EASA
European Union Aviation Safety Agency

Ethics for AI in Aviation

Aviation Professionals Survey Results 2024/2025

EASA ARTIFICIAL INTELLIGENCE PROGRAMME

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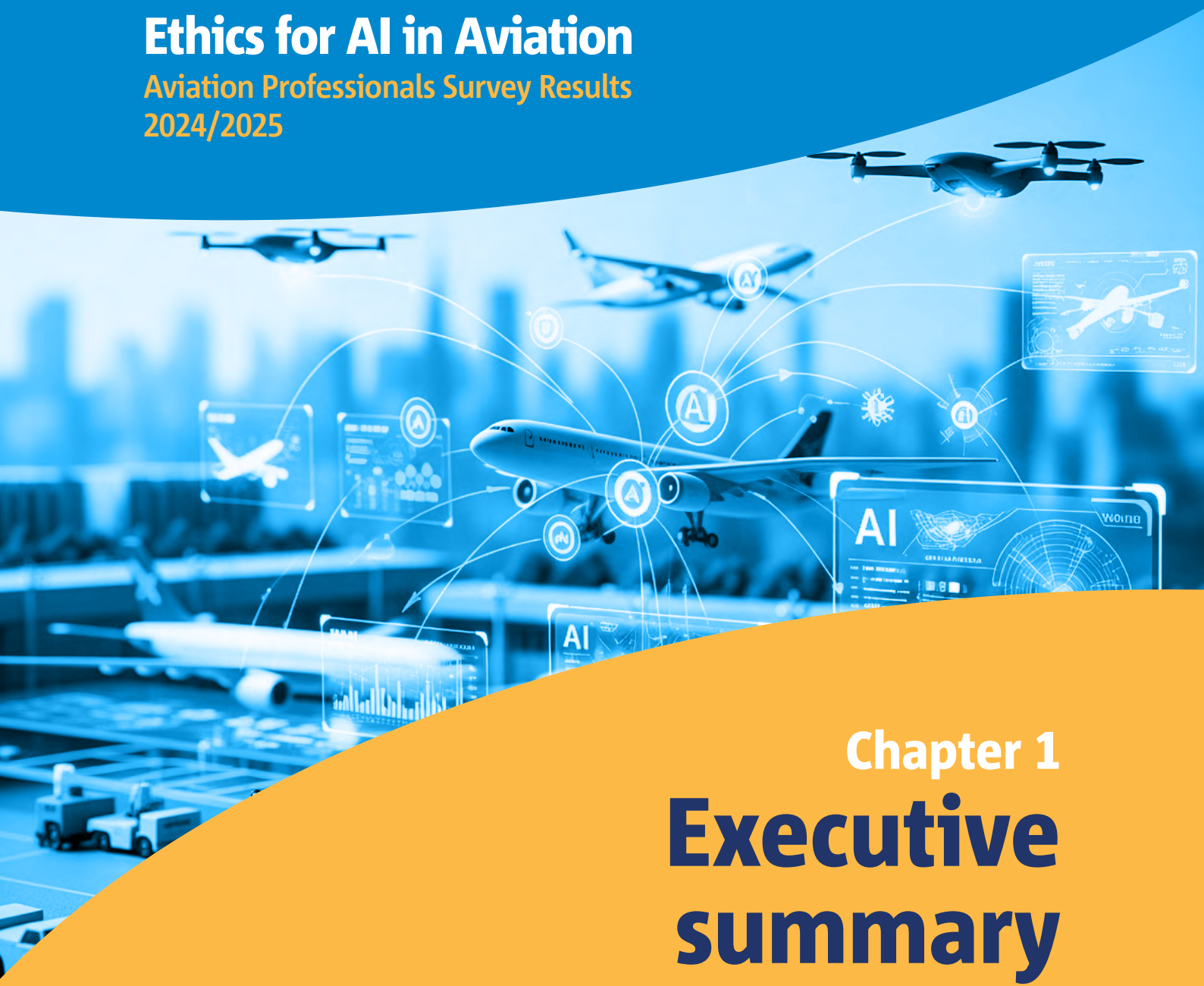

Chapter 1

Executive summary

1. Executive summary

Artificial Intelligence (AI) is changing the way we understand the world. That new technology is already interacting on all fronts — and the economic and aviation sectors are not exceptions.

The use of new AI-based systems in aviation will have an impact on all technical domains and, as such, in all aviation work environments where humans are involved. Benefits in terms of efficiency, quicker solutions, high volumes of data processing, and diminishing of errors clearly reinforce the aviation market. These benefits, however, will need to conform with the European Union's safety standards for aviation and should on no account compromise aviation safety. Safety first since safety is EASA's mission.

Apart from technical assurance and robustness matters, there is also an important aspect EASA and all AI stakeholders are very interested in: how the introduction of AI-based systems is perceived by aviation professionals. Do these new AI technologies cause specific ethical concerns? Will the aviation professionals, the ones to be firstly impacted by AI, be comfortable with the introduction of AI-based systems in their work? Will they trust AI? Will they accept an AI-based system in their working environment?

Based on the Charter of Fundamental Rights of the European Union, in particular the third generation of rights where technologies play a significant role, the application of ethically sound AI-based systems will probably be key for the successful introduction of AI in aviation.

To better understand this topic, an extensive survey was shared with aviation professionals. The survey was based on eight hypothetical scenario cases describing aviation working practices with AI-based systems with the ultimate goal to achieve a mature ethics-based assessment.

Not to EASA's surprise, the survey results showed that aviation professionals have some ethical concerns when dealing with the deployment of AI in aviation. In all three dimensions (namely comfort, trust and acceptance) for all eight cases they positioned themselves as not having a very clear nor certain opinion about the ethical soundness of AI-based systems applied to several aviation domains.

All aviation professionals, however, believe that the topic should be taken very seriously as for all eight cases they are strongly of the opinion that regulation should be put in place no matter the situation. They also explicitly stated that primarily EASA should oversee the matter with the national aviation authorities having a supportive role as regards oversight activities.

The survey results showed that two thirds of the aviation professionals do not accept at least one of the eight cases described. The first set of reasons behind this partial lack of acceptance are firstly linked to the AI-based systems themselves, namely the following aspects should be addressed first: the AI-based systems' performance, the proper definition of operational domains, operational mitigation measures, and mistrust of AI.

A second set of reasons is linked with the negative impacts on human end users, namely data protection, professional threats, accountability matters, personal invasion felt, psychological impacts and perception of unfairness.

A third set of reasons for non-acceptance emerged concerning aviation safety, namely the potential threat to aviation safety, as well as the need to ensure human oversight and control of AI-based systems, to ensure safety demonstration, and for aviation authorities to regulate and oversee the industry practices.

With these ethics-based findings in mind, and considering the recent AI Act, EASA will continue to develop and reinforce the ethics-based assessment in the next issue of the EASA Artificial Intelligence Concept Paper Issue 03 and also in the context of rulemaking task RMT.0742 'Artificial intelligence trustworthiness'.

EASA also acknowledges the request from aviation professionals to continue liaising with them, actively listening to the industry and taking into consideration the wider feedback from aviation stakeholders. To this end, a second survey, to be shared with the general public, is intended to be launched in the coming months. Complementing other initiatives, the EASA AI Days conference plays each year a key role in shaping a safe and ethical future for AI in aviation.

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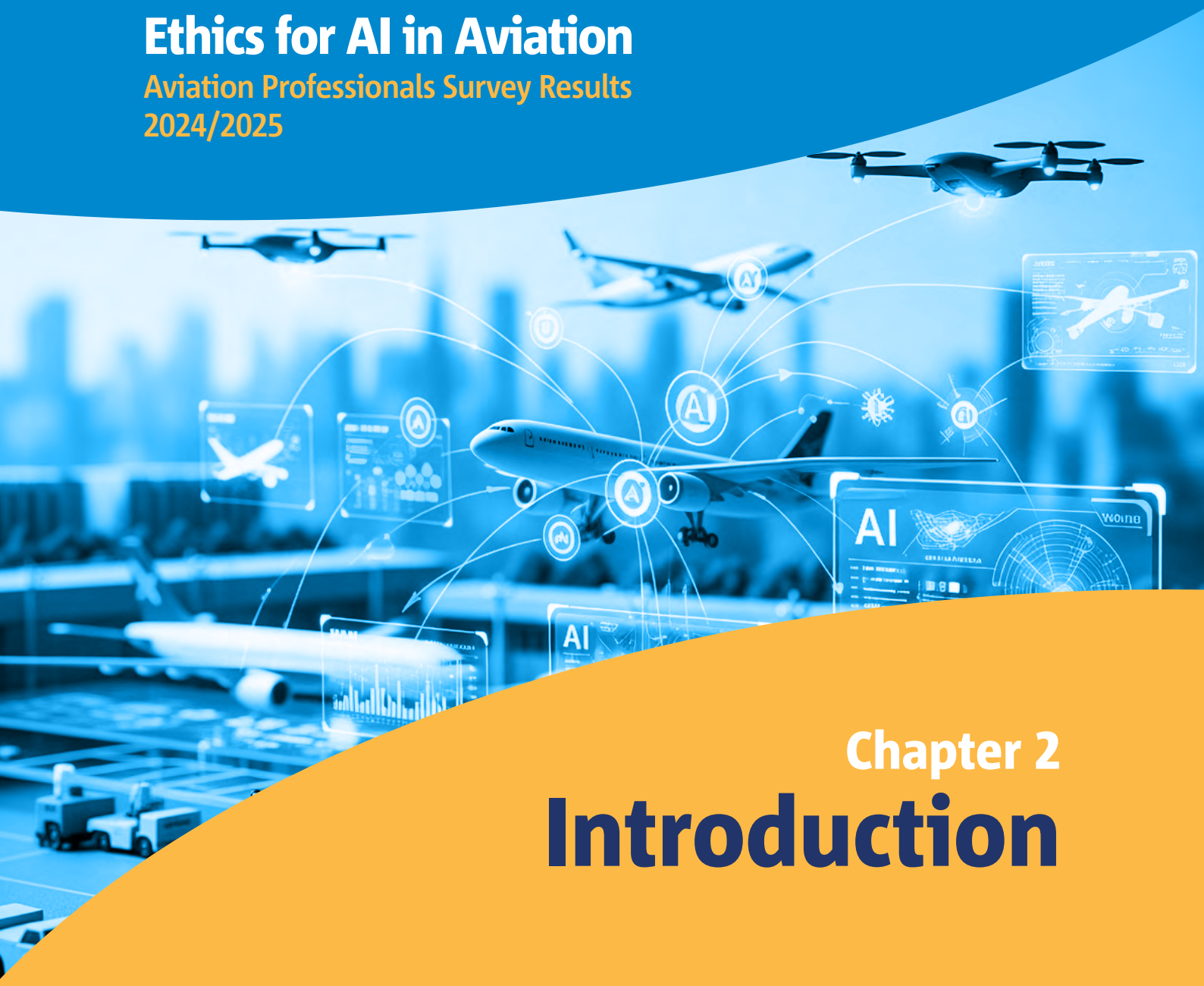

Chapter 2

Introduction

The main reason for taking an ethical approach to the introduction of AI in aviation

In the context of the EASA *AI Programme*, the team saw at an early stage, around 2019, the need to work beyond the technical areas of AI in aviation. This approach was in line with the developments regarding ethics on the European Commission level, and in particular the developments made by the High-Level Expert Group on AI (AI HLEG) and its *Ethics Guidelines for Trustworthy Artificial Intelligence*.

On the one hand there was an absolute need to keep pace with the latest technological developments of AI-based systems that could be applied to aviation, and on the other hand it was important to observe the possible consequences such systems would have on humans. The topic is still developing as the complexity and level of automation and autonomy of AI develops. 'How do the humans perceive these systems and if they are ethically acceptable?' was a question in need for answers and the main motive to develop the present study.

What is *ethics* in the context of this study?

There are many different ways to define and work with ethics; however, considering its nature and mission, EASA took an *artifact* or *tool* approach to ethics meaning that AI technologies are considered tools that support people in activities that could otherwise not be performed by humans alone on the level of the desired performance. Also, recognising that once these technologies are incorporated into aviation practices, they will create new impacts on those practices and in particular to the people involved.

In this sense, the approach to ethics in this study was to analyse the possible impact of AI technologies on aviation by applying certain key ethical concepts to a set of scenarios and consider the opinion of aviation professionals about them. The goal was to use the results of the study when drafting guidance for industry, thus preventing and/or correct eventual injustice or infringement of human rights.

The European Union is based on fundamental human rights, democracy and the rule of law. The *Charter of Fundamental Rights of the European Union* covers the following areas: dignity, freedoms, equality, solidarity, citizens' rights, and justice. The *Charter* is legally binding and entered into force together with the Treaty of Lisbon on 1 December 2009. Adding to that, more recently and important for AI topics is the definition of the 'third generation of fundamental rights' which covers data protection, guarantees on bioethics and transparent administration.

The focus of application of this study was a set of aviation AI-based systems scenarios, where relevant key ethical concepts were applied and evaluated.

The relevant ethical concepts were the basis for the design of the eight scenarios:

- equal opportunities,
- non-discrimination and fairness,
- data protection,
- labour protection,
- right for privacy,
- right for professional development,
- right for decision making,
- transparency, and
- accountability.

These key concepts are considered ethical pillars, despite the different opinions or positions or even the system of values each citizen has.

How to evaluate ethical matters

As a common observation, each time a group discusses about ethics, the point of analysis differs from person to person depending on their interest, professional background, knowledge and experience, culture, values, and emotional involvement. In that sense, the approach followed in this study was to evaluate the key ethical principles applied to AI in three different dimensions.

The focus was on people's consideration about ethics in certain situations, having AI-based systems as tools and not the ethics of the AI itself as an artificial moral agent.

The three evaluation dimensions that were asked to the aviation professionals were the following:

- **Comfort:** How comfortable are they with a given situation, where comfort refers to the feeling of being relaxed and free from tension and negative thoughts;
- **Trust:** How much they trust a situation, where trust refers to the belief that something is safe and reliable; and
- **Acceptance:** How much are they willing to accept a situation, where acceptance refers to the fact that you can agree and approve something.

