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TOWARD A HUMAN PERFORMANCE STANDARD OF EXCELLENCE
IN AIR TRAFFIC MANAGEMENT

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Air Traffic Management (ATM) is a 24/7 industry that strongly depends on people and needs its frontline staff to be on top performance to maintain safety and efficiency of the air transport system. However, Air Navigation Service Providers (ANSPs) too often downplay the integration of human performance against higher priority operational and business issues. At the same time, human factors experts are sometimes challenged in communicating their tools and methods in ways that are seen as pertinent to ANSP issues. In order to bridge these organizational stove pipes, an international approach is being harmonized for ANSPs to gauge their maturity for how human performance is integrated across ATM system design, development and operation. A Human Performance Standard of Excellence (HPSoE) frames a business case to invest in human performance using three axes and associated assessment scales: Business Vision (appreciation of the role of human performance in the safe delivery of service), Human Performance (focusing on all job-related factors at individual, group, and organizational levels), and Human Factors (applying scientific knowledge to optimize human - system performance).

Introduction

Air Navigation Service Providers (ANSPs) around the world place high priority on ensuring and delivering safe and efficient Air Traffic Management (ATM) including Air Traffic Control (ATC) to the flying public. Because ATM is real-time, and incident evolution is typically measured in minutes, frontline staff (e.g., air traffic controllers, traffic management specialists, system technicians, maintainers, supervisors, and managers) need to exhibit peak performance around the clock. Yet the integration of human factors (HF) – the scientific discipline whose sole purpose is to enhance human performance – into ATM, when viewed globally, seems weak and patchy compared to other high-risk, high performance industries such as nuclear power or the defense domain. While some ANSPs have a strong HF capability supporting human performance, most do not and instead deal with human performance issues in other ways. But as ATM becomes ever-busier, more complex, and more inter-connected across different ANSPs, it is timely to consider how human performance is best optimized to continue ATM's reputation for smooth, efficient and safe handling of traffic.

In 2013, the Federal Aviation Administration (FAA), EUROCONTROL, and several ANSPs joined through Action Plan 15 to address and harmonize how the need to optimize safety and human performance can be supported by aligning and leveraging research advancements. One such effort is the development of a Human Performance Standard of Excellence (HPSoE) to assess and understand the

maturity of ANSPs for integrating human performance in ATM systems.[1] This paper describes the need for the HPSoE, identifies examples of industry capability maturity models (CMMs), and explains the approach being taken for the development of the HPSoE.

Why the Need for the HPSoE

Human performance refers to "the performance of jobs, tasks, and activities by operational personnel – individually and together" (EUROCONTROL/FAA, 2010). Human performance is important to ANSPs because people ensure that ATM service is kept safe and efficient for the flying public. In particular, ANSPs can use this HPSoE to establish a baseline upon which improvements can be identified in order to better manage operational safety risks and improve efficiency and resilience. The business case includes managing costs (e.g., insurance, borrowing) that can increase as incidents and accidents occur globally.

Why Human Factors Is Not Used

While human performance can be enhanced by applying human factors (HF) science, usage of HF experts in the ATM industry has generally been less than optimal. Operations and maintenance managers, as well as acquisition program managers, may want and plan for human performance excellence but they may find it necessary to limit how HF science is used, or find ways other than HF to try to reach their goals. This occurs when managers are under time or cost pressure or because they do not have the human performance intelligence to recognize when HF expertise is needed. This may also be due to ATM getting more complex and more dependent on automation, which brings with it tricky challenges like changes in job roles and balancing workload associated with use of new decision support tools that can introduce new sources of operational drift such as automation that is not used or used in ways not intended.

How to Avoid Having Human Factors Lost in Translation

A common complaint in many discussions between HF experts and decision makers is that the former do not speak to the issues of the latter, and the latter do not speak the HF lingo. Decision makers want to know things such as whether operations are safe and cost efficient, has training been effective, and will a new system being installed deliver better performance. In contrast, HF experts talk about human performance assurance through tools and methods like "training needs analysis" and "human centered automation guidelines" that present a different language for decision makers. The HPSoE recognizes that HF comprises a systems discipline and that HF experts need to connect with different parts of the organization. In fact, HF experts often view their efforts as a catalyst for interactions between organizational stove pipes because their expertise and tools contribute to teams in different departments.

