The Effect to Human Performance and Wellbeing of Air Traffic Management Operational Staff Through the COVID-19 Pandemic

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The Covid-19 pandemic reduced air traffic levels in Europe by up to 95% and the system had to respond quickly to preserve safety, maintain efficiency and performance. Operators were significantly affected both in terms of individual and team performance, as well as the longer-term impact to skills and attitudes. Human Performance data from Operators has been collected through this period. The impact to safety risk due to underloading of human performance, as well as the longer-term impact to wellbeing and competencies of operators was analysed. The largest impact to staff was reduced performance because of anxiety and uncertainty around the future as well as changing job roles. Results also demonstrated the positive effect of systems already place to protect human performance.

There has been almost no lives on earth left untouched by the Covid-19 pandemic (Zacher and Rudolph, 2020). Aside from the public health impact and the measures that have had to be put in place, the way we work and interact socially has shifted dramatically (Schieman et al., 2021) Human Performance is one of the essential key performance indicators for many industries and organisations as it produces outputs such as safety or business productivity. Individually, our human performance varies day to day and over time and is driven primarily by our *technical skills and experience* and also by our *non-technical skills* (also sometimes known as soft-skills) such as Confidence and Resilience (Wickens, et. al., 2015). The pandemic has had a significant impact to these non-technical skills, and if not treated seriously by employers may pose the larger threat to business outputs in the long term even as demand recovers (Murden et al., 2018)

Aviation as a specific example. The global pandemic was declared on March 11, 2020 by the World Health Organisation. This began a sharp decline in the amount of air traffic throughout Europe. Austria went into a first national lock down on 16 March 2020. By 30 March, with continued decline in air traffic globally, operations within Austria reduced to approximately 25% of normal traffic levels. By the end of May, Air Traffic Across Europe had reduced up to 95% (Eurocontrol Daily Traffic Variation, accessed Jan 31, 2021). The response to this significant loss of traffic, coupled with health and welfare responsibilities to impose physical distancing amongst technical and operational staff has seen an unprecedented shift in the task requirements not only of Air Traffic Controllers (ATCOs) but to all operational staff in almost every industry. Organisations have had to adapt at very short notice to new human performance demands that their staff were often not trained or prepared for (Vink, 2020a and Eurocontrol, 2020)

Focusing on just Air Traffic Control; a sustained loss of workload to Air Traffic Controllers posed a potential safety risk of ‘underloading’ due to skill fade, monotony and other human performance issues. In Austria, under guidance from the Eurocontrol Network Recovery Plan (Eurocontrol, 2020), measures were taken to off-set these risks and to study the effect of a pandemic on human performance. Initial risk assessment focused on the degradation of technical skills – being the actual skills required such as operating a radar screen, or radio communications. Several studies have been conducted from April 2020 until present looking at all facets of human performance. This paper discusses two key surveys and related occurrence data. Overall, it is concluded that the pandemic has led to a degradation in

non-technical skills which has an effect to safety and performance. This is potentially a longer-term issue in the recovery from Covid-19 for Air Traffic Management. This means, for aviation the message is clear: *we must continue to focus on maintaining and improving staff wellbeing and non-technical skills just as we try to preserve technical skills, safety and business outcomes.*

Expanding this idea to society. In the immediate months following the pandemic, businesses and societies focused on acute solutions – economic, business and medical (Zacher & Rudolph, 2020) As the rest of 2020 unfolded, the impact to mental health was becoming clearer (Pereira-Sanchez et., al. 2020). Efforts are often made by human resource departments to measure it: absent days, sick days, reduced motivation and supervisor checks, however these do not show the true impact to performance because performance is often not very well defined (Patel et al., 2018) There is now a growing consensus that the pandemic and the shift to working from home, or other major changes to tasks of employees is having direct impact to job satisfaction, motivation and mental well-being (Zacher & Rudolph, 2020). In fact, it is likely that even once national and international measures to curb the spread fade away, the impact to employees may be felt for many years to come even as the global economy recovers (Schieman et al., 2021 and Polizzi, Lynn & Perry, 2020).

Within Europe, as in many other Air Navigation Service Providers globally, we call these skills *non-technical skills* and they include: Confidence, Resilience, Adaptability, Trust, Anxiety, Worry and Motivation. Taken together they represent a quantifiable output that directly contributes to human performance (Vink, 2020b). The SHELL Model (Edwards, 1972) is the basis of the human performance pyramid which is used to identify the *most important factors* for producing successful human performance (available upon request to the author). Generally, it is accepted that culture, infrastructure, training/experience, and individual daily variability are the keys to this performance. Individual factors consist primarily of workload, situational awareness, team interactions and non-technical skills (Vink, 2020a).

