Navigating the Skies with DAs

The Evolution of ATC

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SafeTeam

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… some historical perspective

1951 - Paul Fitts proposes HABA-MABA list

Ferranti Mark 1 - 1st working AI system (chess solving)

- explainability (knowledge of automation logic),
- trust,
- levels of automation (adaptive vs adaptable control)
- human in the loop
- automation surprise

CHALLENGES

OPPORTUNITIES

AI

- New training algorithms
- Increased computer power
- Scalable storage resources

Aviation

- Higher traffic demand
- More complex procedures
- Safety requirements

- **AI & Digitalization**
- **Workload & Automation**
- **Big data & cloud computing**
- **Human assistance**

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HF research in automation

CHALLENGES

OPPORTUNITIES

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- Higher traffic demand
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- **Safety requirements**

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… some historical perspective

Sheridan & Verplanck (1978)

A SCALE OF "LEVELS OF AUTOMATION"

1 Computer offers no assistance: human must do it all
2 Computer suggests many alternative ways to do the task
3 Computer prioritizes alternative ways to do the task
4 Computer recommends one way to do the task
5 Computer executes that recommendation when and if the human approves

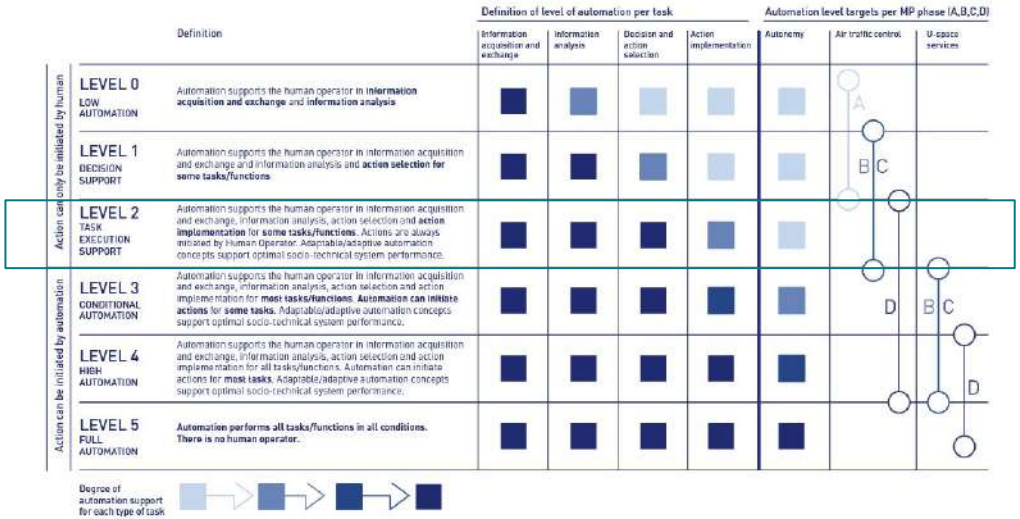
6 Computer allows a restricted time for human veto prior to automatic execution
7 Computer chooses a method, executes and necessarily informs the human
8 Computer chooses a method, executes and informs the human only if requested
9 Computer chooses a method, executes and ignores the human

EASA AI Roadmap 2.0 (2023)

Level 1 AI: assistance to human	Level 2 AI: human-AI teaming	Level 3 AI: advanced automation
• Level 1A: Human augmentation • Level 1B: Human cognitive assistance in decision-making and action selection	• Level 2A: Human and AI-based system cooperation • Level 2B: Human and AI-based system collaboration	• Level 3A: The AI-based system performs decisions and actions that are overridable by the human. • Level 3B: The AI-based system performs non-overridable decisions and actions (e.g. to support safety upon loss of human oversight).

Figure 4: Classification of AI applications

Figure 2: Levels of Automation [1]



SESAR Automation in ATM (2020)

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Current opportunity

Intense research activity in Aviation+Automation.

