

# ASSESSING SPO INCAPACITATION USING LOW FIDELITY SIMULATION

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# INTRODUCTION



### Low Fidelity Simulation (LFS):

### Preliminary evaluation of a system in its early stages of development



### **Core Ideas:**

- Immersive Human-in-the-Loop
- Low Cost & "quick"
- Operational representativity

(e.g. role play game/serious games)

More about LFS toolkit: See presentation tomorrow here at 13:50 *"Towards Human-Centered Design in complex systems development: a toolkit to plan, develop and execute Low-Fidelity Simulations"* 

# **OBJECTIVE**



#### **First Concept Evaluation:**

- Feasibility and acceptability
- Human performance
- Safety







#### Concept Development



Low Fidelity Simulations



Real-Time Simulations



# **DRIVING QUESTIONS**



- Is the GSO able to fulfil his/her **role and responsibilities** in different scenarios?
- Can the GSO react properly to the incapacitation event?
- Can the GSO react properly to the incapacitation event during vectoring?
- Are the **procedures** satisfactory, clear and effective?
- Is the perceived workload acceptable?
- Is the **communication** between the actors satisfactory, clear and effective?
- Is the information presented enough and appropriate to support the Ground Station role?
- Are there **new safety hazards** that should be taken into account (i.e., yet unforeseen and emerging from the actors' interaction)?







### LFS DEVELOPMENT – GROUND CONSOLE

PILOT | 😊

FLIGHT ID: EMBRAER 123

A/C COM | 🙂

RADAR



KEZAL

**NAVIGATION AIDS** 

Their assignment: interact with the other actors and operate the emergency aircraft through the ground console.

7

SYSTEM MESSAGES, ATC, CUES, D-ATIS, CHECK-LIST... **"CONSOLE DO CHECK-**LIST..."

**PILOT AND AIRCRAFT** 

**LINK STATUS** 

SYSTEMS

**CONSOLE USES VOICE** STAR KF7AL 1T SELECTED ALT MODE 5000 RUNWAY 13 L **CONTROLS:** ADV LAND SYS ALT "CONSOLE DO..." AUTOPILOT CATUZ 15000 AUTOTHROTTLE 10000 240 ALT HOLD BP765 230 5000 220 LG BARO UP 1012Ha 299º 309º 319º UP UP COMMS EMER CTRL COM1 124.9 (ATC) GO AROUND LANDING LIGHTS COM2 121.5 (EMER) VERTICAL PROFILE COM3 120.1 (A/C) PILOT INCAP. HEADING ULPAX POSITION **EMERGENCY CONTROLS** 10.000FT 240KTS BP765 ULPAX 10000FT CATUZ



## LFS EXECUTION





#### **SUMMARY**

- 7 pilots: junior to senior. DLR, SWISS, RYANAIR, LUFTHANSA, TAP
- ATC: LFV

#### PRE-SESSION

#### **Provide Briefing Pack**

#### SESSION

Welcome and review briefing pack

Case 1: Nominal landing with no incapacitation Case 2: Landing with incapacitation in STAR procedure Case 3: Landing with incapacitation in radar vectoring Break

#### Questionnaire (written)

Semi-structured debriefing (oral)

**POST-SESSION** 

Data Analysis & Debriefing

### LFS DEVELOPMENT - VIDEO





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#### **Operational Concept Feasibility:**

- Overall, positive evaluation
- GSO responsibilities considered acceptable
- Concept dependency on technological challenges:
  - Automation capabilities and reliability
  - Datalink failures
  - Cybersecurity
- GSO knowledge, skills and operational experience should be similar to those required for a pilot, with specific training for Ground Station tasks



"Overall, the concept is **acceptable**. Flying manually from the ground would not be acceptable. **High levels of automation required**."

#### Tasks:

- Task allocation with **positive evaluation**
- GSO dependency on automated systems:
  - Required high level of transparency and trust
  - Safer than manually flying the aircraft from ground
- Airline Control Center (AOCC) support: added value, mainly in specific situations (e.g., bad weather, failures)

"AOCC could be useful depending on the scenario. It could have no impact at all to critical impact, depending on the situation."









#### Team structure and communication:

- ATC role and procedures did not change much
- Communication and coordination **between GSO and ATC** was satisfactory, **similar to current communication**
- Nominal interaction between GSO and on-board pilot:
  - Dedicated and permanent audio connection is important
  - Clear rules and standardization of communication is required (new CRM)

"We need to define **clear rules on how the GSO and the OBP will interact** and who does what (new CRM based on today's CRM)."



"Communications were as they would be in a present day, dual cockpit emergency."

GSO: Ground Station Operator CRM: Crew Resource Management OBP: On-board Pilot

# **OPEN POINT IN NOMINAL SPO**



SAFEMODE	SAFELÂND
Active GSO role Simulated in LFS	Passive GSO role
GSO communicating with ATC and interacting with OBP, as in current dual pilot operation	GSO only passively monitoring the flight and the OBP
Increase situational awareness and readiness in case of pilot incapacitation handover	Could be more efficient if the OBP does "everything"
Avoid boredom and help with pilot incapacitation detection	
We have to find an <b>intermediate option</b> between fully passive and fully active role to GSO. A more <b>passive role could be acceptable,</b> <b>but it could affect the readiness</b> to assume after incapacitation. "	

GSO: Ground Station Operator OBP: On-board Pilot



- Incapacitation procedure was acceptable
- Need of clearer rules of GSO engagement in case of:
  - Failure of the pilot incapacitation detection system
  - On-board pilot not answering







"Incapacitation procedure was easy because there was a red light, and everyone knew what to do."

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### Workload (WL) and Situational Awareness (SA):

- Overall, acceptable
- Mixed results in radar vectoring scenario:
  - Acceptable WL and SA due to support of automation, ATC and ground console
  - Safety risk, mitigation actions required (e.g., more time to build SA or additional person)
- Inside and outside camera could be useful, but not essential

#### Additional results on:

- Contributions to refine Real Time Simulation
- Hazards identification
- Ground console Human-Machine Interface (HMI)

"Ground Station resources should be basically what the pilot has in a real cockpit."

#### For more information:

SAFELAND Deliverable D2.4 – Integration Report (Part 2)









### LFS First Assessment: No major issues identified with the concept

- Advanced Automation greatly impacts concept feasibility
- No major changes in ATM procedures
- Phraseology needs standardization: "new CRM"
- Open point: in nominal SPO, "active" or "passive" GSO role?
- Protocol for Real Time Simulation execution was improved
- Minor HMI adjustments suggested
- Hazard mapping improved

LFS as a tool: See presentation tomorrow here at 13:50



# THANK YOU FOR YOUR ATTENTION

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### LFS TEASER





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