Even before the pandemic, burnout and other significant losses of human performance were being observed as operations were pushed to their theoretical limits (Vink, 2020b). For aviation, the pandemic has in some ways given some much-needed breathing room and crucially the opportunity to understand exactly how much impact non-technical skills has on our human performance. In their book, "Burnout," the Nagoski sisters discuss the idea of wellness as not being a state of safety and comfort, but as the ability to return to safety and comfort after adversity and difficult performance (Nagoski & Nagoski, 2020). But as the Nagoski sisters point out, we need to learn these skills alongside our day to day required skills. The Covid-19 pandemic has allowed us to capture a unique view into how these non-technical or 'through life-skills' mitigate and mediate our day to day performance. If society can adapt some of the concepts of the human performance pyramid and engineer these skills into sustainable living, then the recovery from this pandemic may be far more effective.

Surveying Human Performance in ATCOs and Operational Engineers

Participants. This paper focuses on the results of two subjective surveys which were carried out in July 2020 (for ATCOs) and January 2021 (for Operational Engineers). For the ATCO survey, n = 94 representing 28% of invited Controllers. For the Engineers n = 149 representing approximately 68% of invited Engineers. The majority of respondents had between 6- and 19-years' experience as operators. Respondents represented an even distribution of operational centres across the country.

Methodology. Two distinct but related questionnaires were produced each focusing on the more specific human performance requirements of the target groups. Both surveys were broken into three areas that asked human performance questions related to: 1 – perception and worry about skill fade, 2 – Monotony and general human performance and 3 – feedback and opinions on Covid-19 measures and impact. For section 1, the focus was on understanding what kinds of skills were impacted by the disruption to normal working patterns. Operators were asked to respond to statements using a 5-point Likert scale and questions included for example, "I am worried about skill fade as a result of the downturn in workload." For section 2, generic human performance measures were needed to understand the average impact to human performance across the reduced traffic period and determine whether boredom and monotony were serious safety threats. These included a variation on the NASA TLX workload indicator (Hart & Staveland, 1988) which asked operators on a 5-point Likert scale about mental and physical workload. Additionally, frustration, effort and self-rated performance were collected. Section 3 contained more generic subjective comment feedback from operators on the specific measures taken during the Covid-period. Using word frequency analysis, the day to day worries and anxieties as well as future psychological wellbeing and concerns could be captured.

Results. Overall, the results were similar between ATCOs and Operational Engineering staff with one notable exception – the difference in workload. In section 1, most operational staff did not need to adjust the techniques and methods for mentally and physically conducting their tasks. 40% of controllers were worried about skill fade, but many took personal initiatives to keep themselves sharp and active. Similarly, engineers were less concerned with general technical skill fade. Some specific skills not used were identified, especially those related to complex situations. But technical skill fade was shown to be less of a concern than first predicted.

Table 1.
Specific Human Performance indicators from ATCOs and Operational Engineers.

	Very Low	Low	Medium	High	Very High
Frustration ATCOs	34 %	18 %	22 %	22 %	4 %
Frustration Engineers	24 %	10 %	24 %	30 %	12 %
Effort ATCOs	30 %	40 %	16 %	9 %	5 %
Effort Engineers	3 %	4 %	38 %	41 %	11 %
Self-rated Performance ATCOs	5 %	5 %	32 %	29 %	29 %
Self-rated Performance Engineers	2 %	13 %	27 %	34 %	24 %
Physical Demand ATCOs	52 %	29 %	13 %	5 %	1 %
Physical Demand Engineers	22 %	20 %	37 %	18 %	3 %
Mental Demand ATCOs	39 %	27 %	24 %	10 %	0 %
Mental Demand Engineers	3 %	7 %	38 %	43 %	9 %

Section 2 revealed key human performance indicators as seen above in Table 1. 66% of the ATCO mental workload is low or very low. This is an indicator of the 'underloading' condition. ATCO workload should be kept at an optimum level to maintain safety. 81% of the physical workload is also considered too low for ATCOs. Conversely, the engineers reported an increase in workload – where over 52% of respondents indicated that their workload had increased. This suggests a shift in the task loading of staff across the company. This can be

explained by the fact that even when there is little air traffic, all operational services such as radars, radios and weather equipment had to be available and maintained. With social distancing and remote working, this increased the workload on engineers. It is crucial to note that although average ATCO workload was low, many smaller regional airports reported increases in workload due to increased VFR traffic. This resulted in some near-overload occurrences even when the aggregate picture appeared to be much reduced air traffic.

Despite this, 89.25% of controllers and 75% of Engineers believed that they continued to perform highly and safely throughout the period. This indicates that Safety Culture remained strong and actively engaged in by staff. Frustration was low amongst air staff despite suggestions of monotony and anxieties. Furthermore, perceived personal performance was high which indicates successful measures taken such as alternating team compositions and individual efforts to cope were appropriate. However, results showed that engineers who traditionally do not work in such large teams or operations rooms may have been left more exposed and isolated (i.e. unsupported) due to remote working.

In section 3, comments from operators indicated that they felt reasonably well supported at the operational level (i.e., on the front lines). However, going beyond the operations room, frequency analysis reveals consistent themes and drivers of worry. There are two major themes that occupy the Operator's daily concerns: a slow breakdown in intra-team communication (25%) due to home office and isolated working conditions, and confusion around leadership and crisis messages (19%). And when asked about the biggest fears and worries affecting their wellbeing, operators overwhelming report having anxiety about the future of Aviation and of having a job (58%) followed by worry about society and the economy (10%) and communication from media and government (10%).

