# EGHD Position Paper

# Optimising ATM staff working stations in the Joint Human-Machine System[1]

## 1 Introduction

This paper identifies principles and recommendations for the European Commission (EC)[2] to ensure that the human dimension is appropriately considered in future industry developments related to the design of Air Traffic Management (ATM) staff working stations.

The Expert Group on the Human Dimension (EGHD) of the Single European Sky (SES) believes that a good working environment will help to optimise both human performance and the use of ATM technologies. On the other hand, a poor working environment may negatively impact the ability of ATM staff to carry out their day-to-day tasks in an optimal, safe and efficient manner. Therefore, the upgrade, development and modification of ATM working stations need to be managed carefully to ensure that the ATM staff working environment is designed optimally for system performance.

## 2 Scope

The EGHD has considered the human dimension impacts of the design of ATM staff working stations from the following ATM staff categories:

- Air Traffic Controllers (ATCOs)
- Air Traffic Safety Electronics Personnel (ATSEP)
- Air Traffic Control (ATC) Supervisors
- ATM Flow Managers
- Aeronautical Information Service (AIS) / Aeronautical Information Management (AIM) personnel
- Flight Data operators
- Flight Information Service Officers (FISOs and AFISOs)

The EGHD's recommendations focus on common issues that are applicable to all ATM staff. However, recommendations may also be tailored for certain ATM staff categories where necessary.

[1] The Joint Human-Machine System (JHMS) is an emerging concept that considers the users and the technical system as a single system. This is further explained in Principle 3 of Section 3.

[2] This paper may also be used to advise other Single European Sky (SES) institutions related to the development of ATM technologies.

# 3 Principles for work station design

The design of ATM staff working stations plays a pivotal role in contributing to optimal human and technological performance. The following principles have therefore been identified as recognised good practice relating to the design of ATM staff working stations. These good practices are endorsed by the EGHD and should continue to be promoted to ensure they are applied consistently:

1. ATM staff are the front-end users of working station designs, and therefore **ATM staff should be involved from the beginning** of the process to design future working station concepts and technologies.

2. The design of ATM staff working stations and the operating environment should consider **good design practices and standards**[3] that have been defined generically (i.e. non-ATM) for use in Human-Machine Interface (HMI) design, control room layouts and environmental aspects. However, as for any application of a standard, a refinement is required in order to consider the specificities of local ATM operational and technical needs and constraints.

3. The achievement of the expected benefits of working station design requires the successful **matching of humans and systems**. This corresponds to the concept of a so-called **Joint Human-Machine System (JHMS)** which considers the user and the system as one. The aim of human factors in ATM is to match the specifications of the working station design with human capabilities and limitations.

4. Design principles should meet generic standards and good practices for working station design, whilst ensuring the design of working stations and the operating environment are tailored, from user-centred perspective, to the **local specificities** of Air Navigation Service Providers (ANSPs) to optimise human and technological performance. The standards in question are highlighted in the Appendix6.

5. Project staff involved in the delivery of changes to the ATM staff working stations should be **aware of general human factors, ergonomic principles and applicable standards**. Project staff should ensure that these principles are adequately considered during this process of change. The continued use of human factors and ergonomics specialists within project teams is of high importance.

# 4 Specific recommendations

This section outlines human dimension issues that require specific attention to ensure that the human is considered appropriately in the future design of ATM staff working stations. The EGHD's recommendations are structured into the following four sections:

1. Strategic management of working station design

2. Design of operating and technical control rooms

3. Design of working station furniture

4. Design of the Human-Machine Interface

[3] See Appendix for a non-exhaustive list of existing standards that the EGHD deems where good practices may be derived from.

## 4.1 Strategic management of working station design

### 4.1.1 Prioritisation of technological Work Package

The current SESAR 2020 programme has a series of Work Packages that are developing concepts that will impact the design of the HMI. Existing Work Packages are identifying features that will support improved HMI design – however, the totality of changes is yet to be fully considered together as part of a single HMI project.