The key ethical concepts were embedded in a set of eight hypothetical aviation cases that were designed and described as possible future situations where AI-based systems could be deployed. Aviation professionals were asked to evaluate their level of *comfort*, *trust* and *acceptance* for these eight aviation cases.

To that end, a survey was developed and shared with the EASA AI community and was also broadly disseminated through digital communication channels. Two conditions were defined for the participation in the survey: a) to be an aviation professional, and b) to have a link to AI, meaning working with or being impacted by an AI-based system. The survey was open to the aviation professionals for 3 weeks, and after the deadline for responses (January 2024) 231 respondents were considered valid. The socio-demographic profile of the respondents is described in Chapter 3.

More than knowing the aviation professionals' position towards the ethics-based assessment, it was also very important to understand the motives behind non-acceptance. So, aviation professionals that positioned themselves between 1 to 3 on the *acceptance* rating scale were asked 'why'. The responses to the open-ended questions were then subject to content analysis and placed into a two-level categorisation result. A total of 2395 content items were identified.

How to understand the questions of the survey and the responses to it:

- Each scenario is a hypothetical case story for which the respondents are asked 3 questions directly related to the problematics of AI.
- Question 1 related to *comfort*, question 2 to *trust*, and question 3 to *acceptance*.
- To respond to each question, aviation professionals used a rating scale of 7 points in which 1 represented the lowest possible level and 7 the highest possible level.
- 'Valid' represented the number of the responses considered, and 'missing' represented the number of questions the respondents did not respond to.
- For question 3 on *acceptance*, the respondents that positioned themselves on the *non-acceptance* part of the scale, were asked what was needed to change their position to *acceptance* and what ethical matters they see as concerns.
- Some of the cases included a question related to the need for the matter to be regulated, and if so, which authority they believed should be responsible for the oversight. This question did not apply to all cases as some are already regulated.

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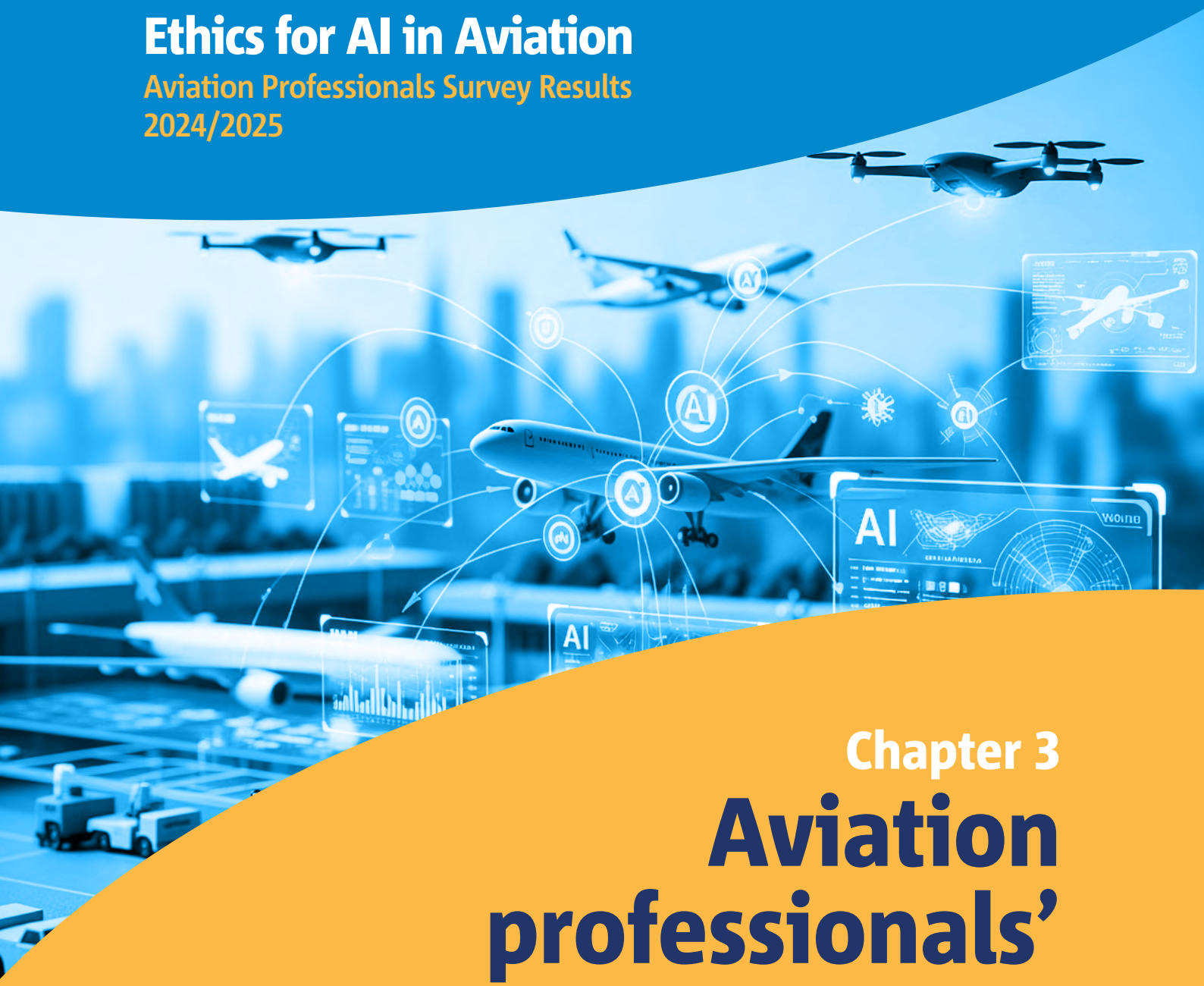

Chapter 3

Aviation professionals' socio-demographic profile

3. Aviation professionals' socio-demographic profile

This survey run for 3 weeks and closed in January 2024. 231 valid respondents replied, fulfilling the following two conditions: a) being aviation professionals, and b) having a link to AI-based systems.

The main socio-demographic characteristics are as follows: approximately 80 % males, 20 % females, and 62 % between 40 and 59 years old. Mainly senior aviation professionals, meaning having more than 10 years of professional experience, considering themselves as having a good understanding of AI for aviation, and saying that their teams have a good understanding of AI in aviation.

Most of the respondents (approximately 80 %) work in different technical aviation domains, and 17 % work for NAAs.

The majority (76,2 %) of the aviation professionals work directly with AI-based systems, being the biggest group, and 20 % use AI-based systems. The aviation professionals feel quite satisfied with their own work.

Summary of the respondents' profile:

Figure 01: Respondents' profile

Gender	**41 females** (17,7 %), **188 males** (81,4 %), not indicated as male nor female 2 (0,9 %)
Age	**87 from 50–59 years old** (37,7 %), followed by **56 from 40–49 years old** (24,2 %)
Seniority	**179 senior professionals** (77,5 %)
Individual's knowledge about AI in aviation	**Average of 3,52** (I consider myself as having a good understanding of AI for aviation) — rating scale of 5 points
Team knowledge about AI in aviation	**Average of 3,01** (I consider my team as having a sufficient understanding of AI for aviation) — rating scale of 5 points
Individual's knowledge about EASA's concept paper	**Average of 3,76** (having a sufficient knowledge about it) — rating scale of 7 points
Aviation area of work	**79,7 %** in different technical areas of aviation (industry), 17,3 % working in regulation (NAAs)
AI area of work	**76,2 %** working directly with AI-based systems, **23,8 %** working indirectly with AI-based systems
Work satisfaction	**Average of 5,91** (I consider myself mostly satisfied) — rating scale of 7 points

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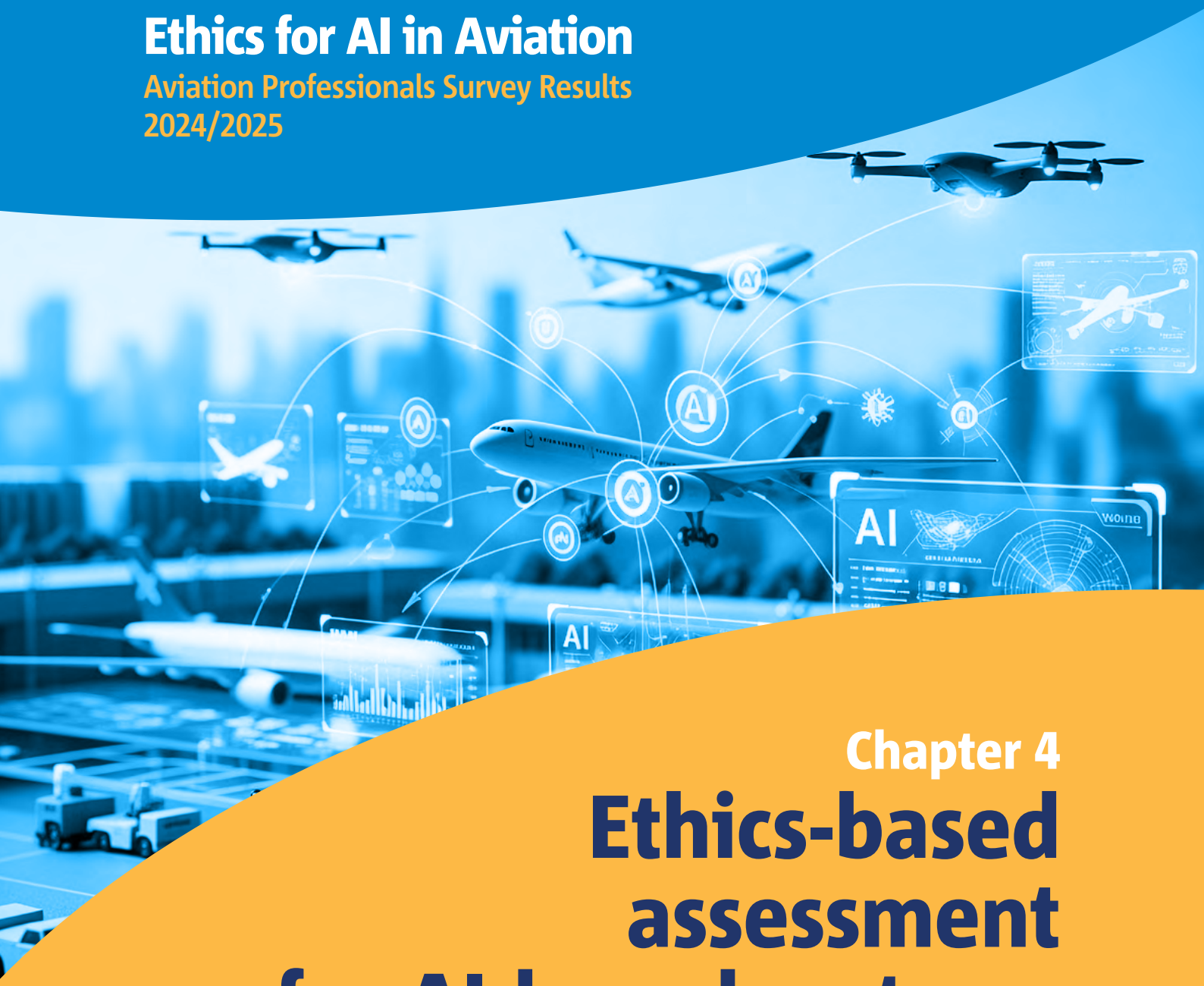


Chapter 4

Ethics-based assessment for AI-based systems applied in aviation — summary of the results

As AI-based systems are being introduced in aviation, EASA decided to conduct an ethics-based assessment of the current and future AI-based systems in order to understand if and how aviation professionals evaluate ethics when developing, applying or using AI-based systems in the aviation world. This study was pursued in parallel with the technical assessment for safety.

The opinions of 231 aviation professionals show that there is a long way to go before aviation professionals feel that AI-based systems are ethically responsible. This is expressed by the average of 4,4 on a rating scale of 7 points where 7 represents the highest level of *comfort*, *trust* and *acceptance* of the use case.

Eight cases were evaluated concerning different aviation situations, namely: flight crew compartment, maintenance, air traffic control, and aerodromes. These cases were hypothetical, situational and aimed to put the person into the situation as an actor.

Three dimensions served as the basis for the ethics-based assessment: the level of *comfort* with the situation described, the level of *trust* felt when evaluating the situation, and the level of *acceptance* of the situation. The mean of the three dimensions represented the ethics-based assessment.

From the three dimensions, aviation professionals demonstrated a higher ethical *comfort* (4,58), followed by *acceptance* (4,34). The dimension where the aviation professionals demonstrated a lower value was *trust* (4,28). However, all dimensions show a tendency for a positive ethics-based assessment, but not very clearly. This shows that there are many doubts and that there is a need for promotion, knowledge sharing and dissemination of information. Also, the need to gain sufficient experience and time to familiarise oneself with AI-based systems is still imperative considering the median values of the scale.

4.1 Ethics-based assessment for the different cases — summary of the results

Considering the eight cases, clearly the one with the lowest ethics-based assessment is that concerning the *risk of deskilling* (case 07 of the study) with the lowest score of the dimension *comfort* (3,62). Aviation professionals do not feel comfortable with having an AI-based system replacing their role in air traffic control and are certain that they will lose their competencies if not practising their job. Consequently, they are convinced that in case of failure of the technology they would not have the ability to successfully recover the situation manually.

The second case with the lowest ethics-based assessment relates to the case where a pilot has an AI-based system monitoring their physiological data for the purpose of evaluating workload (case 01 of the study) with 4,18. Here the dimension with the lowest ethical rate is *trust* (3,86). The reasons for this assessment mostly relate to the negative impacts on humans perceived as risks like personal invasion, professional threats, psychological impacts and AI mistrust. Also, issues concerning data are also relevant as aviation professionals think that the data should be used only for a good purpose, should be protected, and such type of data should not be shared at all with an AI-based system.

To be noted that both cases describe situations where an AI-based system is directly linked to human work-related performance, either substituting or evaluating human behaviour, and as such, impacts negatively and directly on both the person and aviation safety.