How to Consistently Demonstrate the Benefits of Human Factors Integration

It is recognized that HF is by no means the whole answer but, without HF, ANSPs will be challenged to reach the most efficient and reliable levels of safe operations. An investment in HF is an investment in safety as well as efficiency. To accomplish this integration the ANSP needs a vision and a pathway to build that vision in order to achieve sustained improvement in human performance. Of course,

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[1] Action Plan 15 (AP15) on Safety and Human Performance falls under the umbrella of the FAA-EUROCONTROL Memorandum of Cooperation, and is one of more than twenty different Action Plans. Since 2003, AP15 has focused on enhancing understanding of systemic safety issues, ranging from safety toolkits, to safety culture and resilience, to system-wide risk pictures and models, to HF. Like all Action Plans, the AP15 Terms of Reference are revised every three years.

the vision and capability to improve human performance must be tailored and proportionate to the size and complexity of each ANSP.

Capability Maturity Models

CMMs provide a framework for describing and assessing maturity of organizations and their use is well established in many industries. Within ATM, there already exists a CMM. A Standard of Excellence (SoE) for Safety Management Systems (SMS) was developed by the Civil Air Navigation Services Organization (CANSO) and provides an industry standard for gauging SMS maturity of ANSPs on five different levels. Guidance is provided on how improvements can be made to the SMS (CANSO, 2014). The HPSoE is designed to sit alongside and to complement the existing SoE for SMS. As with some CMMs, the SoE for SMS uses five levels to relate maturity and effectiveness, as shown in Figure 1.
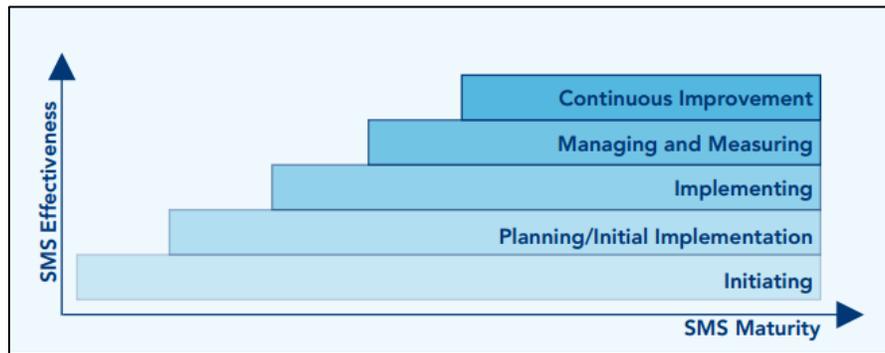

Figure 1. CANSO SoE for SMS Maturity Pathway.

In other industries, the People Capability Maturity Model (People CMM) developed by the Carnegie Mellon University is used by organizations to address their critical human capital issues (Curtis, Hefley & Miller, 2009). The People CMM adapts well-established maturity models for software development capability and uses a process maturity framework to align best practices for managing and developing an organization's workforce. The structure of the People CMM is summarized in Table 1.

Table 1.
Summary of the People CMM.

Level	Maturity	Characteristics
Five – Optimizing	Change Management	Continual improvements made in workforce practices and adoption of innovative technologies
Four – Predictable	Capability Management	Measures used to establish process performance baselines and assess priorities for improvements
Three – Defined	Competency Management	Workforce competencies tied to current and future business objectives as critical enablers
Two – Managed	People Management	Focus at unit level to overcome uneven skills, work overload, and poor communication
One – Initial	Inconsistent Management	Ad hoc practices, oriented toward administration rather than managing people

In the People CMM, an organization can transition from Levels One to Two by focusing on development of repeatable processes; from Two to Three by developing competency based practices; from Three to Four by using measured and delegated practices; and from Four to Five by continuously improving practices.

A CMM developed for the offshore oil and gas industry in the United Kingdom is the Human Factors Assessment Model (HFAM) (McLeod, 2004). HFAM intends to provide a practical and easy-to-use method to assess the maturity by which good practices are used for human issues associated with the design of new or changes in equipment and processes. HFAM uses various HF elements (e.g., roles and responsibilities, user involvement) with examples of possible evidence and weightings that are summed up and translated into an easy to interpret percentage score (see Table 2.).

Table 2.
Summary of HFAM.

