A Human Performance Standard of Excellence

A EUROCONTROL-FAA Action Plan 15 White Paper

December 2015

FOREWORD

EUROCONTROL / FAA Action Plan 15 on Safety Research is aimed at advancing safety concepts and practices in air traffic management, via the sharing of expertise from its membership. Since 2003 it has had three main aims: understanding system safety, developing new approaches to assess and improve safety, and disseminating its results into the industry. AP15 came into existence in 2003 and its current terms of reference run until end 2016.

AP15 activities and projects have focused on safety and more recently on human performance aspects linked to safety, especially in the context of air traffic operations as a high reliability industry. In air traffic management, people create safety and so there has always been an underlying human performance thread running through the AP15 activities. In 2010, an initial AP15 White Paper on Human Performance had sought to 'de-mystify' the relationship between the business goals of human performance and the supporting scientific discipline of Human Factors. The level of integration of Human Factors in the industry has, however, remained low in many ANSPs.

In late 2013, one of the Civil Air Navigation Service Organisation (CANSO) members attending an AP15 meeting asked that AP15 activities consider the development of a Human Performance Standard of Excellence (HPSoE). The aim would be that this HPSoE could be integrated into the successful and influential CANSO Safety Management System (SMS) Standard of Excellence. Since AP15's current terms of reference for 2014-2016 have a central focus on human performance, this was agreed. A Sub-Group of AP15 – Airservices Australia, Austro Control, Avinor, EUROCONTROL, FAA, LFV, NATS, and NAV CANADA – was formed to meet this challenge, including two separate workshops in Ottawa and Vienna in the summers of 2014 and 2015 respectively. The underlying framework was also assessed via two Human Factors conferences and via 14 ANSPs who trialled the HPSoE and found it relevant, useful and easy to apply.

This White Paper documents the HPSoE as developed by AP15. The next stage of evolution for the HPSoE will be by CANSO. They currently plan to integrate key elements into the SMS SoE and to develop guidance material for users. The AP15 Membership hopes this White Paper will help the air traffic management industry realise better usage and integration of human performance approaches in its pursuit of excellence in business performance and safety.

AP15 Membership

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- **FAA** – Jerome Lard [Co-chair], Dino Piccione, Paul Krois, Jim Daum, Michael Sawyer, Chris Scott
- **NASA** – Michael Feary
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- **AVINOR (Norway)** – Anne-ki Chavez
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- **Austro Control** – Michaela Schwarz
- **Airservices Australia** – Damien Armenis, Claire Marrison
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AP15 HPSoE Sub-Group Membership

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EXECUTIVE SUMMARY

People create safety. In the air traffic management industry, we rely on the performance of people to deliver a safe, effective and efficient service 24 hours each day.

A White Paper on Human Performance was produced by AP15 in 2010 and was found to be useful by ANSPs. However, despite that paper and a number of other supporting initiatives, there has been little noticeable adoption of human performance considerations by ANSPs. AP15 looked at the reasons for the limited engagement of the industry and asked more questions to better identify human performance needs. It concluded that Senior Management are looking for effective human performance that will drive business performance using key performance indicators (KPIs) such as safety, cost, efficiency and service delivery. To achieve this, they want to know:

> - Which elements of human performance should they focus on?
> - In which areas are they already doing well, and where would investments for improvement help business performance?
> - What are their peers and future ANSP partners doing in this area?
> - How far do they need to go, considering their size and scale of operations?
> - What are the first steps they need to take?

At a CANSO member's request, AP15 has developed a Human Performance Standard of Excellence (HPSoE) to help ANSPs answer the questions listed above. The AP15 HP SoE has followed the same format as the existing CANSO Standard of Excellence in Safety Management Systems (SMS SoE).

The HPSoE includes 12 elements of human performance with three being of particular importance, namely:

- Policy, Strategy and Resources i.e. the Organisational Focus on Human Performance
- ATM Equipment and Support Tools
- Investigation and Learning

Each of the 12 elements has 5 levels of maturity and each ANSP should assess their current maturity and improvement plans relative to their business goals.

Initial assessments against the HPSoE have been undertaken by 14 ANSPs of differing sizes encompassing different scale and complexities of operations. They believe that the HPSoE will help them to determine:

> - Their current level of human performance
> - Their target level of human performance
> - The actions required to sustain and / or improve human performance

The HPSoE could therefore be a useful tool for ANSPs to assess their human performance status and to show the general level of human performance for the industry. In order to do this, the tools and processes used by ANSPs to deal with these elements need to be fleshed out in more detail and guidance on self-assessment needs to be developed. It is anticipated

that this work will begin in 2016, under the auspices of CANSO, and may include integration of some of the elements into the existing SMS Standard of Excellence. If this happens, the HPSoE will be used to help ANSPs assure that human performance is integrated in ATM globally, maintaining ATM as an ultra-safe industry, and ensuring that people in ATM continue to create safety.

Background

People create safety. In the air traffic management industry, we rely on the performance of people to deliver a safe, effective and efficient service 24 hours each day. The entire aviation industry knows this, that their staff are their most important asset, and that they are key to business performance. Yet it has been known for some time that the scientific discipline that supports human performance, namely Human Factors, is often under-utilised in air traffic system design, development, and operation. This seemed to be because:

1. There was not a clear understanding of the potential contribution of human performance and the supporting discipline of Human Factors.

2. Many, indeed most, ANSPs have gotten along fine without a methodical recourse to Human Factors, so why do they need it?
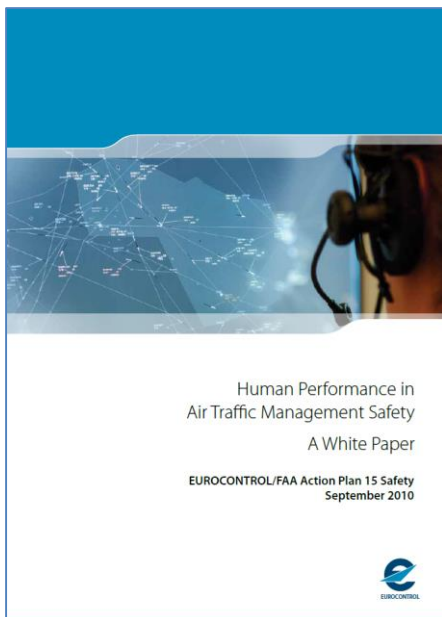
In 2010, AP15 developed and delivered a White Paper on Human Performance. The White Paper clarified what human performance is, and how the discipline of Human Factors supported human performance assessments in a number of key areas. Case studies from several ANSPs were provided showing clear evidence of the usefulness of the approach.

The White Paper was found to be useful by ANSPs (and still is today), and there was positive feedback. A number of ANSPs also welcomed that the paper focused on human performance as a means to improve their business performance, rather than simply aiming to further the discipline of Human Factors itself.

However, despite the positive benefits accruing from the White Paper and other initiatives, there was little noticeable increase in ANSPs' focus on human performance enhancement for business purposes, or the usage of Human Factors approaches and techniques. While this is now beginning to change in some ANSPs, there is still a long way to go.

The Human Factors experts in AP15 decided to take a page from their own book and adopt a user-centred perspective, and ask what the industry needed in terms of human performance. This led to an expansion of the 'normal' issues addressed, namely those closest to safety (including design of equipment, training, and incident investigation), to other broader issues

such as selection of personnel, roles and responsibilities, change management, and staff health and wellbeing.

This broader focus on human performance led to a key consideration, namely where human performance and Human Factors 'sit' in the organisation. All ANSPs, whether or not they have Human Factors experts, have a Safety Department and a Human Resources Department. All ANSPs already have an approach for such key issues as personnel selection, training, operational supervision, and investigation. Unfortunately, these departments often work separately from each other and the organisation does not gain the full benefits (or cost avoidance) available from a system-wide view of human performance.

HF is ready to help the existing team

Currently in ATM, Human Factors people typically are based in the Safety Department, or in Design and Development, or in Engineering, and in a few cases in Operations or Human Resources. Yet the discipline can help in other areas across the organisation.

The user-centred approach led to a simple model of what is needed at three levels. In the upper level, Senior Management are looking for effective human performance that will drive business performance in all areas, and are focused on their own key performance indicators such as safety, cost, efficiency, productivity and service delivery.

