

GLOBAL STATE OF HUMAN PERFORMANCE MANAGEMENT IN AIR NAVIGATION SERVICES

2022 Survey on the current management of
Human Factors and Human Performance

Acknowledgements

This publication is a product of the CANSO Human Performance Management (HPM) Workgroup.

We also thank all the participating members for their invaluable contributions both in terms of data but also for their insights, recommendations and creative solutions. This has enabled our CANSO HPM workgroup to provide the widest range of information and feedback on human performance from across the globe.

This publication also serves as a tool for other ANSPs to gauge their HP/HF effort and to guide those that have not yet started the journey, benefiting their part of the industry over time as an investment in safety.

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Foreword

As we continue to recover globally from the Covid-19 Pandemic, our focus has been renewed towards establishing a strong and resilient future for the Aviation industry. Central to so many of the strategic and management questions are our people. The impact of the pandemic has been most felt in the home, in the operations rooms and in the towers as our teams have had to show great strength, courage and creativity to continue to provide services around the world. But it has often come at a cost to mental well-being, motivation, and confidence.

The state of employment in general has also shifted. Many of us have discovered newfound flexibility in home offices, changes to our working hours or even new roles and opportunities, and all of this is playing out amongst an uncertain future of climate change, increasing automation and technology, and changing philosophies towards work itself.

The results of our survey have shown that Human Performance is increasingly important across the globe. Of note are the initiatives not only for assisting in the acute crises such as maintaining skills, keeping services open and adjusting to changing traffic patterns but also towards longer term planning and evolution of the role of people themselves in our Air Navigation Services.

Human Performance covers a wide range of topics that are fundamental to safe and efficient operations and with an increasingly wide range of experts and knowledge the development of enhanced support to all these topics is becoming more widely available. Our workgroup is comprised of psychologists, human factors specialists, operational experts, safety engineers and scientists and selection, recruitment and training experts who passionately provide support where it is needed. We are a close community and believe that open knowledge sharing is the best way to raise awareness of the importance of human performance for stronger safety and operational results.

In 2019, CANSO introduced the Human Performance Management standards of excellence which aimed to help organisations focus their limited resources into optimising the state of human performance and human factors within a broader Safety and Quality management system. This standard has been adopted by many service providers but there is room for growth and improvement. This survey aimed primarily to establish a baseline understanding of the global state of Human Performance Management so that CANSO can continue to support members and organisations where it most matters. Our goals now shift towards tailoring this support to enhance the standards of excellence. The workgroup is currently active in topics such as fatigue risk management and well-being, air traffic controller competencies, collecting objective human performance data from our systems and promoting human performance topics to our partners and regions.

I would like to thank the HPM workgroup and all participating CANSO members for their invaluable contributions. I would like to especially thank Milena Studic of Skeyes for her contribution and dedication to data collection and data analysis for whom this project would not have been completed. I would also like to thank the Safety Steering Committee for their guidance and support.

Lea Sophie Vink

Chairwoman, HPM Workgroup

Introduction

Human beings at their best

Air navigation service providers (ANSPs) are responsible for the safe and efficient management of global air traffic. This includes managing and enhancing airspace capacity through improvements to technology, infrastructure and above all, the strengthening and development of a skilled and productive workforce. Central to almost every operation on earth are competent and experienced human operators. They link all elements of a complex socio-technical system and are responsible, along with pilots, ultimately for the safe navigation of aircraft.

At our best, human beings can achieve and solve almost any problem and crisis and every day across the earth this human performance quietly maintains one of the most complex socio-technical systems on the planet. But whether they are the experts who manage the system, operational engineers, meteorologists, or air traffic controllers, there is a big cost to this expertise. Every ANSP must manage the cost of these resources against the needs to deliver air traffic. This affects the entire business plan from recruiting and selection through to training and competencies, licencing through to every day performance issues such as stress, fatigue, well-being, and health.

The management therefore of human performance is a central focus for all ANSPs. In 2019, CANSO introduced the human performance management standards of excellence (SoE). The goal of this tool was to help ANSPs centralise expertise and resources to optimise the management of human performance within a wider safety and quality management system. Utilising the standards of excellence maturity model ANSPs can benchmark their own levels and develop and improve their human performance management. The HPM SoE was developed based on a white paper from Eurocontrol, FAA and CANSO members and was written to be in line with the CANSO Standards of Excellence in Safety Management Systems.

Why is it important to benchmark the state of human performance management?

Since the publication of the SoE in 2019, there has been a global uptake of the tool. Early indication suggested the SoE was proving to be very beneficial, especially to organisations with mature safety management systems. However, the arrival of the global Covid-19 pandemic and the subsequent shutdown in air traffic necessarily meant ANSPs worldwide focused on dealing with the acute issues. Many utilised the SoE for advice on the most important factors. However, regular meetings of the HPM workgroup revealed that as ANSPs are beginning to recover the SoE are increasingly being used for strategic planning, the development of get-well plans and for enhanced understanding of the importance of people. It was also reported that the SoE could be enhanced so that organisations could make better use of them in both implementation and for design of future policies and operational guidelines.



Figure 1 - CANSO HPM SoE

The pandemic brought to light not only the importance of people in our complex socio-technical system but also of their creativity and resilience in the face of extremely difficult circumstances. Changes to the way we work such as home office, flexible routines and increased use of digital teamwork via online platforms has made the topic of human performance relevant to every individual not just in our industry but in society. Added to this, the changing pace of what is important to us as people in terms of meaningful work, well-being and work-life

Introduction

balance has shed new urgency on the importance of designing workplaces, jobs and roles correctly as we also introduce new automation and airspace user demands into the system.

In their work with organisations worldwide, the HPM workgroup has also come across a wide range of technical and academic definitions for common subjects such as human performance, human factors, safety culture, just culture, fatigue risk management and team resource management. As we become an increasingly closer international community of experts, with open knowledge sharing, the opportunity has arisen to benchmark these global trends in human performance management so that CANSO support can be tailored appropriately in the years ahead and the HPM SoE can be optimised and their use strengthened to help all ANSPs develop strong human performance plans for the future.

Design of the survey

To improve the SoE, help organisations recover from the pandemic with a clear human focus and to update and tailor the needs of the workgroup for supporting partners, the HPM workgroup, in 2021, elected to focus on a benchmarking exercise by developing a comprehensive survey to address all of the above topics. The questions were developed by a sub-group of experts in human factors, safety management and psychologists. The survey was conducted via an online platform and data was analysed by the HPM workgroup. In total, over 40 ANSPs were invited to participate from every continent. Alongside the survey, ANSPs were invited to hold virtual meetings with the HPM WG experts who helped guide them through their answers.

The survey consisted of 61 questions ranging on topics from demographics, through to definitions on key human performance terminology, strategic and policy tools and ultimately, the most pressing needs of each ANSPs for human performance management.

Next Steps

The data presented in this report can be used in a variety of ways. Organisations are invited to compare their own maturity against the data of over 20 ANSPs around the world and we hope that the information can be used to help guide these organisations in the development of their own human performance strategies and policies. But the HPM workgroup will also use this data to focus on a range of topics. Our workgroup is further divided into sub-working groups that focus on different areas. Four main goals have been developed by the workgroup:

1. The results will ultimately contribute to the development of a CANSO guidelines for human performance management strategy which aims to provide direction for the role of humans in air traffic management in the next decades.
2. Over the next three years we aim to develop enhanced guidance on the use of the HPM SoE based on the results of this survey. We will develop an appendix of how-to's and advice on implementing the SoE into organisations and for using them to develop new strategies or strengthen existing ones.
3. The HPM workgroup will expand our 'open knowledge sharing' approach by hosting and promoting human performance terminology, best practices and theoretical and academic support to organisations who need our help. Based on this report, we will develop a pathway to provide the best support where it is most needed. We will work closer with other CANSO Workgroups to integrate our products and solutions.

Finally, we are working on exciting new initiatives in 'hot topics' such as fatigue risk management, well-being in the operation and deep data analysis for human performance metrics. The results of this benchmark will be used to guide us on how best to present this work for a global reach.

At all times, the HPM workgroup is available for support on any topic concerning human performance, human factors, team resource management and organisational psychology in air traffic management. We encourage organisations to contact us and welcome opportunities to exchange and share knowledge.

1. Demographics

1.1 Participating ANSPs

In total 21 ANSPs spanning across 21 countries and five continents participated in the survey on current management of HF and HP (see Figure 2). The participating ANSPs are listed below in alphabetical order:

- AEROTHAI (Thailand)
- Airservices Australia (Australia)
- Air Traffic Organization, FAA (USA)
- ANA (Luxembourg)
- ATNS (South Africa)
- Austro Control GmbH (Austria)
- BHANSA (Bosnia and Herzegovina)
- BULATSA (Bulgaria)
- DSNA (France)
- ENAIRE (Spain)
- HungaroControl (Hungary)
- IAA (Ireland)
- Jamaica Civil Aviation Authority (Jamaica)
- LPS SR (Slovakia)
- MATS (Malta)
- MNAV (North Macedonia)
- NATS (UK)
- NAV CANADA (Canada)
- PANSA (Poland)
- skeyes (Belgium)
- skyguide (Switzerland).



Figure 2 - Survey participants

1. Demographics

1.2 ANSP size

The population of 21 participating ANSPs was classified into four clusters on the basis of the following criteria:

- number of movements (in 2019)
- number of operational ATCOs (in 2019)
- number of operational ATSEPs (in 2019)
- expert judgement.

ANSP size	ANSP	Number of movements (2019)	Number of operational ATCOs (2019)	Number of operational ATSEPs (2019)
extra-large	FAA	above 10,000,000 movements/year	above 10,000 ATCOs	above 5,000 ATSEPs
large	AEROTHAI AirServices Australia DSNA ENAIRE NATS NAV CANADA	between 1,200,000 and 10,000,000 movements/year	between 800 and 10,000 ATCOs	between 300 and 5,000 ATSEPs
medium	ATNS Austro Control BHANSA BULATSA HungaroControl IAA LPS SR PANSA skeyes skyguide	between 500,000 and 1,200,000 movements/year	between 100 and 800 ATCOs	between 50 and 300 ATSEPs
small	ANA Jamaica CAA MATS MNAV	below 500,000 movements/year	below 100 ATCOs	below 50 ATSEPs

Table 1 - ANSP clusters based on size

1. Demographics

1.3 ANSP ownership

The ownership structure amongst the participating ANSPs is the following (see Figure 3):

- 15 are State-owned (no private shareholders OR a unique shareholder (i.e. the State)),
- Five are Partly state-owned (one or more private shareholders in addition to the State),
- One is Private (one or more private shareholders).

Ownership can be an important factor in considering the impact to humans within organisations. Publicly owned organisations are often more resistant to change because the urgency to maintain competitive advantage is not as pressing. This can make them more stable and resilient, and this is a benefit to staff well-being and stress. However, change management, creative development and innovation can be more difficult and slower. Privately owned organisations have different needs and employees are often acutely aware of these needs. It can make change management faster and more efficient and leads to creative and innovative solutions. However, it can be more unstable and leads to higher levels of stress with reduced well-being. Staff turnover is often much higher and this leads to less resilience. When understanding the human performance needs of an organisation this is especially relevant.

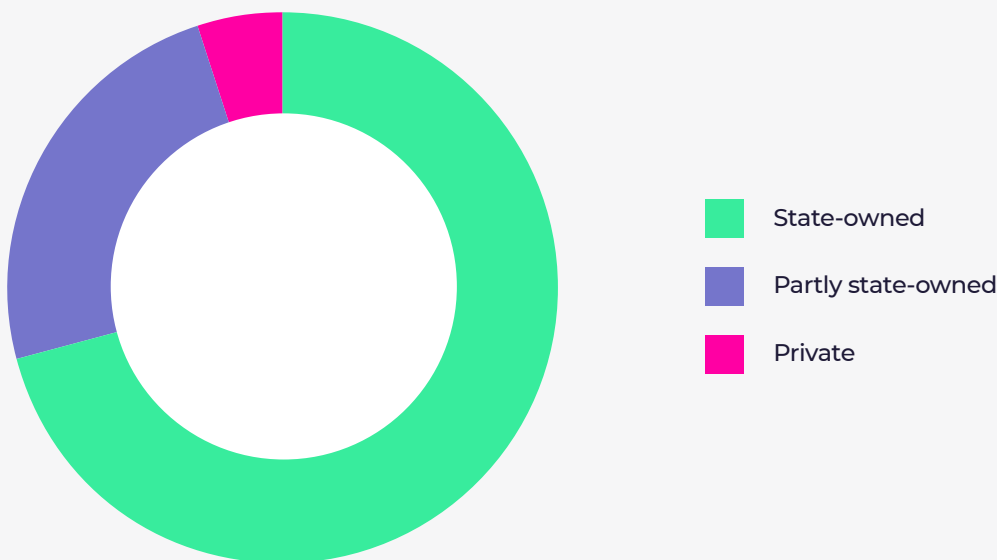


Figure 3 - ANSP ownership

2. HF/HP-related management scope

Expert discussions within the CANSO HPM WG have identified differences in the understanding of HP within the ATM community. The scope of the survey has been derived primarily from the ICAO definitions of HP and HF respectively (IDOC 10151) as follows:

- human performance (HP) refers to how people perform their tasks. HP represents the human contribution to system performance.
- human factors (HF) is concerned with the application of what we know about human beings, their abilities, characteristics and limitations, to the design of equipment they use, environments in which they function and jobs they perform.