Introducing a **transversal** SESAR Work Package for the development and validation of concepts addressing working station design should be considered. This Work Package should consider the EGHD's recommendations outlined in the subsequent three sections. Where recommendations reference 'ATM-specific guidelines', these refer to tailored ATM guidance that are supplementary to existing human factors and ergonomics standards.

This Work Package should consider how the future design of HMIs can support the integration of both existing and emerging concepts and technologies.[4] Indeed, integrating new solutions to working stations by neglecting integration aspects with existing systems may have adverse human impacts. The strategic management of working station design should therefore be viewed holistically, based on a smart systems-integration approach of the latest technological developments.[5]

*Recommendation*

*The EC, with the relevant authorities, should consider introducing a **transversal** SESAR Work Package that coordinates the development and validation of concepts which have an impact on working station design. This Work Package should consider the design of operating and technical control rooms, working station furniture, and the HMI, including how future HMIs can support both existing and emerging concepts and technologies.*

*Recommendation*

*The EC, with the relevant authorities, should ensure that procedures are in place for Professional Staff Organisations (PSOs) to be involved in the definition, development and implementation of any new SESAR transversal Work Package – this concerns the development and validation of concepts that may have an impact on working station design.*

### 4.1.2 Promotion of timely and strategic prioritisation of working station upgrades

The upgrade of ATM staff working stations within individual ANSPs is a complex task. The EGHD recognises that some working stations in one ANSP unit are more in need of upgrade than the working stations of another ANSP unit.

As a result, strategic prioritisation of working station upgrades (by need, and by when) should be a priority within individual ANSPs. It is thus advised that clear upgrade and implementation strategies are in place within individual ANSPs.

This process of strategic prioritisation will mean that those units with more technologically-mature working stations, and thereby more optimally designed for human performance, can be 'leapfrogged', meaning the units that are most in need of upgrade can be prioritised first.

[4] For example, Remotely Pilot Aircraft Systems, Time-Based Separation, and System Wide Information Sharing.
[5] See Appendix for SESAR developments regarding Controller Working Position / Human-Machine Interface.

*Recommendation*

*The EC, with the relevant authorities, should promote the timely and strategic upgrade of ATM staff working stations in national ANSPs. This concerns the design of operating and technical control rooms, work station furniture, and the Joint Human-Machine System.*

### 4.1.3 Harmonisation of working station design

The European ATM network is, in many cases, composed of country-based systems and processes. This increases fragmentation in the provision of Air Traffic Services (ATS) and diversity in terms of working station design.

Harmonisation will lead to greater uniformity in working station design. This will be an enabler for enhanced efficiency when organising ATS operations, and improve staff mobility in and between Air Traffic Service Units (ATSUs). Room for flexibility to adapt to local specificities should be maintained, even if in a more standardised context. Adaption to local specificities is required to ensure optimal local performance.

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to ensure the harmonisation of future working station designs, based on generic human factors and ergonomics standards. This will help to enhance efficiency when organising ATS operations and improve staff mobility in and between ATSUs.*

## 4.2 Design of operating and technical control rooms

### 4.2.1 Layout of operating and technical control rooms

Clear and efficient communication is paramount within ATM. This should not only be the case between ATCOs and pilots for ensuring the safe provision of ATC for handled aircraft, but also between ATM staff within the operating room itself, or in adjacent co-located rooms and between ANSPs.

Operating and technical rooms should be designed in an optimal configuration to promote active participation and cooperation through effective verbal and non-verbal communication between staff. The design of operating and technical control rooms should provide solutions for information sharing to enhance mutual awareness (e.g. a shared video screens / walls, or visibility of one working station to an adjacent working station).

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to ensure the optimal design of the layout of operating and technical control rooms. This should promote active participation, effective verbal and non-verbal communication between staff, and to ensure information sharing to enhance mutual awareness.*

### 4.2.2 Environmental factors

Working conditions in the operating and technical control rooms such as lighting, sound (echoing), noise, heating and ventilation can result in sub-optimal human performance if not managed effectively. This may impact upon the health, wellbeing, comfort and productivity of ATM staff.