At the next level are the elements that together deliver high human performance, from personnel selection and training to investigation and change management. These are functions the organisation needs to have in place, and they can all operate with or without the support of Human Factors. The third layer is where Human Factors can offer support to these areas, in terms of engineering approaches and scientific techniques.
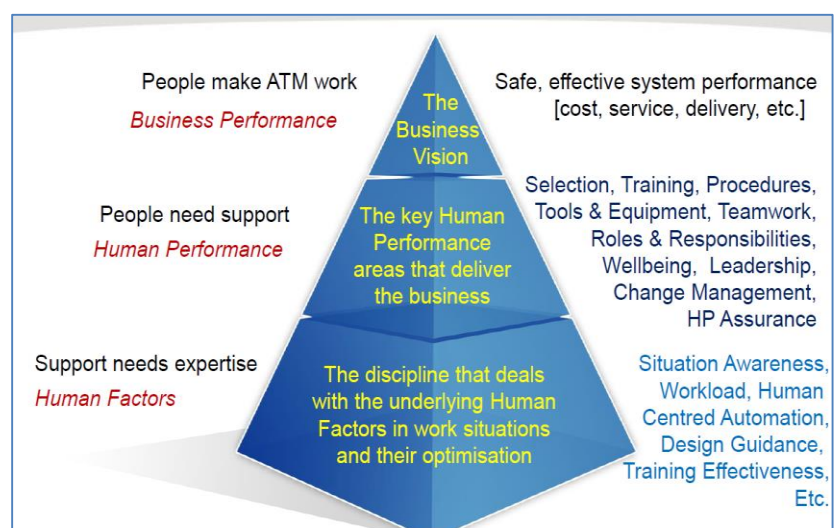
Despite laying out a landscape of human performance – what it is, how it links to business goals, and how Human Factors can support it – this does not necessarily help ANSPs decide what to do. Again, taking the user-centred approach, there were residual questions for an organisation:

> ➢ Which elements of human performance should they focus on?
> ➢ In which areas are they already doing well, and where would investments for improvement help business performance?
> ➢ What are their peers and future ANSP partners doing in this area?
> ➢ How far do they need to go, considering their size and scale of operations?
> ➢ What are the first steps they need to take?

These questions had all been asked before, in another context, that of safety and safety management. Some years ago, ANSPs differed in the ways they did safety, and their 'levels' of safety were perceived as varying significantly. There was no common benchmark from which to judge who was doing well and how others could and should aim to improve.

CANSO Standard of Excellence in Safety Management Systems

CANSO and their Members helped resolve this situation by developing a Safety Management System Standard of Excellence. This was a significant effort over a period of several years, and resulted in a system by which ANSPs could rate themselves on a number of SMS dimensions, and see how they compared with their peers and the general ANSP community. This approach has been hugely beneficial in helping ANSPs to reach a common minimum level of safety management, and since it was first introduced, most ANSPs have significantly improved their SMS approach. ANSP operational safety has therefore been enhanced across Europe, North America and globally.

At a CANSO Member's request during an AP15 meeting in Paris in late 2013, AP15 undertook to develop a similar Human Performance Standard of Excellence (HPSoE). There were two issues recognised as important from the outset. The first is that whereas safety is mandated in ATM, human performance is not. The second is that the degree of human performance desired must be

Benchmarking & Scalability

scalable, since there is a large range of ANSP sizes and operations, from very small to very large ANSPs. The HPSoE is intended to help ANSPs rather than becoming a burden, especially when there is already pressure on most ANSPs to reduce their costs.
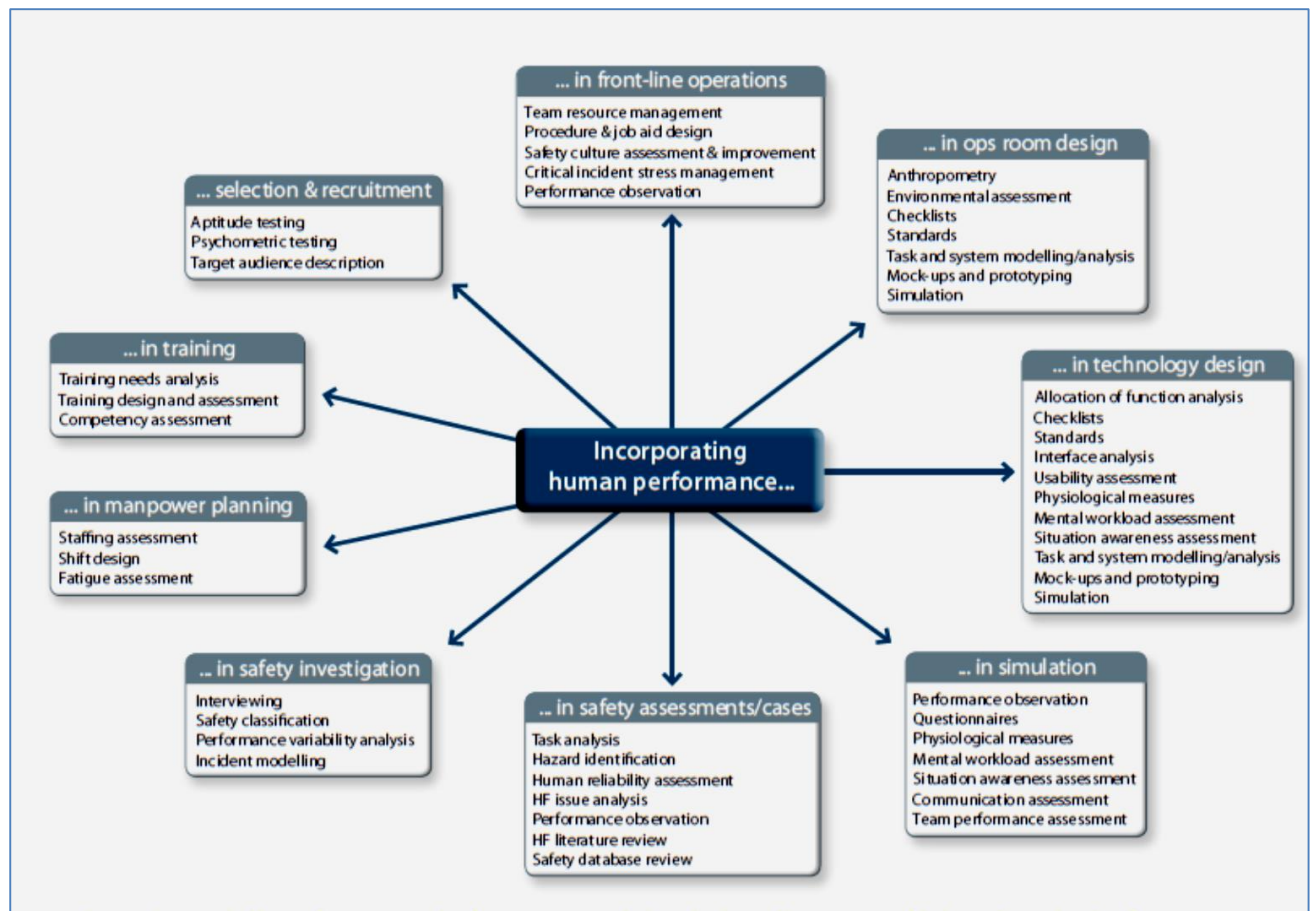
It was also recognised from the outset that development of a HPSoE would require significant and focused work. A Sub-Group of AP15 was formed led by NATS and NAV CANADA, with input from Airservices Australia, Austro Control, Avinor, EUROCONTROL, FAA, and LFV. These ANSPs brought both human performance and operational expertise to the Sub-Group. Workshops were held in August 2014 and 2015 in Ottawa and Vienna to develop and refine the HPSoE.

In the first of these workshops, the overall 'landscape of the HPSoE was developed focusing on twelve elements as shown in the figure below.

Amongst these twelve elements, the first one, Organisational Focus on Human Performance, is a critical one. It determines the degree to which the ANSP strives for excellence in human performance across its entire workforce, and the degree to which such ambitions are reflected in policies, organisational strategies and allocation of resources.

Supporting these twelve elements are Human Factors techniques and approaches, such as those described in the White Paper on Human Performance and summarised in the figure below.

... in front-line operations
Team resource management
Procedure & job aid design
Safety culture assessment & improvement
Critical incident stress management
Performance observation

... in ops room design
Anthropometry
Environmental assessment
Checklists
Standards
Task and system modelling/analysis
Mock-ups and prototyping
Simulation

... selection & recruitment
Aptitude testing
Psychometric testing
Target audience description

... in training
Training needs analysis
Training design and assessment
Competency assessment

... in technology design
Allocation of function analysis
Checklists
Standards
Interface analysis
Usability assessment
Physiological measures
Mental workload assessment
Situation awareness assessment
Task and system modelling/analysis
Mock-ups and prototyping
Simulation

... in manpower planning
Staffing assessment
Shift design
Fatigue assessment

Incorporating human performance...

... in safety investigation
Interviewing
Safety classification
Performance variability analysis
Incident modelling

... in safety assessments/cases
Task analysis
Hazard identification
Human reliability assessment
HF issue analysis
Performance observation
HF literature review
Safety database review

... in simulation
Performance observation
Questionnaires
Physiological measures
Mental workload assessment
Situation awareness assessment
Communication assessment
Team performance assessment

How the HPSoE was developed

Two three-day workshops occurred with the Sub-Group of ANSPs. At the first one in August 2014 at NAV CANADA in Ottawa, a decision was taken to adopt the SMS SoE format as a template for the HPSoE. This workshop defined the human performance element 'landscape' by considering a range of documents from the human performance literature, including non-aviation sources, as well as considering the human performance issues of interest to the ANSPs in the group. This led to the identification of a set of elements that ANSPs as well as Human Factors practitioners would recognise as key to delivering human performance.