On the other hand, the case with the highest value (4,88) for the ethics-based assessment of the aviation professionals is the case where an AI-based system allocates aerodrome terminals to airlines (case 04 of this study). The highest ethical dimension is *comfort* that showed 5,17 and represents overall the highest value of all three dimensions in all eight cases of the study. Aviation professionals feel 'a bit comfortable with the situation' of having an AI-based system with potentially biased outcomes allocating location and gates to airlines. Nevertheless, aviation professionals highlight reasons for concerns linked to AI-based systems, the possible unfair bias and negative impacts on the market for operators. An interesting observation concerning this case is the fact that it is not directly linked to aviation safety matters.

The second highest ethics-based assessment concerns new competencies for teaming with an AI-based system (case 08 of this study) with a mean of 4,71. The lowest ethical dimension is *trust* for this case (4,59), meaning that aviation professionals 'feel a bit of trust' that the AI-based system can ensure safety as much as a human ATCO when teaming with a human.

The rest of the cases are in the middle range of ratings. The case concerning *maintenance assisted by an AI-based system* (case 03 of this study) resulted in an ethics-based assessment of 4,36, the dimension of the lowest rate is *trust* (4,19) meaning that they do not have a clear opinion whether the AI-based system is sufficiently sound to let them decide about the airworthiness of the aircraft.

The case that follows with 4,43 as an ethics-based assessment is the one concerning *AI and speech recognition in voice communications* (case 06 of this study). The dimension with the lowest assessment is again *trust* (4,11), indicating that aviation professionals do not have a clear opinion whether the data derived from one's performance is kept private and confidential and is not misused by the AI-based system.

Another similar rate is seen for the case of *go-around situations supported by an AI-based system* (case 02 of this study), with a value of 4,46. Here the dimension with the lowest value is *acceptance* (4,27), meaning that aviation professionals have difficulties in taking a position when asked whether they would allow an AI system to automatically take over and initiate a go-around manoeuvre in a challenging situation like approach and landing.

The same ethics-based assessment concerns the case of *AI airline crew member attribution to flights* (case 05 of this study) with a value of 4,56. Here, also the lowest dimension was *acceptance* (4,20), which shows that aviation professionals do not have a clear opinion whether they should accept or not having an AI-based system analysing and using personal data related to family condition, social habits, and free-time preferences.

4.2 The need for regulation — summary of the results

Whilst aviation professionals seem uncertain when ethically assessing or evaluating the application of AI-based systems in aviation, they express a very clear and strong opinion when asked about the need for regulating those cases.

For the designed cases where regulation does not currently cover such situations, the results strongly indicate the need to regulate all cases.

The cases with more than 90 % of stated need for regulation are the cases concerning *teaming with AI* (case 08 of this study) and *physiological data monitoring* (case 01 of this study). Cases with the need for regulation between 80 and 90 % are the cases concerning *AI airline crew member attribution to flights* (case 05 of this study), *AI and speech recognition in voice communications* (case 06 of this study), and *AI and the risk of deskilling* (case 07 of this study). The case with the least need for regulation was that on *AI airport allocation of airlines to a terminal* with an 80 % of stated need.

Regulation should be developed and put into practice for all the cases where AI-based systems integrate any of the elements for any aviation domain, meaning that regulating AI should be applied transversally to the aviation sector.

Aviation professionals stated that the main authority responsible for the subsequent oversight of regulation application should be EASA. For all cases, EASA was the first authority mentioned for at least 52 % of the cases, followed by NAAs or other institutions/organisations like the European Union, ICAO, national dedicated agencies for specific topics like data management or ethics, market regulators and trade unions. Another option mentioned was to have oversight exercised jointly by EASA and NAAs.

4.3 New competencies for aviation professionals dealing with AI-based systems — summary of the results

The new professional competencies that aviation professionals considered the most important to be acquired and developed when dealing with AI-based systems were firstly competencies directly linked to AI knowledge, data literacy and IT competencies together with cognitive skills. The second group of competencies was linked to communication and sensory aspects. Social competencies followed as the third group, and lastly physical skills.

Nevertheless, aviation professionals highlighted a complementary set of competencies that would complete the above. Apart from stressing the need to gain competencies concerning the specificities of AI-based systems, they mentioned the importance of developing emotional intelligence, just culture, human autonomy, human–machine interaction, problem solving and ethics.

Competencies like emotional intelligence arise as new and significant; in particular, the following competencies were mentioned: emotion regulation; dealing with boredom; assertiveness; gaining trust in AI; resilience; how to handle AI disruptions and mental strength to deal with environment/relationship dehumanisation.

These new competencies highlight the new psychological challenge for aviation professionals when dealing with AI, indicating that new supporting measures and activities need to be developed and implemented.

4.4 The responsibility and accountability topic — summary of the results

One topic of interest since the beginning of the study was human versus machine responsibility and accountability, particularly in critical situations. Case 08 of the study contained a specific question on that topic.

The evaluation showed that aviation professionals are of the opinion that the responsibility falls first with the organisation that deploys the AI-based system (34 %), with the least responsible being the human end user (13 %).

Concerning accountability, a similar logic applies — however, with a stronger manifestation: the deployer being 39 % accountable and the human end user 6 % accountable.

This topic requires further consideration in the context of the future EASA *AI Concept Paper Issue 03*.

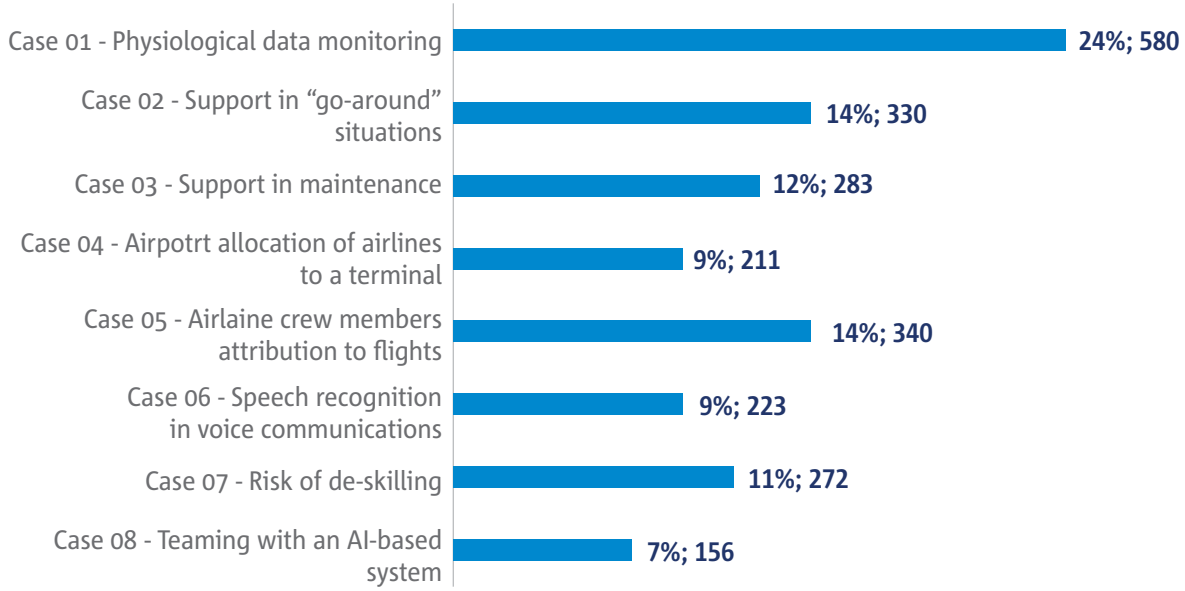
4.5 Reasons for non-acceptance of AI-based systems applied to aviation — summary of the results

From a total of 231 respondents, 171 expressed a ‘non-acceptance’ opinion for at least one of the eight scenario cases. To understand the reasons why AI-based systems were seen as ethically non-acceptable, 2 395 content items in total were analysed and categorised in this study.

4. Ethics-based assessment for AI-based systems applied in aviation — summary of the results

The distribution of the content items for the eight scenario cases is as follows:

Figure 02: Number of content items per case study



The motives behind the non-acceptance of AI-based systems for the eight cases considered show that aviation professionals have ethical concerns about the AI-based system itself (30 %), about the consequent negative impact on humans when using such systems (28 %), about how their data is used by the technology (11 %), and about AI-based systems putting aviation safety at risk (6 %).

These qualitative results show that, in the logic of protecting ethical values, aviation professionals expect from first-line aviation industry to ensure that AI-based systems are transparent, explainable, reliable and perform to the standards they are supposed to perform.

Even when using AI as an enabler for more advanced automation, humans should remain autonomous when making decisions and overseeing systems, and should have the power to maintain their autonomy. They should not feel psychologically uncomfortable, and be able to face an AI-based system as merely a machine.

Based on the feedback received, it is believed that AI-based systems should not be a source of threat to aviation professionals, meaning that AI-based systems should not compromise the ability of humans to perform their job, should not lead or pose a risk to deskilling, and should not jeopardise employment by replacing human roles.

Professional development must be ensured by maintaining and/or developing professional competencies and by gaining experience with AI-based systems; maintaining manual practice is very relevant too. Also, a sound process for competence assessment and relevant training should be in place.

Concerning accountability, a very clear line should be drawn between responsibility and accountability of the human element versus the AI-based system, and such clear definition should apply especially in situations of shared responsibility.

Furthermore, individuals' privacy should be ensured and the General Data Protection Regulation should be implemented.

Finally, unbiased AI-based system behaviour should be ensured: bias should be identified, monitored and eventually eliminated.

More than being technically robust and safe, aspects that are naturally very important for new technologies, it is clear that an ethics-based assessment should play an important role in the conceptualisation, development, application and use of AI-based systems. Without preparing for this human ethical matter, aviation professionals may disapprove of AI-based systems in terms of *comfort*, *trust* and *acceptance*.

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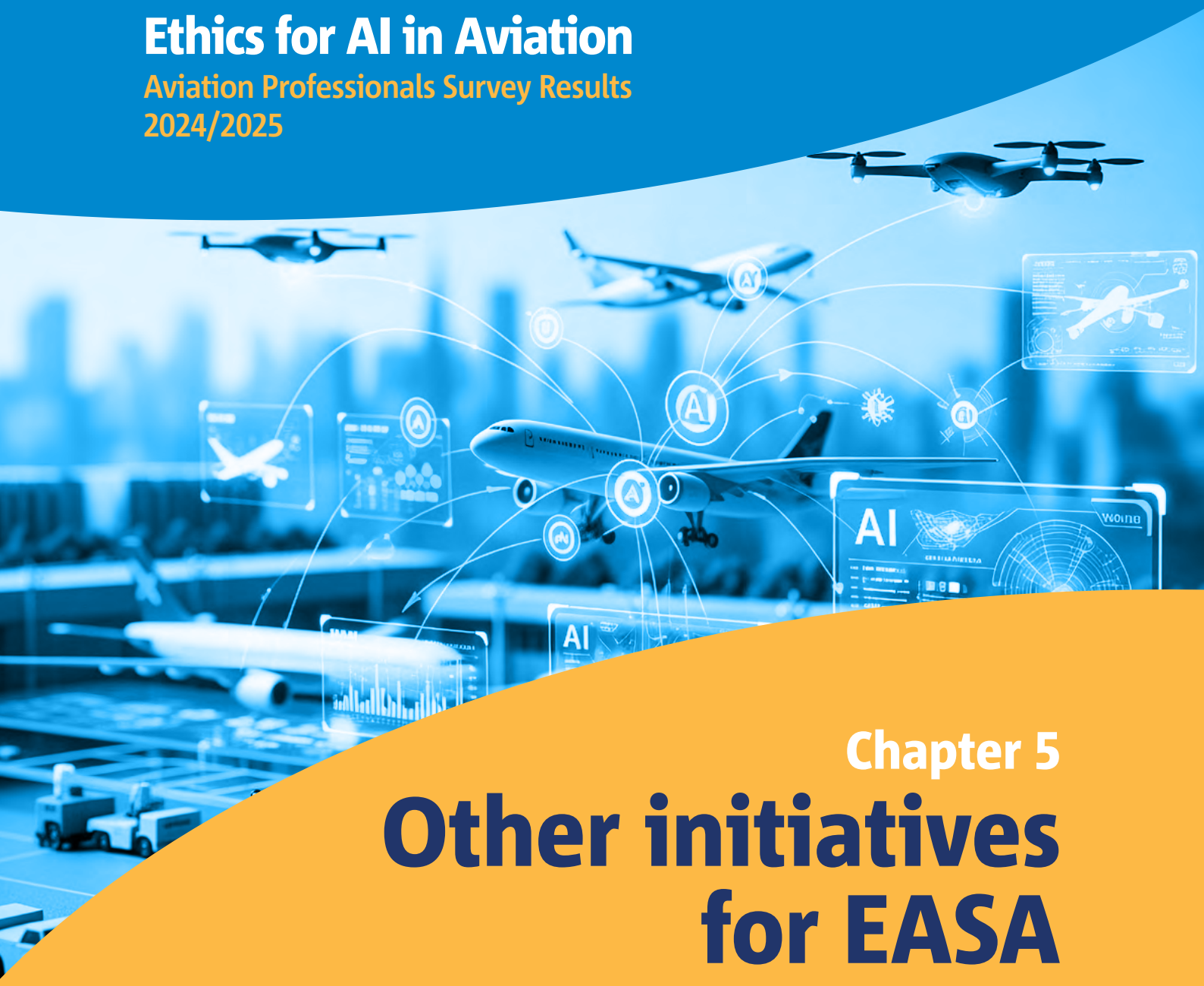
Ethics for AI in Aviation

Aviation Professionals Survey Results 2024/2025



Chapter 5

Other initiatives for EASA

5. Other initiatives for EASA

Since the present survey gave EASA the opportunity to directly liaise with aviation professionals, an additional question was asked: '**In general terms what type of initiatives do you think EASA can develop concerning *ethics in AI for aviation*?**'

Despite the current EASA mandate to **issue rules and guidance material**, aviation professionals pointed out that EASA could be involved in **more initiatives concerning AI ethics in the context of aviation**, namely in **awareness-raising activities and issue of promotion material.** They also mentioned the **need for EASA to closely and systematically engage with stakeholders**, and undertake other initiatives like the establishment of ad hoc expert groups, the establishment of means to listen directly to aviation professionals' and experts' opinions, and liaising at an early stage with operational teams are examples to be taken into consideration.