To understand the perceptions that ANSPs have regarding various concepts, participants were asked to share their internal definitions of HP, HF, OHS and wellbeing as well as to share their experiences about the local implementations of these concepts. This allows for best practice benchmarking and understanding of what key international and national policies are driving the human performance management.

Of the surveyed ANSPs, it can be observed in Figure 4 that the great majority of ANSPs do actively manage HF, HP and OHS. Wellbeing is slightly less present within the sample of surveyed ANSP likely because the topic of wellbeing is often not a mandatory requirement and is the topic which has gradually been gaining popularity in recent years. Another likely reason is that wellbeing is often incorporated in National work and employment law. For example, since the majority of ANSP respondents are based in countries with mature employment law where the rights and wellbeing of employees are protected, this can mean that wellbeing is sometimes assumed.

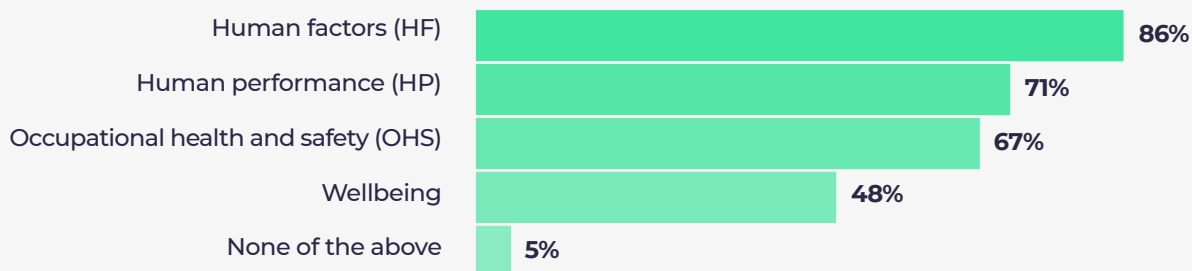


Figure 4 - HF/HP-related management scope

2. HF/HP-related management scope

Content analysis of provided definitions of HF and HP concepts identified 4 clusters of responses:

- responses consistent or aligned with IDOC 10151 (55% of participating ANSPs);
- responses consistent with EU REG 2017/373 (17% of participating ANSPs);
- responses based on definitions could not be attributed to the two points of reference above (17% of participating ANSPs)
- concepts are not defined (11% of participating ANSPs).

Furthermore the results of analysis of definitions of OHS and wellbeing identified and even greater variability in responses that can be attributed to the variability in local regulatory frameworks in the domain of OHS and the absence of regulatory frameworks in the domain of wellbeing. Even within one organisation, a colloquial understanding of terms such as wellbeing can become a cultural norm. Since this concept is rapidly gaining attention, more work could be done to raise a standard industrial understanding of what wellbeing means for Human Performance in terms of Safety and Human Error as well as sustainability of performance.

RC #1: CANSO HPM WG shall move towards defining industry standard definitions by also working with ICAO, IATA and EASA to streamline these concepts for consistency worldwide. Once complete, CANSO HPM WG is to perform a promotion campaign on raising awareness about the definitions of HF, HP, OHS and wellbeing of the concepts and their relationship.

OBS #1: With certain exceptions, the size of the ANSP can be associated with the level of understanding of HF, HP, OHS and wellbeing concepts – larger ANSP had a more precise understanding of the HF, HP, OHS and wellbeing concepts that aligned with international and/or regulatory standards.

3. CANSO HPM SoE familiarity

The CANSO Standard of Excellence (SoE) in Human Performance Management (HPM) was launched in 2019 to help air navigation service providers (ANSPs) assess, develop and improve their human performance management. The use of Standards of Excellence exists in other safety and business domains.

Soon after its launch, the ATM industry was hit hard by the pandemic which halted the future development and validation of the CANSO HPM SoE. Today, three years later after its launch the CANSO HPM WG was interested to find out more about the level of awareness and application of the standard. Results summarised in Figure 5 indicate that, amongst the participating ANSP all about one ANSP were familiar with the are aware of the CANSO HPM SoE. Furthermore, out of those aware of the CANSO HPM SoE, 52% has applied it in their organisation whereas remaining 43%, whilst aware of the survey, have not yet applied it in their organisations. It is encouraging to see the high level of awareness of the CANSO HPM SoE amongst the participating ANSPs, witnessing to the success of the Standard ´s promotion campaign and the usefulness of the approach recommended by CANSO.

RC #2: CANSO HPM WG should investigate into the causes that are impeding CANSO ANSPs to apply CANSO HPM SoE. Further work shall be done by the HPM WG to review the CANSO HPM SoE but also to promote and assist ANSPs in deploying and utilising the SoE.

OBS #2: A vast majority of ANSPs, that participated in this survey, are aware of the CANSO HPM SoE.

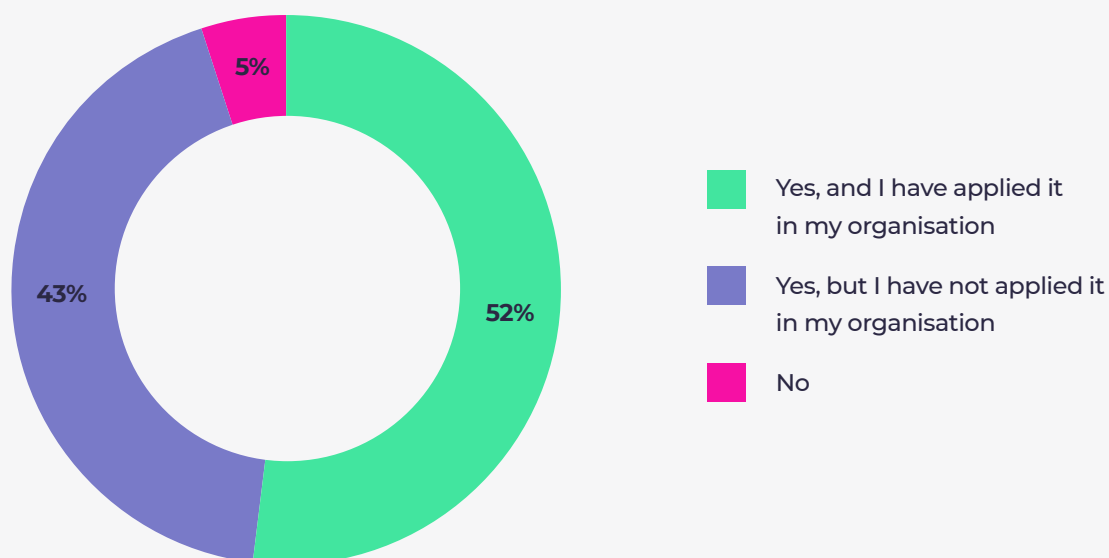


Figure 5 - CANSO HPM SoE familiarity

4. HF/HP management system

Given that management systems provide a formalised approach towards managing performance areas, the HPM WG was interested in exploring the informal and formal approaches to managing HF and HP. From the collected responses (see Figure 6) it was observed that 71% of participating ANSPs, predominantly from Europe, have established a formal or informal system to manage HF/HP. Another 19% of responses, mostly outside of Europe, expressed the ambition to formalise HF/HP management in the future whereas 10% of responses conformed that they have no plans to establish an informal or formal management system.

RC #3: CANSO HPM WG shall investigate the drivers and obstacles of implementing informal or formal of HF/HP management systems. CANSO HPM WG shall also publish guidance on deploying at least a basic HF/HP management system for ANSPs. Assistance shall be given to ANSPs needing help and expertise.

OBS #3: 71% of participating ANSPs, predominantly from Europe, have established a formal or informal system to manage HF/HP.

The CANSO Standard of Excellence (SoE) in Human Performance Management (HPM) identified 12 elements of human performance as illustrated in Figure 7. However, it was important to understand to which extent the 12 elements are prioritised and implemented by ANSPs.

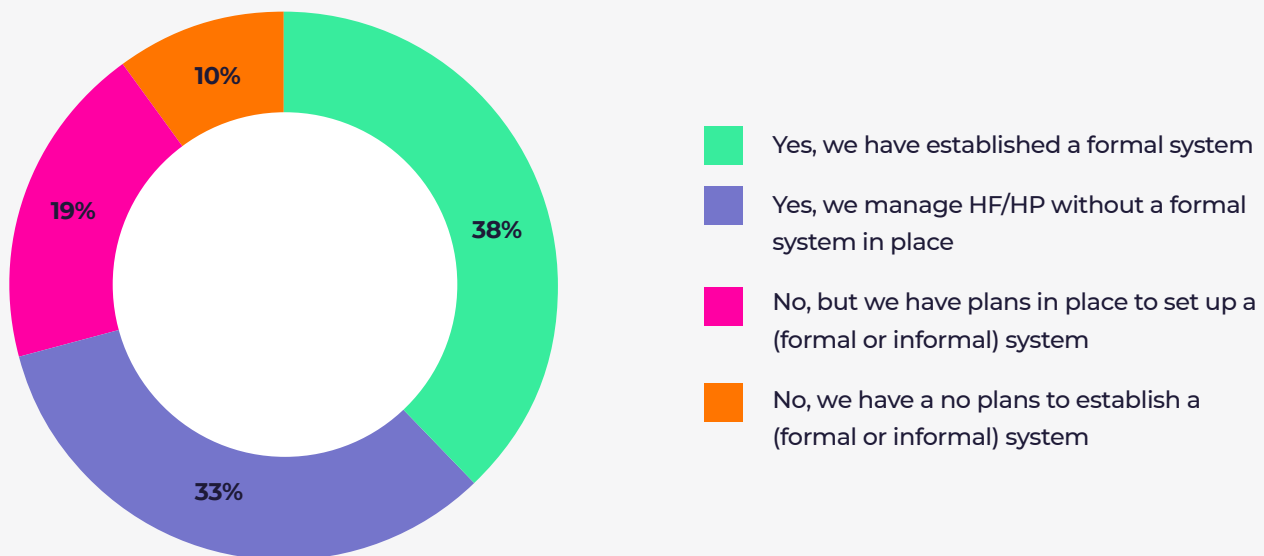


Figure 6 - Implementation of the HF or HP management system

4. HF/HP management system



Figure 7 - The 12 elements of the CANSO Standard of Excellence in Human Performance Management (CANSO, 2019)

4. HF/HP management system

The list of 12 elements from the CANSO HPM SoE has been extended to 20 elements to facilitate intuitive responses of ANSPs that do not require ANSPs to know the exact definitions of the elements. Out of 20 listed elements, overall score for ANSP's implementation (for ANSPs who have implemented an informal or formal of HF/HP management system) was 72 per cent, which shows that not all elements are managed by participating ANSPs.

Out of the elements that are being managed, the following HP elements are being given the most attention by ANSPs (see Figure 8):

- Operational training
- HF/HP investigation
- ATM equipment and support tools
- Policy
- Impact of change.

In contrast, topics such as (see Figure 8):

- Management of interrelationships between HF/HP aspects
- HF/HP research,
- HF/HP management effectiveness,
- Measurement and evaluation of HP aspects
- Leadership

are being given the least attention by participating ANSPs who have established a formal or informal HF/HP management system.

It is very promising to see concentrated efforts on so many elements. However, the elements that are being managed, while crucial for the operation of ANSPs in general, to a higher degree are also in the focus of regulatory requirements (i.e. EU REG 2017/373) which can explain why they are being paid closer attention to. The survey did not delve deeper into the HP/HF specific factors that are driving prioritisation of HF/HP focus on certain elements.

When considering that Interrelationships between HF/HP aspects and HF/HP research are less important this can also indicate that ANSPs may be at risk of not delivering the most optimal human performance within those elements. Furthermore, ANSPs are not giving sufficient attention to evaluation and understanding of the effectiveness of activities they perform to improve HF/HP. This therefore may weaken the arguments when communicating on the benefits of effective HF/HP internally but also externally.