It was also recognised that an additional element was required, one that dealt with the organisational understanding of the need for human performance and a commitment to supply an appropriate level of resources.

Therefore, a key component of the HPSoE is the need for a policy, strategy and resources for improving human performance. People create safety and people make ATM work. An appreciation of this at an organisational level is required if improvements to human performance are going to be made. While the focus of an organisation is often on the front line controllers, other groups of operational staff such as supervisors and Air Traffic Engineers should not be forgotten as their human performance also has an impact on the safety and effectiveness of ATM provision.

These elements were refined and presented to the EUROCONTROL Safety Human Performance group in Malta in September 2014 to test the appetite for such a tool. Feedback was positive. The tool was then further refined and presented at the AP15 meeting in Paris in November 2014 and reviewed by the full AP15 group.

In 2015, the prototype tool was presented at two Human Factors conferences, one in the UK and one in the USA, to gain academic feedback. In both cases this was positive. It is noteworthy that the UK conference was not aviation-specific and at that conference several other industries expressed interest in the approach (e.g. pharmaceutical, nuclear power).

Testing of the HPSoE occurred in two phases. In the first phase, the eight ANSPs involved in the HPSoE's development assessed their own organisations against the HPSoE. This led to a number of refinements of the elements. In Phase 2, six additional ANSPs who had had no prior involvement in the HPSoE carried out assessments for their organisations. This led to final refinements, in particular eliminating one of the elements that was seen as unnecessary.

Phase 1 ANSPs

Australia (Airservices Australia)
Austria (Austro Control)
Canada (NAV CANADA)
Maastricht (EUROCONTROL)
Norway (Avinor)
Sweden (LFV)
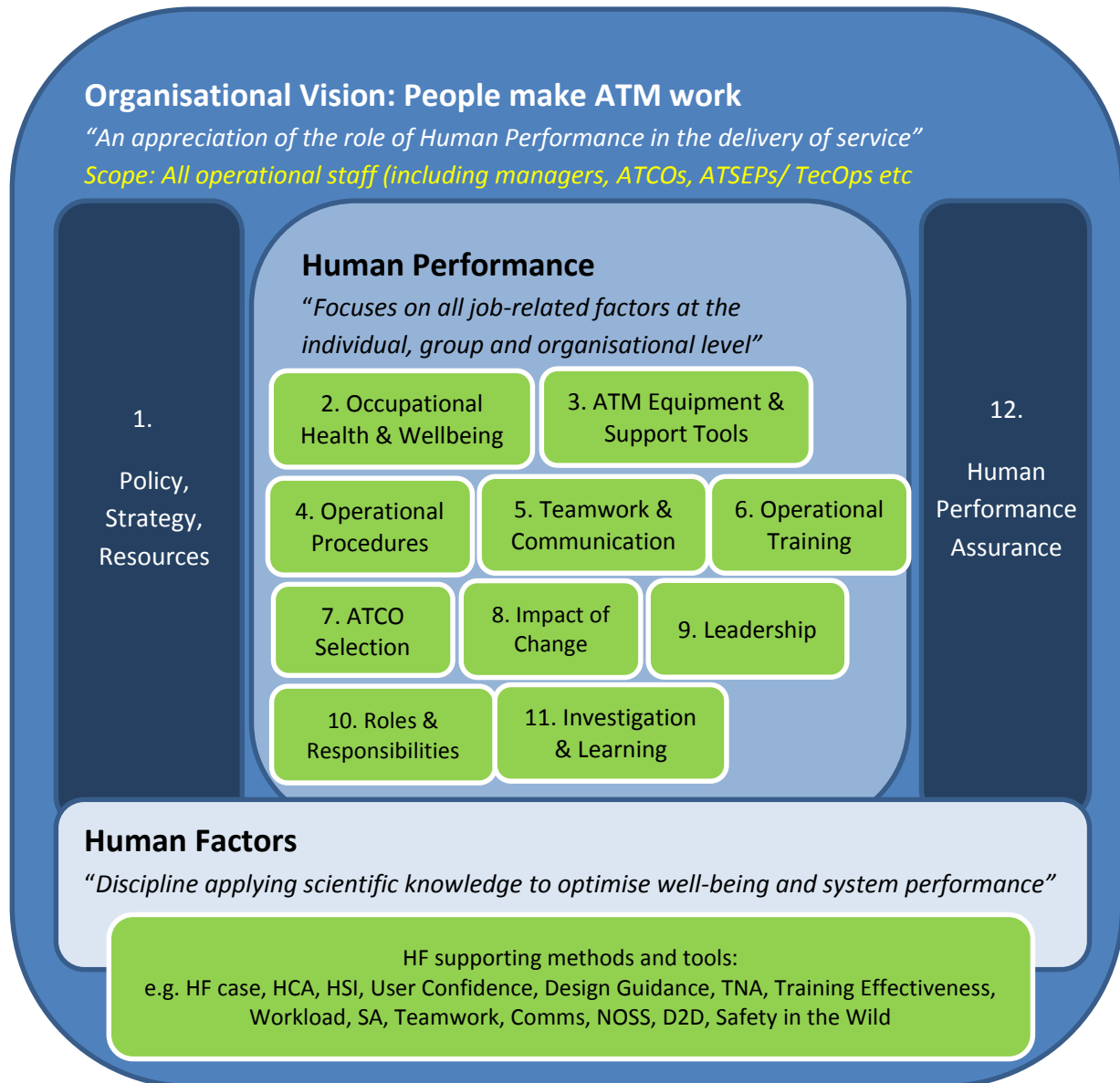UK (NATS)
USA (FAA)

Phase 2 ANSPs

Belgium (Belgo Control)
Finland (Finavia)
France (DSNA)
Hungary (Hungarocontrol)
Ireland (IAA)
Singapore (CAAS)

In August 2015, the AP15 HPSoE Sub-Group met in Vienna at Austro Control and carried out a moderation exercise. This was to ensure that organisations were self-assessing in a consistent manner. The final version of the prototype HPSoE was then produced.

The concept was presented to the CANSO Safety Standing Committee in its meeting in Punta Cana in October 2015. There, a number of additional ANSPs expressed interest in, and support for, the HPSoE.

The Human Performance Standard of Excellence

The figure below gives an overview picture of the HPSoE element 'landscape'.

Organisational Vision: People make ATM work
"An appreciation of the role of Human Performance in the delivery of service"
Scope: All operational staff (including managers, ATCOs, ATSEPs/ TecOps etc

Human Performance
"Focuses on all job-related factors at the individual, group and organisational level"

1.

Policy, Strategy, Resources

2. Occupational Health & Wellbeing

3. ATM Equipment & Support Tools

4. Operational Procedures

5. Teamwork & Communication

6. Operational Training

7. ATCO Selection

8. Impact of Change

9. Leadership

10. Roles & Responsibilities

11. Investigation & Learning

12.

Human Performance Assurance

Human Factors
"Discipline applying scientific knowledge to optimise well-being and system performance"

HF supporting methods and tools:
e.g. HF case, HCA, HSI, User Confidence, Design Guidance, TNA, Training Effectiveness, Workload, SA, Teamwork, Comms, NOSS, D2D, Safety in the Wild

The twelve elements of the HPSoE are as follows:

1. **Policy, Strategy, Resources** - *The degree to which the ANSP recognises the importance of people and puts in place policies and resources to actively measure and monitor their human performance.*

2. **Occupational Health & Wellbeing** - *To ensure occupational health (i.e. mental and physical health) and wellbeing of staff to improve human and system performance. (This is a shared responsibility between ANSP and staff.)*

3. **ATM Equipment and Support Tools** – *To ensure that the operational environment including equipment, support tools and work stations (software and hardware) provide optimal support to job performance.*

4. **Operational Procedures** – *To optimise operational procedures (e.g. SOPs, maintenance / AIS procedures), take into account job tasks as done and involve end users so as to optimise Human-System performance.*

5. **Teamwork and Communication** - *To optimise communication, performance and shared situational awareness when working together and across system interfaces.*

6. **Operational Training** - *To ensure that training provides the required skills, knowledge and safe attitudes for air traffic operations. This includes the successful completion of training and periodic refresher training used for certification approval.*

7. **ATCO Selection** - *To ensure that recruitment, screening, interviewing and selection for controller positions is done to ensure safe and effective performance.*

8. **Impact of Change** - *To ensure the impacts of a change on human performance are identified, assessed and managed.*

9. **Leadership** - *To improve human performance across the organisation by providing purpose, direction and motivation for the operational environment by leaders (e.g. supervisors, shift and unit managers, project managers and middle and top management).*

10. **Roles and Responsibilities** - *To ensure that roles and responsibilities are clearly defined, reflect work as done and lead to effective human performance across the organisation.*

11. **Investigation and Learning** - *To identify strengths and weaknesses related to human performance aspects arising from events and to share and implement lessons learnt across the workforce.*

12. **Human Performance Assurance** - *To provide assurance that human performance is managed effectively. To ensure that the integration and application of Human Factors methods and processes are fit for purpose and focused on reducing risk, optimising human-system performance and realising business benefits.*
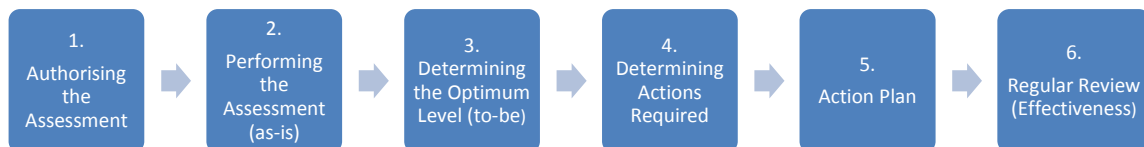
The detail of these 12 elements can be found in Appendix A, while Human Factors supporting tools are listed in Appendix B. The list of tools presented here is for illustration purposes - there may be others that can also be used to support human performance. It is intended to develop more detailed guidance at a later stage on how such tools and associated processes can support the different human performance elements.