Further suggestions were linked to the importance of **promoting training activities, competence development initiatives and knowledge and information sharing**, and the **importance of the certification process for AI-based systems, thus ensuring their reliability and safety.**

Figure 03: List of proposals for new EASA initiatives

Activities regarding:	Proposals:
Rules and guidance	• Standards and guidelines for the ethical use of AI in aviation, addressing issues such as safety, security and human factors. • Principles on collaboration between humans and autonomous systems. • Guidelines about the deployment of AI in aviation. • Robust framework and controls to protect individuals from the misuse of AI and related data. • Alignment with existing legislation on the subject. • Industry-wide standards. • Regulation itself should focus on quality assurance throughout the entire processes. • AI should be treated in terms of regulation like humans. Both do not act deterministically. • Create a regulatory framework in which it is possible for companies to invest in and build the AI solutions mentioned in this survey. • EASA needs to incorporate its own CS 25.1309 regulatory guidance into the discussion on AI hazard consequences. Recommend that AI be given roles where there is low severity for the hazard (minor or no safety effect) and expect a high probability of occurrence. • Guidance material formulated in plain, user-friendly language for greater accessibility— the concept paper is really good so far! • A broader set of rules needs to be established now, and EASA should take the lead in this for aviation. • Establish means to differentiate between aviation-centric AI topics and non-aviation-centric topics, e.g. passenger flight optimisation should be based on airline operational rules and not on EASA rules.

5. Other initiatives for EASA

Activities regarding:	Proposals:
Ethics	• First, start with ethics in aviation. • Embed ethics into the rules to clearly allocate responsibilities and to enable oversight by competent authorities, while maintaining complementarity with other EU legislation (e.g. the General Data Protection Regulation and the Product Liability Directive). • Raise awareness about the importance of ethics and that it is on your [EASA] agenda. • Give ethics some priority, like you do for safety. • EASA can spearhead initiatives focusing on establishing ethical guidelines. • These initiatives should prioritise safety, fairness, transparency and evaluation of AI applications in aviation. • Ethics would very much depend on the use cases. These would need to be developed first and then an analysis of their potential ethical implications should be conducted. In general, questions on safety, privacy and societal benefits would be critical considerations. • The so-called AI software raises a huge number of ethical concerns, so please work on ethics. • From my point of view, EASA should be more aware of the importance of ethics in aviation at all levels. This survey is a very good example. • Making sure the dignity and human aspects of the person's sensory data are not compromised and respected while doing their daily jobs. • Ensure that AI serves people and not vice versa. • You absolutely must ensure that humans come before AI.
Stakeholder management	• Surveying expectations of sector stakeholders, addressing problems indicated in the survey, acting to change unreasonable perceptions. • EASA needs to listen to people who know what they are talking about. • Collaboration of industry/research/ethics working groups. • Expert working groups. • Discussion between traditional safety development experts and AI software developers. • I feel EASA/NAAs have drifted too much into the direction of oversight and lost their touch with the daily ops. I feel the same will happen with implementing AI. • Instead of having mainly back-office managers involved in system development, get more front-line operators (i.e. ATCOs, pilots, maintenance technicians) involved in the early stages of system development. • Very difficult to provide an answer since it can only be solved if we know the openness of the human, number of persons required (operational task, AI management tasks), adjust data protection regulations, tailored just culture for AI, manufacturers' responsibility, etc. • EASA must assess the evolution of AI and its impacts. EASA must alert politicians and stakeholders, show them the possibilities and risks, but should never regulate on its own initiative, or even suggest regulations on ethics. In a democracy, this is the business of the elected assemblies. • EASA should absolutely have the most talented professionals in AI before it does anything with it whatsoever. There is a need for an independent security council that will oversee, vet and regulate EASA and FAA in relation to AI.

5. Other initiatives for EASA

Activities regarding:	Proposals:
Training	• Educate people about AI and the processes, risks and advantages, and algorithms used. • Workshops on: AI and accountability / just culture, AI and the role of the regulator, AI and competence, AI in relation to work and privacy. • Great competence in the AI topic of regulators and inspectors is mandatory and must be kept up to date throughout their duty time. 'False' compromises will backfire! • Provide knowledge exchange and knowledge fora. • Training programmes for aviation professionals to navigate the integration of AI in aviation. • There are two main initiatives: educate and provide a certification path with clear decision on the criteria. EASA shall be accountable for these criteria. • Organise a series of workshops with a balanced participation of aviation professionals (both manned and unmanned aviation), ethics experts, passengers and professionals of other areas where automation and AI are either more present or growing (automotive, marine, medical). • Public awareness campaigns with specific communication material delivered to NCAAs and similar authorities to be disseminated. • Promote responsible practices.
Certification	• Certify AI systems and databases. • High-fidelity validation of AI modelling and stringent approval processes for AI systems. • To ensure safe operations, AI solutions should be certified only with a proper proof of concept and this transition needs to be gradual, not allowing full transition at once. • Endorse liability and accountability for certified AI systems and databases. • Perform detailed impacts analyses (on the whole aeronautics industrial ecosystem) of any possible new requirement that is envisaged to support the development of new functions or services embedding IA. • There are two main initiatives: educate and provide a certification path with a clear decision on the criteria. EASA shall be accountable for these criteria. • Making sure that whatever is implemented is done so with safety as the number one concern and not fall to wishful thinking regarding the capabilities of AI and the goodwill of those who develop and implement it. • Action on autonomous machine decision-making without user control. Especially when it comes to critical operations (i.e. structural damage evaluation).

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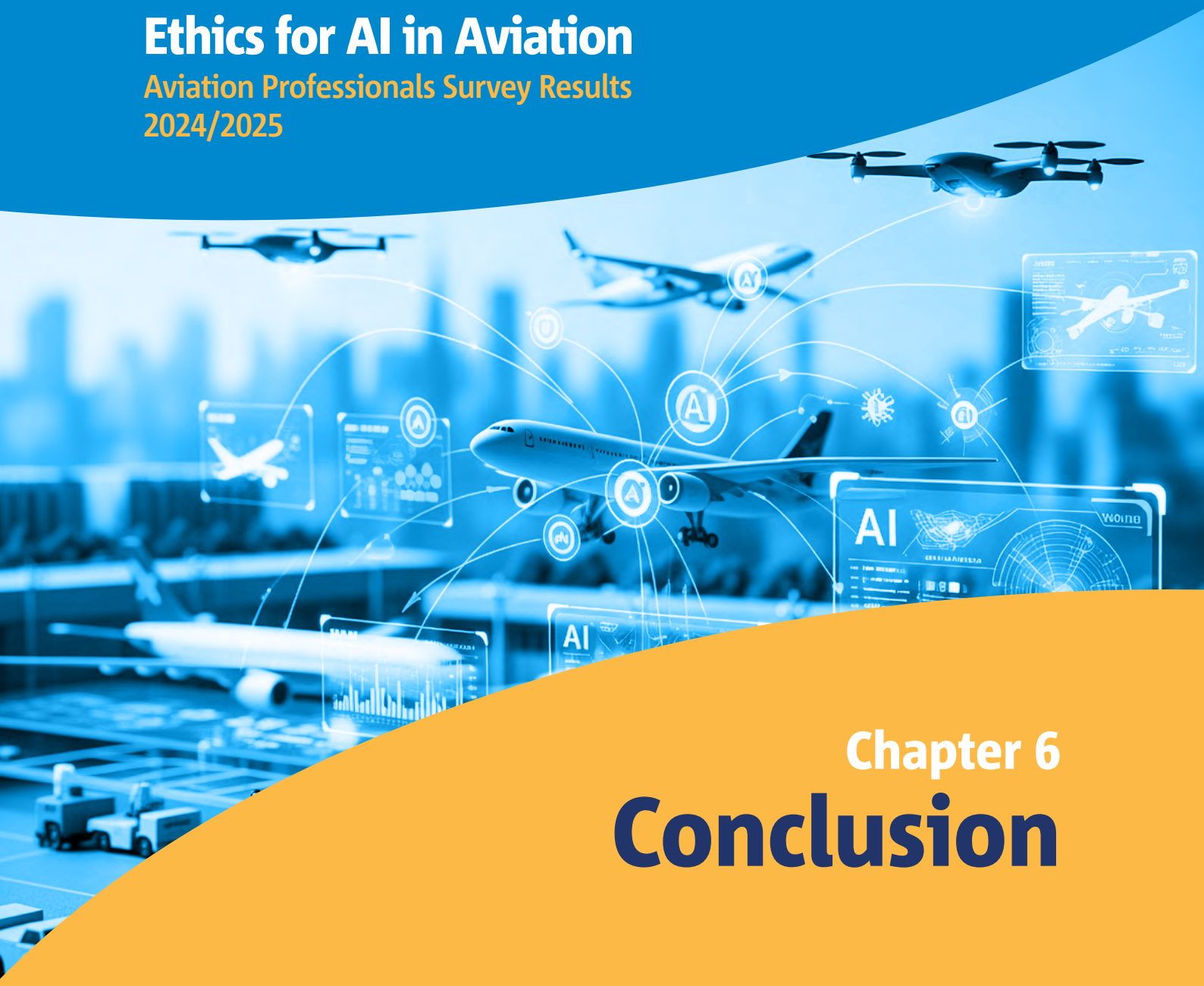

Chapter 6

Conclusion

6. Conclusion

The survey results highlight the importance of considering ethical implications in the development and deployment of AI-based systems in aviation. As such, the survey serves as an important tool for EASA to engage with aviation professional stakeholders on how to frame and address the ethical challenges and opportunities presented by the deployment of AI in aviation.

Notably, the survey results indicate a relatively balanced position among the aviation professionals, with a slight positive average rating on the three chosen evaluation criteria (namely *comfort*, *trust* and *acceptance*) and no strong polarised opinions in either direction. They also show that further steps should be taken in terms of explainability, demonstration of concepts, proven experience and practice until aviation professionals can take a more positive position concerning their level *comfort*, *trust* and *acceptance* of AI in aviation.

Furthermore, the responses from aviation professionals provided valuable insights into the current state of AI adoption, perceived benefits and risks, and ethical concerns. They highlighted some specific concerns with applications involving a high degree of automation under human oversight, such as the automatic go-around use case, as well as with specific associated risks of deskilling.

Finally, the findings of this survey demonstrate that there is a need for ongoing engagement and dialogue between stakeholders, including regulators, industry leaders and professionals to ensure that AI is developed and used in a responsible and ethical manner.

In alignment with the European Union's strategy on AI, as outlined in the EU *AI Act*, EASA intends to use the results of this survey to further develop the ethics-based assessment aspects of the AI trustworthiness framework in the upcoming *Proposed Issue 03* of its *AI Concept Paper*, as well as in the rulemaking activities under RMT.0742, considering a pragmatic two-step approach with a preliminary ethics-based risk assessment, followed by a risk-mitigation strategy where necessary.

EASA also acknowledges the request from aviation professionals to continue liaising with them, continue listening to the industry and continue taking into consideration the wider feedback from the general public. To this end, a second survey, to be shared with the general public, is intended to be launched in the coming months. Complementing other initiatives, the EASA *AI Days* conference plays each year a key role in shaping a safe and ethical future for the deployment of AI in aviation.

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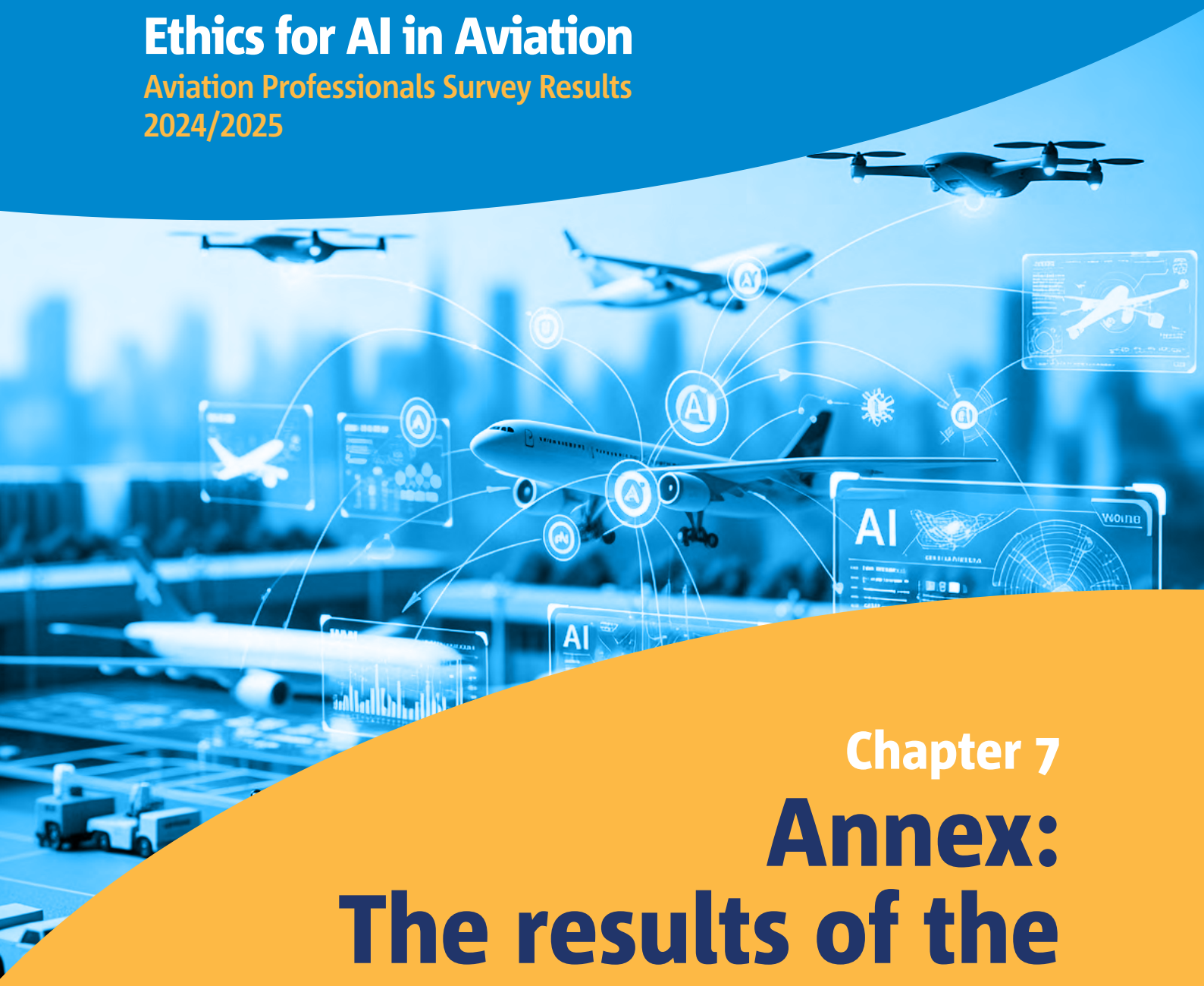


Chapter 7

Annex: The results of the eight cases

7. Annex: The results of the eight cases

7.1 AI and physiological data monitoring

The first case was about a situation in the flight crew compartment where an AI-based system could monitor the physiological data of the pilots to measure their physiological reaction to workload. Aviation professionals were asked to imagine the following situation and rate it on a *type* Likert scale of 7 points, where 1 was the minimum and 7 the maximum.