ATM by SESAR2020 and **SESAR3 - Digital** European Sky, but also H2020, HE, National programmes, internal R&D

- AI Situational Awareness - AISA
- ATCO Speech Recognition - HAWAII
- ATC instructions and traffic/conflict prediction
  - Advanced Auto Planner
  - TSAFE
  - SafeOPS
- Safety intelligence and data security - SafeClouds
- Single Pilot Operations

Technology readiness, opportunities for safety and performance. Implementation requires:

HUMAN - AI Partnership
Certification and regulation

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Project overview
Use cases

Safe Human-Digital Assistant teaming for higher levels of automation in aviation

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Objectives

Human-centric approach to automation and its integration in air traffic operations

Assessment and monitoring of Human-Machine cooperation. Focus: safety and resilience

Digital Assistants for aviation operations in support of human performance

Regulatory and certification requirements to address market needs and societal acceptance

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Research

Industry and SME - Tech development

Safety Agencies

Airlines

ANSPs

Users group

Aviation AI, Human Factors, Operations, Certification

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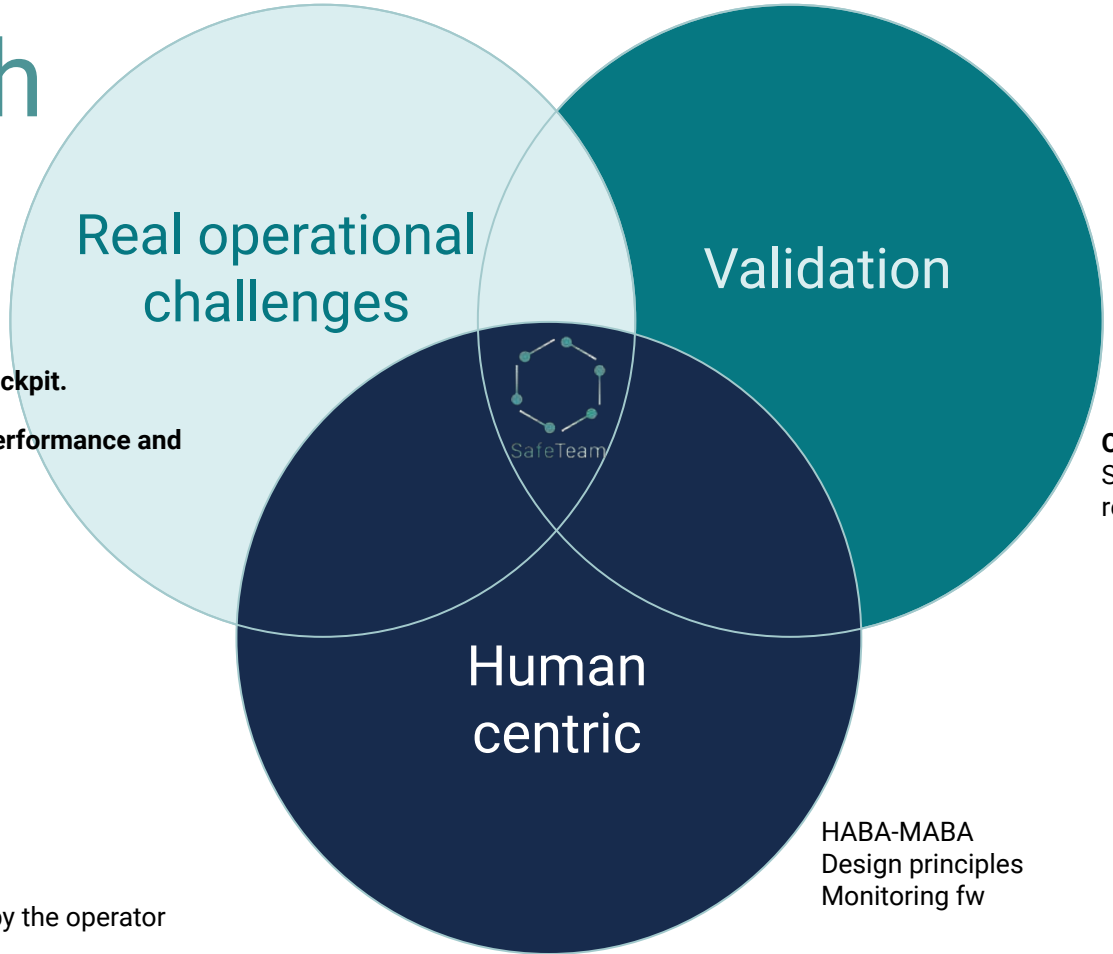

AI assistant for en-route ATCOs

Automatised detector of UAs for the cockpit.