At the lowest level of excellence, an ANSP fails to recognise sufficiently the importance of the role that people play in delivering a safe, efficient and high quality level of service. The ANSP complies with the minimum regulatory requirements but no more. At higher levels of excellence, the ANSP has better recognition of the importance of people and puts in place policies and resources to actively measure and monitor their human performance. At the highest level of excellence, human performance is an integral part of the ANSP's strategic vision and business plan with people being recognised as integral to the success of the organisation regardless of the minimum regulatory requirements.

The organisational element is therefore seen as having an overriding influence on the degree to which the ANSP can optimise its human performance effectiveness.

How to use the HPSoE

Step-Model Process of Assessment

1. Authorising the Assessment	→	2. Performing the Assessment (as-is)	→	3. Determining the Optimum Level (to-be)	→	4. Determining Actions Required	→	5. Action Plan	→	6. Regular Review (Effectiveness)

1. Authorising the Assessment

The prime objective of this step is to put someone in charge for the conduct of the assessment. The assessment can be performed by one individual on behalf of the organisation, however the experience from the previous assessments of 14 trial ANSPs has shown that a more accurate assessment is gained by involving someone from as many departments as possible, namely those who manage the day-to-day processes associated with each element. Depending on the organisational structure, this will differ from ANSP to ANSP. For example, an ANSP may involve someone in charge of training, engineering, procedures, acquisitions, safety and human resources departments. Preferably, it may also involve one or more operational persons such as a supervisor / manager from one of the units. The objective is to gain a multi-disciplinary perspective during the assessment.

It is good practice to involve operational experts (air traffic controllers, air traffic safety electronics personnel, flight information services etc.) as well as trade unions / staff associations in the process as early as possible. This will increase the awareness of what Human Factors can bring to the organisation and facilitate the implementation of action plans to improve human performance. Experience from the trial assessments shows that, depending on the structure of the organisation, managers or safety experts may over / underrate human performance depending on their level and breadth of operational knowledge.

2. Performing the Assessment (as-is)

The process used to perform the maturity assessment consists of taking each element one at a time, understanding the objective and then reading each column, from Initiating (Level 1) to

Continuous Improvement (Level 5). The ANSP would then determine where the ANSP believes they are meeting the requirements of each level. It is possible that an organisation finds that it has portions of each level of maturity. However, before one can determine if an organisation is at a particular level for a particular element, all the requirements under lower levels have to be met. For example, if an organisation determines that they are meeting all the requirements for Implementing under the Policy, Strategy and Resources element plus one or two requirements under Managing and Measuring, the level of maturity score for that element would be 3 (Implementing).

It is important to document the justification or reason as to why an ANSP believes they are at a particular level for any element and what steps are needed to get to the next maturity level. This is valuable information for future assessments to go back to and revisit the previous justification so as to understand shortfalls and assess progress. It may also be useful if an organisation compares themselves to other ANSPs of comparable size and complexity in an attempt to understand their respective scores and performance.

3. Determining the Optimum Level (to-be)

Once the assessment is completed, an organisation has to determine if the maturity level for each element is acceptable or whether higher levels are required to achieve desired business performance goals. For example, an organisation may have reached, say, Level 4 (Managing & Measuring) on the personnel selection element, but still experience an undesirable validation success rate. Further work could therefore need to be undertaken at Level 4 before considering a move to Level 5. Further, an ANSP may decide that a Level 2 or 3 for any element is perfectly acceptable and that they are meeting their business performance goals by staying at that level.

There are several ways for determining the optimum maturity level. One approach is to look at other performance data from within the organisation that is collected from, for example, incident investigation, safety assessments, hazard analyses, regulatory audits, safety cases, post implementation reviews and Senior Management meetings. The principle here is to use multiple lines of evidence that may suggest certain deficiencies in, for example, the ATCO training programme or how operational procedures are developed. Such information will prove invaluable in corroborating the results of the assessment, but also point at which elements (if any) need improvement and their priority.

Another approach which is known to have benefits is to share and discuss your assessment results with other ANSPs to understand their assessments, and learn where their strengths and areas for improvement are. This may shed light in terms of another ANSP's experience in human performance management and how they achieve a particular level. Sometimes moving up a level, especially from Level 1 to 2 or even from Level 2 to 3, may not be as difficult as it might first seem.

A third approach is to give priority to the core elements of effective human performance which are 1) Policy, Strategy and Resources, 2) ATM Equipment and Support Tools and 3) Investigation and Learning. If an ANSP scores low (Level 1 or 2) for any of these elements, it is recommended that a higher level of maturity is sought as a priority.

It should be noted that it is the organisation that determines which level of maturity should be reached. Depending on the size and complexity of the organisation it may be decided that lower levels of maturity are sufficient.

4. Determining Actions Required

The description under each maturity level for the respective elements provides a general idea of the process(es) that an ANSP needs to have in place in order to attain a higher maturity level. Once these have been identified, the determination of the specific actions needed to implement any processes is best done either by soliciting other ANSP's input on what they did in order to implement specific processes indicative of higher maturity, or else engaging with human performance professionals. While there are numerous books and other publications that can provide insight, the most efficient approach is generally to learn from other ANSPs, possibly with some Human Factors consultancy support if required. Overall, learning from other ANSPs what works and doesn't work, and what actions are needed to implement a new process, is an effective and efficient approach.