4. HF/HP management system

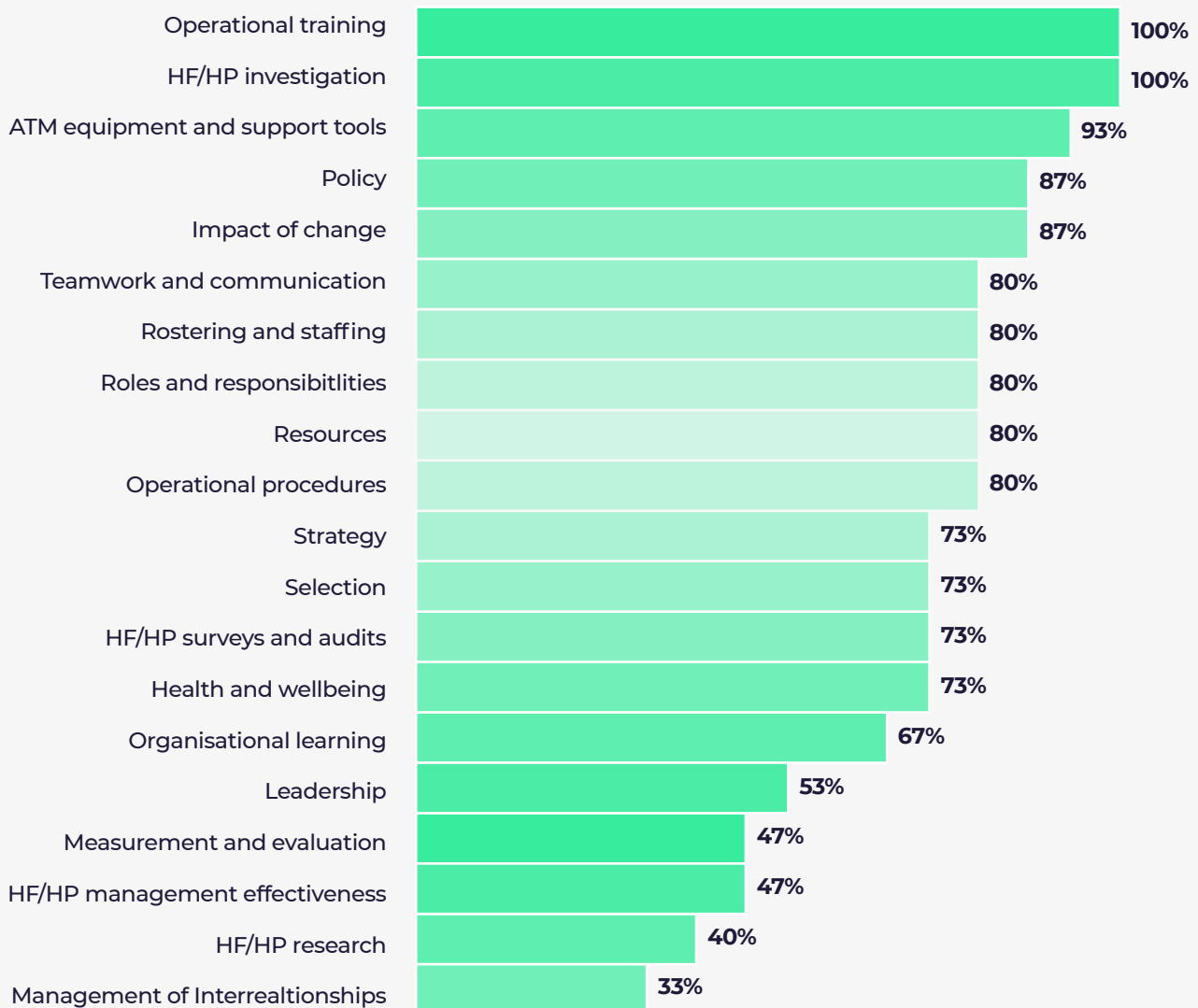


Figure 8 - HF/HP elements included in the scope of HF/HP management

OBS #4: Those ANSPs who have implemented an informal or formal of HF/HP management system are managing 72 per cent of elements derived from the CANSO SoE in HPM.

OBS #5: Out of ANSPs who have established a formal or informal HF/HP management system, the topics which are being given the most attention by participating ANSPs are: i) Operational training, ii) HF/HP investigation, iii) ATM equipment and support tools, iv) Policy, v) Impact of change. In contrast, topics that are given the least attention to by ANSPs are: i) Interrelationships between HF/HP aspects, ii) HF/

HP research, iii) HF/HP Management effectiveness, iv) Measurement and evaluation of HP aspects, and v) Leadership.

OBS #6: ANSPs are giving greater attention to managing those elements, derived from CANSO SoE in HPM, that also in the focus of regulatory requirements (i.e. EU REG 2017/373).

RC #4: The CANSO HPM WG shall continue to develop deeper guidance on practical steps and how-to's for implementing HF/HP solutions for all 12 elements of the CANSO SoE in HPM.

4. HF/HP management system

Management of people and their performance is distributed across ANSPs so it was important for the CANSO HPM WG to understand which departments are responsible for management of HF/HP elements. The results from the survey participants are summarised in Figure 9 below. It can be observed that the majority of the HF/HP related activities are included into the Safety, Quality, HR, Operations and Training departments within the participating ANSPs.



Figure 9 - Departments that play the biggest role in HF/hp management

OBS #7: In the management of HF/HP the following departments play the most important roles: i) Safety, ii) Quality, iii) Risk, iv) OPS, v) HR.

5. HF/HP management policy

Policies represent a foundation of any management system and set a direction for development of a particular performance area of interest. Within the scope of this survey on current management of HF and HP practices, participating ANSPs were asked to share their level of implementation along with their actual policies.

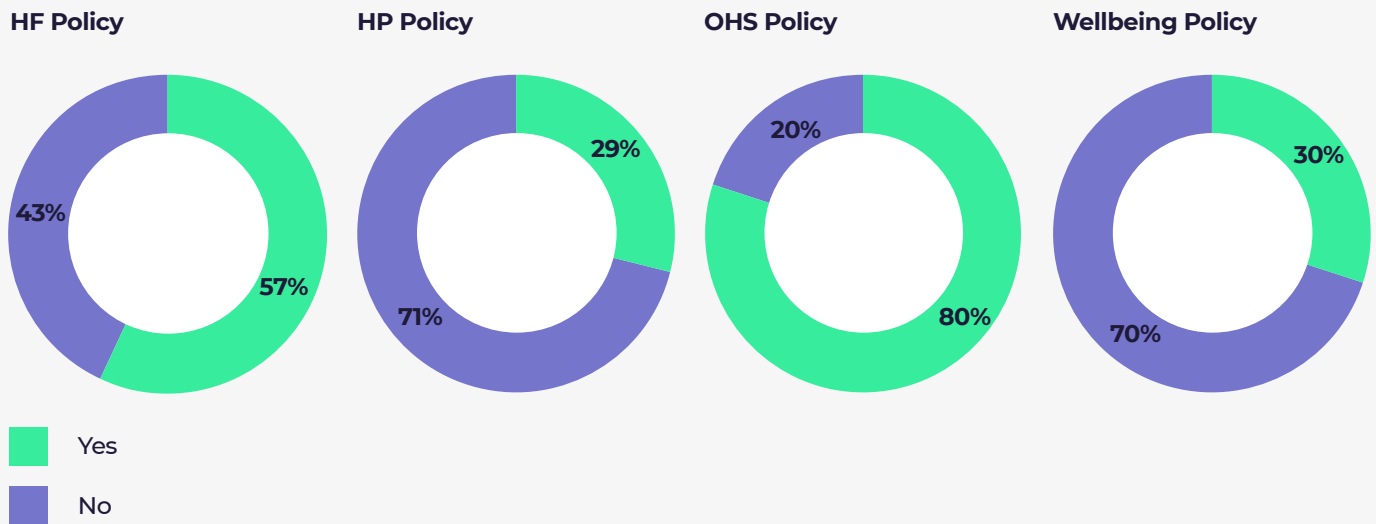


Figure 10 - HF, HP, OHS and Wellbeing policy implementations

From the results presented in Figure 10, it can be seen that the vast majority of ANSPs (i.e. 80 per cent) have developed and implemented an OHS policy likely because the OHS regulatory framework is highly mature and dates from the 80s and is in most cases implemented in National Law. Some 57 per cent of ANSPs have implemented an HF policy, HP and Wellbeing policies were developed by only one in three ANSPs which can be explained by raising popularity of HP and wellbeing initiative in recent years.

OBS #8: The mature OHS regulatory framework across the globe can explain a high rate of OHS policy development. In contrast, only about one in two ANSPs have defined and implemented the HF policy and only one in three ANSPs have defined and implemented HP or Wellbeing policies.

ANSPs were asked to share with the HPM WG their policies. In total, seven HF, five HP, 12 OHS and five Wellbeing policies were gathered by this survey. These policies will be analysed by the HPM WG with the objective to generate guidance on the development of HF, HP, OHS and Wellbeing policies that could support the policy development process in those ANSPs who have not created their policies yet.

RC #5: The CANSO HPM WG shall create a sub-group that will analyse the gathered HF, HP, OHS and wellbeing policies in order to generate the guidance material that could support the policy development process in those ANSPs who have not created their policies yet.

Out of participating ANSPs who have HF/HP-related policies in place, 60 per cent apply them either to ATCOs exclusively or to all staff.

RC# 6: The CANSO HPM WG shall investigate communication strategies to encourage ANSPs to expand their policies and strategies to cover all personnel within their organisations and not just operational. This is because sustainable human performance and minimising human error (and raising Safety) involves entire organisations.

6. HF/HP management strategy, objectives and resources

Following the results obtained in Section 2 in which it was found that between 70 and 90 per cent of participating ANSPs manage HF/HP, this Section examines in more detail the strategy and short- and long-term objectives defined by HF/HP management at participating ANSPs to implement their strategy.

A HF/HP strategy definition is the first step designed to achieve a long-term or overall aim of an ANSP in the HF/HP domain. However, only 38 per cent of ANSPs have developed an all-encompassing HF/HP strategy (or roadmap/plan). Similarly, only 30 per cent of ANSPs use CANSO HP SoE to assess the effectiveness of their HF/HP policy and strategy. Knowing that 52 per cent of ANSPs have applied the CANSP HP SoE in their organisation the question is why they are not using the same framework to assess the effectiveness of their HF/HP policy and strategy.

ANSPs' short- and long-term objectives, summarised in Table 2, clearly distinguish between three types of objectives, those related to training and competence, organisation and information management. In terms of training and competence, in addition to ongoing competency checks, TRM sessions and CISM, ANSPs identified the need (both in the short- and long-term) to develop HF and HP competences.

To effectively manage HF/HP, ANSPs have envisaged a number of organisational objectives related to: i) compliance (i.e. implementing regulatory requirements), ii) methodological (integration of HF/HP in management of changes, safety assessment and occurrences investigations), iii) gathering and implementing good practices (e.g. stress and fatigue management), iv) improve employee satisfaction at work and general wellbeing, v) increase the integration of HF/HP in the management system. Lastly, both in short- and medium-term ANSPs highlighted the drive to gather and monitor HP data preferably in real-time to enable immediate feedback.

RC #7: The CANSO HPM WG should create a guidance material that would assist ANSPs in the development and the implementation of a HF/HP strategy.

OBS #9: The following trend in short- and long-term objectives was observed amongst the participating ANSPs:

- training and competence:
 - i. the need (both in the short- and long-term) to develop HF and HP competences (and expertise in-house);
- organisation:
 - i. compliance (i.e. implementing regulatory requirements),
 - ii. methodological (integration of HF/HP in management of changes, safety assessment and occurrences investigations),
 - iii. gathering and implementing good practices (e.g. stress and fatigue management),
 - iv. improve employee satisfaction at work and general wellbeing,
 - v. increase the integration of HF/HP in the management system,
- information management:
 - i. identify human performance/state data collection tools/technology,
 - ii. gather and monitor HP data preferably in real-time to enable immediate feedback.

Contrasting with the objectives that ANSPs have prioritized in the short- and long-term, an analysis was performed to better understand how HF/HP resources are distributed within participating organisations. From results, summarised in Figure 11, three clusters could be observed:

- sufficient resources: includes those HF/HP elements that have either a long tradition of being managed within an ANSP (e.g. health and wellbeing) or are part of regulatory requirements (e.g. rostering and staffing),
- insufficient resources: includes those resources that are related to the integration of HF/HP in organisation's management system (e.g. policy),
- highly insufficient resources: refers to those resources that look beyond here and now (e.g. strategy).