CASE 01

The airline where you are employed as a pilot chose to implement a single-pilot operation. In this operation there is just one pilot in the cockpit and an AI-based system operating from the ground providing assistance to the pilot. Both (pilot and AI-based ground system) work as a team for a safe successful flight.

To know how to best support you, and when to intervene, the AI-based system needs to understand your cognitive workload and your continuous mental ability to operate the flight.

To achieve that, the AI-based system measures your physiological indicators such as cardiorespiratory measures, brain and electrodermal activity, body temperature, and eye movement parameters, through dedicated sensors. By measuring we mean the identification, collection and analysis of your human physiological data taking anonymisation into account.

7.1.1 Level of *comfort* for AI and physiological data monitoring

Question:

Your level of comfort having an AI system measuring your physiological reaction to workload?

A total of **192** valid responses was received representing **83,1 %** of all the respondents. **The distribution of the responses is very balanced towards the different points of the scale and does not show a strong tendency towards feeling comfortable nor uncomfortable.** The positive part of the scale, from 'a bit comfortable' to 'totally comfortable', represents 47,9 % of the responses.

The same exercise for the negative part of the scale from 'not at all comfortable' to 'a bit uncomfortable' represents 39,6 % of the responses. This shows that the **respondents show a slight tendency for *comfort*** considering *AI and physiological data monitoring*. The mean of all responses is **4,22**, median is 4,00 on a seven-point *type* Likert scale.

Figure 04: Case 01 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	25	10,8	13,0	13,0
	Mostly not comfortable with the situation	24	10,4	12,5	25,5
	A bit uncomfortable with the situation	27	11,7	14,1	39,6
	Not comfortable nor uncomfortable with the situation	24	10,4	12,5	52,1
	A bit comfortable with the situation	27	11,7	14,1	66,1
	Mostly comfortable with the situation	30	13,0	15,6	81,8
	Totally comfortable with the situation	35	15,2	18,2	100,0
	Total	192	83,1	**100,0**	
Missing		39	16,9		
Total		231	100,0		

7.1.2 Level of *trust* for AI and physiological data monitoring

Question:

Your level of trust that your data is kept private and confidential?

A total of **174** valid responses, representing **75,3 %** of all the responses, was provided to this question. The positive part of the scale from 'feeling a bit of trust' to 'feeling total trust' represents **36,8 %** of the responses. When doing the same exercise for the negative part of the scale from 'not feeling any trust' to 'a bit not feeling trust', the result is **44,3 %**. On that basis, the conclusion is that the **respondents tend to not trust that their data will be kept private and confidential**. Also, the mean for the *trust* question was **3,86** (median of 4,00), which is below the values for *comfort*.

Figure 05: Case 01 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	15	6,5	8,6	8,6
	Mostly not feeling trust	37	16,0	21,3	29,9
	A bit not feeling trust	25	10,8	14,4	44,3
	Not feeling trust nor untrust	33	14,3	19,0	63,2
	Feeling a bit of trust	25	10,8	14,4	77,6
	Feeling mostly trust	22	9,5	12,6	90,2
	Feeling total trust	17	7,4	9,8	100,0
	Total	174	75,3	**100,0**	
Missing		57	24,7		
Total		231	100,0		

7.1.3 Level of *acceptance* for AI and physiological data monitoring

Question:

Your level of acceptance having an AI system measuring your physiological reactionto workload?

A total of **182** valid responses, representing **78,8 %** of the respondents, was provided to the question. On the results, **one can observe a tendency for *acceptance***. The sum of the three positive points of the scale from 'will tend to accept this situation' to 'will accept this situation' resulted in **52,2 % of all the responses**, while the sum of the three negative points of the scale from 'will not accept this situation' to 'will tend to not accept this situation' resulted in **35,1 %** of all the responses. The average of the question concerning the level of *acceptance* having an AI system measuring your physiological reaction to workload was **4,47** (median 5,00) on a seven-point scale.

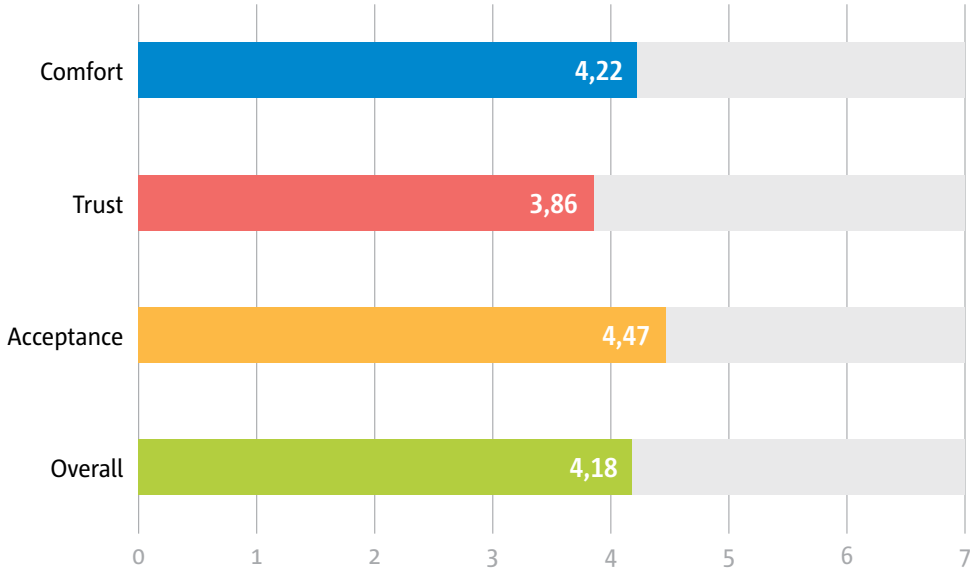
Figure 06: Case 01 — ACCEPTANCE

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	12	5,2	**6,6**	6,6
	Will mostly not accept this situation	27	11,7	**14,8**	21,4
	Will tend to not accept this situation	25	10,8	**13,7**	35,2
	No opinion about this situation	23	10,0	**12,6**	47,8
	Will tend to accept this situation	24	10,4	**13,2**	61,0
	Will mostly accept this situation	37	16,0	**20,3**	81,3
	Will accept this situation	34	14,7	**18,7**	100,0
	Total	182	78,8	**100,0**	
Missing		49	21,2		
Total		231	100,0		

7.1.4 Summary of the ethics-based assessment for AI and physiological data monitoring

The first conclusion is that the level of ethics-based assessment for the case concerning *AI and physiological data monitoring* stands at **4,18** with a maximum of 7 points. Considering that the midpoint of the scale is 3,5, **aviation professionals tend to have a positive but ethically a rather low opinion of the factors observed**. They show a slightly positive tendency for *acceptance* and *comfort*; however, **the level of *trust* is the lowest of the three measures** with a value of **3,86**, almost in the middle of the scale meaning not having a clear opinion in terms of *trust* of having an AI system measuring their physiological reaction to workload.

Figure 07: Case 01 — Overall evaluation



7.1.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering AI and physiological data monitoring?

The aviation professionals that placed their opinion on the negative part of the scale from 1 to 3, meaning from 'will not accept this situation' to 'will tend not to accept this situation', were asked the following two questions:

1) What would be necessary for you to change your position to acceptable?

2) Do you see any other ethical concerns? If yes, please shortly explain.

These were open-ended questions and the responses were analysed qualitatively. The two questions were treated together as one and are presented here with the criteria of explaining at least 10 % of the category to which the content belongs and representing at least 10 frequencies, meaning at least 10 responses.

Case 01 resulted in a **35 % non-acceptance** (52 % acceptance and 13 % no opinion). This 35 % represented a sum of **580 content items**.

This case yielded the highest number of content items, representing 24 % of all content items of the study (580 out of 2 395).

From the most frequent to the least frequent motives, the results for non-acceptance of having an AI-based system monitoring pilot physiological data are presented in Figure 08:

7. Annex: The results of the eight cases

Figure 08: Case 01 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
Human impact n = 181	Personal invasion	46	25 %
	Professional impacts	40	22 %
	Mistrust	29	16 %
	Psychological impacts	24	13 %
total against the category:			76 %

Examples for *Human impact* of case 01
Professional threat; AI mistrust; Personal invasion; Discrimination; Accountability threat; Psychological discomfort; Human substitution; Medical vulnerability; Feeling of being controlled; Refusal of personal data sharing; Stress reinforcement; Lack of human interaction; Human behaviour interference by AI; Human overruled; Pertinence for safety questioned; Avoiding overreliance; Ethical discomfort; Discomfort on information dissemination; Some indicators acceptable; Managing accountability; Trust gaining; Transparency; Loss of control; Communication; Explainability of AI; Fairness assurance.

Data n = 129	Data good usage assurance	57	44 %
	Data protection	39	30 %
	No data sharing	18	14 %
total against the category:			88 %

Examples for *Data* of case 01
Data usage to a good intent; Data protection; Data protection — not to be shared; Data ethical treatment; Data transparency management; Data usage by medicals only; Data significance for safety; Data security threats; Data protection; Data ownership; Data interpretation; Data usage; Managing data privacy; Data retention; Data incompleteness; Data misuse; Data access; Data usage for safety matters; Data deletion after usage; Data collection — not to be done; Mistrust of data usage; Data analysis reliability; Data interpretation.

AI-based systems n = 115	Ensuring systems' performance	27	23 %
	Ensuring human oversight	20	17 %
	Ensuring proper operational domain definition	15	13 %
	Compensating for mistrust of AI	12	10 %
total against the category:			63 %

Examples for *AI-based systems* of case 01
Ensuring system performance; Ensuring human oversight; Ensuring proper operational domain definition; Compensating for mistrust of AI technology; Ensuring system transparency; Ensuring system security; Gaining experience; Ensuring operational mitigations; Ensuring continuous safety monitoring; Avoiding AI personification; Managing ethics in organisations; Tailoring system to end-user profiles; Managing accountability; Managing data privacy; Managing recording capabilities; Managing competence training.

Safety n = 70	Human command and control	29	41 %
	Threats to aviation safety	23	33 %
	Demonstration of safety	16	23 %
total against the category:			97 %

Examples for *Safety* of case 01
AI jeopardises aviation safety; Two humans in control, not AI; Human cross check needed; Applicable only for operations safety; Applicable only for accident investigation; Cybersecurity threats; Need for extensive testing; Usefulness of AI; Two humans in control plus AI; Market drive not safety drive; Malfunction threats; Transition with two humans; Doubt about AI decision on aircraft safety; AI operating from the ground; Overreliance; Pilot responsibility for passengers.

7. Annex: The results of the eight cases

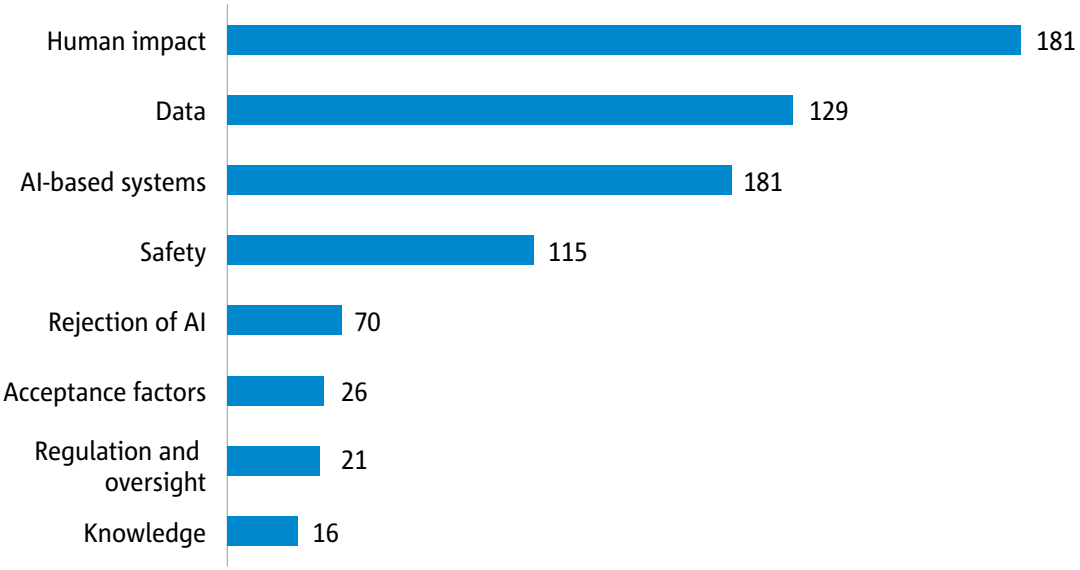
Rejection of AI n = 26	Unacceptable situation	13	50 %

Examples for *Rejection of AI* for case 01
Unacceptable situation; Refusal of physiological measuring; AI has no intelligence; Not to be done by AI; AI refusal; Commercial usage; Ethical rights

Remaining 10 % left explained by:
Contents on regulation and oversight; some factors of possible acceptance and building knowledge about AI.

