making a major decision, if it doesn't feel right in my gut. or if I don't have a little voice, if it's starts talking to me and I'm like I need to re-evaluate.
05:44:29.5
CAM-1 yeah

05:44:43.2
CAM-2 you know it'd be nice to go over there and fly heavy metal, fly international, but they work you hard over there I've been told.
05:44:50.3
CAM-1 oh do they?

05:44:51.1

CAM-2 yeah, they fly you if they can up to a hundred hours ** they have triple sevens *. like for you with the kids, you'd get a housing allowance at a villa. and for me and my wife with no kids, we'd get an apartment. the apartments don't allow any animals and I have four dogs and I'm not, I'm not about to give up, I've had 'em for a while. if I fly overseas, I wanna start and finish here in the States.
05:45:32.4
CAM-1 yeah.
05:45:32.9
CAM-2 ***.
05:45:36.1
CAM-1 you were overseas already. is that what you said?
05:45:36.9
CAM-2 no, if I, if I did fly overseas.
05:45:38.8
CAM-1 ah, okay.

05:45:44.8

CAM-1 emergency equipment, checked, crew

oxygen masks, checked left and right,

** psi, CVR, checked, standby instruments,
checked, fire protection, checked, gravity cross-flow, checked,
duct monitor, checked, hydraulics, auto and on, ice detector, has
been checked, cabin signs are on, emergency lights are armed ,
stall protection system, checked, anti-skid, checked and armed,
MLG bay overheat, checked, stab/mach trim, engaged, engine
controls, checked, aileron rudder trims checked yaw damper engaged,
cabin/exterior checks complete gear and safety pins, have
been removed acceptance checklist is complete.

05:46:19.5

CAM-2 *** it just became ** I started looking at it a little more, there was just too many * to get through.

05:46:30.3

CAM-1 you know I....

05:46:31.4

CAM-2 is this First Officer single?

05:46:34.8

CAM-1 I don't think so but his, his name is, he's got an Arab uh.

05:46:40.5

CAM-2 oh.

05:46:42.3

CAM-1 he got a, he has some kind of Arab name. @ or something er.

05:46:50.9

CAM-1 he might blend in a little bit but I heard it's like sixty or seventy percent European I mean.

05:46:55.2

CAM-2 well it's not even owned by United Arab Emirates. it's owned by a British company.

05:47:01.1

CAM-1 oh really.

05:47:08.9

CAM-2 yeah but you gotta deal with a lot of Brits and Australians. you know it some of these Brits are a little up tight.

05:47:34.5

CAM-2 if circumstances were different I, I'd consider it, they are as such.
05:47:46.7
CAM-2 plus if I have the opportunity to make Captain.
05:47:51.0
CAM-1 yeah.
05:47:55.9
CAM-2 I'm gonna talk to my dad to see if maybe he can help me out but I think I'm gonna invest in a seven three type rating. if I make Captain here. I need like three hundred PIC to be eligible to meet their requirements and then I'll....
05:48:14.1
CAM-1 who's that, Southwest? isn't that three thousand PIC?
05:48:16.7
CAM-2 fifteen hundred.
05:48:18.6
CAM-1 fifteen hundred?
05:48:18.7
CAM-2 actually no, thirteen hundred PIC.
05:48:20.8
CAM-1 oh, okay.
05:48:21.1
CAM-2 like thirteen hundred, that's a weird number.
05:48:24.4
ATIS Lexington Bluegrass information Alpha, 0854 automated weather. wind one niner zero at eight, visibility eight, few clouds six thousand, sky broken niner thousand. temperature two four, dew point one niner, altimeter three zero zero zero. ILS and visual approaches in use. landing and departing runway two two. runway two two glideslope out of service. pilots use caution for construction on air carrier ramp. hazardous weather information available on HIWAS, Flight Watch or Flight Service frequencies. all departures contact ground control on one two one point niner. advise you have information Alpha.
05:49:42.2
RDO-2 clearance good morning. Comair one ninety one's going to Atlanta with ALPHA.