5. Action Plan

The next step is to put into a plan the actions needed to achieve a higher maturity level. If no change is desired, the plan could simply be to review the status after a certain period (e.g. two years) although actions to sustain a current level are usually required.
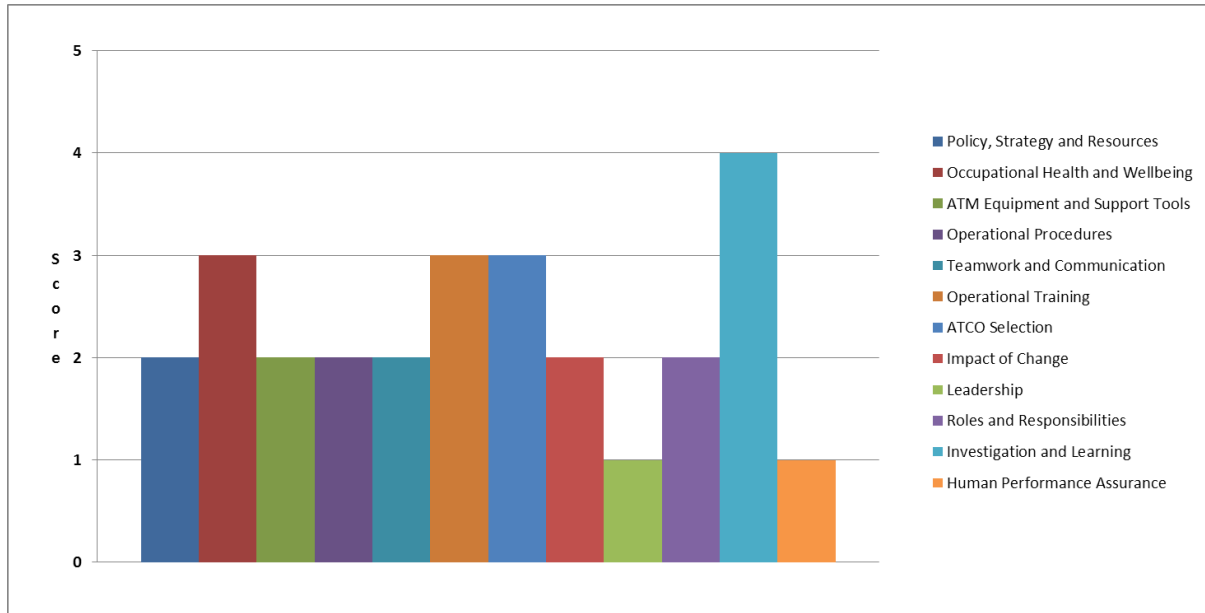
One of the key steps in the development of any action plan is to determine the roles and responsibilities assigned to any specific action. The 12 elements of the HPSoE indicate that a multi-disciplinary approach will be most effective in human performance management. This is why, at the very beginning of the assessment, a multi-disciplinary team was recommended. This same team can be empowered to implement the action plan, as they will have been involved throughout the assessment. More importantly, they will have buy-in and take ownership of it. It is suggested that this team report to one of the Directors (e.g. Safety Director, Director Operations, Director Human Resources, Director Acquisitions, etc.) who can periodically update the appropriate governance group (e.g. the Executive Board) on status and progress. As with any action plan, realistic time frames should be assigned for each action (other ANSPs may provide insight) along with measures and indicators for determining the successful implementation of actions i.e. that the desired effect has been achieved and not merely that the action has been 'done'.
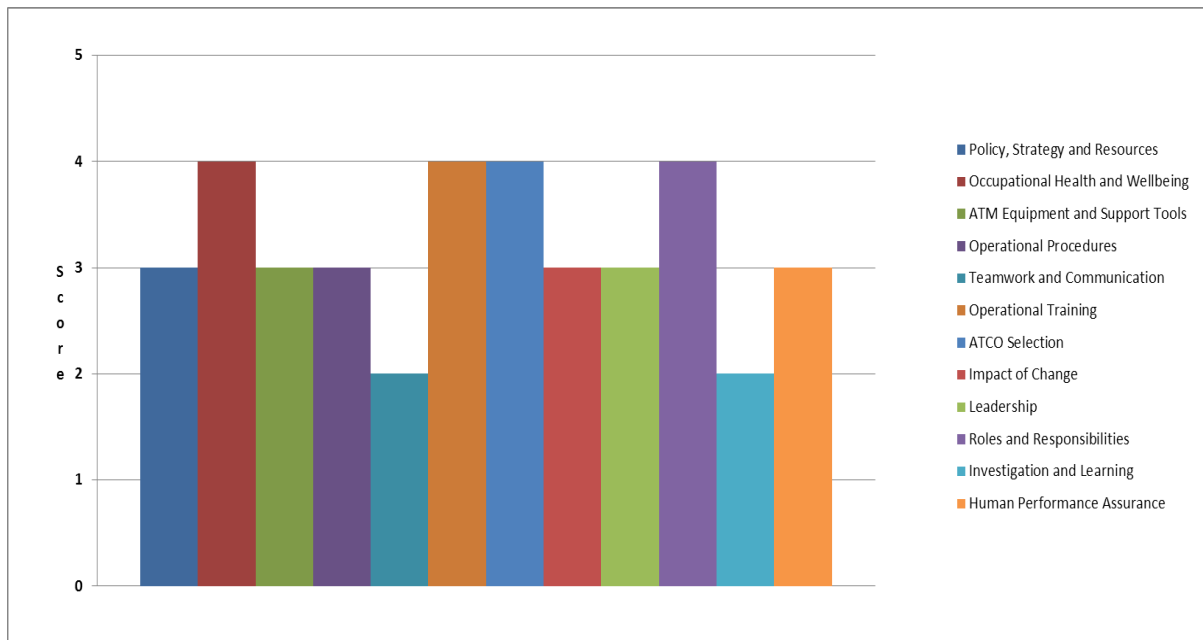
6. Regular Review (Effectiveness)

The final step is to regularly review the previous assessment results and compare them to the current situation and the business performance goals. The main objective of this last step is to determine whether the organisation has improved its human performance at the associated levels. It is also possible, based on the actions taken, that the organisation has improved but still does not fulfil all requirements at a particular level and so cannot progress to the next level. It is also possible that while the organisation has improved on some elements, it may have decreased performance in others.

Trial Assessments by ANSPs

As part of the development process, 14 ANSPs assessed themselves against the SoE. Three examples of the results from these assessments are shown below.

Legend:
- Policy, Strategy and Resources
- Occupational Health and Wellbeing
- ATM Equipment and Support Tools
- Operational Procedures
- Teamwork and Communication
- Operational Training
- ATCO Selection
- Impact of Change
- Leadership
- Roles and Responsibilities
- Investigation and Learning
- Human Performance Assurance
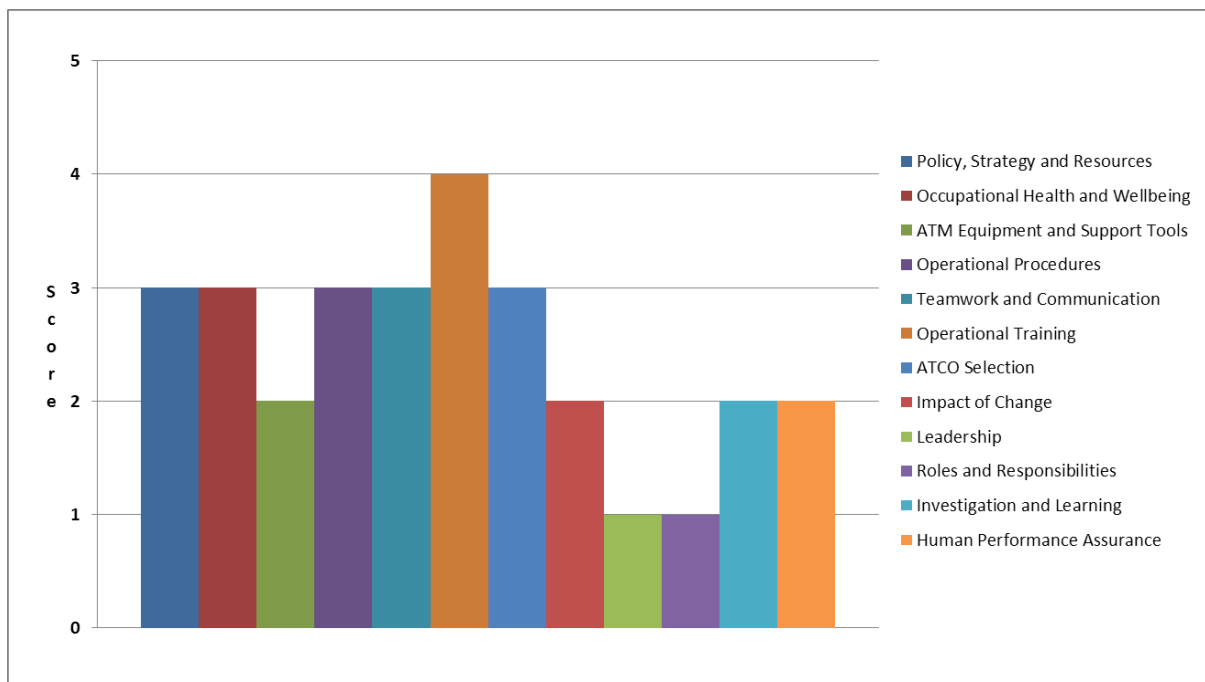
While these are initial and not fully validated assessments, a number of interesting points can be noted.

- Each ANSP has a wide spread of scores across the different elements. For example, the first two ANSPs shown have scores ranging from Level 1 (Initiating) up to Level 4 (Managing and Measuring).
- The assessments identify clearly where each ANSP already has a high level of human performance, and where they could improve should they choose to do so.
- Across the three ANSPs, there is a spread of scores for each element. For example, scores for Roles and Responsibilities range from Level 1 (Initiating) to Level 4 (Managing and Measuring). This shows that sharing knowledge and best practice about human performance across ANSPs could be mutually beneficial.
- Even the third ANSP, while generally scoring better than the other two, could potentially learn from them.

ANSPs were asked to provide evidence as to why they believed that they had achieved a particular level. Some examples provided are as follows:

An ANSP assessed itself as achieving **Level 3 (Implementing)** against the **Occupational Health & Wellbeing** element. The rationale for this score was:

- A Critical Incident Stress Management (CISM) programme is in place for all controllers.

- Preventative measures such as regular free medical health checks, a free gym and free fruit are available for all controllers.

- Evaluations of mental workload are undertaken for all staff.

- Good quality rest facilities are provided for all controllers.

- Occupational health and wellbeing factors are considered during incident investigations.

- Some fatigue risk management education material is available.

An ANSP assessed itself as achieving **Level 4 (Managing and Measuring)** against the **ATM Equipment and Support Tools** element. The rationale for this score was:

- A process is in place within the project management procedures which ensures that the end users of the system (controllers, supervisors, engineers etc.) are involved throughout the project lifecycle for new or upgraded ATM equipment and tools.

- All stages of the project lifecycle are covered by the process including requirements identification and definition, design and prototyping, build, test and validation, training, implementation and operation. The process covers both systems that are bought off the shelf with little adaptation and systems which are bespoke to the ANSP.

- Throughout the project lifecycle, Human Factors measures are taken to provide assurance that safety requirements will be met. These Human Factors measures include: workload, situation awareness, team working, communication, the effectiveness of training, and the competence and confidence of the users in using the new equipment / tool.

- A set of principles is available against which the use of or implementation of automated functions should be assessed. These principles are used by the Human Factors team during the project lifecycle to determine the impact on the user of automating a function and whether this is appropriate.


An ANSP assessed itself as achieving **Level 4 (Managing and Measuring)** against the **Operational Training** element. The rationale for this score was:

- Daily briefing is conducted by means of face to face and electronic briefing systems.