Individual control over environmental factors offers ATM staff the possibility to refine their local environment to their preferred physical conditions, which may differ from the average recommended conditions outlined in standards. For example, specific action to reduce echo issues in operating and

technical control rooms may require specific sound echoing systems or sound insulation. The EGHD endorses the benefits of this approach as it contributes to enhanced performance of ATM staff.

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to ensure that environmental factors are appropriately considered in the design of operating and technical control rooms. Existing standards and the local specificities should be considered when defining the associated operational requirements and technical specifications.*

### 4.2.3 Contingency and simulation rooms

As part of future operating and technical control room upgrades, contingency and simulation rooms should be designed identically (as far as technically possible) to normal operating rooms. Contingency rooms refer to those specifically designed for continuity of operations within the same Area of Responsibility (AoR).

For contingency, harmonisation is an enabler for service continuity in the case that ATM staff are required to move to an alternative operating or technical control room. In such instances, ATM staff may be required to resume their tasks in the alternative facility at short notice, in a safe and efficient manner. This will effectively contribute to enhanced procedural memory of ATM staff (i.e. automated reactions within a familiar environment).

Additionally, for simulation rooms, harmonisation will help to replicate real-time operational environments which will improve the effectiveness of trials of new airspace and technology changes whilst helping to realise efficiencies in training-related costs.[6]

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to promote the harmonisation in design of contingency and simulation rooms with normal operating rooms.*

## 4.3 Design of working station furniture

ATM staff working station furniture is not always designed optimally for human performance. Some of the issues with the physical ergonomics of working station designs have principally concerned the increase in the likelihood of developing musculoskeletal and computer vision syndrome risk factors. These include:

- Awkward postures – e.g. poor back posture, too many screens that result in turning the head to view a particular screen;
- Repetition and duration of a task;
- Environmental factors – e.g. lighting, noise, heat and ventilation (see Section 4.2.2);
- Monitor position – e.g. number of screens, distance of screens, angle in relation to user's eyes, and glare;
- Inadequate vision breaks — constant focusing at the same distance;
- Brightness and contrast of screens.

Working stations should be designed with the front-end user in mind (e.g. flexibility of desk height, adjustable keyboard height / angle, backrest angle, screen position / angle, adjustable screen

[6] See Article 4 of Regulation (EU) 2015/340 for definitions of 'simulator' (definition 25) and 'synthetic training device' (definition 26).

brightness). They should also be designed in line with human factors and ergonomics standards and existing good practices from other human-centric industries (e.g. cockpits).

To reduce the likelihood of the aforementioned risk factors, ATM staff need to be provided with means to fine-tune their individual working station (e.g. to enable good posture). Ultimately, good design practices should lead to the appropriate use of such designs.

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing human factors and ergonomics standards to ensure that working station furniture is optimally designed for human performance. To do so, it is necessary to consider local specificities when defining associated operational requirements and technical specifications.*

## 4.4 Design of the Human-Machine Interface

The HMI (e.g. screens, devices, alerting systems) must be appropriately designed and validated from a user's point-of-view. The EGHD believes that the following areas require specific attention:

### 4.4.1 Size of screens

ATM staff should be presented with clear, concise and appropriate information to perform their operational tasks. This is fundamental to ensuring that ATM staff have the highest degree of situational awareness.

One notable example is the surveillance picture which is a fundamental requirement within an ATCO staff working station. The size of the screen should be fit-for-purpose by ensuring screens display key pieces of information in the correct orientation and scale. To demonstrate this, the shape of the screen may mean that the entire sector cannot be fully or clearly displayed. Oversized screens may also block the line-of-sight of the ATM staff actor.

To ensure an appropriate level of situational awareness, ATM staff should be provided with all relevant information useful for the execution of their tasks. To avoid screen overcrowding, the ATM staff actor should also have the means to display and hide certain information (e.g. squawk, routing, aircraft type, wake turbulence category).

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing human factors and ergonomics standards to ensure the clarity of information presented on screens.*

### 4.4.2 Number of display screens and input devices

One of the greatest issues facing the existing design of ATM staff working stations are the number of screens and input devices, such as mice and keyboards, that ATM staff rely on to execute their operational tasks. Currently, there are cases in Europe where ATM staff actors are exposed to at least five display screens at a single working station. ATSEP face a unique issue where information is often presented by up to a dozen display screens across multiple working stations.

