Agenda

• The role and organisation of Human Factors in Airbus
  • The rationale for HF
  • Understanding HF
  • HF key success factors

• Overview on the Human Factors Design process

• An extended view on the end-user:
  • The integration of the ATM perspective
Why Human Factors: Benefits and Obligations

**Benefits**

- Safety benefits (aircraft experience)
- **Economical efficiency**
  - Reduced training need (but be careful of skill abrasion)
  - Increase of standardised operations (airlines) and flight performance optimisation
  - Increased traffic capacity (SESAR)
- **Life protection** in Dangerous Operations (military threats)

**Obligations**

- Certification

**Drawbacks**

- Cost
- Time
UNDERSTANDING HUMAN FACTORS

Understanding the end-users Work…in Aviation

- Manage the Mission: Cargo, passengers, airline, airport…
- Fly, Navigate, Communicate
- Manage the System: ECAM, Flight Attendant Panel…
- Be aware of: Weather, traffic, terrain…
Human Factors mission in Airbus

“Understand the work and adapt the WORK to the HUMAN”
(Use knowledge of human behavior and HF methods to understand the work)

- Predict/understand the end users’ behavior during real operations, when interacting directly or indirectly with the aircraft (normal and non normal situations)
- Ensure that the missions & modes of use are acceptable for the end users
- Ensure that the cockpit:
  - is mature before Entry Into Service
  - complies with Human Factors Regulations

EASY TO USE, SAFE, EFFICIENT and PLEASANT

Optimising relationships between end-users and operational tasks

- Clear & unambiguous procedures
- User task achievement
- Training
- Staffing
- Human-human cooperation
- Adverse flight conditions
- Environment
- Workplace layout
- Control & information usability
- HMI (alerts, information requirements, )
- Workplace usability
- Function allocation
- Fatigue
- Culture
- Stress
- Work organization
- Workload
- Motivation
- Situation awareness
- Human errors
KEY SUCCESS FACTORS

Key success factors: HF process and methods

Explore, learn, rationalise, consolidate, demonstrate

- Systemic & systematic approach in realistic operational contexts
- Involvement of relevant End users: pilots, Air traffic controllers.....
- Human Factors methods complying with HF certification
Key success factors: Certification

- CS 25.1302 and related sections of CS 25 including their Associated Means of Compliance
- HF process as a mean to answer certification specification
CS–25 BOOK 1

SUBPART F – EQUIPMENT

GENERAL

CS 25.1301 Function and installation
(See AMC 25.1301)

Each item of installed equipment must –

(a) Be of a kind and design appropriate to its intended function;

(b) Be labelled as to its identification, function, or operating limitations, or any applicable combination of these factors. (See AMC 25.1301(b).)

(c) Be installed according to limitations specified for that equipment.

[Amdt. No.:25/2]

CS 25.1302 Installed systems and equipment for use by the flight crew
(See AMC 25.1302)

This paragraph applies to installed equipment intended for flight-crew members’ use in the operation of the aeroplane from their normally seated positions on the flight deck. This installed equipment must be shown, individually and in combination with other such equipment, to be designed so that qualified flight-crew members trained in its use can safely perform their tasks associated with its intended function by meeting the following requirements:

(a) Flight deck controls must be installed to allow accomplishment of these tasks and information necessary to accomplish these tasks must be provided.

(b) Flight deck controls and information intended for flight crew use must:

(1) Be presented in a clear and unambiguous form, at resolution and precision appropriate to the task.

(2) Be accessible and usable by the flight crew in a manner consistent with the urgency, frequency, and duration of their tasks, and

(3) Enable flight crew awareness, if awareness is required for safe operation, of the effects on the aeroplane or systems resulting from flight crew actions.

(c) Operationally-relevant behaviour of the installed equipment must be:

(1) Predictable and unambiguous, and

(2) Designed to enable the flight crew to intervene in a manner appropriate to the task.

(d) To the extent practicable, installed equipment must enable the flight crew to manage errors resulting from the kinds of flight crew interactions with the equipment that can be reasonably expected in service, assuming the flight crew is acting in good faith. This sub-paragraph (d) does not apply to skill-related errors associated with manual control of the aeroplane.

[Amdt. No.:25/3]

CS 25.1303 Flight and navigation instruments

(a) The following flight and navigation instruments must be installed so that the instrument is visible from each pilot station:

(1) A free-air temperature indicator or an air-temperature indicator which provides indications that are convertible to free-air temperature.