- All operational units have a published Unit Training Plan and conduct training throughout the year.

- Investigations feed input into training updates and this is included in refresher and Unit Competency Examination checks.

- In-house simulators are utilised for training.

- Training budgets are factored into yearly business plans, for future developments and improvements in an operational context.

A Snapshot of the State of Human Factors in ATM

The following graph shows the range of scores from the 14 ANSPs. The most popular score differs greatly between the elements. For example, ten of the ANSPs scored themselves at Level 4 (Managing and Measuring) on *Operational Training*. For *Teamworking and Communication*, *Leadership* and *Human Performance Assurance*, seven or eight of the ANSPs considered themselves to be at Level 2 (Planning / Implementing). Very few ANSPs in the survey considered themselves to be at Level 5 (Continuous Improvement) for any of the elements.

The 'average' level across all the ANSPs is approaching Level 3 (Implementing). However, a number of the ANSPs sampled are only at the Level 2 (Planning / Initial Implementation) stage for a number of the elements. Given the importance of human performance and the changes the industry is facing, it might be desirable to see the overall average shift to Level 3 (Implementing) or higher, whether for the entire set of elements or for those judged to be most critical for safe operations. Whilst this 'snapshot' is based only on trial assessments, it does for the first time give an indication of the state of Human Factors and human performance support across the ATM sector.
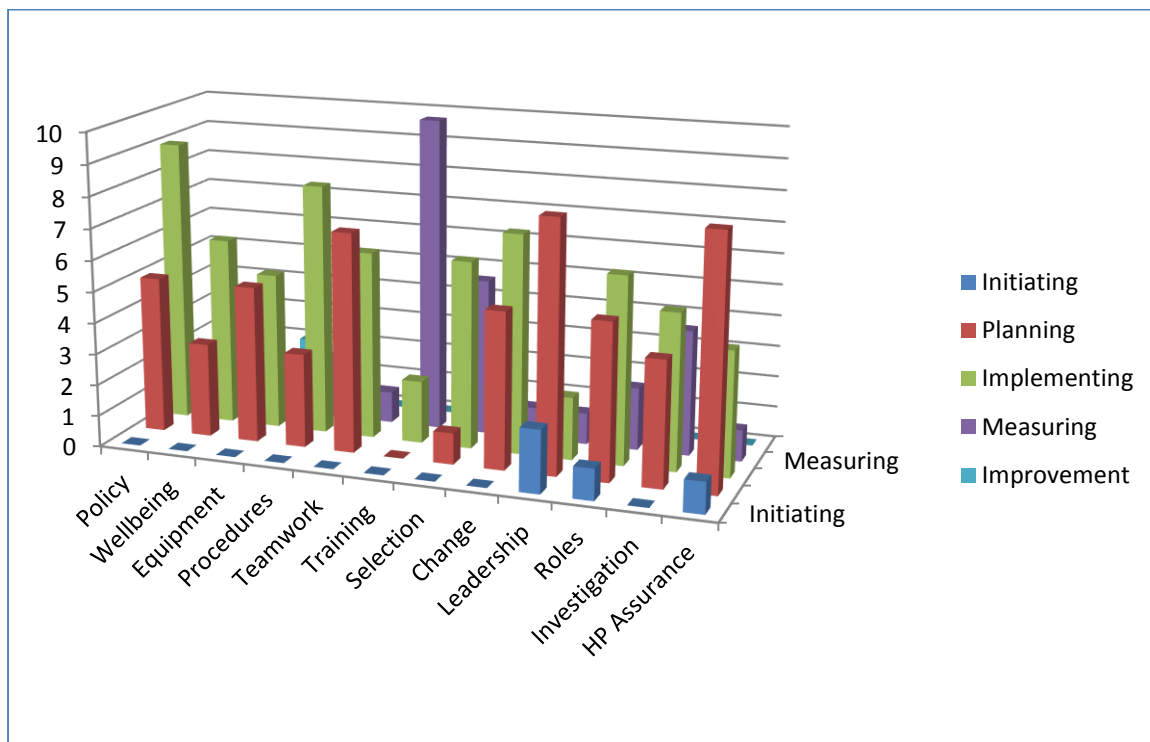
Improving Human Performance

As stated earlier, an ANSP firstly needs to consider whether it is appropriate to move to a higher level for a particular element. The following Case Study from an ANSP demonstrates an example of where it may not be appropriate to strive to achieve higher levels of human performance.

An ANSP purchases all of its ATM equipment from a large, renowned supplier. The equipment purchased has been used successfully for a number of years by other ANSPs of a similar size and type of operation and no changes or customisations are made to the equipment when installed. The ANSP uses the equipment in the same way as other ANSPs.

The ANSP currently assesses itself as being at Level 3 (Implementing) for ATM Equipment and Support Tools. Given the way that the ANSP procures, implements and operates equipment, this is an appropriate level to achieve. The costs of achieving Level 4 (Managing and Measuring) are judged to outweigh the benefits and human performance needs for this particular ANSP.

There are circumstances, however, where it may be appropriate to strive for higher levels of human performance. This is illustrated by the following Case Study from an ANSP.

An ANSP is undertaking a large change programme to modernise its technologies, systems and procedures such that it can cope with expected increases in traffic and to meet its customers' service expectations.

For Impact of Change, the ANSP currently assesses itself as being at Level 2 (Planning / Initial Implementation). This is because end users have very little involvement in the changes being planned unless the change is very significant. There are no procedures or methods in place to assess the impact of change on human performance.

The ANSP wants to achieve Level 3 (Implementing) because it recognises that implementing the planned changes successfully are critical to the business and its customers. In order to achieve Level 3, it plans to:

- Increase communication about the change programme including: the need for change; the consequences for individuals affected; and the benefits to be realised
- Implement procedures that require the impact of change on users to be determined
- Secure the services of a specialist Human Factors expert who will contribute to projects by identifying the potential impact of change on human performance
- Increase the size and budget of project teams so that they can take appropriate actions to implement the findings of the Human Factors expert.

There are clearly costs associated with implementing the above actions but the ANSP considers that these are outweighed by the potential business benefits of implementing necessary change quicker, cheaper and without increasing safety risk.

First reactions to the HPSoE

The first version of the HPSoE was introduced to the EUROCONTROL Safety and Human Performance group in October 2014 in Malta and was further tested in two rounds of facilitated self-assessments with more than a dozen ANSPs in 2015. A selection of first reactions from COOs, safety management and human performance experts participating in the facilitated self-assessments can be found below in chronological order:

- *"Great idea, this is something we needed 10 years ago!"*
    - Keith Cartmale, Safety Manager, EUROCONTROL Maastricht.
- *"I consider it an excellent tool to measure the human performance level within an organisation"*
    - Des Whitty, ATM Specialist, IAA.
- *"The template gives good advice on where to reach and what to seek next"*
    - Paavo Puranen, Safety Analyst, Finavia.
- *"The HPSoE is a great health check for organisations on how to evolve and it is easy to use!"*
    - Thomas Hoffmann, Chief Operating Officer, Austro Control.
- *"It was a gift, this is really what we need"*
    - Raf Haazen, ATCO / ATS Instructor, CISM Manager, Belgocontrol.

Conclusions

The work undertaken to develop a Human Performance Standard of Excellence (HPSoE) for ATM has demonstrated that:

- A landscape can be produced outlining the human performance elements that should be considered by an ANSP
- The HPSoE can be used effectively by ANSPs of different sizes, operational scale and complexity, and levels of maturity
- The 14 ANSPs in the proof of concept believe that the HPSoE will help them to determine:
    - Their current level of human performance
    - Their target level of human performance
    - The actions required to sustain and / or improve human performance

The HPSoE could therefore be a useful tool for ANSPs to assess their human performance status and to show the general level of human performance and Human Factors across the industry. In order to do this, the tools and processes used by ANSPs to deal with these elements need to be fleshed out in more detail and guidance on self-assessment needs to be developed. It is anticipated that this work will begin in 2016, under the auspices of CANSO, and may include integration of some of the elements into the existing SMS Standard of

Excellence. If this happens, the HPSoE can be used to help ANSPs assure that human performance is integrated in ATM globally, maintaining ATM as an ultra-safe industry and ensuring that people in ATM continue to create safety.

Acknowledgements

Appendix A: The HPSoE

Element 1: Policy, Strategy, Resources

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To provide a consistent and reliable level of Human Performance which ensures a safe, efficient and high quality level of service.	There is no recognition of the importance of the role that people play in delivering a safe, efficient and high quality level of service. The ANSP is in continual compliance with the minimum regulatory standards in respect of licencing, training, reporting etc.	There is some recognition of the value that improving Human Performance can bring. The company has functions responsible for areas such as training, occupational health, investigations etc. Initial planning is in place to improve Human Performance but only after problems are identified.	There is a policy in place that addresses human performance in a systemic way (e.g. inside existing policies). Human Performance is being actively improved. There is recognition of the value that Human Factors expertise can bring. A person is identified with a clear remit, budget and program for addressing Human Factors issues and they are embedded within a division of the organisation.	Key Performance Indicators are in place to measure Human Performance and to identify priorities for improvement. The Human Factors capability (formal HF qualification i.e. academic degree, internal/ external) available is tailored and proportionate to the maturity and complexity of the ANSP. They are operating within several divisions of the organisation.	HP is built into the organisation's strategic vision/ business plan. The role of the human is recognised as being integral to the success of the organisation and is considered early in concept development. The ANSP supports and uses Human Factors research & development (e.g. collaboration with universities on specific research questions e.g. Master/ PhD students, external publications etc.) as a means of gaining intelligence on how to improve Human Performance.