05:49:49.3

CLR Comair one ninety one, Lexington clearance. cleared to Atlanta Airport via Bowling Green, ERLIN TWO arrival.

maintain six thousand, expect flight level two seven zero one zero minutes after departure. departure's one two zero point seven five. squawk
six six four one.
05:50:06.5
RDO-2 okay, got uh, Bowling Green uh, missed the other part. six thousand, twenty point seven five. six six four one.
05:50:14.1
CLR Comair one ninety one, it's ERLIN TWO, Echo Romeo Lima, India, November Two arrival.
05:50:20.4
RDO-2 'kay ERLIN Two, 'preciate it, Comair one ninety one.
05:50:38.0
CAM-2 nothing like **.
05:50:41.2
CAM [sound of click]

05:50:44.6

CAM-? [sound of person whistling]

05:50:53.7
CAM-1 direct Bowling Green, Bowling Green the ERLIN TWO. is that good?
05:50:58.4
CAM-2 any easier than that.

05:50:59.9

CAM-1 [sound of laughter]

05:51:29.3
CAM-1 Chattanooga looks good for the alternate.
05:51:29.8
CAM-5 well, how's it going guys?
05:51:30.5
CAM-2 dude, what's up?

dude ⇒ (slang) a man ; fellow【American Heritage dictionary】

⇒ a very common word which refers to a friend or even just a person. Other similar words are bro and mate【HP】

05:51:32.6
CAM-5 how you doin'?
05:51:33.3
CAM-1 hey good, how you doin'?
05:51:34.8
CAM-5 I'm @ with Air Tran trying to get a lift to work this morning.
CAM-1 hey, no problem any seat, * you already got one.
05:51:38.8
CAM-5 there you go.
05:51:40.0
CAM-1 beauty.
05:51:43.2
CAM-5 all right sir.
05:51:44.4
CAM-1 'preciate it.
05:51:45.1
CAM-5 you bet.
05:51:46.1
CAM-1 any time.
05:51:47.2
CAM-5 thanks a lot.
05:51:47.7

CAM-1 can I get the white sheet from you?
05:51:48.9
CAM-5 all right.
05:51:51.2
CAM-1 there you go sir.
05:51:52.5
CAM-5 thanks a lot.
05:51:53.8
CAM-1 any time.
05:52:04.3
CAM-1 well @ did you bring it in the other day or what's the sequence? keep on with whatever you're doing.
05:52:09.1
CAM-2 it don't matter to me.
05:52:11.3
CAM-1 oh. I'm easy buddy. but, I tell you, I always feel good like I could eat a little more when I get a seatbelt like this man. [sound of laughter]
05:52:19.6
CAM-2 Jesus.
05:52:22.9
CAM-2 *, I'll take us to Atlanta.
05:52:24.0
CAM-1 sure.
05:52:24.5
CAM-2 I looked at, for some weird reason, I don't have that. I have the airport diagram and the arrival and departure plates. I don't have the San Antonio charts.
05:52:36.3
CAM-1 uh, okay.
05:52:42.2
CAM-2 either I'm just waiting for the stuff to come up from Cincinnati or for now or the secretary there.

05:52:50.6

CAM-1 [sound of chuckle]

chuckle ⇒ laugh quietly

05:52:51.8
CAM-2 very capable.
05:52:52.8
CAM [sound of click]
05:52:55.2
CAM-2 plus we have, we don't have a chief pilot any more.
05:52:57.9
CAM-1 oh, that's right. I heard @ got promoted or something.
05:53:00.2
CAM-3 ** passenger' s request for an electric cart in the gatehouse for a passenger.
05:53:03.7
CAM-1 @, can I grab another Coke from you?
05:53:05.2
CAM-3 would you like ice?
05:53:06.1
CAM-1 no thanks.
05:53:27.2
CAM-1 thank you.
05:53:27.7
CAM-3 can I have the PA please so I can do my verification?
05:53:29.4
CAM-1 sure.
05:53:58.3
CAM-2 ** three *.
05:54:12.5
CAM-2 sixteen-forty *.