This results in ATM staff being unable to quickly access the information they require, and at the time they require it. In addition, this creates the risk of errors when selecting equipment during high-pressured situations. This over-crowding of the working station will lead to a sub-optimal organisation of the devices on the desk which have, in some cases, negatively impacted an ATM staff actor's working efficiency.

Timely, appropriate, accurate and an adequate amount of information must therefore be presented to the ATM staff actor for the optimal fulfilment of tasks. If information provided by a non-optimal number or configuration of screens overwhelms the ATM staff actors' cognitive capacities, critical information could either be missed or misinterpreted. This could have a detrimental impact on performance and safety.

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing generic human factors and ergonomics standards that ensure the number of screens on a working station does not hinder the ATM staff actor's ability to carry their tasks safely and efficiently.*

### 4.4.3 Presentation of information

The manner in which information is presented is a key concern for the EGHD, as this is closely related to the efficiency and safety of an ATM staff actor's task accomplishment. Information presentation on screens should ensure good accessibility, awareness, intuitiveness and understanding by users.

Despite the variety in ATM staff working station designs, the HMI should be designed in such a way that information is presented according to a set of common functional capabilities required of the JHMS. Therefore, consistency, uniformity, clarity and usefulness of the information being presented should be ensured.

This is particularly pertinent for ATSEP working stations. It is common for ATSEP to interpret information from multiple HMIs (each with their own unique layout). These differences can cause errors and the misinterpretation of information, and thus the HMI of different systems should be uniform by adhering to a standard layout to ensure that information presented is as clear as possible. This can be achieved by the definition of a generic integrative HMI that applies the same design rules for all systems. This is a key enabler for safe and efficient ATM operations.

*Recommendation*

*The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing generic human factors and ergonomic standards to ensure that HMI design allows an efficient presentation of information based on a set of defined functional capabilities. This includes ensuring that the information presented is consistent, uniform, clear, non-ambiguous, useful and intuitive.*

### 4.4.4 Alerting and monitoring tools for ATM staff

**ATCO**

The detection of alerts in a timely fashion is a key safety concern for ATCO operations. In some instances, alerts may not be relevant in a given context. In other instances, alerts may not be perceived in time for executing the recovery action.

To mitigate some of these adverse impacts, smart and efficient alerting systems should be integrated into the ATCO working station. Some examples are included below:

- Alerting of safety-nets must be perceived. Alert levels could be increased when an alert, that requires a timely recovery action, is not detected in time.
- The type of alert could be adapted to the context and urgency of the situation. The type of alert should be adapted to the working environment of the ATCOs involved to avoid startling and unintended distraction for other ATCOs (e.g. use of sounds and visuals).

- Information coding for alerts could be introduced. This could mean that, in some instances, alerts or warnings could be automatically inhibited to reduce information overloading.

**AIS / AIM personnel**

To ensure the safe, dynamic and integrated management of aeronautical information, AIS / AIM personnel require smart alerting and monitoring tools to provide and exchange quality-assured digital aeronautical data with all relevant stakeholders. Some examples are included below:

- Alerting of safety-critical operations must be perceived. Alert levels could be increased when an alert, that requires a timely recovery action, is not detected in time.
- The type of alert could be adapted to the context and urgency of the situation. The type of alert should be adapted to the working environment of the AIS / AIM personnel involved to avoid startling and unintended distraction for other AIS / AIM personnel (e.g. use of sounds and visuals).

**ATSEP**

Under normal operating conditions, the responsibility of the ATSEP is to monitor the performance of the HMI process and also of the wider ATM system. However, in the case that a system begins to fail or tends towards a more degraded mode of operation, the ATSEP on duty will take control of the technical processes, leave aside his / her monitoring of the functioning system(s), focus and divert their attention to the problematic system(s) at hand.