The number of content items per category level 01 is as follows:

Figure 09: Case 01 — Number of content items per category



7.1.6 Summary of non-acceptance feedback for 'AI and physiological data monitoring'

The reasons for the ethical non-acceptance of *AI and physiological data monitoring* are mainly linked to negative impact on humans perceived as risks, like the case of invasion of privacy, professional threats, psychological impacts and AI mistrust.

The respondents indicated that the data should be used only for a good purpose, should be protected, and such data should not be shared at all.

Concerning AI-based systems, they indicated that they should perform as expected, human oversight is needed, operations should be well defined, and measures to mitigate mistrust should be put in place.

On safety, it was stated that a human should exercise oversight and control, and that these systems could represent a threat to aviation safety and their level of safety has still to be demonstrated.

Although the number of contents is not very high, there is also a strong drive for considering the situation as unacceptable and AI should not be applied in such a scenario type.

The following are examples shared by aviation professionals concerning the case *AI and physiological data monitoring* that demonstrate their non-acceptance of this case:

'Nothing. Would quit job.'

'If pilots know that their employer can use all the monitored data against them will immediately be the end of this initiative.'

'I don't trust the AI itself, at least not what is currently on offer, and I trust management and regulators even less to not fall prey to calls for increasing efficiency by putting pretend solutions that are simply a way to reduce wages and personnel and funneling funds to startups.'

'Utter garbage. I don't trust the actual science of being able to correlate such physiological data with an individual, who won't be an 'average human', I trust the training of the AI even less and I have absolutely zero trust that management won't use this as an excuse to simply cut costs.'

'AI gets quite 'close', closer than many other humans do get to me.'

'We will be eliminating all humanity in aviation, makes me sick to think where this is going.'

'Health and physiological data are sensitive, is similar to being naked. I would use example as being stripped naked and being photographed for statistical or measuring reasons. With such exposure I would feel insecure.'

'The idea of having an AI system recording personal data is against human rights.'

7.1.7 Need for regulation concerning AI and physiological data monitoring

Question:

Do you think that ethical matters concerning physiological data monitoring done by an AI-based system should be regulated?

It was a clear, common opinion from almost all the respondents (215 out of 231) that **cases involving AI-based systems applied to the monitoring of physiological data should be regulated**.

Figure 10: Case 01 — NEED FOR REGULATION

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	No	16	6,9	6,9	6,9
	Yes	215	93,1	93,1	100,0
	Total	231	100,0	100,0	

7.1.8 Oversight of AI applications for physiological data monitoring

Question:

In case of yes, which authority should exercise oversight?

Concerning the authority that should have the responsibility to exercise oversight, **more than half of the respondents pointed to EASA as the competent oversight authority** (60,1 %). Almost 18 % considered that this topic should be overseen by NAAs. The rest of the responses representing 22 % were open to other types of organisations.

Figure 11: Case 01 — OVERSIGHT AUTHORITY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	EASA	131	56,7	60,1	60,1
	NAAs	39	16,9	17,9	78,0
	Others	48	20,8	22,0	100,0
	Total	218	94,4	100,0	
Missing		13	5,6		
Total		231	100,0		

7.1.9 Other oversight authorities for AI and physiological data monitoring

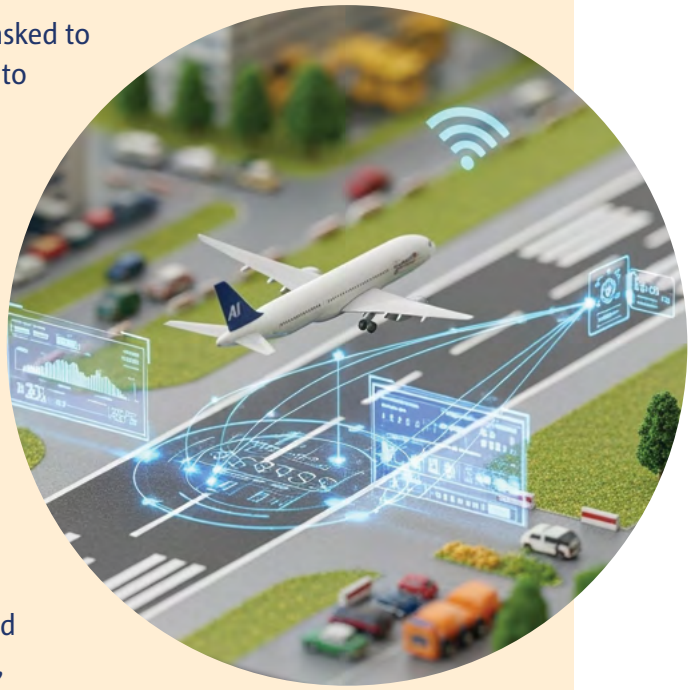
When asking about what other types of authorities other than EASA or whether NAAs should be involved, in the respondents' opinion the authorities best suited to exercise oversight for this case were mainly the **European Union, health organisations and organisations dealing with ethical matters,** and secondarily **ICAO, national organisations, national governments, professional organisations and data protection organisations.**

7.2 AI and pilot support in go-around situations

The second case was about the situation where the pilot is supported by an AI-based system that can automatically initiate a go-around manoeuvre of the aircraft. Aviation professionals were asked to imagine the following situation and rate it on a *type* Likert scale of 7 points, where 1 was the minimum and 7 the maximum.

CASE 02

A safe approach and landing require keeping certain aircraft parameters, such as speed and altitude, within given limits, as well as monitoring other parameters related to the external situation such as wind, weather, traffic and obstacles.



Today you and your co-pilot are tasked to monitor all these parameters and to initiate a 'go-around' in case the prerequisites for a safe landing cannot be ensured any longer. The aircraft you are flying with your co-pilot has a new feature, which is a 'go-around' assistant. This automated AI-based function is designed to support you during approach.

It has been highly trained to identify situations, in which 'go-around' decisions may be expected with a high probability. Therefore, it is capable of estimating continuously the likelihood of a missed approach in a given situation.

If a threshold is about to be exceeded, the system will provide an acoustic warning and automatically initiate the 'go-around' manoeuvre. This feature can be overridden by you as a pilot.

7.2.1 Level of *comfort* for AI and pilot support in go-around situations

Question:

Your level of comfort having an AI-based system, which is trained by observations from earlier flights, initiating a go-around manoeuvre?

Of the **198** valid responses, representing **85,7 %** of all the respondents, the positive part of the scale from 'a bit comfortable' to 'totally comfortable' represented **59,6 %** of the responses whilst for the negative part of the scale from 'not at all comfortable' to 'a bit uncomfortable' represented **24,3 %** of the responses. This leads to the conclusion that the **respondents show a tendency for *comfort*** considering AI and pilot support in go-around situations. The mean of all responses for the measure *comfort* was **4,63** on a seven-point *type* Likert scale, median was 5,00.

Figure 12: Case 02 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	28	12,1	**14,1**	14,1
	Mostly not comfortable with the situation	10	4,3	**5,1**	19,2
	A bit uncomfortable with the situation	10	4,3	**5,1**	24,2
	Not comfortable nor uncomfortable with the situation	32	13,9	**16,2**	40,4
	A bit comfortable with the situation	36	15,6	**18,2**	58,6
	Mostly comfortable with the situation	44	19,0	**22,2**	80,8
	Totally comfortable with the situation	38	16,5	**19,2**	100,0
	Total	198	85,7	**100,0**	
Missing		33	14,3		
Total		231	100,0		

7.2.2 Level of *trust* for AI and pilot support in go-around situations

Question:

Your level of trust that the decision basis of the AI system is sound and will ensure at least the same level of safety as manually piloted operations?

A total of **200** valid responses, representing **86,6 %,** were provided to this question. The positive part of the scale from 'feeling a bit of trust' to 'feeling total trust' represented **59,0 %** of all the responses, and the negative part of the scale from 'not feeling any trust' to 'a bit not feeling trust' represented **26,0 %**. This indicates that the **respondents tend to trust that the AI system is sound and will ensure at least the same level of safety as manually piloted operations**. Also, the mean for the *trust* question was **4,50** (median was 5,00).

Figure 13: Case 02 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	21	9,1	**10,5**	10,5
	Mostly not feeling trust	12	5,2	**6,0**	16,5
	A bit not feeling trust	19	8,2	**9,5**	26,0
	Not feeling trust nor untrust	30	13,0	**15,0**	41,0
	Feeling a bit of trust	53	22,9	**26,5**	67,5
	Feeling monstly trust	42	18,2	**21,0**	88,5
	Feeling total trust	23	10,0	**11,5**	100,0
	Total	200	86,6	**100,0**	
Missing		31	13,4		
Total		231	100,0		

7.2.3 Level of *acceptance* for AI and pilot support in go-around situations

Question:

Your level of acceptance allowing an AI system to automatically take over and initiate a go-around manoeuvre in a challenging situation like approach and landing?

The sum of valid responses was **188**, representing **81,4 %** of the respondents. The sum of the three positive points of the scale from 'will tend to accept this situation' to 'will accept this situation' resulted in **50,0 %**, while the sum of the three negative points of the scale from 'will not accept this situation' to 'will tend to not accept this situation' resulted is **34,0 %**. The average of the question concerning the level of *acceptance* having an AI-based system supporting go-around situations was **4,27** on a seven-point scale (median was 4,50). **Basically, half of the respondents would accept the support of an AI-based system.**

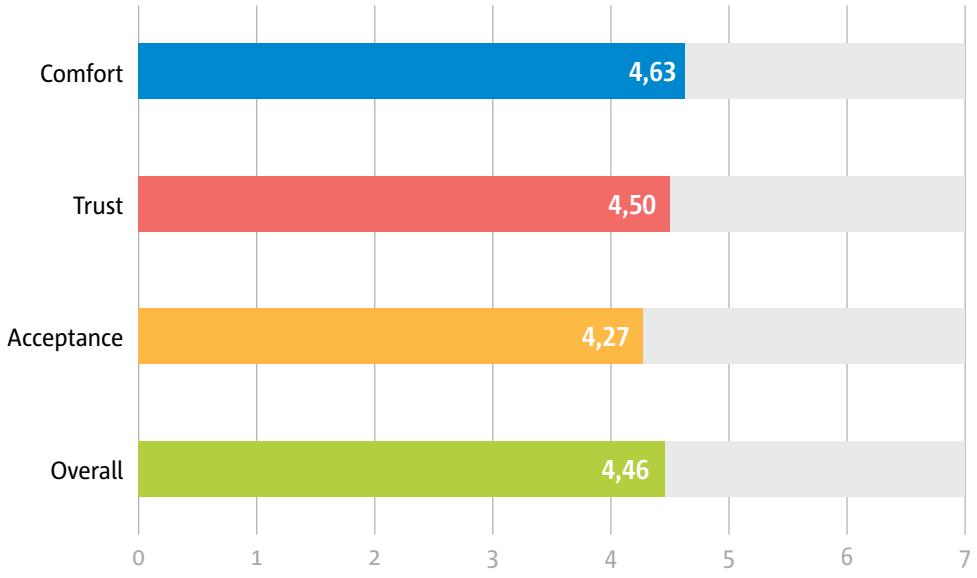
Figure 14: Case 02 — ACCEPTANCE

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	26	11,3	13,8	13,8
	Will mostly not accept this situation	12	5,2	6,4	20,2
	Will tend to not accept this situation	26	11,3	13,8	34,0
	No opinion about this situation	30	13,0	16,0	50,0
	Will tend to accept this situation	34	14,7	18,1	68,1
	Will mostly accept this situation	36	15,6	19,1	87,2
	Will accept this situation	24	10,4	12,8	100,0
	Total	188	81,4	**100,0**	
Missing		43	18,6		
Total		231	100,0		

7.2.4 Summary of the ethics-based assessment for AI and pilot support in go-around situations

The ethics-based assessment for the case of *go-around situations supported by an AI-based system* stands at **4,46** on a scale of 7 points. The tendency to *acceptance* is a bit higher than for case 01, and in this sense placed on the positive part of *comfort*, *trust* and *acceptance*. *Comfort* is the highest figure, followed by *trust* and finally by *acceptance*. The mean of the overall ethics-based assessment for the *go-around situation* is **4,46**.

Figure 15: Case 02 — Overall evaluation



7.2.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering AI and pilot support in go-around situations?

Two additional questions were asked to the aviation professionals that placed their opinion on the negative part of the scale from 1 to 3, meaning from 'will not accept this situation' to 'will tend not to accept this situation':

1) What would be necessary for you to change your position to acceptable?

2) Do you see any other ethical concerns? If yes, please shortly explain.

These were open-ended questions and the responses were analysed qualitatively.

Case 02 resulted in a **34 % non-acceptance** (50 % tendency for acceptance, and 16 % no opinion). This 34 % represented a sum of **330** content items, meaning 14 % of the overall 2 395 content items of the study.

When analysing the subcategories and applying the following criteria: a) explaining at least 10 % of the category; and b) having at least 10 responses, the following reasons were identified:

Figure 16: Case 02 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
AI-based systems n = 109	Ensuring human oversight	49	45 %
	Ensuring operational mitigations	19	17 %
	Compensating for mistrust of AI technology	15	14 %
total against the category:			76 %

Examples for *AI-based systems* of case 02
Ensuring human oversight; Ensuring operational mitigations; Compensating for mistrust of AI technology; Ensuring proper operational domain definition; Gaining experience; Ensuring system performance; Ensuring system transparency; Ensuring continuous safety monitoring; Ensuring system security.