05:54:20.2

CAM-? [sound of person whistling]

05:55:04.4
CAM-2 I think I have *** this thing I got. my wife called a little excited about it but *** yeah you'd be gone like three or four days at a time, which you know with your wife and kids it might be a little difficult.
05:55:20.2
CAM-3 it's all yours.
05:55:21.0
CAM-1 all right.
05:55:24.9
PA-1 ladies and gentlemen from the flight deck, like to take this time to welcome you also on board Comair flight fifty one ninety one direct flight to Atlanta. we'll be cruising at uh, twenty-seven thousand feet this morning. and once we do get in the air, it looks like one hour and seven minutes enroute. distance of travel today, we got we got four hundred and twenty two miles. weather conditions Atlanta, * some light winds out of the east, looks like some broken clouds and current temperature of seventy-two degrees Fahrenheit. we'll try to keep it as quiet as possible. hopefully you can catch a nap going into Atlanta. it's our pleasure having you all on board.

05:56:14.0

CAM-1 for our own briefing, Comair standard. run the checklist your leisure. keep me out of trouble. I'll do the same for you. I don't jump on the brakes on your landing. I'll follow along with you. just let me know when you want me to take it. that's it.

05:56:23.8
CAM [sound of two clicks similar to pilot seat adjustment]
05:56:25.2
CAM-2 I'll do the same whenever you're ready.
05:56:26.9
CAM-1 all right.
05:56:27.6
GND information Bravo is now current. the altimeter's three zero zero
zero.
05:56:28.0
CAM-2 * control ***.
05:56:30.4
CAM-1 sounds good.

05:56:34.1

CAM-2 right seat flex takeoff procedures off of um....

he said what runway ? one of 'em. two four.

05:56:43.4

CAM-1 it's two two.

05:56:45.9
CAM-2 one ninety at eight
05:56:49.9
CAM-2 two two up to six, white data * FMS, flaps twenty. * smokes or
breaks come back here. come into four or two two. on two two
the ILS is out. or the glideslope is, the REILS are out. the uh,
came in the other night it was like [sound similar to audible exhale]
lights are out all over the place.
05:57:07.8
CAM-1 all right.
05:57:08.4

CAM-2 right. remember this runway predicated, before we just go back to Cincinnati.
05:57:12.9
CAM-1 okay.
05:57:13.7
CAM-2 uum, no continuous, anti-ice, weather radar, hand fly 'til about ten. taxi instructions with ATC.
05:57:21.7
CAM-1 all right.
05:57:23.3
CAM-2 let's take it out and um, take uuuh, Alpha. two two's a short taxi.
05:57:31.1
CAM-1 yeah.

05:57:35.4

CAM-2 **any questions ?**

05:57:36.5

CAM-1 **no questions. before starting at your leisure.**

05:57:38.4
CAM-2 ACM crew briefing.
05:57:39.3
CAM-1 complete.
05:57:40.0
CAM-2 takeoff brief.
05:57:40.4
CAM-1 complete.
05:57:40.7
CAM-2 radios, NAV aids.
05:57:42.0
CAM-1 uh, six thousand, your side, both in white data, confirmed the flight plan. we got uh, tower, ground twenty one *, is everything on one? do you know?
CAM-2 no it's not.

05:57:50.7
CAM-3 do you want to do a brief?
05:57:53.5
CAM-1 nothing differed back there that I saw. weather's good Atlanta, scattered to broken clouds. seventy degrees uum, standard chimes, standard calls. if we do have an emergency, I like to open the door and talk face to face.
05:58:04.5
CAM-3 okay.
05:58:06.0
CAM-1 that's about it. anything for me?
05:58:07.0
CAM-3 sounds great.
05:58:07.9
CAM-1 all right.
05:58:08.4
CAM-3 see you in Atlanta.

05:58:12.2

CAM-1 uuh, start engines your leisure.

05:58:14.8
CAM-2 uuuh, ACM crew brief.
05:58:16.7
CAM-1 complete.

05:58:17.1

CAM-2 takeoff brief

05:58:18.3

CAM-1 hey man, we already did that one.

05:58:20.5

CAM-2 we did ?

05:58:21.0

CAM-1 yeah.

05:58:21.2

CAM-2 I'm sorry.

05:58:22.2

CAM-? [sound of laughter]

05:58:23.3
CAM-2 I'll get it to ya.