To adequately manage the potential adverse impacts of the increasing digitalisation of ATM (e.g. cyber-attacks), the future design of the HMI should offer technical staff the necessary supporting tools and information to perform their tasks. In particular, there is a need for robust smart alerting and monitoring tools to inform ATSEP of potential threats to the ATM system with the intention of facilitating service continuity. For example:

- To alert and assist in the case of a system malfunction, the HMI should be equipped with software tools to support information sharing and easy debriefing between ATSEP during the handover of shifts.
- Specific alerting tools should be integrated into the HMI to inform the ATSEP of potential malfunctions, degradations, or threats that could negatively impact the ATM system.
- Specific tools should be integrated into the HMI to log all previous technical malfunctions, degradations or threats (including the causes and effects). This can help to promote lessons learnt, and for ATM staff actors to better prepare for, and manage, such risks in future.
- To facilitate system-wide technical situational awareness, specific cybersecurity monitoring tools should be integrated into existing monitoring systems. This should be a transversal service to be monitored distinctly by an ATSEP with appropriate cybersecurity competence in accordance with Annex XIII Subpart A of Commission Implementing Regulation (EU) 2017/373.[7]
- The type of alert could be adapted to the context and urgency of the situation. The type of alert should be adapted to the working environment of the ATM staff involved to avoid startling and unintended distraction for other ATM staff (e.g. use of sounds and visuals).

[7] Annex XIII Subpart A – AIR TRAFFIC SAFETY ELECTRONIC PERSONNEL

*Recommendation*

*The EC, with the relevant authorities, should ensure that ATM-specific guidelines are introduced to ensure that smart alerting and monitoring tools are integrated into future Human-Machine Interfaces to support ATM staff during the execution of their day-to-day tasks.*

### 4.4.5 Management of workload and fatigue

It is essential that ATM staff understand the potential risks of fatigue, the range of human capabilities, and how to manage or mitigate these risks and limitations through improvements to the JHMS.

ATM staff workload is a crucial indicator that ANSP's should consider during shift changes. Additionally, ANSP's may also wish to monitor various aspects of human performance such as cognitive workload, inattentional blindness and fatigue, the latter of which comes under Commission Implementing Regulation (EU) 2017/373 for ATM / ANS providers.[8]

To monitor an ATM staff actor's human performance, new tools may be integrated into working station designs. These tools may include:

- Dedicated tools on the supervisor's working station to ensure they are able to anticipate an ATM staff actor's workload and fatigue.
- Dedicated tools on the working station to allow an ATM staff actor to monitor their own workload (e.g. log-in access to retrieve both subjective and objective information).

Future research and development activities for the design of work stations should also focus on the way human performance neurometrics tools could be integrated into the HMI. Tools such as voice analyser, drowsiness meters (linked to mental workload), pupil diameter measurers (linked to mental workload / fatigue), and eye-tracking solutions (to address inattentional blindness) may help to support the transition to higher automation levels in ATM. At the same time, these tools may help to analyse and manage the potential adverse impacts on human performance.

The EGHD supports the use of any output from monitoring tools to implement positive change in the workplace – in particular, the effective management of the workload of all ATM staff, and ensuring the safe and continuous provision of the ATM service. As a result, information retrieved from monitoring tools shall only be used within EU General Data Protection laws and not be used for the purposes of administrative action against ATM staff.

*Recommendation*

*The EC, with the relevant authorities, should develop rules to manage the introduction of human performance monitoring tools that are integrated into the future design of Human-Machine Interfaces. These tools should ensure that the workload and fatigue of ATM staff are monitored, and information is only used to improve the safety of the ATM service, and not be made available for the purposes of administrative action against ATM staff.*

# 5 Conclusion

The EGHD requests that the Commission considers the five human dimension principles identified as fundamental to the design of ATM staff working stations, and the following 13 recommendations on topics that require specific attention to ensure that the potential impacts on the human dimension are adequately managed.