Monitoring and evaluation of **training performance and competencies.**

Operational experts
Safety, security, resilience, cyber

HABA-MABA
Design principles
Monitoring fw

* Instruction executed if approved by the operator

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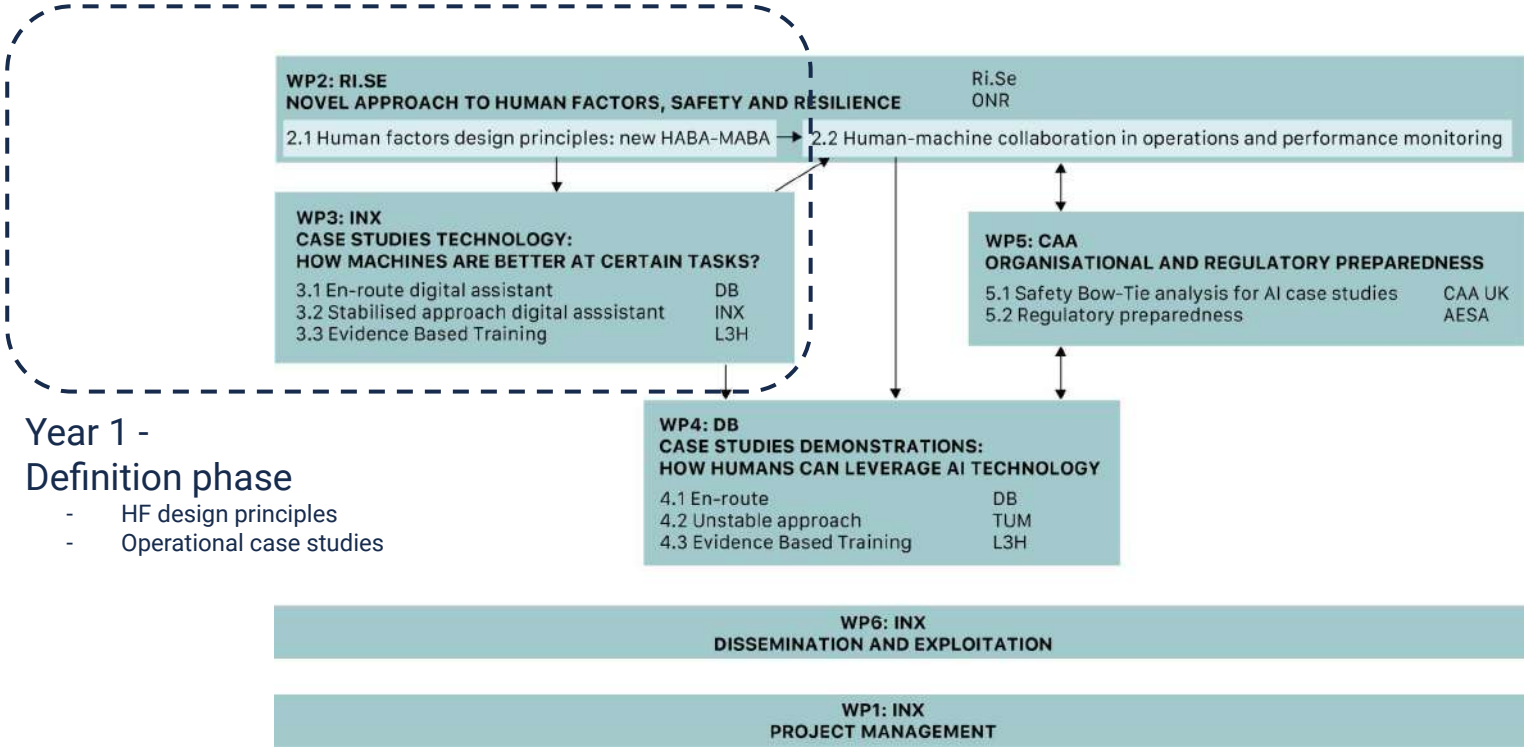
WBS



Year 1 -
Definition phase

- HF design principles
- Operational case studies

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HF design principles

Human factors design principles: new HABA-MABA, Leader: **RISE,**

– Support the coordination between humans and AI-powered systems.

– Identify format of the information to be provided by the digital assistants to optimize human-machine cooperation