05:58:24.1

CAM-1 [sound of laughter]

05:58:24.6
CAM-2 papers, manifest.
05:58:26.0
CAM-1 it's complete out the door.
05:58:27.2
CAM-2 fuel quantity.
05:58:27.4
CAM-1 required to have (seventy), seventy-three.
05:58:30.0

CAM-? **.
05:58:33.3
CAM [sound of several clicks similar to cockpit door operation]

05:58:35.1

CAM-2 V speeds, takeoff data fifty temp. V one, V r is thirty-seven fortytwo * forty-five ********. [spoken at a very fast speed] you got normal thrust ** point two.
05:58:43.5
CAM-1 set for flaps twenty.
05:58:44.5
CAM-2 doors.
05:58:44.9
CAM-1 closed.
05:58:45.3
CAM-2 beacon.
05:58:45.6
CAM-1 on.
05:58:46.0
CAM-2 fuel pumps.
05:58:46.8
CAM-1 number one's on.

05:58:48.7

CAM-2 see this is telling me that I really need to do something.

05:58:51.7

CAM-1 [sound of laughter]

05:59:05.7
RDO-1 and ground, Comair one ninety one, just a heads-up on the push.
05:59:11.1
GND Comair one ninety one advise ready to taxi.
05:59:13.3
RDO-1 roger.
05:59:14.1
INT-1 hey, how you doin'? you ca.... can you hear me? okay, brakes released, we're cleared to push sir.

05:59:24.6

HOT-2 must be one of us, skinny flight attendant.

05:59:26.5

HOT-1 [sound of laughter]

05:59:33.0
E882 ground, Eagle flight eight eighty two ready to taxi with Alpha.
05:59:42.0
HOT-1 he said it's okay to turn one at your leisure.

05:59:43.6

GND Eagle flight eight eighty two taxi to runway two two, altimeter three zero zero zero and the wind's two zero zero seven.

************************************** Line-1

HOT-2 that's pretty cool the family got to come down.
05:59:47.2
HOT-2 how long of a ride is that ?

05:59:50.9
HOT-1 uuuuh. maybe, maybe an hour.
05:59:52.9
E882 taxi to **, Eagle flight eight eighty two.
05:59:57.5
HOT-2 that's cool.
06:00:09.4
HOT-1 both kids were sick though, they, well they all got colds. it was an interesting br, dinner last night.
06:00:16.1
HOT-2 really.
06:00:16.6
HOT-1 huh, oh gosh.
06:00:19.1
HOT-2 how old are they?
06:00:20.0
HOT-1 three months and two years old. who was sneezing, either nose wiped, diaper change I mean that's all we did all night long.
06:00:31.0
HOT-2 oh yeah I'm sure.

06:00:32.2

GND ** sixteen ninety two thanks, turn right heading two seven zero

runway two two, cleared for takeoff.

06:00:32.4

HOT-2 [sound of laughter]

06:00:34.9
HOT-2 that's a nice range, age range.
06:00:37.7
HOT-1 yeah, I like two years apart basically and that's the kinda what we were going for.

06:00:45.3
HOT-1 my wife wants four, I, I, I'm, I was good at one.
06:00:48.5
HOT-2 she wants four.
06:00:49.9
CAM [sound of chime]
06:00:50.1
HOT-1 yeah.

06:00:50.2

HOT-1 [sound of chuckle]

06:00:52.7
HOT-2 it'd be like honey….
06:01:02.7
CAM [sound of chime]
06:01:07.1
HOT-2 yeah, it's especially being on reserve it, it's gotta be tough being away.

06:01:12.2

HOT-1 ah, tough on her, oh my God. that's why she came down yesterday.

she's like, I just need to get out of this house.

06:01:18.0
HOT-2 yeah, I bet.

06:01:18.9

HOT-1 I'm like I understand. I, I told her, why don't you just spend the night.

she said well, if you're gonna get up at oh dark thirty and she said you'll end up waking up the babies.

I'm like yeah, you're probably right.

06:01:32.1
HOT-2 yeah it would just be like being at home.
06:01:35.5
HOT-1 yeah, she's like you know, I don't know, she's like I'll....
06:01:38.5
HOT-2 instead of having her rush back and drive....
06:01:40.6
HOT-1 and we got a dog.
06:01:40.8
GND *** Lexington tower roger, hold short.
06:01:42.9
HOT-2 aah, trust me the dog *. be on the @ slim-fast diet * for a night.