6. HF/HP management strategy, objectives and resources

Short-term objectives	Long-term objectives
<p>Training and competence:</p> <ul style="list-style-type: none"> • Competency check • Fatigue training • TRM sessions • CISM • Corporate HF/HP training 	<p>Training and competence:</p> <ul style="list-style-type: none"> • Availability of sufficiently skilled and trained resources • Provide all staff with adequate and appropriate aviation safety information • HF education and training
<p>Organisation:</p> <ul style="list-style-type: none"> • Implementing regulatory requirements • Integrate HF principles into the SMS • Restructuring • Updating HF procedures • Introduce HPM and defining roles • Integration of HF/HP with safety investigations • Efficiency and effectiveness of HF methods integration • Increasing maturity of the HPM SoE • Identifying and implementing good practices on stress and fatigue management • Increase the commitment, motivation and satisfaction of air traffic controllers • Optimize health and well-being of professionals • NOSS • Safety Culture surveys • Improve communication, social dialogue and working relations 	<p>Organisation:</p> <ul style="list-style-type: none"> • Improve the safety of the entire system, increasing safety margins • Increase productivity and efficiency of the entire organisation • Enhance organisational resiliency • Symbiotic integration of humans with automation • HF assessment of changes • HF safety assessment • HF investigation of occurrences • Role of ATCO in the future • Achievement of Sustainable Wellbeing at work • Inclusion of HF/HP documents into integrated management system • Transparency and clarity regarding stress and fatigue risk management
<p>Information management:</p> <ul style="list-style-type: none"> • HP data gathering plan • Monitoring of fatigue indicators • Monitor roster exceedances • Real time HP metrics 	<p>Information management:</p> <ul style="list-style-type: none"> • Identify human performance/state data collection tools/technology • Real-time data feedback of Human Performance metrics • Healthy reporting system

Table 2 - ANSPs short- and long-term objectives

6. HF/HP management strategy, objectives and resources

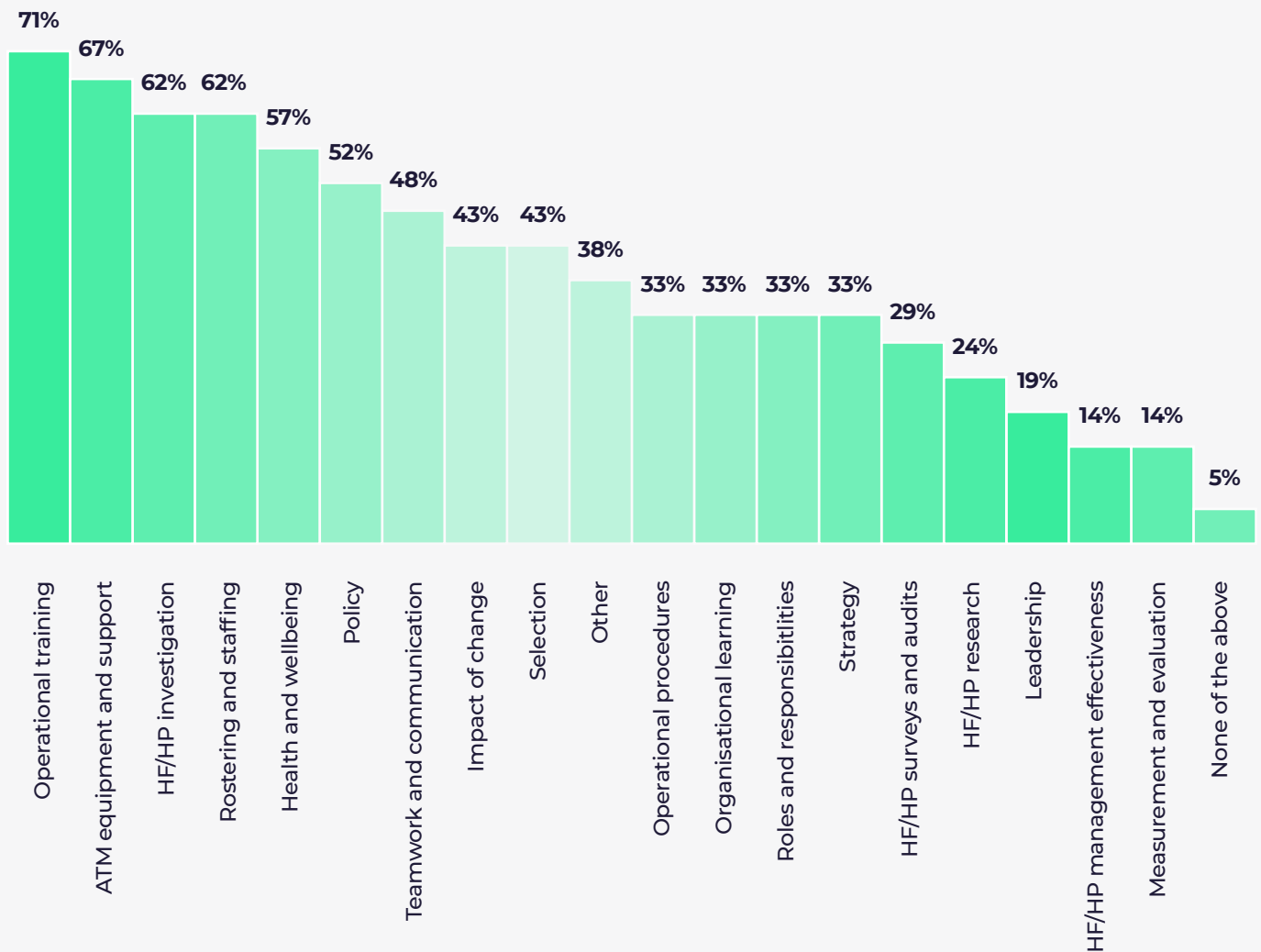


Figure 11 - Perception of HF/HP resources distribution

OBS #10: It could be concluded that resources for HF/HP are prioritised for those elements that have a long tradition of being managed within an ANSP or are part of regulatory requirements. In contrast, ANSPs report insufficient sources related to the integration of HF/HP in organisation’s management system. The least amount of resources are allotted to elements that address the development of future HF/HP research, Leadership, HF/HP management effectiveness and Measurement and evaluation of HP aspects.

RC #8: The CANSO HPM WG shall assist ANSPs in the process of integration of HF/HP into ANSPs’ management systems.

RC #9: The CANSO HPM WG could assist ANSPs in the development and implementation of the CANSO medium- to long-term vision and strategy for HF/HP (REF RC #7).

7. HF/HP competences

To achieve maximum level of competences, HF/HP need to be accounted for early on – already in the selection process. Out of surveyed ANSPs, 81 per cent of ANSPs consider HF/HP in the selection process in contrast to 19 per cent of ANSPs who do not do this yet (see Figure 12).

As a function of the role in question, all employees working for an ANSP should be sufficiently qualified and trained to perform their roles effectively.

To better understand HF/HP competence, ANSPs were asked to indicate those categories of staff for whom HF/HP competence have been defined. The results, presented in Figure 13, showcase that the competence requirements have predominantly been defined for staff working on operational positions (i.e. ATCOs, OJTIs and ATSEPs). In contrast, only 33 per cent of ANSPs who participated in this survey has defined competence requirements for all staff and 19 per cent for the HF/HP expert/specialists and safety investigators. Only between 10-15% of surveyed ANSPs have defined HF/HP competences for Operational leaders/managers, Safety Surveyors and Safety Assessors.

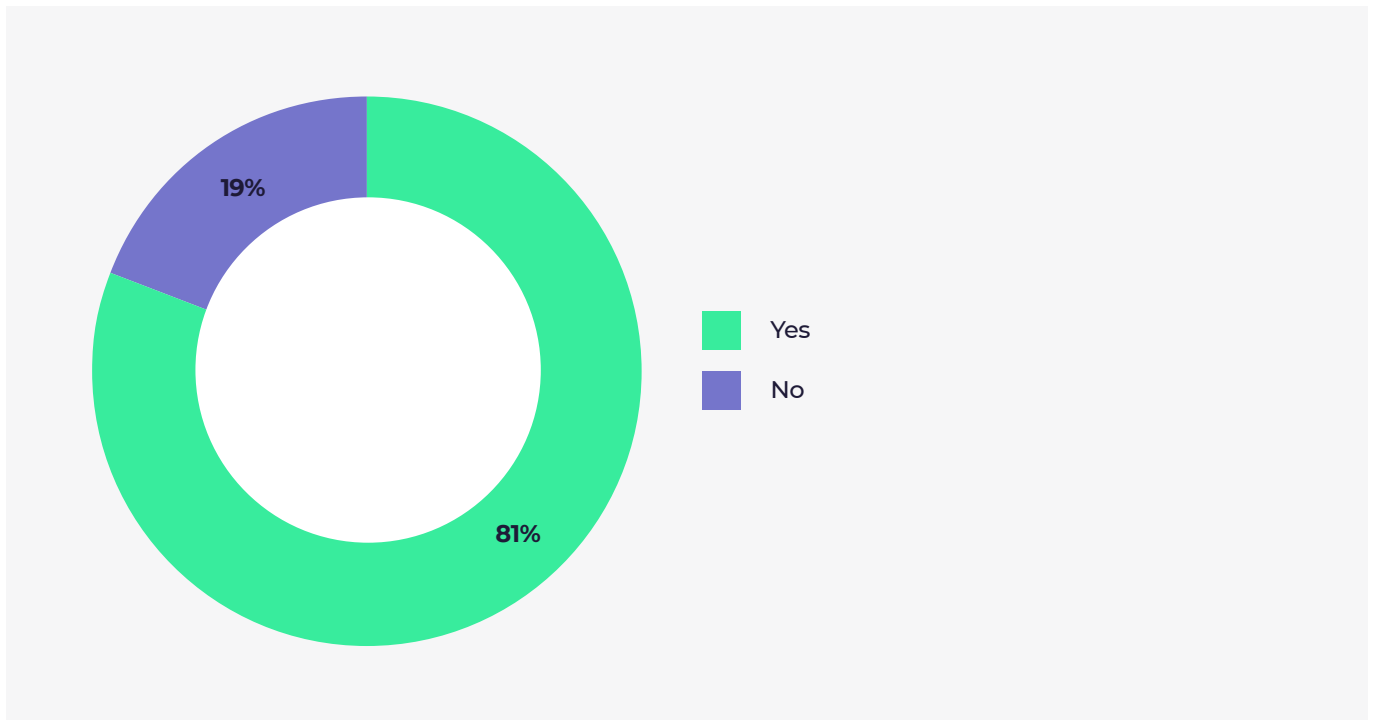


Figure 12 - HF/HP requirements in the selection process for operational positions (i.e. ATCOs, OJTIs and ATSEPs)