Human impact n = 93	Accountability impacts	35	38 %
	Psychological impacts	13	14 %
	Human command and control	12	13 %
total against the category:			65 %

Examples for *Human impact* of case 02
Responsibility and accountability; Human command and control; No blaming culture; Error management; Professional threat; Not ready to work with AI; Discrimination; Emotion is also part of situational awareness; Personal invasion; Feeling of being controlled; Avoiding overreliance; Overreliance; Ensuring human redundancy; Managing accountability; Higher workload; Not to be taken by surprise; Passengers should be informed; Psychological discomfort; Risk of deskilling; Complexity increase; Stress reinforcement; Resource management; Life-threatening fear.

Safety n = 33	Threats aviation safety	18	55 %
total against the category:			55 %

Examples for *Safety* of case 02
Risk of unsafe situation; Not safe for aviation; Safety needs to be demonstrated; Increasing complexity and workload; Not trusting that it is safe; Dissonance between pilot and AI is risky; Need for certification; Ensuring safety by pilot control; Need for regulation; Ensuring same level of safety; Safety considerations depending on the type of aircraft; Safety and oversight; Certification needed; Risk of AI-based system malfunction.

7. Annex: The results of the eight cases

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
Operations n = 25	Landing is more than go-around criteria	10	40 %
total against the category:			40 %

Examples for *Operations* of case 02
Landing is more than go-around criteria; Pilot deselecting go-around possibility; False positives management; Stress increasement; Need for testing and demonstration; Overreliance; Private or commercial operation dependent; Insufficient data to perform a go-around; AI capacity for cumulative situations; Accountability; Autopilot as example for AI; Pilot evaluation surpasses AI; Human reacts quicker than AI.

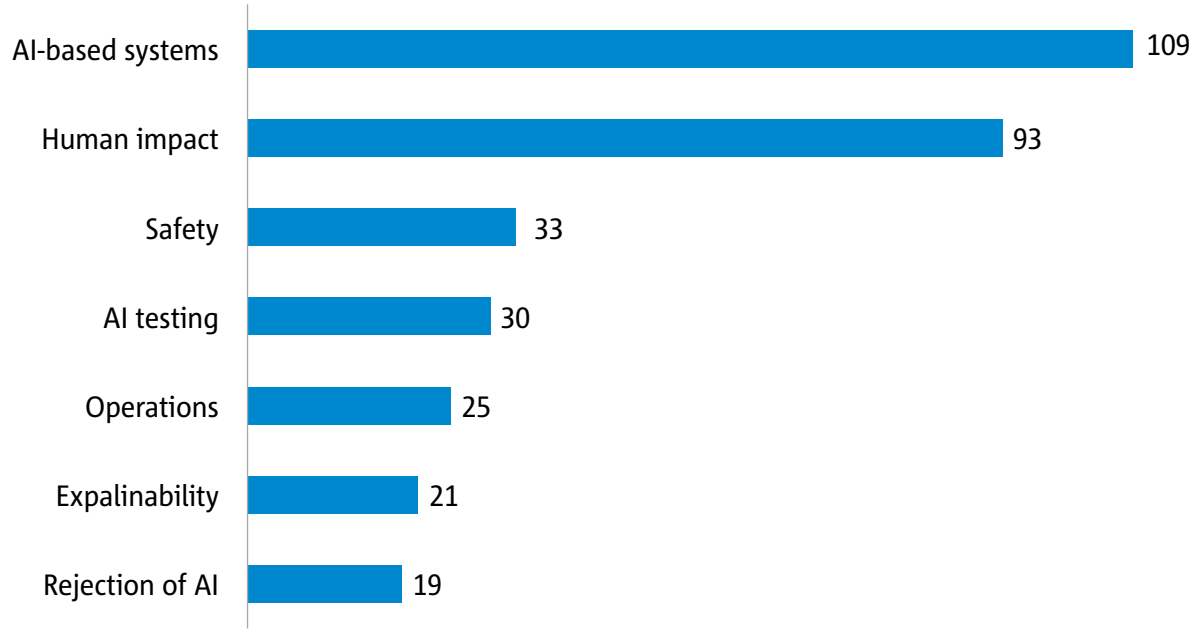
Explainability n = 21	Need for deep knowledge of the AI procedures	10	48 %
total against the category:			48 %

Examples for *Explainability* of case 02
Need for deep knowledge of the AI procedures; Transparency of code and training; Right timing and clear instructions for pilot decision; Need for testing and demonstration; Responsibility and accountability.

Remaining 15 % left explained by:
Contents on AI testing and rejection of AI.

The number of content items per category is as follows:

Figure 17: Case 02 — Number of content items per category



7.2.6 Summary of non-acceptance feedback for AI and pilot support in go-around situations

The reasons for the ethical non-acceptance of *allowing an AI system to automatically take over and initiate a go-around manoeuvre in a challenging situation like approach and landing* are firstly linked to the AI-based systems themselves, namely ensuring human oversight of the situation, having operational mitigations in place and measures to reinforce trust towards AI technology.

The second type of reasons for non-acceptance is about negative impacts on humans, like accountability, consequences in case of failure, the psychological impacts suffered due to the influence of such a system, and the need for a human to be in command and control of the go-around operation.

The respondents pointed out the threat to aviation safety, the fact that landing is more than just a go-around set of criteria, and that they would need to have deep knowledge of AI-based systems' behaviour.

Some respondents highlighted also the need for testing, and some rejected AI technology for such types of situations.

The following are some examples shared by the aviation professionals concerning the non-acceptance of *AI and pilot support in go-around situations*:

'I need to have AI system certified, to be sure that the system is not taking 'automatically a go around maneuver' which could be inappropriate, and Unsafe.'

'A human co-pilot has their own intuition, which in turn cannot be replaced to the same extent by an AI.'

'An AI can be a supplement and a relief, but it cannot replace a human. This breaks the basic principle of redundancy between two identical systems.'

'Critical decisions can be made based on many reasons, not all of which are accessible for an AI. Even if one limit is exceeded, within the proper situation a pilot could yet decide wisely to continue the approach, with enough margin to correct it. An automatic GA system would boost the number of GA's.'

'How do I teach AI the concerns and fears that I may have for my life in order to absolutely make sure it is working as hard as I would to save my passengers, my crew, and myself?'

'Moral agency, will the crew be exempt from AI system errors?'

'Pilots may become overly reliant on automated systems, situational awareness lost, technical malfunctions, cyber-attacks, unpredictable AI behavior.'

'Who is to blame if the AI go-around in a situation like above really ruins the landing and kills people? The pilot(s), the AI producer, the operating airline, the aircraft producer?'

7.3 AI in maintenance

The third case was about a scenario concerning maintenance where maintenance staff are supported by an AI-based system that would evaluate the aircraft structures through a traffic light scheme. Aviation professionals were asked to imagine the following situation and rate it on a rating scale of 7 points, where 1 was the minimum and 7 the maximum.

CASE 03

You, as a maintenance expert, are trained to check aircraft according to today's standard processes and rules. However, a new material and production process for aircraft structures has been introduced and the existing means of assessing the soundness and airworthiness of structures are not applicable any longer.

Instead, a new sensing system is inspecting the hull of the airframe autonomously, e.g. by means of a sensor-equipped drone flying along the aircraft scanning the structure. The resulting data is analysed automatically by the AI-based system.

The outcome of this process follows a traffic light scheme indicating either a 'green light' (structure ok), a red light (structure not ok) or an amber light (a specific section is to be assessed manually). At the end, you need to sign off the airworthiness of the aircraft.

7.3.1 Level of *comfort* for AI in maintenance

Question:

Your level of comfort of having an autonomous system assessing the aircraft structure's health status automatically without human intervention?

The number of valid responses to this case was **207**, representing **89,6 %** of all the respondents. **57,0 %** of the responses were on the positive part of the scale from 'a bit comfortable' to 'totally comfortable', and **26,1 %** on the negative part of the scale from 'not at all comfortable' to 'a bit uncomfortable'. According to the results, the **respondents show a tendency for *comfort*** considering AI in maintenance. The mean of all responses is **4,63** on a seven-point Likert scale. The mean for *AI in maintenance* was **4,63** and the median was 5,00 on a seven-point rating scale.

Figure 18: Case 03 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	20	8,7	**9,7**	9,7
	Mostly not comfortable with the situation	16	6,9	**7,7**	17,4
	A bit uncomfortable with the situation	18	7,8	**8,7**	26,1
	Not comfortable nor uncomfortable with the situation	35	15,2	**16,9**	43,0
	A bit comfortable with the situation	33	14,3	**15,9**	58,9
	Mostly comfortable with the situation	47	20,3	**22,7**	81,6
	Totally comfortable with the situation	38	16,5	**18,4**	100,0
	Total	207	89,6	**100,0**	
Missing		24	10,4		
Total		231	100,0		

7.3.2 Level of *trust* for AI in maintenance

Question:

Your level of trust that the highly condensed output of the inspection process is sufficiently sound to let you decide about the airworthiness of the structure?

A total of **203** responses representing **87,9 %** of all the respondents were provided to this question. **47,8 %** of the responses were on the positive part of the scale from 'feeling a bit of trust' to 'feeling total trust', and **33,0 %** on the negative part of the scale from 'not feeling any trust' to 'a bit not feeling trust'. The results show that the **respondents tend to trust that the highly condensed output of the inspection process is sufficiently sound to let them decide about the airworthiness of the structure**. The mean for the *trust* question was **4,19**, supporting the positive tendency for *trust* (median 4,00).

Figure 19: Case 03 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	26	11,3	**12,8**	12,8
	Mostly not feeling trust	12	5,2	**5,9**	18,7
	A bit not feeling trust	29	12,6	**14,3**	33,0
	Not feeling trust nor untrust	39	16,9	**19,2**	52,2
	Feeling a bit of trust	45	19,5	**22,2**	74,4
	Feeling monstly trust	31	13,4	**15,3**	89,7
	Feeling total trust	21	9,1	**10,3**	100,0
	Total	203	87,9	**100,0**	
Missing		28	12,1		
Total		231	100,0		

7.3.3 Level of *acceptance* for AI in maintenance

Question:

Your level of acceptance to rely on the AI-based assessment as an integrated element of the check process you are responsible for?

The number of valid responses was **199**, representing **86,1 %** of the respondents. **49,3 %** of these responses were positive on the scale from 'will tend to accept this situation' to 'will accept this situation' whilst **35,2 %** were negative on the scale from 'will not accept this situation' to 'will tend to not accept this situation'. The average of the question concerning the level of *acceptance* of having an AI-based system supporting maintenance activities was **4,28** on a seven-point scale (median 4,00). **Basically, half of the respondents would accept the support of an AI-based system in maintenance.**

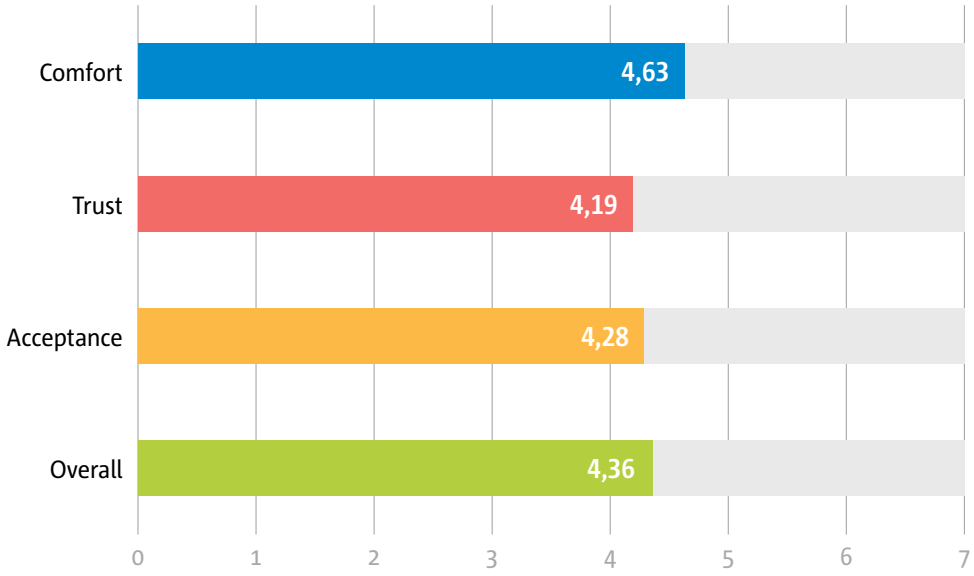
Figure 20: Case 03 — ACCEPTANCE

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	25	10,8	**12,6**	12,6
	Will mostly not accept this situation	17	7,4	**8,5**	21,1
	Will tend to not accept this situation	28	12,1	**14,1**	35,2
	No opinion about this situation	31	13,4	**15,6**	50,8
	Will tend to accept this situation	36	15,6	**18,1**	68,8
	Will mostly accept this situation	29	12,6	**14,6**	83,4
	Will accept this situation	33	14,3	**16,6**	100,0
	Total	199	86,1	**100,0**	
Missing		32	13,9		
Total		231	100,0		

7.3.4 Summary of the ethics-based assessment for AI and maintenance

The ethics-based assessment for the case of *AI and maintenance* stands at **4,36** on a scale of 7 points. As regards the three dimensions, the respondents have indicated higher values for *comfort* (4,65) followed by *acceptance* (4,28), and the lowest value was indicated for *trust* with 4,19. Nevertheless, there is a slight tendency for a positive ethics-based assessment for *AI in maintenance*.

Figure 21: Case 03 — Overall evaluation



7.3.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering AI and maintenance activities?

The aviation professionals that placed their opinion on the negative part of the scale from 1 to 3, meaning from 'will not accept this situation' to 'will tend not to accept this situation', were asked the following two questions:

1) What would be necessary for you to change your position to acceptable?

2) Do you see any other ethical concerns? If yes, please shortly explain.

These were open-ended questions and the responses were analysed qualitatively. These two questions were treated together, and the results are presented here with the following criteria: a) explaining at least 10 % of the category to which they belong; and b) representing at least 10 frequencies.

Case 03 resulted in a **35,2 % non-acceptance** (49,3 % acceptance and 15,6 % no opinion). This 35,2 % represented a sum of **283** content items.