06:01:47.4

HOT-1 [sound of laughter]

** Line-2

06:01:48.7
HOT-2 uh, parking brake.
06:01:49.6
HOT-1 that's on.
06:01:50.0
HOT-2 number two, actually, engine.

06:01:51.7
HOT-1 one and two are started.
06:01:52.5
HOT-2 starting engines complete.
06:01:54.3
HOT-1 and before taxi.
06:01:55.6
HOT-2 anti-iiiiice.
06:01:56.6
HOT-1 windshields and probes are low and on.
06:01:58.3
HOT-2 nosewheel steering.
06:01:59.5
HOT-1 that's armed.
06:02:00.0
HOT-2 taxi check complete.
06:02:01.3
RDO-2 Comair one ninety one is ready to taxi we have ALPHA.

06:02:03.8

GND Comair one ninety one, taxi to runway two two. altimeter three zero zero zero and the winds are two zero zero at eight.

06:02:08.9

RDO-2 three triple zero and taxi two two, Comair one ninety one.

06:02:12.6

GND Eagle flight runway two two, cleared for takeoff.

06:02:15.1
HOT-1 clear left.
06:02:17.3
HOT-2 on the right.
06:02:17.9

GND Skywest six eight nineteen radar contact, say altitude leaving.
06:02:18.9
HOT-1 flaps twenty, taxi check.
06:02:21.0
HOT-2 full right.
06:02:23.8
GND Skywest sixty eight nineteen, climb and maintain one zero thousand,
ten thousand, join Victor one seventy one and resume *,
own navigation.
06:02:24.0
HOT-2 full left.
06:02:25.5
HOT-1 test your brakes any time.
06:02:31.1
HOT-2 I want to *** down.
06:02:32.3
HOT-1 sure.
06:02:41.5
HOT-2 let's see, comin' back.
06:02:51.6
HOT-1 brakes.
06:02:52.3
HOT-1 they're checked.
06:02:53.2
HOT-2 right, flaps.
06:02:54.4
HOT-1 set twenty, indicating twenty.
06:02:55.6
HOT-2 flight controls.
06:02:56.3
HOT-1 check left.
06:02:58.3
HOT-2 on the right, trims.
06:02:59.5
HOT-1 engage zero seven point two.

06:03:02.2
HOT-2 radar terrain displays. [spoken in a yawning voice]
06:03:04.0
HOT-2 all the taxi check's complete. [spoken in a yawning voice]
06:03:12.0
HOT-1 finish it up your leisure.
06:03:16.4
HOT-2 yeah, I know three guys at Kennedy. actually two guys uh....
@@ he went but he didn't get past the sim.
06:03:26.7
HOT-1 oh, really.
06:03:29.1
HOT-2 and then um, a First Officer from Cinci....
06:03:34.5
GND Eagle flight radar contact, radar contact. say altitude leaving.
06:03:35.1
HOT-2 got through the second part....
06:03:37.2
HOT-2 what do you do the uh, these tests.... and he didn't, and that's as far as he got.
06:03:40.8
GND Eagle flight eight eighty two, climb and maintain one zero thousand, ten thousand.
06:03:49.3
HOT-2 and then @@ he actually got offered the position.
06:03:54.5
HOT-1 did he take it or....
06:03:55.5
HOT-2 yeah.
06:03:56.1
HOT-1 ah, okay.
06:04:01.2
HOT-2 second engine started, anti-ice probes windshield low.
06:04:03.1
GND * sixteen ninety one, previous question.
06:04:05.6

HOT-2 hydraulics checked, APU's on, FMS we got runway two two out of Lexington up to six.
06:04:13.3
HOT-2 thrust reversers are armed, auto crossflow is manual, ignition is off, altimeters three triple zero across the board, crosschecked. I'll be in the back.
06:04:24.8
HOT-1 got one.
06:04:25.7
TWR Skywest sixty eight nineteen contact Indy center one two six point three seven.
06:04:29.6
S6819 two six three seven, Skywest sixty eight nineteen.
06:04:32.6
TWR Eagle flight eight eighty two, turn right heading two seven zero, join Victor one seventy-one. resume navigation.
06:04:37.5
E882 two seven zero, join victor one seventy one, ****.
06:04:38.2
PA-2 and folks one * time from the flight deck, we'd like to welcome you aboard. we're going to be underway momentarily.... sit back relax enjoy the flight. Kelly, when you have a chance, please prepare the cabin.
06:04:48.2
CAM [sound hi-lo chime similar to cabin/cockpit interphone signal]
06:04:49.3
HOT-2 pre-takeoff * complete cabin report received CAS.
06:04:53.4
HOT-1 checked and clear.
06:04:54.4
HOT-? **, six seven, **. [whispered]
06:04:56.6
HOT-1 oh.
06:04:58.1
HOT-2 oh yeah.