7. HF/HP competences

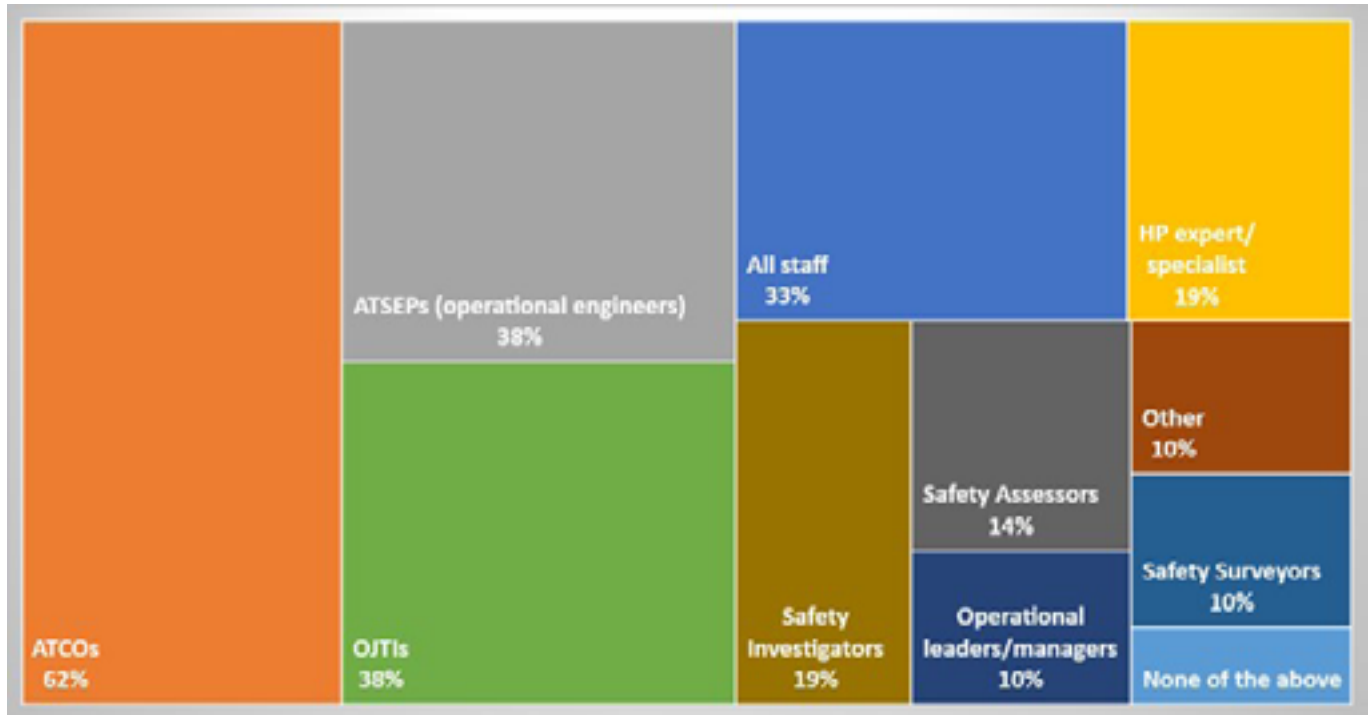


Figure 13 - Distribution of competence requirements among ANSP employees

With respect to competencies within training organisations, ANSPs were asked to indicate those categories of staff for whom HF/HP training modules have been developed. The results, presented in Figure 14, showcase that HF/HP training modules (similar to competence requirements above in Figure 13) have primarily been targeting staff working on operational positions (i.e. ATCOs, OJTIs and ATSEPs) and safety investigators. In contrast only 24 per cent and 14 per cent of participating ANSPs have developed HF/HP training modules for Safety Assessors and Safety Surveyors respectively which supports the case for further integration of HF/HP into SMS. Furthermore, for effective management of HF/HP management (corporate and operational) needs to be sufficiently knowledgeable in the domain – nevertheless only between 19 and 38 per cent of participating ANSPs have developed HF/HP training modules for this audience. Lastly, only 43 per cent of participating ANSPs have developed training modules for the HP experts/specialists.

7. HF/HP competences

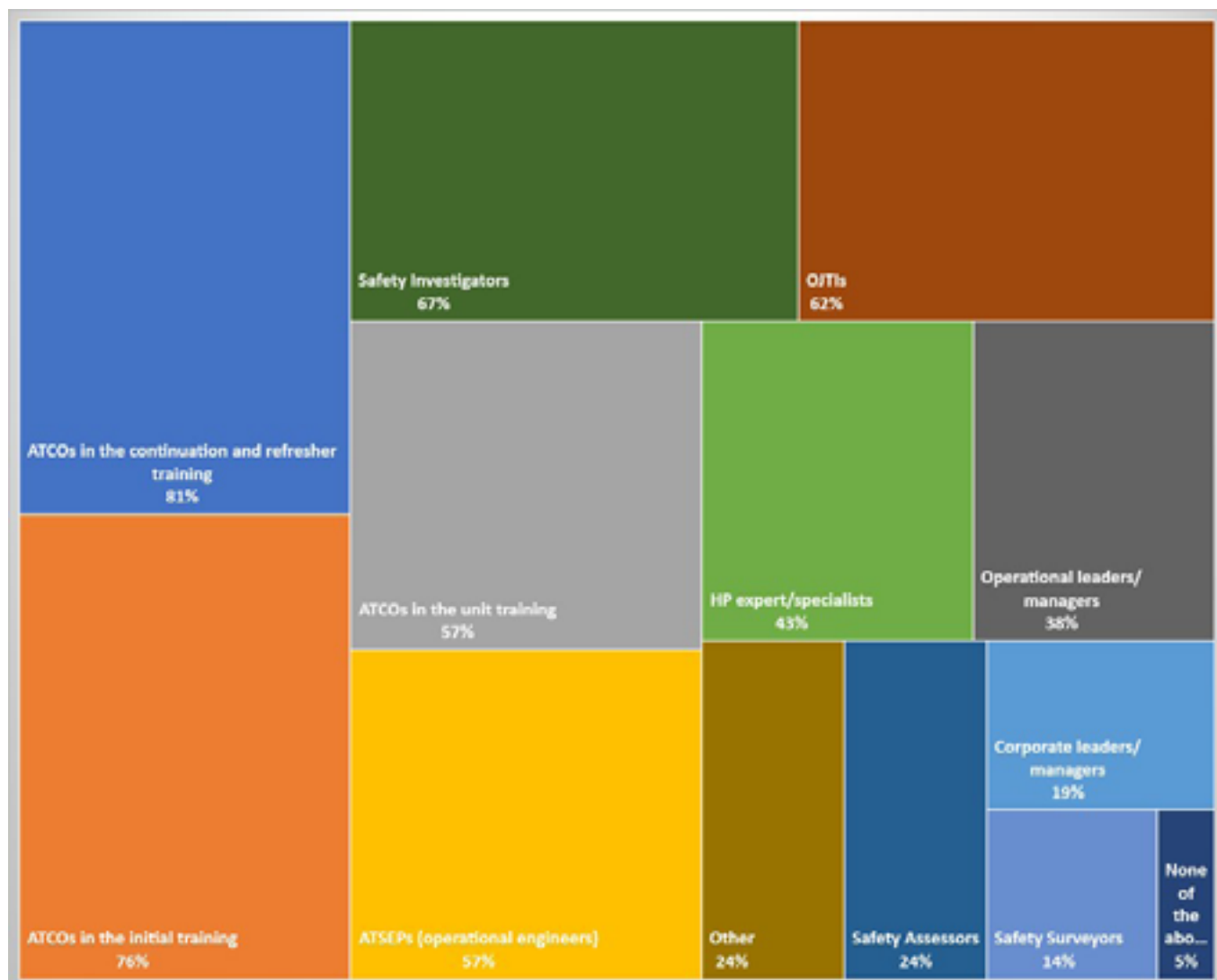


Figure 14 - Distribution of HF/HP training modules per category amongst ANSP employees

OBS #11: HF/HP competence requirements and corresponding training modules have predominantly been developed for staff working on operational positions (i.e. ATCOs, OJTIs and ATSEPs) likely because of applicable regulatory requirements. In contrast, in accordance with the absence of applicable regulatory requirements, between 67 and 81 per cent of participating ANSPs have not defined competence requirements and training modules for all staff and the HF/HP expert/specialists respectively.

OBS #12: HF/HP competence requirements and corresponding training modules have been the least developed for corporate management, which may slow down the promotion and prioritisation of HF/HP within ANSPs.

OBS #13: While ANSPs have predominantly developed HF/HP competence requirements and corresponding training modules for safety investigators, very few developments have been reported to be made in the domains of safety assessment and safety surveys thus impeding HF/HP integration in the SMS (beyond safety investigations).

7. HF/HP competences

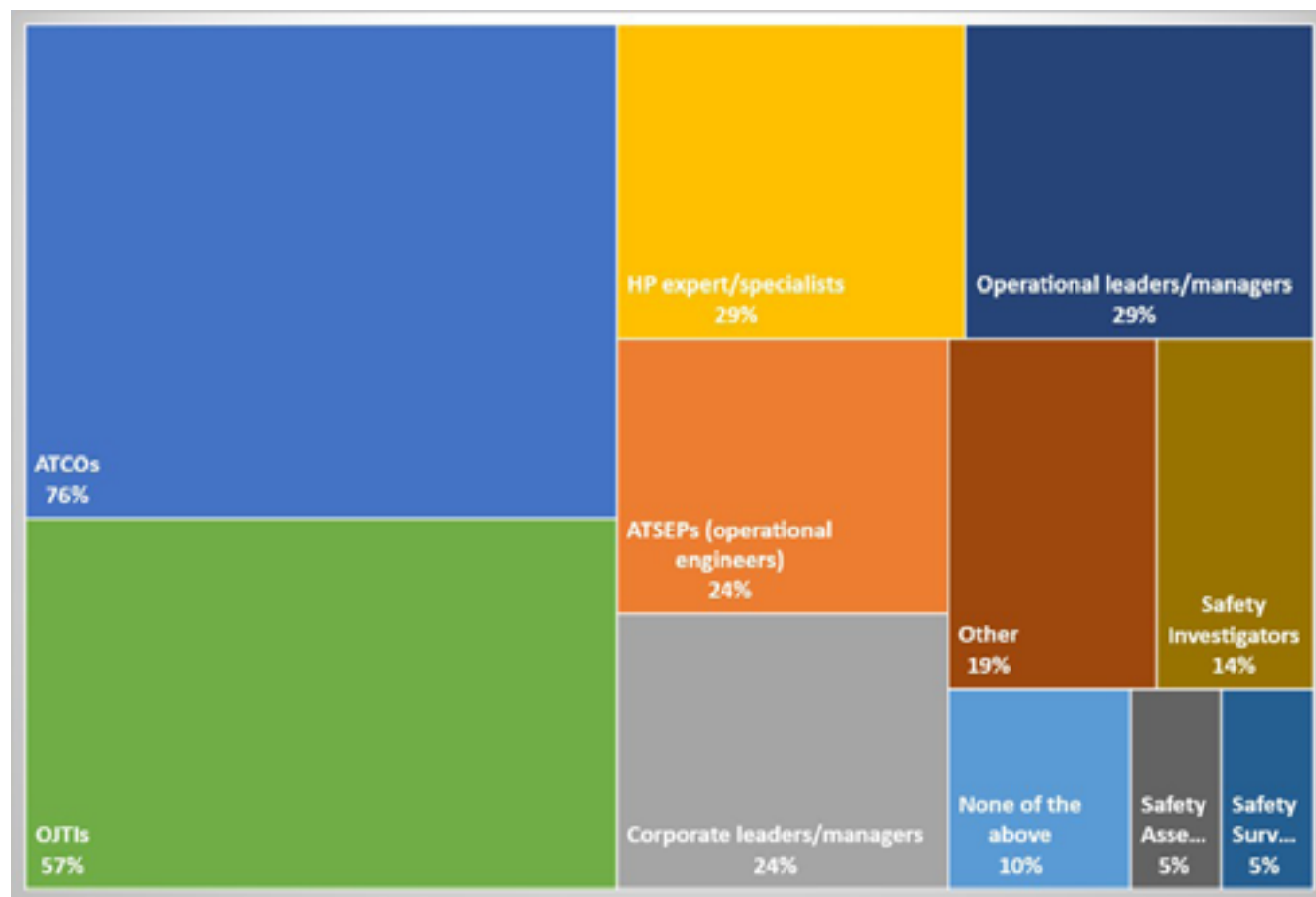


Figure 15 - Distribution of ANSP employees who receive training on communication and teamwork skills

RC #10: The CANSO HPM WG could assist ANSPs in the development and implementation of HF/HP competence requirements and training modules for all categories of staff within an ANSP.

In line with the findings on the generic HF/HP training for various categories of ANSP employees, dedicated trainings on communication and teamworking skills are predominantly targeting ATCOs and OJTIs (see Figure 15).

8. HF/HP integration in the organisation

HF/HP integration in the organisation is paramount to ensure that HP has been considered in the establishment of the system processes and that the management system supports HP to achieve the system's goals.

Awareness about HF/HP is the first step towards its integration within ANSPs' management systems. As a function of the audience, in participating ANSPs, HF/HP awareness can take many forms:

Operational employees:

- initial and continuation training,
- written promotion material based on lessons learned
- safety promotion by means of verbal briefings and meetings,
- HF expert interaction during investigations, surveys and/or safety assessments,
- specific HF training,
- TRM,

Operational leaders/managers:

- targeted training
- meetings, presentations and reports for corporate managers on lessons learned
- written promotion material,
- workshops,

Corporate leaders/managers:

- targeted training
- meetings, presentations and reports for the Executive Committee,
- written promotion material,
- safety comity/board,
- sharing of lessons learned,
- corporate safety plan,

All staff:

- written promotion material,
- workshops, presentations and webinars,
- targeted training,
- intranet,
- surveys (wellness/HF).

Due to the transversal nature of HF/HP, several different departments/roles play an important role in its management. These include, but are not limited to, the following departments/roles (when applicable): operations, HF/HP, safety, projects, roster design and management, OHS, HR, performance monitoring. Therefore, it is necessary to establish formal or informal interfaces between all departments/roles that contribute to the management of HF/HP within an ANSP. Out of surveyed ANSPs, the vast majority (81 per cent) has established either an informal or a formal interface between those departments that contribute to the HF/HP management (see Figure 16).