[8] Commission Implementing Regulation (EU) 2017/373 – ATS.OR.315 Fatigue

## 5.1 Principles

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| *Principle 1* | *ATM staff are the front-end users of working station designs, and therefore ATM staff should be involved from the beginning of the process to design future working station concepts and technologies.* |
| *Principle 2* | *The design of ATM staff working stations and the operating environment should take into account good design practices and standards that have been defined generically (i.e. non-ATM) for use in Human-Machine Interface design, control room layouts and environmental aspects. However, as for any application of a standard, a refinement is required in order to consider the specificities of the ATM operational and technical needs and constraints.* |
| *Principle 3* | *The achievement of the expected benefits of working station design requires the successful matching of humans and systems. This corresponds to the concept of a so-called Joint Human-Machine System (JHMS) which considers the user and the system as one. The aim of human factors in ATM is to match the specifications of the working station design with human capabilities and limitations.* |
| *Principle 4* | *Design principles should meet generic standards and good practices for working station design, whilst ensuring the design of working stations and the operating environment are tailored, from user-centred perspective, to the local specificities of Air Navigation Service Providers (ANSPs) to optimise human and technological performance. The standards in question are highlighted in the Appendix.* |
| *Principle 5* | *Project staff involved in the delivery of changes to the ATM staff working stations should be aware of general human factors, ergonomic principles and applicable standards. Project staff should ensure that these principles are adequately considered during this process of change. The continued use of human factors and ergonomics specialists within project teams is of high importance.* |

## 5.2 Recommendations

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| *Recommendation 1* | *The EC, with the relevant authorities, should consider introducing a **transversal** SESAR Work Package that coordinates the development and validation of concepts which have an impact on working station design. This Work Package should consider the design of operating and technical control rooms, working station furniture, and the HMI, including how future HMIs can support both existing and emerging concepts and technologies.* |
| *Recommendation 2* | *The EC, with the relevant authorities, should ensure that procedures are in place for Professional Staff Organisations (PSOs) to be involved in the definition, development and implementation of any new SESAR transversal Work Package – this concerns the development and validation of concepts that may have an impact on working station design.* |
| *Recommendation 3* | *The EC, with the relevant authorities, should promote the timely and strategic upgrade of ATM staff working stations in national ANSPs. This concerns the design of operating and technical control rooms, work station furniture, and the Joint Human-Machine System.* |
| *Recommendation 4* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to ensure the harmonisation of future working station designs, based on generic human factors and ergonomics standards. This will help to enhance efficiency when organising ATS operations and improve staff mobility in and between ATSUs.* |
| *Recommendation 5* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to ensure the optimal design of the layout of operating and technical control rooms. This should promote active participation, effective verbal and non-verbal communication between staff, and to ensure information sharing to enhance mutual awareness.* |
| *Recommendation 6* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to ensure that environmental factors are appropriately considered in the design of operating and technical control rooms. Existing standards and the local specificities should be considered when defining the associated operational requirements and technical specifications.* |
| *Recommendation 7* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to promote the harmonisation in design of contingency and simulation rooms with normal operating rooms.* |
| *Recommendation 8* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing human factors and ergonomics standards to ensure that working station furniture is optimally designed for human performance. To do so, it is necessary to consider local specificities when defining associated operational requirements and technical specifications.* |
| *Recommendation 9* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing human factors and ergonomics standards to ensure the clarity of information presented on screens.* |

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| *Recommendation 10* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing generic human factors and ergonomics standards that ensure the number of screens on a working station does not hinder the ATM staff actor's ability to carry their tasks safely and efficiently.* |
| *Recommendation 11* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to supplement existing generic human factors and ergonomic standards to ensure that HMI design allows an efficient presentation of information based on a set of defined functional capabilities. This includes ensuring that the information presented is consistent, uniform, clear, non-ambiguous, useful and intuitive.* |
| *Recommendation 12* | *The EC, with the relevant authorities, should introduce ATM-specific guidelines to ensure that smart alerting and monitoring tools are integrated into future Human-Machine Interfaces. This will support ATM staff in their execution of day-to-day tasks.* |
| *Recommendation 13* | *The EC, with the relevant authorities, should develop rules to manage the introduction of human performance monitoring tools that are integrated into the future design of Human-Machine Interfaces. These tools should ensure that the workload and fatigue of ATM staff are monitored, and information is only used to improve the safety of the ATM service, and not be made available for the purposes of administrative action against ATM staff.* |

# 6 Appendix

## Developments in SESAR

**Project ID:** PJ16 Controller Working Position / Human Machine Interface

**Project Duration:** 1st November 2016 to 31st December 2019

PJ16 aims to reduce development and operating costs of ANSPs. These savings will ultimately benefit airlines and their customers. It achieves this by delivering the ATM Master Plan goals, and updated as part of the 2018 ATM Master Plan campaign, for a more efficient deployment of human resources, a progressive increase in automation support, the implementation of virtualisation technologies and the use of standardised and interoperable systems whilst increasing the safety level.