06:04:59.4

HOT-2 I'm looking at it 'cause like, okay I see **seven** but it's....

???
My/Fujii's question-1 ;
Is "seven" of "okay I see seven" is "A7" ?
【A7 is a taxi from runway 26 (wrong) to runway 22 (correct) 】
???
My/Fujii's question-2 ;

Did the PIC surely recognize that they were at the hold short line for runway 22 (right takeoff runway) when actually stopped at the hold short line for runway 26 (wrong takeoff runway) ?

Why was the PIC confident the aircraft was on the correct runway while ignoring information which didn't match his expectations ?
???

06:05:01.9
HOT-1 yeah there's a green extra one there but....
06:05:06.3
HOT-2 uuuh, cabin report's received, CAS clear, ** before takeoff check's complete, ready.
06:05:12.6
HOT-1 all set.

06:05:15.1

RDO-2 "churliser" [at your leisure spoken very fast] Comair one twenty one **ready to go**.

06:05:17.7

TWR Comair one ninety one, Lexington uh, tower,

fly runway heading,

cleared for takeoff.

??

My/Fujii' s question-3 ;

Why did TWR (tower controller) say "fly runway heading, cleared takeoff" ?

??

06:05:19.2

HOT-? *.

06:05:21.0

RDO-1 runway heading, cleared for takeoff, one ninety one.

06:05:23.7

HOT-1 and line-up check.

06:05:25.1

TWR Eagle flight eight eighty two, **that heading work for you**, do you wanna go uh, northwest around the uh, weather that's ahead of you ?

??

My/Fujii' s question-4 ;

Why did TWR (tower controller) say "that heading work for you" ?

??

06:05:30.7

E882 no that looks fantastic. thank you very much.

06:05:32.7

TWR * say again please.

06:05:33.8

E882 *** eight eighty two.

06:05:34.4

HOT-1 throw that bad boy on.

06:05:36.3
TWR Eagle flight eight eighty two, contact Indy center one two six point three seven. good day.
06:05:39.5
E882 twenty six, thirty seven, * eight eighty two.
06:05:41.3
HOT-2 transponder's on, packs on, bleeds closed, cleared for takeoff, runway heading. six grand.
06:05:45.4
HOT-1 all right.
06:05:46.4
HOT-2 anti-ice off, lights set, takeoff config's okay, line-up check's complete.
06:05:51.2
CAM [sound of clicks similar to pilot adjusting his seat]
06:05:57.6
HOT-1 all yours Jim.
06:05:58.9
HOT-2 my brakes, my controls.
06:06:05.0
CAM [sound similar to increase in engine RPM]
06:06:07.8
HOT-2 set thrust please.
06:06:11.7
HOT-1 thrust set.

06:06:16.3

HOT-2 dat is weird with no lights.

dat ⇒ that

06:06:18.0

HOT-1 yeah.

06:06:24.2
HOT-1 one hundred knots.
06:06:25.1
HOT-2 checks.
06:06:31.2
HOT-1 V one, rotate.

06:06:31.8

HOT-1 whoa.

JUST

13sec

06:06:32.2
CAM [unknown ambient (surrounding) noise]
06:06:32.6
HOT-1 #.
06:06:33.0
CAM [sound of impact]
06:06:33.3
HOT-? [unintelligible exclamation]
06:06:33.8
CAM [sound similar to stick shaker]
06:06:34.7
CAM [sound of chime]
06:06:34.7
CAM [sound similar to stall warning starts and continues to end of recording]
06:06:35.1
HOT-? #.
06:06:35.7
HOT-1 [unintelligible exclamation]

06:06:36.2

END of RECORDING

*
****

6. Afterword

Honesty is the best polity.