Element 2: Occupational Health & Wellbeing

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To ensure occupational health (mental and physical health) and wellbeing of staff to improve human and system performance. (shared responsibility)	Health and Wellbeing is not at all considered as an organisational responsibility. It is individual staff member responsibility to care for personal health and welfare at work (as well as at home).	It is recognised that the organisation can influence and support occupational health and wellbeing at work (e.g. healthy food / drink options, regular medical checks, free vaccines, reduced gym fees, supervisory observations, psychological evaluation, provisions to call in sick/ unfit for duty)	There is a strategy and procedures / processes in place to support occupational health and wellbeing including awareness training and support programs (access to Critical Incident Stress Management (CISM) peers, coaching etc.). Factors affecting occupational health and wellbeing are considered during incident investigations or other surveys. Ad-hoc fatigue risk management (FRM) education material is distributed.	There are structured support programs (e.g. employee assistance programs, critical incident stress management) in place for all staff in line with occupational health & wellbeing standards (e.g. ISO, ICAO / ECTL) Factors affecting occupational health and wellbeing (e.g. task and workload, fatigue, stress & rostering/ shift planning, job satisfaction, career opportunities) are measured and monitored (e.g. people engagement surveys, wellbeing and absenteeism studies, FRMS).	Factors affecting occupational health and wellbeing are continuously measured and improved. A feedback process is in place to inform Human Resources of key Human Performance issues. It is recognised that health and wellbeing is a shared responsibility between the employer and the employee. Research and Development studies are addressing health and wellbeing in ATM staff.

Element 3: ATM Equipment and Support Tools

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
The operational environment, including equipment, support tools, work stations (software and hardware), provides optimal support to job performance.	Operational systems are implemented with limited consideration of user needs. Operational capabilities are driven by commercially available technology availability rather than user requirements.	Reliance is on common sense and operational experience. Design acceptance is driven by operational preference.	Available human factors design standards and best practices are used. Prototypes and real time simulations are used to test designs (depends on the size and complexity of the change/ as part of risk assessment). End users are involved in the requirements definition and testing process. A formal process is used to integrate human factors in operational and acquisition projects and addresses human performance benefits and issues throughout a project's lifecycle.	Feedback is received to improve future designs. End users are involved in the design and test processes and / or tailoring of design to the operational environment. Human Factors measures (e.g. workload, situational awareness, etc.) are used to validate new interfaces and tools. Changes to automation or new automated functions are assessed in specific HF studies (e.g. surveys, deeper analysis of impacts on the operators).	Users are at the centre of the workstation / tool design process. Live operational data is used to determine how the system is actually used compared to the intended concept of use and to identify opportunities for improvement and evolution of working practices. Formal Human Factors analyses are used to inform allocation of functions between controllers and automation.

Element 4: Operational Procedures

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
The operational procedures (e.g. SOPs, maintenance/ AIS procedures) take into account job tasks, as done, and involve end users so as to optimise Human-System performance.	The regulatory required procedures are in place. There is reliance on manufacturers' commercially available procedures with minimal or no tailoring. Non-users (e.g. Controllers, Engineers, Technicians) develop the procedures.	A dedicated procedure design function exists but with reliance on common sense and non-current operational experience. Procedures are documented but not tested in an operational context.	User requirements are specified based on a range of operational conditions. The adequacy of a procedure (e.g. error tolerance, complexity, non-nominal conditions, degraded modes) is assessed with users of the procedures using a formal method (e.g. simulation, risk assessment, HAZOP, safety survey). Some simulation (e.g part-task \ full-scale, low fidelity) is used to develop and test procedures. Data from investigations and safety analyses is used to inform procedures development.	Procedures consider interfaces between different operational users (e.g. Controllers, Pilots, Technicians, Ramp Operations). Human Factors methods (e.g. Human Factors review or HF Case, task analysis, usability analysis) are used as an input into the design, structure, and content of the procedures. Full scale high fidelity simulations are used using current, licensed operational staff (e.g. controllers, pilots) to optimise procedures. Some field observation (e.g. NOSS/ EUROSS/ D2D) and data collection is used to determine the effectiveness of procedures and human performance.	A recognised user-centered approach ensures that users (e.g. Controllers, Pilots, Technologists) are at the centre of the procedure design process. Live field observations (e.g NOSS) and operational data (e.g. data mining using system outputs) is used to determine how the procedure is actually used and its effectiveness . The evolution of working practices and opportunities for improvement in system performance is identified. Users have formal opportunities to discuss procedures and identify areas for enhancement. .

Element 5: Teamwork and Communication

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To optimise communication, performance, and shared situational awareness when working together and across system interfaces.	Teamwork and team performance is not considered as being part of the service delivery. Operational groups are working independently from each other to achieve different goals	There is some recognition of team attitudes, behaviours and teamwork relations and how they influence performance. Operational groups from a distinct unit or department are considered as having dedicated team responsibilities working together towards a common goal / purpose. Groups from different units / departments work independently from those teams. There are some "team building" activities in place. Teamwork is recognised as contributing factor to safety events.	Teamwork is considered a skill supporting human and system performance. Controllers are trained on positive attitudes and behaviours towards teamwork. There is a policy in place to develop and reinforce Team Resource Management (TRM) principles (e.g. teambuilding activities, watch briefings, facility safety councils). Groups from different units / departments who collaborate over time to achieve a common goal are considered as being a "team" with dedicated team responsibilities.	There is a systematic TRM Program in place including regular training & licensing of all operational staff (including engineers/ technicians) and recording and evaluation of team working skills. Teamwork is recognised as a mitigating factor to safety events. TRM skills are part of the competency scheme and are practiced and reinforced in live and simulator operations.	Effective team working practices and team performance are considered as major resources to mitigate safety events and to improve performance. Team performance is compared across operational teams to ensure teams learn from each other and continuously improve their performance. Research is done looking at team factors in the ATM system.

Element 6: Operational Training

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To ensure that training provides the required skills, knowledge and safe attitudes for air traffic operations. This includes the successful completion of training and periodic refresher training used for certification approval.	The training approach adheres to ICAO or state minimal training requirements. No in-house simulation capability exists.	Training responsibility is assigned to operational staff. They report training performance to an operational manager. Training is provided on changes to airspace, procedures and equipment in response to new and recurrent safety hazards associated with incidents and accidents. Minimal in-house simulation capability exists for training.	Responsibility for training is identified as a key duty at the local facility level via the provision of full-time training staff. An in-house simulation capability exists. Controllers and engineers/ technicians are trained to handle adverse events and degraded modes. Training is available for supervisors and managers. Training is also available for recruiters, OJTIs, competency examiners and investigators.	There is centralised management of training performance. Written training plans exist with measures for tracking training effectiveness. Training requirements and costs are factored into business plans. Local operational experience is used to update training content and techniques. Multi-position simulation capability is used for major changes. The incident investigation team informs training content. Exit interviews are used to increase the performance of the training process	A multi-year business strategic vision is built for continuously improving training. The effectiveness of daily briefings for controllers and engineers/ technicians is assessed and continuously improved. Outcomes from continual improvement include reduction in incidents and increased training success. The ANSP works with others outside of the organisation to seek to improve training effectiveness. New training packages are used to enable the controller and engineers/ technicians to transition into new roles and functions in line with major changes in the ATM system (e.g. FABs, SESAR, NextGen).

Element 7: ATCO Selection

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To ensure that recruitment, screening, interviewing, and selection of applicants for controller positions is done to ensure safe and effective performance.	There is a human resources office that provides a central administrative function for hiring new controllers. New hires are already certified controllers or the ANSP relies on contractors to provide resources.	The ANSP uses generalized, non-ATC specific assessments of applicants' prior education, work experience and other minimum qualifications. The ANSP considers different pools of job applicants, e.g. military controllers, college graduates, the general public. The ANSP recognises the need to test for specific ATC aptitudes.	Specific ATC testing is used to screen applicants for aptitudes found to be important for successful job performance. Multiple assessment methods are used to evaluate applicants (e.g. psychometric tests, computer based tests, interviews, personality tests etc.)	The aptitude of applicants is determined through performance-based assessments of multiple dimensions. Studies are conducted to demonstrate the empirical validity of its aptitude assessments. Exit interviews are used to increase the performance of the selection process	A multi-year business strategic vision is built for continuously improving the selection process using scientific methods and criteria. Outcomes include increased training success, reduced training costs and time, staff retention, staff satisfaction and on the job performance. The ANSP supports and uses Human Factors research and development to continually validate the personnel selection system and to guide changes to it in pace with changes in the ATC system.