This will be achieved via six concepts: automatic speech recognition, user profile management, attention guidance, multi-touch inputs, efficient development processes and CWP virtualisation.

It should be noted that PJ16 does not look holistically at HMI design.

## Applicable standards

Applicable standards to the design of ATM staff work standards exist in both civil and military domains. The following provides a non-exhaustive list of existing standards that the EGHD deems where good practices may be derived from:

- SESAR P16.04.01. D10-001 – the Human Performance (HP) Assessment Process serves to ensure that HP aspects are systematically identified and considered in SESAR developments.
- EASA CS 25 establishes certification specifications and Acceptable Means of Compliance for Large Aeroplanes. The CS 25.1302 and associated AMC 25.1302 'Installed systems and equipment for use by the flight crew' focus on human factors aspects.
- FAA Guidance HF-STD-001 'Human Factors Design Standard' provides reference information to assist in the selection, analysis, design, development, and evaluation of new and modified Federal Aviation Administration (FAA) systems and equipment.
- ICAO's Fatigue Risk Management System (FRMS) provide air operators with information for implementing an FRMS that is consistent with ICAO Standards and Recommended Practices (SARPs).
- ICAO Human Factors Training Manual (Doc 9683) summarises Human Factors issues across multiple stages in the aviation industry, including within ATM systems and air traffic control processes. It also lists recommended training for all ATM staff.
- Council Directive from the European Community issued on 29 May 1990 addresses the minimum safety and health requirements for work with display screen equipment.
- Defence Standard 00-25 comprises human factors guidelines for designers of military equipment.
- ARP4754 is a guideline from SAE International, dealing with the development processes which support certification of Aircraft systems.
- ISO 18152 'Ergonomics of human-system interaction' describes the process and the associated steps to consider human factors issues from design to operations.

- ISO 1503 ‘Spatial orientation and direction of movement’ outlines design principles for controls and displays. It emphasises the necessary uses of human perception characteristics, part of the body which operates the movement and the task to be performed when a control, display or workplace is to be designed.

- ISO 9241 ‘Ergonomics of human-system interaction’ provides guidance on human-centred design throughout the life-cycle of any computer-based interactive system and addresses the ergonomic requirements for both hardware and software. This includes:

    - Part 100: Introduction to standards related to software ergonomics
    - Part 110: Dialogue principles
    - Part 112: Principles for the presentation of information
    - Part 125: Guidance on visual presentation of information
    - Part 129: Guidance on software individualization
    - Part 161: Guidance on visual user interface elements
    - Part 171: Guidance on software accessibility
    - Part 210: Human-centred design for interactive systems
    - Part 300: Introduction to electronic visual display requirements
    - Part 302: Terminology for electronic visual displays
    - Part 303: Requirements for electronic visual displays
    - Part 304: User performance test methods for electronic visual displays
    - Part 400: Principles and requirements for physical input devices
    - Part 410: Design criteria for physical input devices

- ISO 11064-1 ‘Ergonomic design of control centres’ establishes a generic framework for applying requirements and recommendations relating to ergonomic and human factors in designing and evaluating control centres with the view to eliminating or minimising the potential for human errors.

- The ISA101 Committee will establish standards, recommended practices, and / or technical reports pertaining to HMIs in manufacturing applications.

- ARINC 661 is a standard used by aircraft manufacturers to address many of the concerns related to cockpit avionics displays design. It aims to normalise the definition of a Cockpit Display System (CDS), and the communication between the CDS and User Applications (UA) which manage aircraft avionics functions.

- BME 207 ‘Introduction to Biomechanics’ provides anthropometric data (e.g. normalised mass and length of body segments) that are useful to the design of working positions.