– Design a smart assistant that is **intelligible to the human operator**

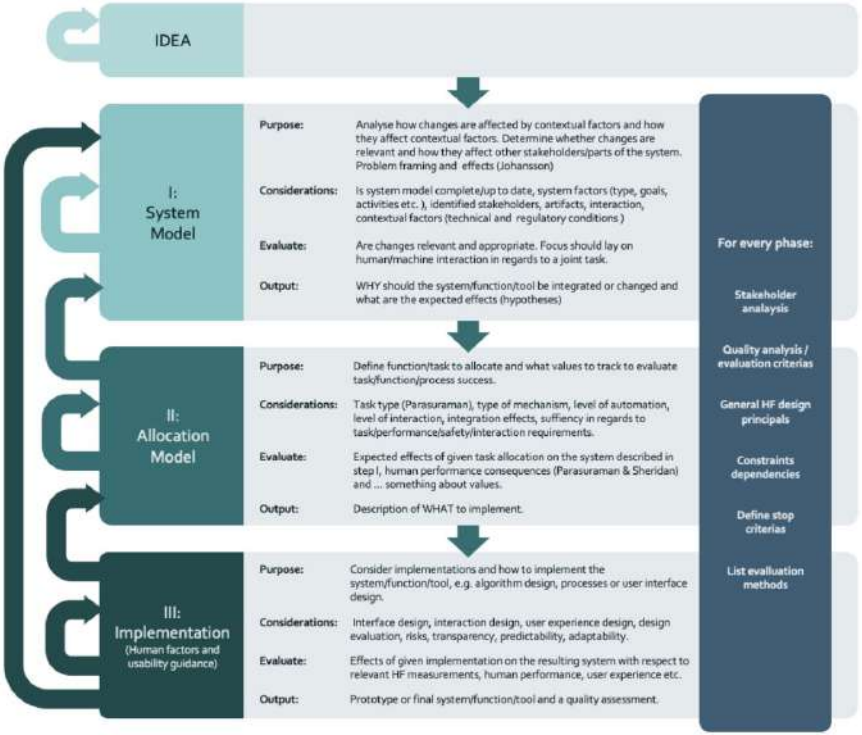

Figure x: This framework can serve as guidelines suggesting how designing automated systems can be approached.

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Operational case studies

Operational

User perspective, challenge to solve, requirements

Technological

TRL, data, targeted autonomy, AI performance (explainability, accuracy, recall…)

Human Factors

HMI, responsibilities distribution, safe teaming

En-route ATC

Digital Assistant ATCOs Consultation

VICTOR5

Real time surveillance data

Terrestrial and satellite ADS-B

Automatic conflict detection

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En-route digital assistant

ATCOs consultation on current functionalities and usability

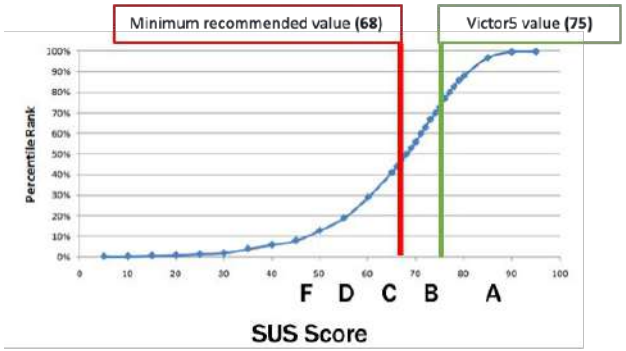
MTCD

Non-conflicting

Segment

5NM Halo

Wind model - acft data



Re-evaluation after system updates - phase 2

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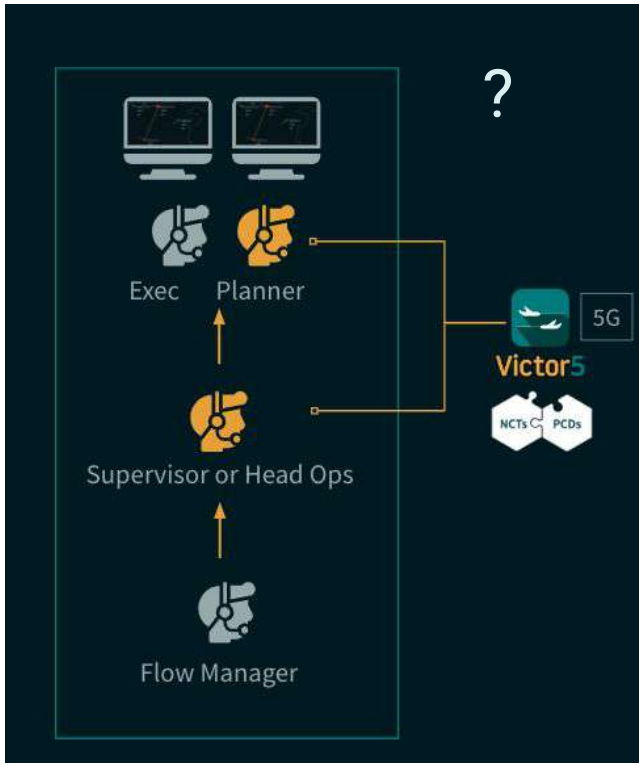
En-route digital assistant

Basic requirements and users

Multi Sector Planner Auto Planner Executive



Who is the user? - safety criticality, gradual adoption

Basic requirements

- **Safety of use,** adapted to the target level of autonomy, human supervision and verification.
- **Validation of the technology**, engaging the final user (ATCOs) at the different design and development stages, gradual improvement.
- **Adaptability to the existing technology and ATC procedures** - seamless integration in the OpsRoom.
- **Scalability** to adapt to current and future traffic demands and sector configurations.
- **Easiness for the regulator's approval and/or certification** to be used in an operational environment.

