

JUST CULTURE AND ARTIFICIAL INTELLIGENCE DO WE NEED TO EXPAND THE JUST CULTURE PLAYBOOK?

Embracing the digital era in air traffic management brings forth the integration of artificial intelligence and machine learning. As these technologies spread throughout the industry, questions arise regarding compatibility with the principles of Just Culture. **Marc Baumgartner** and **Stathis Malakis** explore the need to revise the Just Culture playbook.

KEY POINTS:

- **Digital transformation and adaptability are crucial for organisations, including air navigation service providers, to thrive in the digital economy.**
- **Artificial intelligence and machine learning (AI/ML) technologies have the advantages of rapid pattern identification, real-time decision support, and finding the best combination of settings or values for multiple variables to solve a problem or achieve a desired outcome.**
- **The integration of AI/ML poses challenges for Just Culture, as decision-making processes are often seen as a 'black box'.**
- **Concerns regarding Just Culture in the AI/ML era include considering redefining the line between negligence and honest mistakes and the need to provide formal training on AI/ML to air traffic controllers to raise their awareness.**

As the air traffic management (ATM) system rapidly transitions towards the vision of a Digital European Sky, the integration of artificial intelligence and machine learning (AI/ML) has become a key enabler. This integration raises the question of whether we need to expand the Just Culture playbook. In this article, we will explore two layers of concerns that prompt the expanding of the Just Culture playbook.

Black Boxes

Not long ago, computers were perceived as infallible machines that processed numerical inputs into accurate outputs. Today, digital machines, ranging from smartphones and tablets to personal computers and data warehouses, are handling humanlike tasks that go beyond basic number crunching. These tasks involve higher cognitive processes such as information analysis, pattern recognition, predictive insights, and decision-making using AI/ML.



The main advantages of AI/ML are:

- a) rapid identification of patterns in complex real-world data that humans and conventional computer assisted analyses struggle to identify,
- b) real-time support in decision-making, and
- c) finding the best combination of settings or values for multiple variables to solve a problem or achieve a desired outcome.

To cope with events such as pandemics, political unrest, military conflicts and climate change, the future depends on adaptation. To survive and thrive, organisations must embrace changes to generate new strategic possibilities. This means creating an adaptable organisation that can thrive in the digital economy. An adaptive organisation in the 21st century is typically digitally powered, leading many organisations to pursue so-called digital transformation. This also applies to air navigation service providers (ANSPs).

Current ATM infrastructure is already data intensive and, in the years to come this is expected to increase. AI and ML are seen as crucial enablers for overcoming current limitations and meeting the changing and uncertain demands of normal operations, disruptions, and crises. It is envisioned that ATM practitioners will be able to design and eventually operate a system that is smarter and safer, by constantly analysing, gaining insights, and learning from all aspects of the ATM ecosystem by utilising AI/ML, deep learning algorithms and big data analytics.

As the volume, velocity and variety of data intensify, AI and ML have the potential to offload work once tasked to humans onto computers, lessening the cognitive load for controllers.

New and emerging AI/ML capabilities are recommended for the future ATM and U-space environment to provide the necessary levels of performance beyond current limits. Full-scale implementation of ATM virtualisation will allow the complete decoupling of ATM service provision from the physical location of the personnel and equipment. Full-scale virtualisation also entails negative aspects, for instance loss of human contact. This heavily relies on digitalisation and state-of-the-art AI/ML algorithms.

Just Culture

Safety science and safety management will need to evolve to cope with the safety challenges posed by the introduction of AI/ML. ATM safety is based on relevant safety information flowing through the 'information veins' of the aviation system. Just Culture encourages front-line operators to share safety information by reporting incidents and other safety-related issues, with a commitment from the organisation to act upon the shared information to improve safety.

Formally, Just Culture is defined in EU regulation as follows: *"just culture" means a culture in which front-line operators or other persons are not punished for actions, omissions or decisions*

taken by them that are commensurate with their experience and training, but in which gross negligence, wilful violations and destructive acts are not tolerated." Before proceeding, it is stressed that *"gross negligence"*, *"wilful violations"* and *"destructive acts"* are regulatory terms, not human factors terms.

The concept of Just Culture addresses the mutual recognition of two key functions: aviation safety and the administration of justice. It represents the understanding that both domains benefit from a carefully established equilibrium, moving away from fears of criminalisation and balancing the interests of these two unique and very different domains.

Black Boxes and Just Cultures

Maintaining the equilibrium of Just Culture is based upon a) the notions of acceptable and unacceptable behaviours and b) the concept of the "honest mistake". State-of-the-art AI/ML systems, such as neural networks, are essentially "black boxes" in terms of explainability. Although they provide accurate predictions based on historical data, the reasoning behind their outputs remains incomprehensible. So, consider an air traffic controller in the operations room who receives a peculiar suggestion from an AI/ML digital assistant that employs neural networks. If something goes wrong, who is to blame?

Automation refers to the use of technology to perform tasks that were previously done by humans. This can include simple, repetitive tasks like data entry, as well as more complex processes. Automation typically involves the use of pre-programmed rules or algorithms to guide the technology's behaviour. AI/ML, on the other hand, involves the use of algorithms and statistical models to enable machines to learn from data and make predictions or decisions based on that learning. This can include tasks like image recognition, natural language processing, and predictive analytics. Unlike traditional automation, AI/ML systems are designed to learn and adapt over time, allowing them to make more accurate and nuanced decisions as they gain more experience. Therefore, the key differentiating characteristic between automation and AI/ML is learning. AI/ML algorithms learn and change behaviour with time and context given new data while automation is more static.

This represents the first level of concerns we face regarding Just Culture in the AI/ML era. The second level of concerns relates to the training of air traffic controllers. The definition of Just Culture emphasises that actions, omissions, or decisions taken by air traffic controllers should be commensurate with their experience and training. However, air traffic controllers do not currently receive formal training on AI/ML and its state-of-the-art algorithms, such as Neural Networks, and their limitations. Should we provide training to controllers on AI/ML, and to what extent? Should they understand terms such as bias-variance trade-offs, explainability issues, data validation, feature engineering, hyper-parameter selection,

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overfitting, limitations of data-driven models, and other aspects of AI/ML before being provided with digital assistants in the operations room? The chances are that most of us would need ample training and education to understand these terms. The burden of responsibility gravitates towards the organisation to provide sufficient and appropriate training to air traffic controllers. If they are not well trained it will be hard to blame them for actions, omissions or decisions arising from AI/ML situations (because then you can argue that those are perfectly commensurate with their experience and training).

These concerns present difficult questions for which we do not have definitive answers in the current Just Culture playbook. The introduction of AI/ML can be as transformative as the advent of radar in the 1950s. While we may not know the full extent of this transformation yet, we must guide it in the right direction. Organisations will have to be assured that no negligence causes a serious incident or accident. And it is not only the pilots and ATCOs, but also the engineers, testers, safety and quality professionals, air traffic safety electronics personnel (ATSEPs), etc. It seems that the ‘black box’ is an organisational responsibility. Is it necessary to change our understanding of Just Culture in response to these changes? We tend to believe that the answer is yes. We will need to consider redefining just culture and expand its playbook in the era of digitalisation.

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Just culture was designed as a tool to acknowledge and account for the fallibilities in human decision-making and judgement in light of adverse events. AI/ML, by design, take none of these elements into account. If we are to implement AI/ML into air traffic control, significant efforts will need to be made to bridge the gap between the inevitable capabilities and performance of people and computers. **S**



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