Level	HFAM Score	Maturity
Five	91% or more	Best practice
Four	76-90%	Good practice achieved, towards best practice
Three	66-75%	Good practice
Two	46-65%	Some elements of good practice achieved, but not enough to be confident that it will be applied consistently (reasonable good practice)
One	45% or less	Definitely not following good practice

Human Factors Integration Strategy

Following review of CMMs from several industries it became apparent that a common HF integration strategy needed to be developed that would reach across the diversity of ANSPs. The strategy is depicted in Figure 2. The strategy leverages where and how improvements can be gained relative to both quick wins and for long haul efforts. The strategy enables each ANSP to assess how its capability aligns with its organizational vision and resources. Fortunately, the SoE for SMS in ATM (CANSO, 2014) provided a foundation of best practice with ANSPs. This included using multiple elements to construct the Standard with a phased approach to enable step wise implementation by ANSPs.
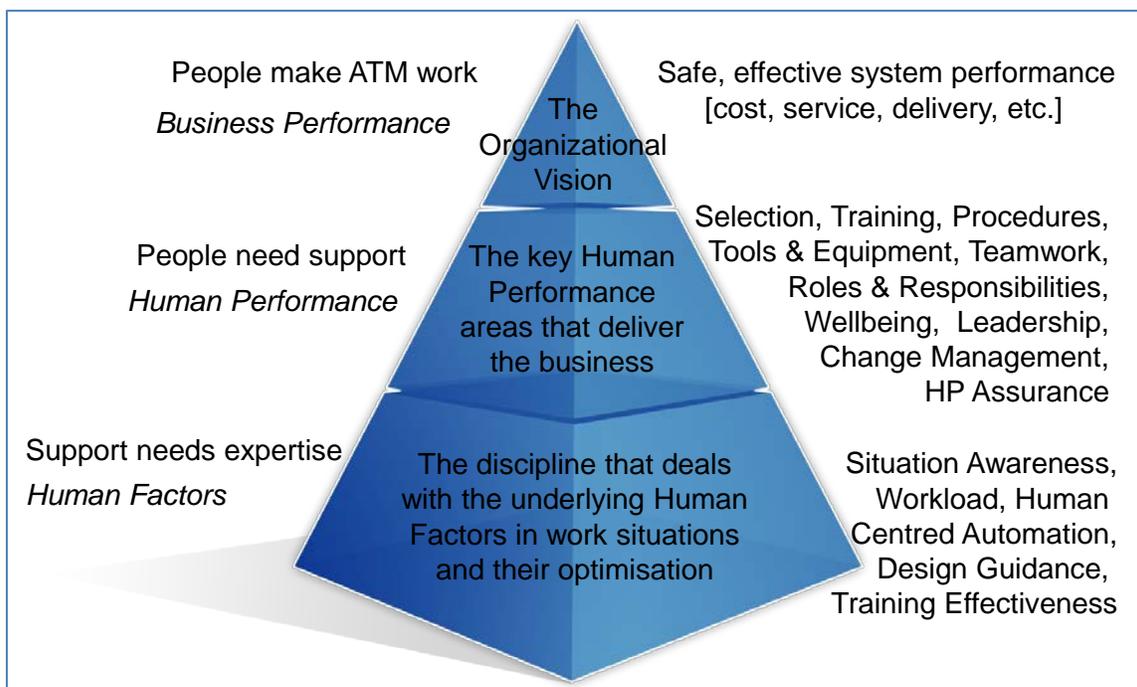

Figure 2.
Human Factors Integration Strategy as Foundation for the Development of the HPSoE.