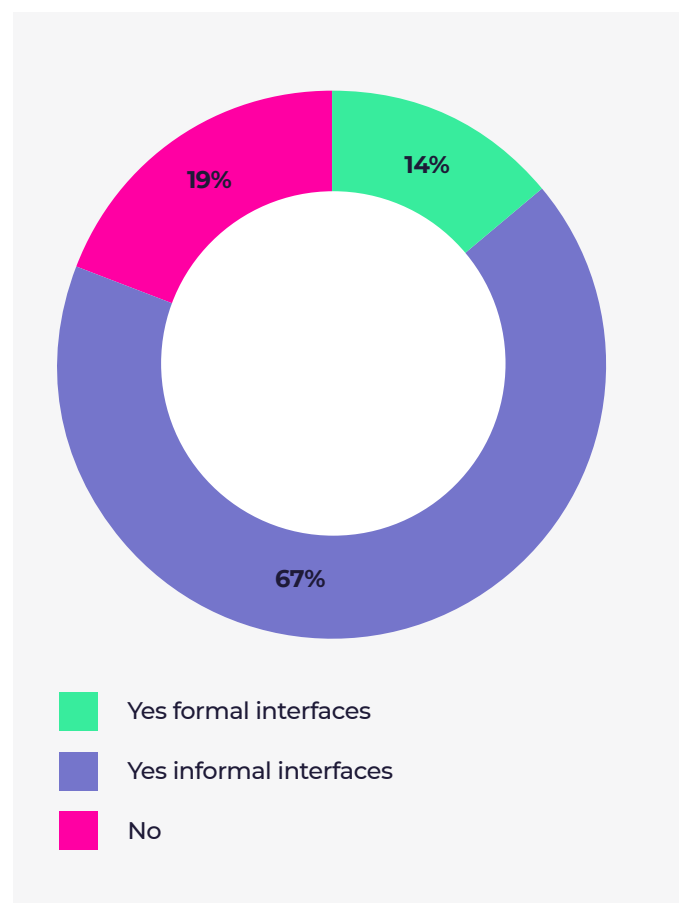


Figure 16 - Distribution of interface types

8. HF/HP integration in the organisation

When asked whether HF/HP have been integrated into their organisation's SMS, 81 per cent of ANSPs responded positively (see Figure 17). This finding, whilst encouraging, brings into question the understanding of HF/HP integration into a SMS and the quality of such integration, especially considering previous findings:

- **RC #1:** the wide range of understanding of HF, HP, OHS and wellbeing of the concepts and their relationship,
- **OBS #8:** that only one in two ANSPs have defined and implemented the HF policy and only one in three ANSP have defined and implemented HP or Wellbeing policies,
- **OBS #10:** ANSPs report insufficient sources related to the integration of HF/HP in organisation's management system,
- **RC #8:** The CANSO HPM WG assist ANSPs in the process of integration of HF/HP into ANSPs' management systems,
- **OBS #11, 12&13:** competence requirements and corresponding training modules focused on staff working on operational positions.

RC #11: The CANSO HPM WG could assist ANSPs in increasing the scope and the quality of HF/HP integration into SMS.

As effective risk management is the ultimate aim of a SMS, the survey explored the top HF/HP risks amongst the participating ANSPs. Figure 18 lists all identified HF/HP risks along with their mitigations (in no particular order). Four cluster of top risks can be observed:

- cluster A performance 1 (e.g. fatigue),
- cluster B performance 2 (e.g. workload),
- cluster C organisational (e.g. organisational climate),
- cluster D management system (e.g. integration of HF/HP into SMS).

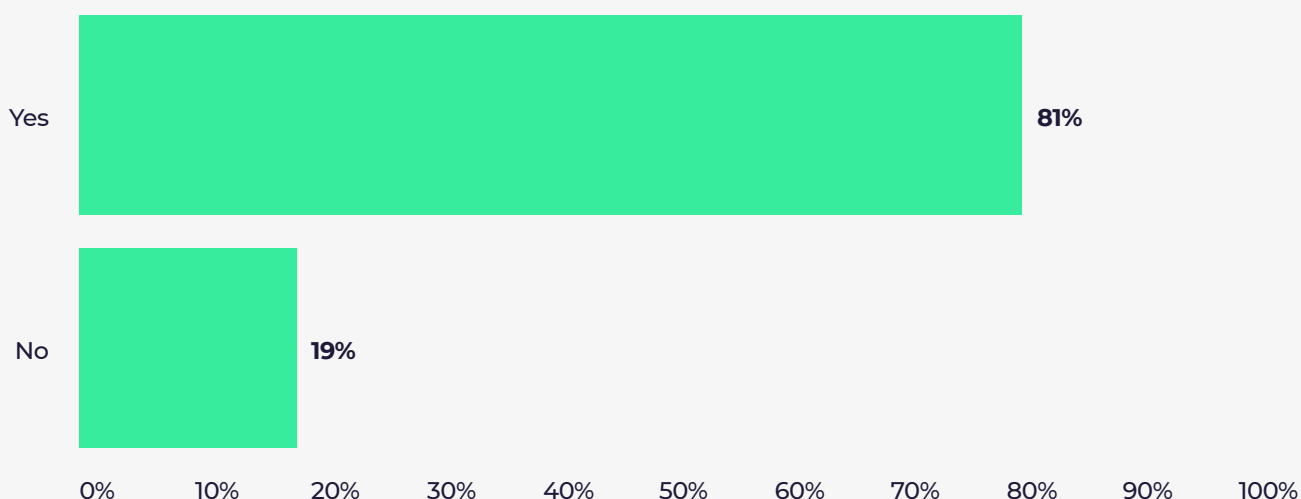


Figure 17 - HF/HP integration into SMS

8. HF/HP integration in the organisation

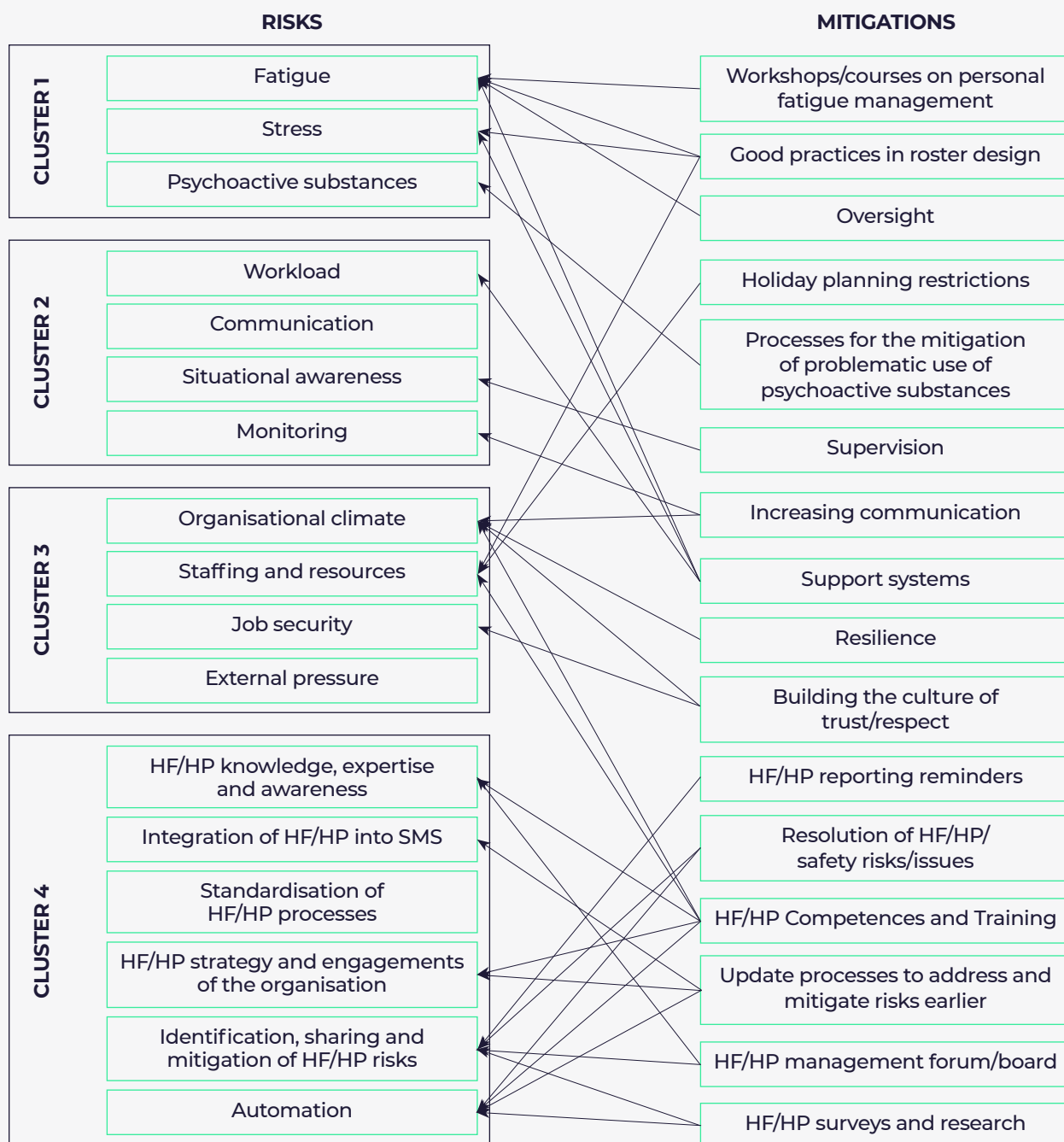


Figure 18 - Top HF/HP risks and their mitigations

Cluster 1 of risks is typically being managed by a combination of individual measures (e.g. courses for personal fatigue management) and organisational (e.g. oversight of employees and consideration of good practices in roster design). Cluster 2 risks are primarily being managed by means of communication, supervision briefings and support systems. Cluster 3 risks are being mitigated by improving organisational culture

(e.g. increasing communication and transparency) and by managing staffing shortages (e.g. restricted holiday planning). Cluster 4 risks are being managed by building knowledge, experience and awareness of HF/HP by means of training, integration of HF/HP into the SMS by updating SMS process to accommodate earlier mitigation of HF/HP risks and finally by systematic management of HF/HP risks in a dedicated HF/HP forum/board.

8. HF/HP integration in the organisation

8.1 HF/HP in occurrence reporting and investigation

All participating ANSPs have implemented HF/HP in their occurrence reporting and investigation processes. HF/HP in occurrences are primarily being investigated by a combination of safety occurrence investigator and a HF/HP expert/specialist (38%) or safety occurrence investigators (33%). However, in some cases the HF/HP experts/specialists (10%) are performing HF/HP investigations as illustrated in Figure 19.

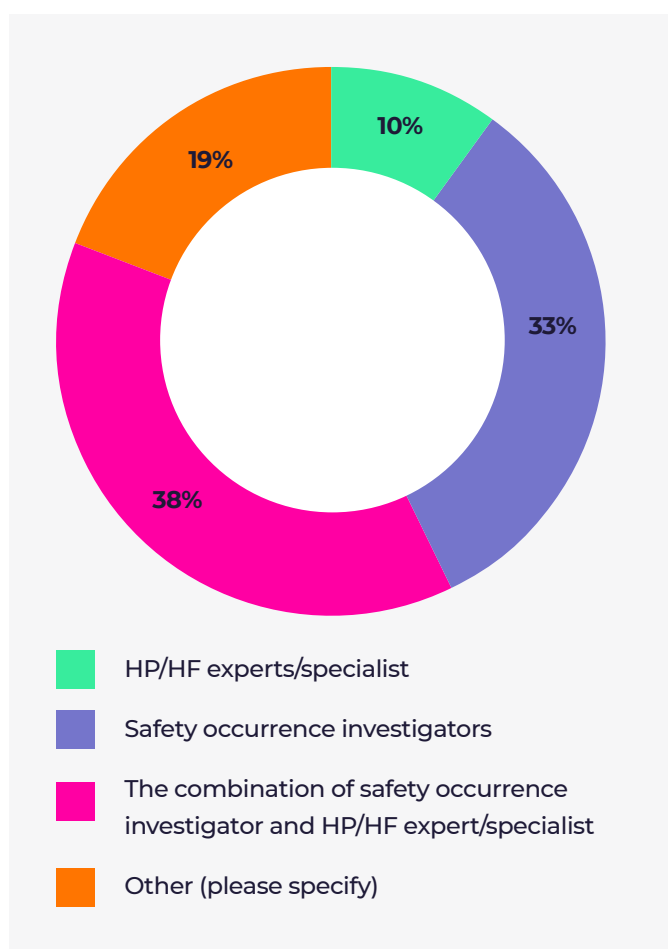


Figure 19 - Distribution of roles responsible for HF/HP occurrence investigation

OBS #14: At majority of ANSPs, HF/HP in occurrences are primarily being investigated by a combination of safety occurrence investigator and/or a safety occurrence investigator.