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En-route digital assistant

Questionnaire context

Voluntary participation
IFATCA support

4 group of questions

- **Respondent profiling**:
- **System Usability**
- **Interface** - design
- **Digital Assistants**: potential uses of digital assistants in ATC

Not ATC system - additional support system

Users requirements
Users test - CONTEXT

Respondent profiling

Users	Age	Current main role	Experience in ATC operations
User 1	51-55	ATCO	>16 years
User 2	51-55	ATCO	>16 years
User 3	51-55	Supervisor	>16 years
User 4	51-55	ATCO	>16 years
User 5	51-55	ATCO	>16 years
User 6	46-50	ATCO	>16 years
User 7	51-55	Supervisor	>16 years
User 8	56-60	ATCO	>16 years
User 9	41-45	ATCO	>16 years
User 10	36-40	ATCO	11-15 years
User 11	46-50	ATCO	>16 years
User 12	26-35	ATCO	11-15 years

Individual, not supervised environment
Anonymous
Instructions and guidelines provided

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En-route digital assistant
Questionnaire Results

Usability - 75 score

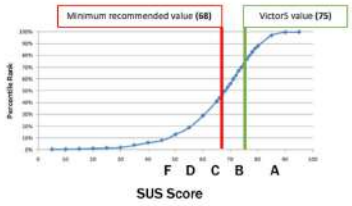


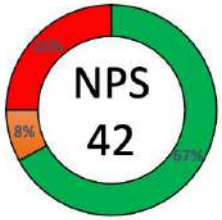
Figure 13 Victor5 SUS Score assessment

HMI - design. Likert scale

Users requirements
Users test - RESULTS / 1

Requirements for the next version / phase 2

Net promoter score



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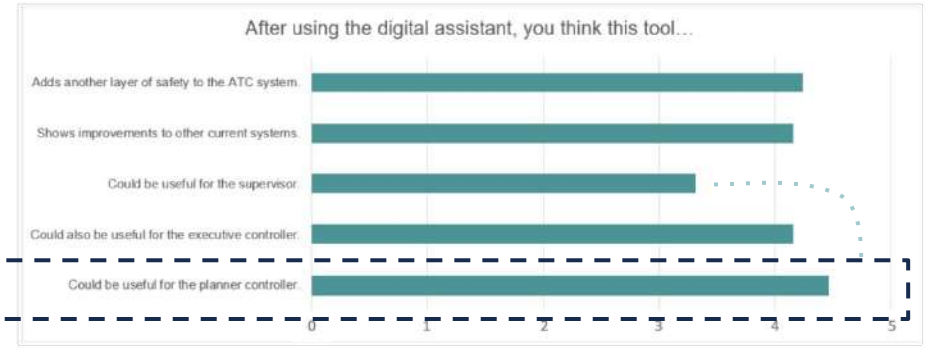
En-route digital assistant

Questionnaire Results

Users requirements

Users test - RESULTS / 2

About Digital Assistants



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En-route digital assistant

Questionnaire Results

Users requirements
Users test - Additional feedback

Although stated V5 was not an ATC system, controllers highlighted they missed some of the ATC functionalities: highlighted traffic under control, zoom to sector level, … - *Lowest rating*

The active **detection of potential conflicts** and non-conflicting traffic is considered an added value - *Highest rating*

One of the participants declared no trust

- **Do you consider digital assistants a technical improvement for ATCOs?**

The 13 participants replied YES. Some of them stated that they saw a special interest for contingency and post-analysis, adding an additional security layer.

En-route digital assistant

Phase II - Implementation and validation

SafeTeam system upgrades to meet users requirements:

Most appreciated features by ATCOs

Medium-Term Conflict Detection (MTCD) improved by combining **navigation data with flight plans and wind information.**

Non-Conflicting Traffic (NCT): introduction of **AI-based prediction**

GOAL:

- Real time and prediction of traffic complexity and workload metric. Optimize sectorization and resources allocation
- Post- analysis - safety.
- Traffic replay. Investigate in a very simple, handy manner

Most suitable 1st uses

Thank you!

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