Development of the HPSoE started with recognizing how HF experts currently contribute to ANSPs. This includes operating across existing organizational structures by being an important part of teams involved in operations, design, safety, training, engineering, and human resources. Through this perspective, three principal Axes emerged that characterize the contributions that HF make to these teams. Finally, these Axes were decomposed into thirteen Elements with assessment scales to gauge levels of maturity for how HF contribute to these teams and ANSPs. Together these Axes and Elements provide the framework for how ANSPs can rate themselves for maturity. At this point in time in development of the HPSoE, the three principal Axes with their thirteen Elements are shown in Figure 3.
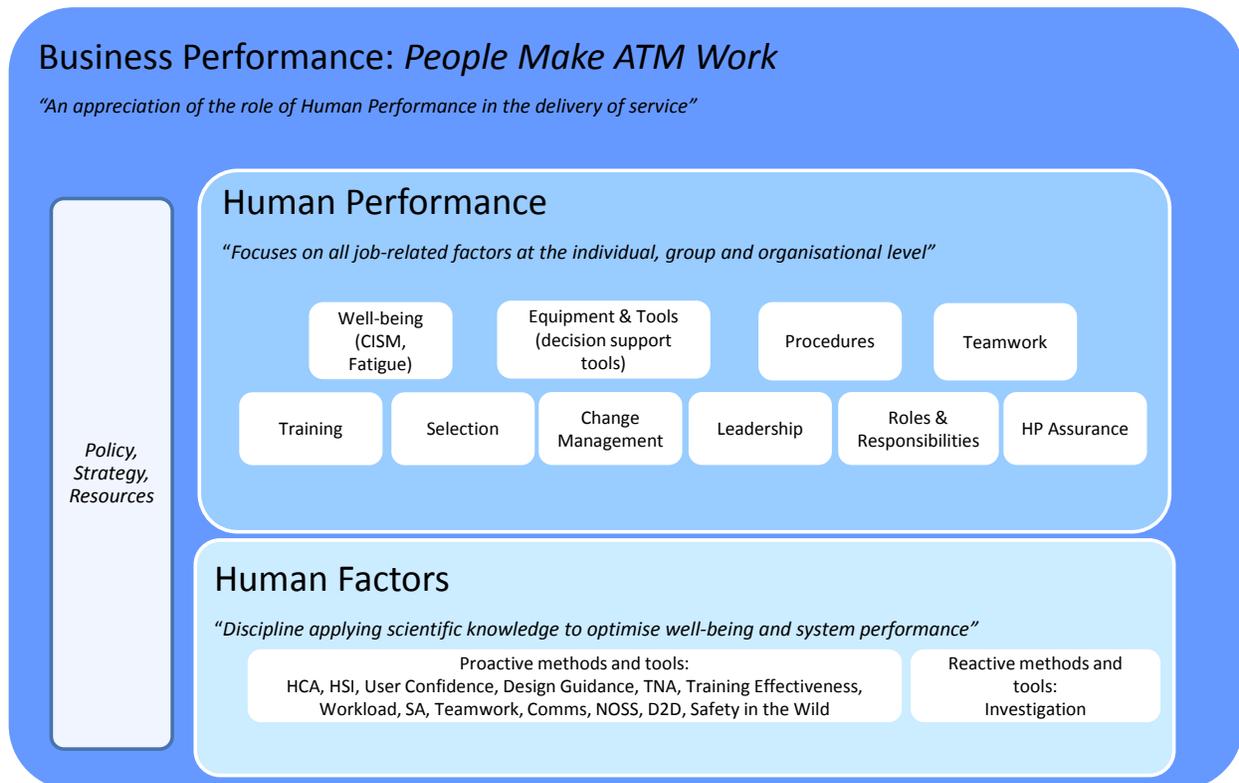

Figure 3.
Framework of Axes and Elements

An example of the assessment scales for Elements developed to assess ANSP maturity is shown in Table 3, for Policy, Strategy, and Resources.

Way Forward

Development of the HPSoE is accompanied with questions still needing to be addressed. This includes, for example, how does the HPSoE scale up or down with different sizes and complexities of ANSPs? What requirements or guidance is used as evidence of maturity assessments? What different paths can ANSPs use to step up to the next level of maturity? Does reaching a certain level of maturity infer comparability across ANSPs rated as having that level of maturity?

Conclusions and Outlook

The HPSoE can provide a benchmarking system to facilitate ANSPs seeking to improve Human Performance and so leverage the integration of HF in ATM system design, development and operation. It

provides a vision for how ANSPs can raise their maturity to better leverage the human contributions to operations, acquisitions, and maintenance of ATM systems.

Table 3.
Example Rating Scale for Element of Policy, Strategy, and Resources.

Objective	Initiating	Planning/Initial Implementation	Implementing	Managing & Measuring	Continuous Improvement
Provide a consistent and reliable level of Human Performance which ensures a safe and high quality level of service.	There is no recognition of the importance of the role that people play in delivering a safe and high quality level of service. The ANSP meets the minimum regulatory standards in respect of licensing, training, reporting, and so forth.	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, and investigations. Initial planning is in place to improve Human Performance.	Human Performance is being actively improved. There is recognition of the value that HF expertise can bring. A person is identified with a clear remit and budget for addressing HF issues and they are embedded within a division of the organization.	Key Performance Indicators are in place to measure Human Performance and to identify priorities for improvement. The HF capability available is tailored and proportionate to the maturity and complexity of the ANSP. HF experts are operating within several divisions of the organization.	The role of the human is recognized as being integral to the success of the organization. A strategic vision is built around continuously improving the capability and performance of its people. The ANSP supports and uses HF R&D as a means of gaining intelligence on how to improve Human Performance.

Acknowledgement

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