During occurrence investigations, ANSPs consider a range of HF/HP factors. On the basis of accounted HF/HP factors, ANSPs could be differentiated into two categories:

European ANSPs that are predominantly focused on REG EU 2017/373 requirements (39% of participating ANSPs) prioritise HF topics referred to in the article ATS.OR.300 limited to:

- problematic use of psychoactive substances,
- stress,
- fatigue.

Analysis of these three topics is often underpinned by the secondary analysis of:

- workload
- rostering
- critical incidents
- cognitive skills
- equipment
- context
- performance
- sleep
- teamwork
- communication

remaining ANSPs (61 % of participating ANSPs), in and outside of Europe, apply various very granular HF frameworks in their analysis of occurrences. These frameworks include, but are not limited to, Human Factors Analysis and Classification System (HFACS) framework, that includes the following HF/HP factors:

- errors (skill-based, decision and perceptual errors)
- violations (routine and exceptional violations)
- environmental factors (physical and technological environment)
- conditions of operators (adverse mental state, adverse physiological state and physical/mental limitations)
- personnel factors (crew resource management and personal readiness)

8. HF/HP integration in the organisation

- unsafe supervision (inadequate supervision, plan inappropriate operation, fail to correct known problem and supervisory violation)
- organisational influences (resource management, organisational climate and operational process).

Other notable frameworks that are used are Human Error in ATM Technique (HERA) JANUS, Systemic Occurrence Analysis Methodology (SOAM), AcciMap, Federal Aviation Administration’s (FAA) Air Traffic Organization (ATO) methodology, Software, Hardware, Environment, Liveware and Organisation (SHELL/O), Generic Error Modelling System (GEMS), Skill, Rule, and Knowledge (SRK) model, Person-Equipment-Task-Environment (PETE), Cognitive Human Error Assessment Tool (CHEAT).

Lastly some ANSPs have developed their own investigation frameworks, derived from the combination of the models above and their experience.

RC #12: The CANSO HPM WG could assist ANSPs in developing guidance on the methodology to use in HF/HP investigations.

With the exception of one, no other ANSP has submitted a HF/HP reporting form.

8.2 HF/HP integration in the change management process

Some 67 per cent of participating ANSPs have included HF/HP assurance in their respective change management processes but not equally for all types of changes. While all ANSPs, that have included HF/HP in the change management process, account for HF/HP in changes to the functional system or changes which affect the functional system, ANSPs account HF/HP to a lesser degree for the following change types (see Figure 20):

- changes to ANSP’s provision of service, management system and/or safety management system, other than ERC and FSC,
- emergency changes (ERC),
- activities are already part of ANSP’s accepted operational envelope.

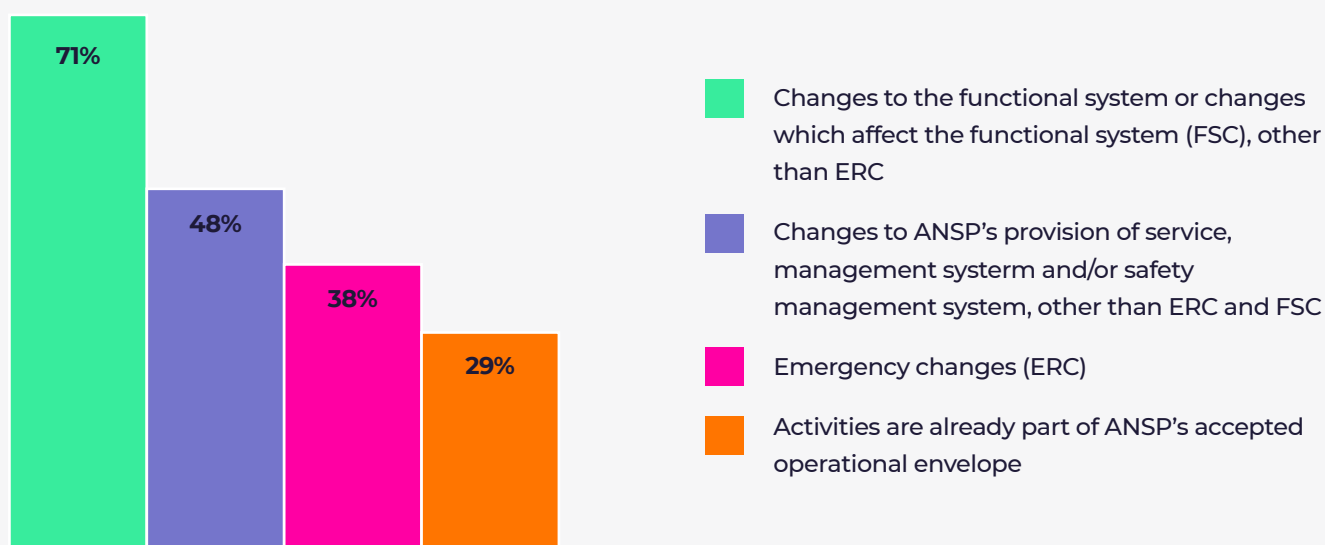


Figure 20 - Distribution of ANSPs in terms of HF/HP management of various change types

8. HF/HP integration in the organisation

8.2 HF/HP integration in the change management process (cont.)

OBS #15: The majority of participating ANSPs included HF/HP assurance in their respective change management processes but not equally for all types of changes.

Out of ANSPs who have integrated HF/HP in the management of change process, 57 per cent actively involve and consult operational personnel in the HF/HP aspects of changes. In addition, operational personnel contributes, to a lesser degree (between 33 and 57 per cent), in other aspects of change management such as review, communication and training of HF/HP aspects when introducing the change.

OBS #16: One in two of participating ANSPs actively involve and consult operational personnel in the HF/HP aspects of changes.

Similarly, 73 per cent of participating ANSPs, who have integrated HF/HP in the management of change process, do introduce HP/HF requirements in their respective contract management processes.

OBS #17: Two out of three of participating ANSPs introduced HP/HF requirements in their respective contract management processes.

RC #13: The CANSO HPM WG could encourage ANSPs to more consistently apply HF/HP assurance in the management of changes process.

Some 48 per cent of ANSPs use design guidelines in the management of change process. In doing so, ANSPs apply design guidelines and standards from some of the following sources:

- FAA Human Factors Design Standards (HF-STD-001, HF-STD-001B, HF-STD-004A)
- MIL-STD-1472
- MIL-STD-46855
- DEF STAN 00-25
- ISO 9241-220:2019
- NUREG 0700 and 0711 (Process and Design)
- European Commission (REG EU 2017/373)

- CANSO
- EUROCONTROL Human Factors Case
- SESAR SRM (Safety Reference Material and HPRM (Human Performance Reference Material))
- ICAO (Doc 9654, Doc 9966)
- internally developed documentation
- academic theory.

When it comes to fatigue risk management, approximately 63 per cent of ANSPs have adopted a prescriptive approach and the remaining 37 per cent have implemented a Fatigue Risk Management System (FRMS).

OBS #18: Approximately 63% of ANSPs have adopted a prescriptive approach and the remaining 37 per cent have implemented a Fatigue Risk Management System (FRMS).

Exploring further the integration of HF/HP in the management of changes, the survey attempted to identify the main elements of health and wellbeing programs, implemented by participating ANSPs, that contribute the most to the improvement in HF/HP. The following programs were identified:

- Peer support programs (e.g. CISM))
- Psychological wellbeing
- Team Resource Management
- Occupational Health & Safety (OHS) programs (e.g. personal protective equipment)
- Employee Assistance Program (e.g. financial wellbeing)
- Fatigue management
- Training and education of employees (i.e. psychoeducation)
- Psychologists
- Sport and wellbeing facilities
- Nutrition programs
- Annual health checks
- Disability management.

9. HF/HP Monitoring

A proven practice from the airline industry that contributes to improving HP on the sharp end is learning from all operations. While ANSPs have the retrospective techniques on analysis of negative outcomes anchored into their knowhow, attention could also be given to a better understanding of the “normal/everyday” operations and their variability when compared to plans or the beliefs of people who drafted the descriptions of the norm for normal operations. Nevertheless, only 38 per cent out of surveyed ANSPs do collect information on differences between the Work-as-Imagined (WAI) and Work-as-Done (WAD).

OBS #19: Only 38 per cent out of surveyed ANSPs do collect information on differences between the Work-as-Imagined (WAI) and Work-as-Done (WAD).

RC #14: The CANSO HPM WG could encourage and assist ANSPs to more consistently monitor differences between the Work-as-Imagined (WAI) and Work-as-Done (WAD). The HPM WG should investigate whether guidance is needed on how to proactively monitor HF/HP indicators from system and HR data.

Qualitative and quantitative data can be used to help improve the HF/HP management of an organisation. While some HF/HP elements can be captured easier than others, the HPM WG investigated what sort of indicators participating ANSPs used in their respective organisations. Some 55 per cent of participating ANSPs have implemented certain HF/HP indicators from the list below:

- ATS occurrence trends
- Stress and fatigue report trends (not related to ATS occurrences)
- Human error (i.e. GEMS)
- OHS occurrence trends
- Contributing factor analysis (i.e. PETE)
- External ANSP threat, including Military (e.g., coordination issue, read back error, handoff issue)
- General Traffic Characteristics (e.g., similar call signs)
- Operational demand (e.g., combining or splitting of sectors, increasing traffic load/complexity)
- Rostering data
- Workload
- Saturation
- Complexity
- Situational Awareness
- Workspace - operational context (e.g., console layout, distraction - non job related, lighting, noise from equipment/maintenance, noise from people, other workspace threat, temperature, visual impairment - line of sight)
- Communication - ATCO (e.g., incomplete read back, incorrect read back, supervisory issue)
- Position relief/handover takeover (e.g., checklist not used, incomplete HOTO, incorrect information provided)
- Communication - Pilot (e.g., non-standard phraseology, incorrect read back, language difficulties)
- Pilot/Aircraft performance (e.g., pilot report/estimate error, pilot error, pilot request)
- Weather (e.g., low visibility)
- Equipment and systems (e.g., false or nuisance alerts/alarms, screen clutter)
- Wellbeing
- HP-related surveys
- Deviations from WAI
- Observations in simulation sessions
- effectiveness of HP-related RCs
- CANSO HPSoE
- Selection
- Education
- Complaints
- Assessment of working positions
- Sick leaves
- Personal injuries
- Medical examination results.

9. HF/HP Monitoring

Results point out that 57 per cent of ANSPs are experiencing difficulties to identify trends in collected qualitative and quantitative data. This happens for many different reasons: i) not monitoring trends, ii) not having sufficient quantity and quality of data, and iii) not finding causation/correlation. ANSPs who identified certain trends, observed the following:

- correlation between stress and sick leave
- correlation between the selection data and the success rate
- correlation between wellbeing and HP and safety incidents
- slips/lapses of attention associated with low workload.

OBS #20: Some 43 per cent of participating ANSPs have implemented certain HF/HP indicators that tend to focus on stress and fatigue reporting and investigations.

OBS #21: Some 57 per cent of ANSPs are experiencing difficulties to identify trends in collected qualitative and quantitative data.

RC #15: The CANSO HPM WG could assist ANSPs by developing an inventory of HF/HP indicators along with the recommendations for collection, calculation, analysis and acting upon this data.

10. Sharing and exchange of HF/HP lessons learnt and good practices

One of the enablers for HF/HP improvements is effective sharing and exchange of lessons learnt and good practices that supports ANSPs in building a knowledge and experience base about i) how HF/HP events were addressed in the past, but also ii) processes or activities that yield success or at least meaningful results internally or externally.

It is rather encouraging to see that between 67 and 71 per cent of participating ANSPs did identify benefits of the gathering, sharing and exchange of HF/HP lessons learnt and good practices and that they do exercise it in their respective organisations. In this process ANSPs have the tendency of consulting the following external sources of HF/HP information on lessons learnt and good practices:

- ICAO
- CANSO
- EUROCONTROL (i.e. Skybrary, hindsight)
- SESAR
- EASA
- ANSPs (e.g. FAA, NATS)
- COOPANS
- FABs
- CAAs
- external psychologists
- HF consultancies
- EAAP
- Airlines
- IATA
- universities
- other industries
- Bureau Veritas.

OBS #22: Between 67 and 71 per cent of participating ANSPs are gathering, sharing and exchanging HF/HP lessons learnt and good practices. In doing so ANSPs primarily rely on ICAO, CANSO, EUROCONTROL, SESAR and EASA information sources.

11. Future HF/HP developments

All participating ANSP believed that HF/HP management will play an increasingly important role in the ATM industry in the coming years.