Other comments revealed that the operation is still performing relatively well with few major occurrences, good team spirit and performance, with individual measures and professionalism remaining strong and trust in each other. However, as lockdowns persist, remote working is having an increasingly isolating effect, and staff report struggling sometimes just to get work done because of the unavailability of colleagues and tele-working barriers.

Discussion

The data from both surveys as well as evidence from occurrences has led to the conclusion that *technical skills* have not degraded. This is most likely because of proactive and professional behaviours taken by all personnel as well as support for these personnel including simulator training, briefings, communication and team resource management exercises to keep people sharp and practicing busier situations.

What has become evident though is a marked degradation in *non-technical skills*. Of particular concern is the confidence levels of personnel. This is directly linked to their level of anxiety and worry about the future. In aviation, there has been a growing threat of automation replacing much of the hands-on tactical air traffic controlling or flying of aircraft. Autopilots and auto-controllers have already replaced large sections of the skills traditionally used (Wickens, et al., 2015). When the entire industry is threatened and demand for air travel is low, it is unsurprising that the future might seem less certain. Subjective comments reveal that this anxiety or worry is contributing to reduced confidence and strain on resilience.

Taken together; confidence, resilience and trust are decreased and worry and anxiety are increased across the operational staff. This indicates an overall degradation in non-technical skills. Between July and December 2020, occurrence data reveals that human factors contribution to occurrences has remained relatively normal. However, the types of human

errors have shifted. Whereas it is usually found that technology and procedures contribute to sub-conscious lapses and slips (Reason, 1990) the types of human errors observed during the period have reflected this degradation in non-technical skills. Pilots and Air Traffic controllers reported that their concentration and attention to procedures are degraded because of distraction due to worry. Corporate measures such as sending staff on leave to clear down their leave balances has also meant that many are coming back after longer periods away and some occurrences have cited being 'rusty' or 'complacent to changes' as reasons for human errors.

The data from these surveys is extensive and revealing. Furthermore, it is a snapshot of a highly unusual situation. There were many positives. Human Performance despite showing signs of significant changes to working roles, remained safe and delivered services throughout the period, with relatively few major occurrences. Frustration was generally low, and camaraderie at an operational level was high. People came through for each other and support was to be found. However, much of this professional behaviour is to be expected in highly safety focused systems such as air traffic management. The key indication though is that non-technical skills have degraded which might not be able to be sustained long term – especially if traffic is to rebound quickly once lock downs and other national measures are relaxed. Therefore, ANSPs in Europe have taken measures to implement non-technical skills training for all staff (not just operational staff). Because of the ability for non-technical skills to mediate human performance and according to the swiss-cheese concept of safety (Reason, 1990) and the Human Performance pyramid, it is vital to help staff boost-up their confidence alongside maintaining their technical day to day skills.

This concept can be applied more widely. New techniques for the teaching and practice of confidence and resilience training which includes teaching the neuropsychology concepts, human error causes and forgiveness of mistakes, acceptance techniques including elements of positive psychology and mindfulness/wellbeing and finally confidence building which includes elements of sports psychology and positive goal setting are now being taught. This method is showing positive effects on staff (although data is limited currently). But this approach of treating professionals with the idea of *'elite professional development'* is a much more positive message than treating people as if they are broken due to lack of confidence. This approach is also a proactive technique for engineering non-technical skills back into the operation.

Conclusion

The pandemic may be causing long term degradation in non-technical skills for personnel and society more generally. By reclassifying traditionally mental health or wellbeing phenomena as skills that can be taught, practiced, and lifted back up this can have a positive impact on human performance. The goal needs to be for individuals to achieve *sustainable* well-being *and* human performance. This is because of the direct impact that wellbeing (non-technical skills) has on human performance. As lockdowns continue and the future of work (e.g. working at home) changes, we have a chance to radically redesign the need for wellbeing to play a more engineered role in the required human performance. If organisations, society and individuals take a proactive approach to deigning their own wellbeing requirements against the human performance requirements this will provide a much greater benefit to outcomes in the long term. It is also much more successful than waiting until after skill degradation or negative mental health effects to try and repair them.

The aviation industry has demonstrated that proactive steps were taken based on risk assessments to maintain both the technical skills and non-technical skills of their staff. As research has emerged, these programs have been rolled out to all staff in the company, not just front-line operators. The same approach can be applied in all industries. The key is to remove

the stigma and negative public relations messaging around non-technical skills and to treat them as mediating skills for total human performance that can be proactively trained and developed across the lifetime and career. By training confidence and resilience scientifically and practically this can offset the impact of reduced human performance and allow people to become more adaptive to novel and unusual situations. As is so often pointed out by human factors specialists, the price of investing in these requirements early is significantly less than investing when it is too late.

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