Sydney Dekker in his book “BEHIND HUMAN ERROR”;
“Safety is not a commodity to be tabulated, it is a chronic value ‘under your feet’ that infuses all aspects of practice. People create safety under resource and performance pressure at all levels of socio-technical system. They continually learn and adapt their activities in response to information about failure. Progress on safety does not come from hunting down those who err. Instead, progress on safety comes from finding out what lies behind attributions of error – the complexity of cognitive systems, the messiness of organizational life, and ultimately your own reactions, anxieties, hopes, and desires as a stakeholder and as a participant in human systems serving human purposes. Progress on safety comes from going behind the label human error, where you discover how workers and managers create safety, and where you find opportunities to help them do it even better.”

Matthew Syed says in his book “Black Box Thinking”;
“All of us are aware, in our different ways, that we find it difficult to accept our own failures. Even in trivial things, like a friendly game of golf, we can become prickly when we have underperformed, and we are asked about it in the clubhouse afterwards. When failure is related to something important in our lives – our job, our role as a parent, our wider status – it is taken to a different level altogether.
When our professionalism is threatened, we are liable to put up defences. We don’t want to think of ourselves as incompetent or inept. We don’t want our credibility to be undermined in the eyes of our colleagues. For senior doctors, who have spent years in training and have reached the top of their profession, being open about mistakes can be almost traumatic.
Society as a whole, has a deeply contradictory attitude to failure. Even as we find excuses for our own failings, we are quick to blame other who mess up.
We have a deep instinct to find scapegoats.
We are so willing to blame others for their mistakes that we are so keen to conceal our own. We anticipate, with remarkable clarity, how people will react, how they will

point the finger, how little time they will take to put themselves in the tough, high-pressure situation in which the error occurred. The net effect is simple: it obliterates openness and spawns cover-ups. It destroys the vital information we need in in order to learn.
When we take a step back and think about failure more generally, the ironies escalate. Studies have shown that we are often so worried about failure that we create vague goals, so that nobody can point the finger when we don't achieve them. We come up with face-saving excuses, even before we have attempted anything.
We cover up mistakes, not only to protect ourselves from others, but to protect us from ourselves. Experiments have demonstrated that we all have s sophisticated ability delete failure from memory, like editors cutting gaffes from a film reel – as we'll see. Far from learning from mistakes, we edit them out of the official autobiographies we all keep in our own heads.
This basic perspective – that failure is profoundly negative, something to be ashamed of in ourselves, and judgemental about in others –has deep cultural and psychological roots. According to **Sydney Dekker, a psychologist and system expert at Griffith University, Australia,** the tendency to stigmatize errors is at least two and a half thousand years old."

In conclusion :

Though we mankind are destined to make errors, we can get "Absolute Safety" in aviation industry/operation with the help of "Redundant System Integration", the core of which is Deep Learning AI.
Though to maximize the margin of aviation safety is so hard under the increasing complexity of the global air transportation system and its interrelated aviation activities, as a wise man said once "a goal without a plan is just a dream", I'm quite sure we can overcome someday because "our problems are man-made, therefore they may be solved by man. And man can be as big as he wants. No problem of human destiny is beyond human beings" (JFK).

Yes, We shall overcome someday !
Yes, We Can !

Finally :

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Mr. Allan Greene, Pelesys Vice President !
Pelesys is a leading aviation training courseware developer and publisher.
http://website.pelesys.com/
In 2015, Mr. Greene visited my office in Tokyo, Japan and gave me the demo on the Pilots Initial Training Course and Training Management Systems.
To learn the most advanced tech in aviation industries in the world, he kindly taught me what "WATS" was and strongly recommended me to be at WATS/2016 so I attended it, which impressed me so much.
That's why I could be a WATS/2018 presenter, which is great honor to me.

And
Mr. Sidney Dekker, Professor at Griffith University in Brisbane, Australia !
https://www.amazon.com/s/ref=nb_sb_noss?url=search-alias%3Daps&field-keywords=Sidney+Dekker
He is an authority on human factors and system safety.
He has encouraged me a lot saying

"You will change the world, a small bit by small bit.

Good on you !"