(2) A clock displaying hours, minutes, and seconds with a sweep-second pointer or digital presentation.

(3) A direction indicator (non-stabilised magnetic compass).

(b) The following flight and navigation instruments must be installed at each pilot station:

(1) An airspeed indicator. If airspeed limitations vary with altitude, the indicator must have a maximum allowable airspeed indicator showing the variation of $V_{MO}$ with altitude.

(2) An altimeter (sensitive).

(3) A rate-of-climb indicator (vertical speed).

(4) A gyroscopic rate of turn indicator combined with an integral slip-skid indicator (turn-and-bank indicator) except that only a slip-skid indicator is required on aeroplanes with a third attitude instrument system usable through flight attitudes of 360° of pitch and roll, which is powered from a source independent of the electrical generating system and continues reliable operation for a minimum of 30 minutes after total failure of the electrical generating system, and is installed in accordance with CS 25.1321 (a).

(5) A bank and pitch indicator (gyroscopically stabilised). (See AMC 25.1303 (b)(5).)
Human: a complex system capable of adaptation in a dynamic & contextual manner but also with limitations that we have to consider.

Key success factors: Human Factors competences.

- **Physiology**
  - Comprehension and decision making
  - Automation
  - Human error
  - Workload & cognitive resources management...

- **Psychology**
  - Human perception
  - Stress
  - Alertness & Fatigue
  - Hypoxia...

- **Linguistic**
  - Terminology
  - Syntax
  - Controlled language

- **Sociology**
  - Team cooperation and communication
  - Effect of culture..

Key success factors: HF methods embedded in other key processes.

1. Identify need for human-centered design
2. Understand/specify the context of use & tasks
3. Evaluate solutions against requirements and HF objectives
4. Modifications: design, training, use
5. Specify the users, performance & functional requirements
6. Produce design solutions (from concept to detailed)
7. Concept of use
8. Need & Task analysis
9. HF issues
10. Input for FRD, SFD
11. HF test programs
12. HF test objectives
13. HF validation & certification plans
14. Deliverables
Key success factors: Towards HF

Getting there....

....Maintaining....

....Evolving

AN EXTENDED VIEW for evolving Air Traffic Management
### ATM Initiatives

- International Civil Aviation Organisation (ICAO)
- Europe: SESAR (Single European Sky Aviation Research) [www.sesarju.eu](http://www.sesarju.eu)
- US: Next-Gen
- Others…

### An extended view on the end-users

Increasing ATM Performance by adding new technologies
- New tools
- Increased automation
- New/changed tasks
- New roles & responsibilities
Future ATM functions in the aircraft

HF considerations for the integration of new ATM functions:
- Functions represent modifications to pilots' tasks and their working environment
- Interaction with ATM is only one of the flight crew’s many tasks
- Human Factors Design Process to evaluate modifications

Aspects to be addressed in the extended ATM picture
- Diverse ATM environments
- Shared artefacts and suitable level of automation between air/ground
- Teamwork, communication and cooperation between air/ground functional teams with changed roles and responsibilities
- Qualification and training for future ATM demands
- Social and transition issues: to facilitate end-user acceptance
- Worldwide consistency of procedures and interoperability

Need for a Human Factors Design Process
Shared within ATM Community

→SESAR Human Performance Assessment Process
(Integrated in the SESAR System Engineering Process)
Example: Air/Ground validation of concepts from HP perspective (SESAR HP)

PREPARATION OF THE VALIDATION ACTIVITIES
Develop a common validation plan for coupled Air/Ground exercises
Example: Air/Ground validation of concepts from HP perspective (SESAR HP)

**POST-EXECUTION OF THE VALIDATION EXERCISE**

Analyze data and produce interoperability results & conclusions for validation report

- Initial Data Analysis
  - Air Analysis
  - Ground Analysis

- Recommendation and Requirements
  - Define recommendations and requirements concerning interoperability (which may affect air, ground or both)

- Ground Rec/Reqs
- Air Rec/Reqs

- Produce an integrated set of results and conclusions for the air-ground interoperability HP-related issues

- Integrated results & Conclusions

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Airbus understanding of automation

- Authority
  - Being able to influence the course of events

- Automation/Autonomy
- Responsibility
  - obligation to answer for an action, i.e. to justify actions or decisions

- Accountability
  - a duty or obligation to satisfactory perform or complete a task assigned to a specific role
Example: Competence Impact Management (SESAR HP)

- Systematic collaboration with Training department
- Early identification and management of competences along the recently internationally agreed Key Competence Areas

Conclusion?