A vast majority of ANSPs (81 per cent are rather optimistic about the future HF/HP management developments. They expect these future developments should take place in the following domains:

- HF/HP and automation (i.e. AI, UAS, UTM, remote towers)
- HF/HP in change management and leadership
- Understanding the discrepancies between WAI and WAD
- new generation of employees (i.e. transition from controlling to monitoring)
- new generation of airspace users
- new generation of air transport system
- cost pressure
- fatigue and stress measuring based on science
- harmonisation and standardisation in HF/HP domain
- wellbeing and sustainability.

In contrast, 19% of participating ANSPs are rather sceptical about the future developments in the domain. Some ANSPs are concerned by drivers of current HF/HP developments, that are in Europe, mainly based on compliance as opposed to benefits embedding HF/HP in the core management of the company. By extrapolating current priorities and HF/HP management practices, these ANSP believe that the focus, at least in Europe, will remain on CISM, TRM and fatigue management which they deemed not sufficient. Other ANSPs believe that the lack of formal academic knowledge and methodologies is going to continue to hinder the progress in HF/HP development in the ATM industry.

OBS #23: Some 81 per cent of participating ANSPs are rather optimistic about the future HF/HP management developments. They expect that these future developments should take place in the following domains:

- HF/HP and automation (i.e. AI, UAS, UTM, remote towers)
- HF/HP in change management and leadership

- new generation of employees (i.e. transition from controlling to monitoring)
- new generation of airspace users
- new generation of air transport system
- cost pressure
- fatigue and stress measuring based on science
- harmonisation and standardisation in HF/HP domain
- wellbeing and sustainability.

Going forward, the participating ANSPs expressed interest in the support of the CANSO HPM WG in addressing the following HF/HP topics:

- HF/HP input to strategic safety planning
- HPM program implementation
- HF/HP policy
- HF/HP during selection
- awareness and training programme for HF/HP for all categories of staff
- HF/HP in change management
- HP risk and safety assessment
- system design and automation (i.e. automation acceptance)
- integration of UTM and GA
- defining HF/HP metrics
- technology (e.g., wearables, eye tracking, physiological measures) that provide insight into operator physiological and cognitive state and may inform development of KPIs
- fatigue management
- wellbeing
- CISM
- TRM
- situational Awareness
- sharing and exchange usable lessons learnt and good practices
- differences between work as imagined and work as done
- observations in normal operations
- interrelationships between HF/HP aspects
- HF/HP research (i.e. sector capacity/ATCO capacity, menopause in ATCOs)
- CANSO HPM SoE.

11. Future HF/HP developments

RC #16: The CANSO HPM WG could assist ANSPs by addressing the following topics:

- HF/HP input to strategic safety planning
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- awareness and training programme for HF/HP for all categories of staff
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- situational Awareness
- sharing and exchange usable lessons learnt and good practices
- differences between work as imagined and work as done
- observations in normal operations
- interrelationships between HF/HP aspects
- HF/HP research (i.e. sector capacity/ATCO capacity, menopause in ATCOs)
- CANSO HPM SoE.

12. Conclusion

The CANSO HPM WG survey is the largest survey to date of ANSPs worldwide focusing on perceptions and actual practices concerning Human Performance and Human Factors management. It has revealed a large amount of useful information that will still need further analysis. By understanding the current state of HP/HF management in ANSPs, CANSO can better tailor support for Safety and HF/HP for members. Additionally, the results have revealed areas for development and focus that ANSPs can now benchmark against other ANSPs. By sharing this data within this document, it is now possible to see where other ANSPs are doing well and this can raise the level of inter-company collaboration and sharing of resources.

The CANSO HPM WG will continue to develop guidance and recommendations as well as best practice research for ANSPs and intends to conduct this survey on a more regular basis to establish trends.

12.1 Survey observations

OBS #1: With certain exceptions, the size of the ANSP can be associated with the level of understanding of HF, HP, OHS and wellbeing concepts – the larger the ANSP the crisper understanding of the HF, HP, OHS and wellbeing concepts is.

OBS #2: A vast majority of ANSPs, that participated in this survey, are aware of the CANSO HPM SoE.

OBS #3: Some 71 per cent of participating ANSPs, predominantly from Europe, have established a formal or informal system to manage HF/HP.

OBS #4: Those ANSPs who have implemented an informal or formal of HF/HP management system are managing 72 per cent elements derived from the CANSO SoE in HPM.

OBS #5: Out of ANSPs who have established a formal or informal HF/HP management system, the topics which are being given the most attention by participating ANSPs are: i) Operational training, ii) HF/HP investigation, iii) ATM equipment and support tools, iv) Policy, v) Impact of change. In contrast, topics that are given the least attention to by ANSPs are: i) Interrelationships between HF/HP aspects, ii) HF/HP research, iii) HF/HP Management effectiveness, iv) Measurement and evaluation of HP aspects, and v) Leadership.

OBS #6: ANSPs are giving greater attention to managing those elements, derived from CANSO SoE in HPM, that also in the focus of regulatory requirements (i.e. EU REG 2017/373).

OBS #7: In the management of HF/HP the following departments play the most important roles: i) Safety, ii) Quality, iii) Risk, iv) OPS, v) HR.

OBS #8: The mature OHS regulatory framework across the globe can explain a high rate of OHS policy development. In contrast, only about one in two ANSPs have defined and implemented the HF policy and only one in three ANSPs have defined and implemented HP or Wellbeing policies.

OBS #9: The following trend in short- and long-term objectives was observed amongst the participating ANSPs:

- training and competence:
 - ii. the need (both in the short- and long-term) to develop HF and HP competences (and expertise in-house);
- organisation:
 - ii. compliance (i.e. implementing regulatory requirements),
 - iii. methodological (integration of HF/HP in management of changes, safety assessment and occurrences investigations),
 - iv. gathering and implementing good practices (e.g. stress and fatigue management),
 - v. improve employee satisfaction at work and general wellbeing,
 - vi. increase the integration of HF/HP in the management system,
- information management:
 - iii. identify human performance/state data collection tools/technology,
 - iv. gather and monitor HP data preferably in real-time to enable immediate feedback.

12. Conclusion

OBS #10: It could be concluded that resources for HF/HP are prioritised for those elements that have a long tradition of being managed within an ANSP or are part of regulatory requirements. In contrast, ANSPs report insufficient resources related to the integration of HF/HP in organisation's management system. The least amount of resources are allotted to elements that address the development of future HF/HP research, Leadership, HF/HP management effectiveness and Measurement and evaluation of HP aspects.

OBS #11: HF/HP competence requirements and corresponding training modules have predominantly been developed for staff working on operational positions (i.e. ATCOs, OJTIs and ATSEPs) likely because of applicable regulatory requirements. In contrast, in accordance with the absence of applicable regulatory requirements, between 67 and 81 per cent of participating ANSPs have not defined competence requirements and training modules for all staff and the HF/HP expert/specialists respectively.

OBS #12: HF/HP competence requirements and corresponding training modules have been the least developed for corporate management, which may slow down the promotion and prioritisation of HF/HP within ANSPs.

OBS #13: While ANSPs have predominantly developed HF/HP competence requirements and corresponding training modules for safety investigators, very few developments have been reported to be made in the domains of safety assessment and safety surveys thus impeding HF/HP integration in the SMS (beyond safety investigations).

OBS #14: At majority of ANSPs, HF/HP in occurrences are primarily being investigated by a combination of safety occurrence investigator and/or a safety occurrence investigator.

OBS #15: The majority of participating ANSPs included HF/HP assurance in their respective change management processes but not equally for all types of changes.

OBS #16: One in two of participating ANSPs actively involve and consult operational personnel in the HF/HP aspects of changes.

OBS #17: Two out of three of participating ANSPs introduced HP/HF requirements in their respective contract management processes.

OBS #18: Approximately 63 per cent of ANSPs have adopted a prescriptive approach and the remaining 37 per cent have implemented a Fatigue Risk Management System (FRMS).

OBS #19: Only 38 per cent out of surveyed ANSPs do collect information on differences between the Work-as-Imagined (WAI) and Work-as-Done (WAD).

OBS #20: 43 per cent of participating ANSPs have implemented certain HF/HP indicators that tend to focus on stress and fatigue reporting and investigations.

OBS #21: 57 per cent of ANSPs are experiencing difficulties to identify trends in collected qualitative and quantitative data.

OBS #22: Between 67 and 71 per cent of participating ANSPs are gathering, sharing and exchanging HF/HP lessons learnt and good practices. In doing so ANSPs primarily rely on ICAO, CANSO, EUROCONTROL, SESAR and EASA information sources.

OBS #23: 81% of participating ANSPs are rather optimistic about the future HF/HP management developments. They expect that these future developments should take place in the following domains:

- HF/HP and automation (i.e. AI, UAS, UTM, remote towers)
- HF/HP in change management and leadership
- new generation of employees (i.e. transition from controlling to monitoring)
- new generation of airspace users
- new generation of air transport system
- cost pressure
- fatigue and stress measuring based on science
- harmonisation and standardisation in HF/HP domain
- wellbeing and sustainability.

12. Conclusion

12.2 Survey recommendations

RC #1: CANSO HPM WG shall move towards defining industry standard definitions by also working with ICAO, IATA and EASA to streamline these concepts for consistency worldwide. Once complete, CANSO HPM WG is to perform a promotion campaign on raising awareness about the definitions of HF, HP, OHS and wellbeing of the concepts and their relationship.

RC #2: CANSO HPM WG should investigate into the causes that are impeding CANSO ANSPs to apply CANSO HPM SoE. Further work shall be done by the HPM WG to review the CANSO HPM SoE but also to promote and assist ANSPs in deploying and utilising the SoE.

RC #3: CANSO HPM WG shall investigate the drivers and obstacles of implementing informal or formal of HF/HP management systems. CANSO HPM WG shall also publish guidance on deploying at least a basic HF/HP management system for ANSPs. Assistance shall be given to ANSPs needing help and expertise.

RC #4: The CANSO HPM WG shall continue to develop deeper guidance on practical steps and how-to's for implementing HF/HP solutions for all 12 elements of the CANSO SoE in HPM.

RC #5: The CANSO HPM WG shall create a sub-group that will analyse the gathered HF, HP, OHS and wellbeing policies in order to generate the guidance material that could support the policy development process in those ANSPs who have not created their policies yet.

RC# 6: The CANSO HPM WG shall investigate communication strategies to encourage ANSPs to expand their policies and strategies to cover all personnel within their organisations and not just operational. This is because sustainable human performance and minimising human error (and raising Safety) involves entire organisations.

RC #7: The CANSO HPM WG should create a guidance material that would assist ANSPs in the development and the implementation of a HF/HP strategy.

RC #8: The CANSO HPM WG shall assist ANSPs in the process of integration of HF/HP into ANSPs' management systems.

RC #9: The CANSO HPM WG could assist ANSPs in the development and implementation of the CANSO medium- to long-term vision and strategy for HF/HP (REF RC #7).

RC #10: The CANSO HPM WG could assist ANSPs in the development and implementation of HF/HP competence requirements and training modules for all categories of staff within an ANSP.

RC #11: The CANSO HPM WG could assist ANSPs in increasing the scope and the quality of HF/HP integration into SMS.

RC #12: The CANSO HPM WG could assist ANSPs in developing guidance on the methodology to use in HF/HP investigations.

RC #13: The CANSO HPM WG could encourage ANSPs to more consistently apply HF/HP assurance in the management of changes process.

RC #14: The CANSO HPM WG could encourage and assist ANSPs to more consistently monitor differences between the Work-as-Imagined (WAI) and Work-as-Done (WAD). The HPM WG should investigate whether guidance is needed on how to proactively monitor HF/HP indicators from system and HR data.

RC #15: The CANSO HPM WG could assist ANSPs by developing an inventory of HF/HP indicators along with the recommendations for collection, calculation, analysis and acting upon this data.

12. Conclusion

RC #16: The CANSO HPM WG could assist ANSPs by addressing the following topics:

- HF/HP input to strategic safety planning
- HPM program implementation
- HF/HP policy
- HF/HP during selection
- awareness and training programme for HF/HP for all categories of staff
- HF/HP in change management
- HP risk and safety assessment
- system design and automation (i.e. automation acceptance)
- integration of UTM and GA
- defining HF/HP metrics
- technology (e.g., wearables, eye tracking, physiological measures) that provide insight into operator physiological and cognitive state and may inform development of KPIs
- fatigue management
- wellbeing
- CISM
- TRM
- situational Awareness
- sharing and exchange usable lessons learnt and good practices
- differences between work as imagined and work as done
- observations in normal operations
- interrelationships between HF/HP aspects
- HF/HP research (i.e. sector capacity/ATCO capacity, menopause in ATCOs)
- CANSO HPM SoE.