Element 8: Impact of Change

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To ensure the impacts of a change on Human Performance are identified, assessed and managed.	There is no consideration of the impact of change on Human Performance. It is assumed that end users will simply adapt to the change. End users are not involved when considering the need for change or how to ensure the change is successful.	There is recognition that change impacts Human Performance and should be considered in the change process. End users are informed about the change process, but have no opportunity or role to have a substantive impact on the Human Performance aspects of the change.	There is a function in place manage the impacts of each change (project view) on human performance. The change process includes human performance analysis. Human Performance requirements are identified. End users understand their role in the change process and have an opportunity to impact the change in time.	There is a function in place that manages and monitors the potential impact of multiple changes (program view) on human performance at the individual, group, unit and organisational level. There is evidence that the Human Performance requirements have been met and are sustained. Measures are used to evaluate the effectiveness of the change in meeting the human performance requirements. Tools are integrated across the design, development, implementation and operational stages of the project lifecycle. Post implementation reviews are carried out and inform how human performance requirements are addressed in the change process.	The medium and long term social, cultural and demographic factors resulting from change are predicted. Management is trained in recognising the signs of readiness for change and the organisation is assessing readiness for change. There is evidence that formal monitoring mechanisms beyond the post-implementation review are in place to support the benefits of the change in Human Performance. Emerging or changing trends in Human Performance are identified.

Element 9: Leadership

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To improve Human Performance across the organisation by providing purpose, direction and motivation for the operational environment by leaders (e.g. supervisors, shift and unit managers, project managers and middle and top management).	There is no recognition of the role that leadership plays in improving Human Performance. Leadership is related to seniority or job title. Staff are passive and have no motivation, or desire to be involved in change or improvement.	There is recognition that leadership plays an important part in improving Human Performance. Staff are motivated and engaged in at least one area of the business. Plans are being developed to increase leadership capability with a focus on human performance.	There is a process in place to identify leadership potential. Leaders receive training on how to be effective leaders (e.g. having difficult conversations). Leaders engage staff in a shared vision with a specific focus on human performance. Staff are motivated and engaged at work. They understand that they are responsible for their behaviours and actions.	The effectiveness of leadership is measured and informs an organisation-wide leadership program. Staff have the opportunity to provide confidential feedback on their leaders. Leaders are open and welcome challenge by staff. Leaders give recognition for outstanding Human Performance. The organisation recognises and uses informal leaders (e.g. union representatives, well-respected ATCOs and engineers).	Incentives and reward systems have a measured positive effect on human performance across the organisation. Everyone is prepared to take the lead. Senior leaders spent time in the operational environment on a regular basis and engage with ATCOs and engineers to understand Human Performance challenges to the business.

Element 10: Roles and Responsibilities

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To ensure that roles and responsibilities are clearly defined, reflect work as done, and lead to effective human performance across the organisation.	Basic roles and responsibilities are in place but are not linked to the Human Performance goals of the organisation. Many job descriptions do not accurately reflect the way in which people actually execute their duties (work as done vs work as designed).	There are plans in place to formally assign roles and responsibilities for delivering Human Performance goals within the organisation. Plans are in place to identify how work is actually done within the organisation.	There is a clear understanding of the requirements to assign roles and responsibilities for delivery of the Human Performance goals of the organisation. Analysis in connection with new or changed functions (e.g. human performance review) identifies new or changed roles and responsibilities. There is a process in place to align roles and responsibilities with the way in which duties are actually executed within the organisation.	Roles and responsibilities are communicated and understood by all staff (e.g. to avoid unclear mandates, overlapping duties). The organisation measures how effective staff are fulfilling their roles and responsibilities related to Human Performance management against a set of requirements. As a result of understanding work as done, there is alignment of individual and collective efforts to the Human Performance goals of the organisation.	A formal review process is in place to ensure that the roles and responsibilities remain valid up-to-date and integrated with the changing organisation, strategy and environment. The organisation consistently strives to optimise Human Performance through allocation of roles and responsibilities as a standard part of its organisational review processes.

Element 11: Investigation & Learning

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To identify strengths and weaknesses related to Human Performance aspects arising from events and to share and implement lessons learnt across the workforce.	There is no consideration of the Human Performance aspects of events.	The need to identify the human aspects is recognised and plans are in place to achieve this. There is no taxonomy for Human Performance aspects in place.	A Human Factors method (e.g. Human Factors review or HF Case, task analysis, usability analysis) is used by qualified and experienced personnel to identify the human performance aspects. Lessons learned on Human Performance are disseminated to the rest of the workforce.	The positive and negative Human Performance aspects for significant investigations are determined directly from all involved parties and are evaluated. Human Performance trends and indicators are identified using different data sources to determine underlying and systemic factors. Early warnings of developing trends are transmitted to the workforce. Lessons learnt on Human Performance are fed back into training, design and other areas to reduce the likelihood of reoccurrence.	There is a focus on what parts of the system need to be addressed to ensure improvement. Human Performance data sources are used to anticipate the evolution of safe Human Performance in the organization, and to identify drift into failure. Lessons learnt related to human performance are shared with external stakeholders. The organisation learns from stakeholders and other industries.

Element 12: Human Performance Assurance

Objective	Initiating	Planning / Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
To provide assurance that human performance is managed effectively.

To ensure that the integration and application of Human Factors methods and processes are fit for purpose and focussed on reducing risk, optimising human-system performance, and realising business benefits. | There is no perceived business need to manage and measure human performance.

There are only ad hoc considerations of Human Performance.

No Human Factors methods are applied. | The organisation recognises the relevance of Human Factors methods in enhancing business performance.

Plans are being developed to provide Human Performance assurance.

The organisation to a particular project / change / issue, where human performance is seen as critical. | An accepted Human Performance assurance process exists.

Human Factors methods are applied to a range of activities such as system design and service delivery.

Expertise is available to draw informed conclusions on the application of Human Factors methods in projects, investigations and change. | A Human Performance approach is integrated within the organisation's documented policies and processes.

Indicators have been developed to evaluate the effectiveness of Human Factors methods and to track the success of the Human Performance assurance process. | The resulting data from the evaluations of Human Factors methods are used to make continuous improvements to the Human Performance Assurance approach.

Evaluation indicators are also used to drive business and operational decisions. Return on Investment is evaluated.

Real time Human Performance data is used to identify trends over a wide spectrum of performance parameters. |

Appendix B: HF Supporting Tools

The list of tools presented here is for illustration purposes (there may be others that can also be used to support human performance). It is intended at a later stage to develop more detailed guidance on how such tools and associated processes can support the different human performance elements.

HF Supporting Tools	
Scope	**Tool/ Method**
Front-line Operations	- Team Resource Management (TRM) - Procedure & Job Aid Design - Safety Culture Assessment & Improvement - Critical Incident Stress Management (CISM) - Performance Observations - Safety Surveys (NOSS, EUROSS, D2D, Safety in the Wild) - Automation Management
Ops Room Design	- Anthropometry - Environmental Assessment - Checklists - Standards - Task & System Modeling / Analysis - Mock-Ups & Prototyping - Real-time / fast-time Simulation
Technology Design	- Allocation of Function Analysis - Focus Groups - Mission analysis - Checklists - Standards - Interface Analysis (e.g. heuristic analysis, interface surveys) - Usability Assessment (e.g. user trials, walkthrough analysis) - PsychoPhysiological Measures (e.g. heart rate, electrodermal activity, brain activity, eye movements / blinks) - Mental Workload Assessment - Situation Awareness Assessment - Task & System Modeling / Analysis - Mock-Ups & Prototyping, scenario based Design - Simulation
Simulation	- Performance observation - Questionnaires

HF Supporting Tools	
	• Psycho-Physiological measures • Mental workload assessment (e.g. NASA TLX, SWAT, ISA) • Situation awareness assessment (e.g. SAGAT, SART, SASHA) • Communication assessment • Team performance assessment (e.g. BOS, HTA (T), TTA)
Safety Assessments/ Cases	• Task analysis (hierarchical / cognitive task analysis) • Performance Time Assessments (e.g. critical path analysis, KLM) • Hazard identification • Human reliability assessment (e.g. SHERPA) • HF issue analysis • Performance observation • HF literature review • Safety database review • Fault/ Event Tree Analysis • Decision Aid Diagrams • Work Domain Analysis • Resilience Assessment (e.g. FRAM)
Safety Investigation	• Interviewing • Safety classification • Performance variability analysis • Human Error Analysis (HAZOP, HERA, HEIST, HEART etc) • Accident Models (e.g. STAMP, AIM) • Time Event Analysis • Root Cause Analysis
Manpower Planning	• Staffing assessment (e.g. LAMP / CHAMP) • Shift design • Fatigue assessment (e.g. FIT, KSS, Sams-Perelli)
Training	• Training needs analysis • Training design and assessment • Competency assessment
Recruitment & Selection	• Aptitude testing (e.g. FEAST, KASOs) • Psychometric testing • Target audience description • Personality testing • Work sample tests • Resilience Assessment (e.g. CDrisk)