7. Annex: The results of the eight cases

From the most frequent to the least frequent motives, Figure 22 contains the results for non-acceptance to rely on an *AI-based assessment as an integrated element of maintenance*:

Figure 22: Case 03 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
Human impact n = 105	Difficulties with the definition of responsibility borderlines	17	16 %
	Managing accountability	17	16 %
	Professional threats	15	14 %
	Not responsible for AI check	13	12 %
total against the category:			59 %

Examples for *Human impact* of case 03

Difficulties with the definition of responsibility borderlines; Managing accountability; Not responsible for AI check; AI responsibility and accountability; Professional threats; Shared responsibility; Human to take final decision; Fear of legal charges; Explainability; Fear of accountability; Fear of blaming; Level of acceptance depends on the level of responsibility; AI as a tool, not a replacement; Unacceptable situation; Not trusting the system; Risk of deskilling; Unfair situation; Assurance concerns; Loss of practical experience; Liability concerns; Avoiding overreliance; Responsibility and accountability; Company responsibility; Transparency; Risk of deskilling; Taking away the essence of the expert; Responsibility only for the human check; Need to build psychological confidence; Need for testing and validation; AI manufacture responsibility.

AI-based systems n = 94	Ensuring human oversight	35	37 %
	Compensating for mistrust of AI technology	15	16 %
	Ensuring system performance	11	12 %
	Ensuring continuous safety monitoring	10	11 %
total against the category:			76

Examples for *AI-based systems* of case 03

Ensuring human oversight; Compensating for mistrust of AI technology; Ensuring system performance; Ensuring continuous safety monitoring; Gaining experience; Ensuring system transparency; Ensuring operational mitigations; Ensuring proper operational domain definition; Delay of flights; Managing ethics in organisations.

Explainability n = 39	Need for knowledge of the calculation methods of the AI-based systems	10	26 %
	Deep knowledge of the system	10	26 %
total against the category:			51 %

Examples for *Explainability* of case 03

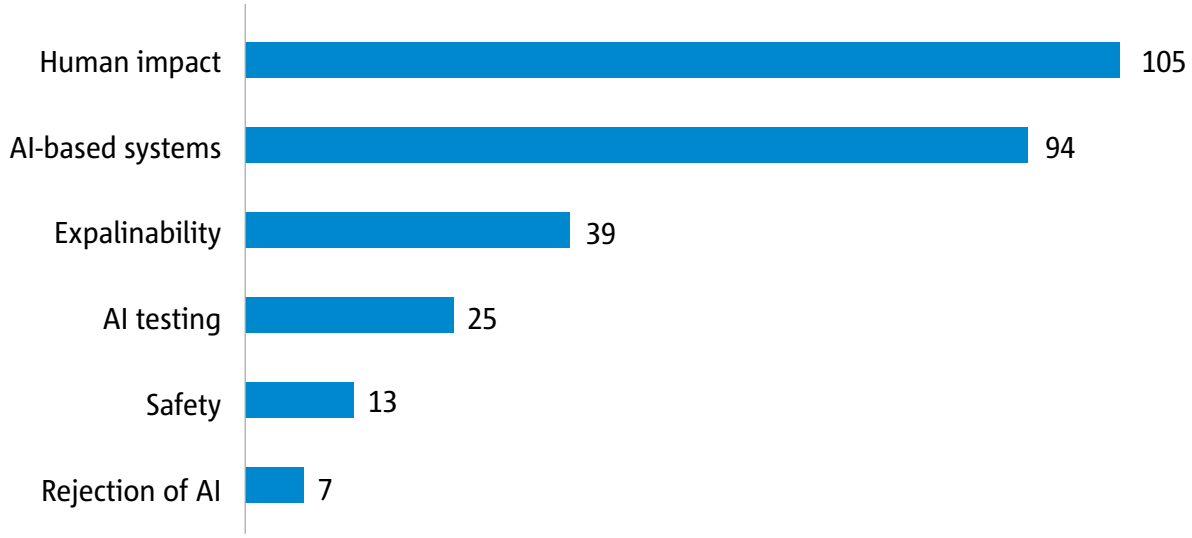
Need for knowledge of the calculation methods; Deep knowledge of the system; Total transparency needed for the system; Training the experts; Clear guidance behind the colouring code result; Need for human final decision; Human check at some points; AI interactive and transparent based on sensory input; Reliability shown by evidence; Data in open source for verification; Assessment of the health of the device; Involvement in AI development; Knowledge of system limitations; Need for record keeping; Management of errors by the AI; Reporting system on AI errors detected.

Remaining 16 % left explained by:

Contents on AI testing, safety and rejection of AI.

The number of content items distributed per each category is as follows:

Figure 23: Case 03 — Number of content items per category



7.3.6 Summary of non-acceptance feedback for AI in maintenance

The main reasons for the ethical non-acceptance to *rely on an AI-based assessment as an integrated element of the check process the professionals are responsible for in maintenance* are mostly linked to the impact on humans, namely the difficulties to draw a clear line between what will be the responsibility of the human and what will be the responsibility of the system. Managing accountability is, therefore, difficult and consequently aviation professionals express some professional threats they see like fear of unemployment, fear of being professionally scrutinised by the system, fear of being exposed to the employer, fear of not understanding why the system has taken some decisions, etc. Aviation professionals do not feel responsible for the check done by the AI-based system.

Further reasons have to do with the AI-based systems themselves: aviation professionals believe that human oversight of the system should be ensured, mechanisms for mitigation of mistrust of AI should be in place, that the system's performance should always be ensured as well as the continuous safety monitoring of the activity.

Aviation professionals also point to the need for a deep knowledge of the calculation methods used by the system and also a deep knowledge of the AI-based system itself.

Some other reasons for non-acceptance are related to the need for further AI testing regarding safety, namely the need for oversight and inspection, and also that AI should not be applied in these cases.

The following are examples shared by the aviation professionals concerning the case of *AI supporting maintenance activities* that show their non-acceptance:

7. Annex: The results of the eight cases

'If me, as a maintenance engineer, am forced to sign the airworthiness, I expect that the producer of the system (drone + AI based system) is also responsible/ accountable for possible accidents/incidents.'

'Need detailed education in the working of the AI system. Assurance that all failure scenarios have been tested, documented, and mitigated. Transparent procedures outlining interface responsibilities and delineations.'

'Either you trust the AI completely and take the human out of the loop or use the info to provide warnings and alerts to the human. The moment you turn the human simply into a monitoring machine you make it useless.'

'Transition period is needed on a larger scale where people check for the machine processed work for mistakes till it's proven that accuracy is the same or better as mechanic inspected action. Otherwise, airworthiness is surely jeopardized. AI should help and speed up the process, not replace yet.'

'My level of comfort would be linked to the level of criticality of the maintenance task carried out by IA system (without human intervention). I´m not comfortable with the exclusive use of AI for maintenance tasks with high level of criticality or directly related with safety.'

'The meaning of my sign-off must be very clearly defined. I can sign-off that the automated check has been done, but not the quality of the result. Is not totally fair to sign off the airworthiness of the aircraft in the cases when I am not implied in the process.'

'To much comfort and relaxation which could compromise the airworthiness. AI and automation should speed up the process as well as make it more accurate but human inspection would be still needed.'

'If accident occurs and the structure is found to be at fault due to lack of detection of fatigue, this would be because of error of the system but my signature is still there so would I be charged with neglect?'

7.4 AI airport allocation of airlines to a terminal

Case 04 was about a scenario concerning the ability of an AI-based system to allocate airlines to certain airport terminals. Aviation professionals were asked to imagine the following situation and rate it on a *type* Likert scale of 7 points, where 1 was the minimum and 7 the maximum.

CASE 04

At the airport where you are hired as a terminal manager, airlines have fixed allocations to terminals. In these locations flights are serviced with the necessary provisions and passengers embark and disembark through the corresponding gates. Within the terminal that you are managing the allocation of the gates has been done by planning based on the scheduled landing time, not considering the walking distance between gates in the case of connecting flights.

As a consequence, passengers lost flights and heavily complained. To solve this issue an AI-based system was trained to propose a walk-time-optimised aerodrome gate allocation for passengers with the advantages of minimising walking distance and time spent to catch a second flight and to ensure a fair distribution of means to access the gates (direct access versus by bus).

Your airport is hosting a large fleet of a domestic airline with a specific traffic pattern. Training the AI-based system with data from your airport may lead to special behaviour patterns in its operational phase.

Although the AI developers have taken into account the removal of biases in the AI-based system, there is an acceptable residual risk that the system can give advantage to some airlines by allocating better gates with shorter walking distance over other airlines, despite paying the same fees.

7.4.1 Level of *comfort* for AI airport allocation of airlines to a terminal

Question:

Your level of comfort of having and AI-based system with potentially biased outcomes allocating location and gates to airlines?

For this question, **208** valid responses were received representing **90 %** of all the respondents. **68,8 %** of the responses were on the positive part of the scale from 'a bit comfortable' to 'totally comfortable', and **13 %** on the negative part of the scale from 'not at all comfortable' to 'a bit uncomfortable'. The results show that the **respondents have a clear tendency for *comfort*** for AI-based systems allocating airlines to an airport terminal. The mean of all responses is **5,17** on a seven-point Likert scale, reinforcing the *comfort* tendency (median of 5,00).

Figure 24: Case 04 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	5	2,2	**2,4**	2,4
	Mostly not comfortable with the situation	10	4,3	**4,8**	7,2
	A bit uncomfortable with the situation	12	5,2	**5,8**	13,0
	Not comfortable nor uncomfortable with the situation	38	16,5	**18,3**	31,3
	A bit comfortable with the situation	40	17,3	**19,2**	50,5
	Mostly comfortable with the situation	59	25,5	**28,4**	78,8
	Totally comfortable with the situation	44	19,0	**21,2**	100,0
	Total	208	90,0	**100,0**	
Missing		23	10,0		
Total		231	100,0		

7.4.2 Level of *trust* for AI airport allocation of airlines to a terminal

Question:

Your level of trust that the AI-based system ensures fairness in the allocation of location and gates to different airlines?

A total of **208** responses, representing **90,0 %** of the respondents, were provided to this question. **54,8 %** of the responses are on the positive part of the scale from 'feeling a bit of trust' to 'feeling total trust', while **23,1 %** of the responses are on the negative part of the scale from 'not feeling any trust' to 'a bit not feeling trust'. On that basis, one can say that the **respondents tend to trust that the AI-based system will ensure fairness in gate allocation**. Also, the mean for the *trust* question was **4,67** (median of 5,00).

Figure 25: Case 04 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	12	5,2	**5,8**	5,8
	Mostly not feeling trust	12	5,2	**5,8**	11,5
	A bit not feeling trust	24	10,4	**11,5**	23,1
	Not feeling trust nor untrust	46	19,9	**22,1**	45,2
	Feeling a bit of trust	37	16,0	**17,8**	63,0
	Feeling monstly trust	45	19,5	**21,6**	84,6
	Feeling total trust	32	13,9	**15,4**	100,0
	Total	208	90,0	**100,0**	
Missing		23	10,0		
Total		231	100,0		

7.4.3 Level of *acceptance* for AI airport allocation of airlines to a terminal

Question:

Your level of acceptance letting an AI system take over the allocation of location and gates without human intervention to change the AI decision?

The **203** valid responses represented **87,9 %** of the respondents. The results **show a tendency for *acceptance***. **58,6 %** of the responses are positive on the scale from 'will tend to accept this situation' to 'will accept this situation', while **24,1 %** of the responses are on the scale from 'will not accept this situation' to 'will tend to not accept this situation'. The average of the question concerning the level of acceptance of having an AI system taking over the allocation of location and gates without human intervention was **4,82** on a seven-point scale, meaning that the respondents 'will tend to accept this situation' (median of 5,00).

Figure 26: Case 04 — ACCEPTANCE

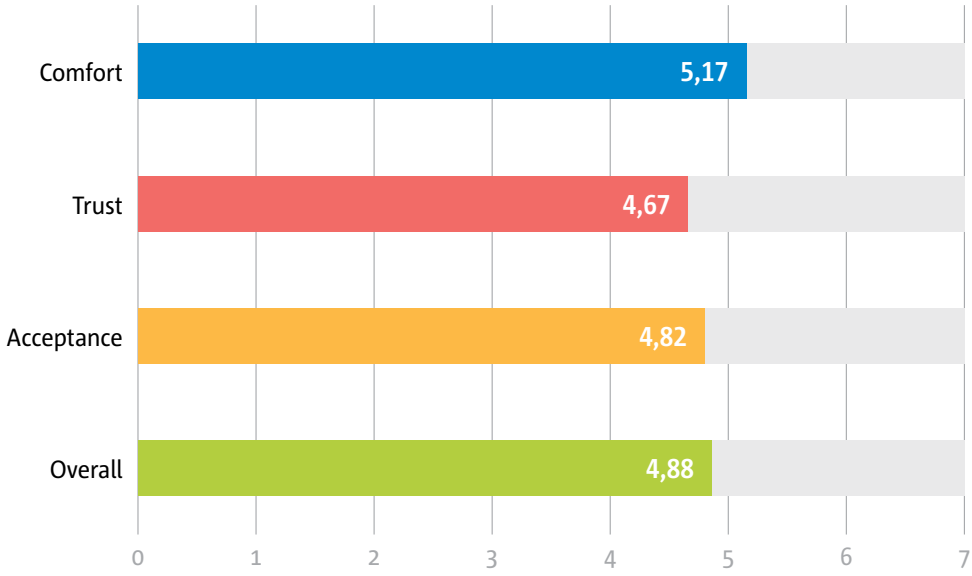
		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	11	4,8	**5,4**	5,4
	Will mostly not accept this situation	10	4,3	**4,9**	10,3
	Will tend to not accept this situation	28	12,1	**13,8**	24,1
	No opinion about this situation	35	15,2	**17,2**	41,4
	Will tend to accept this situation	35	15,2	**17,2**	58,6
	Will mostly accept this situation	40	17,3	**19,7**	78,3
	Will accept this situation	44	19,0	**21,7**	100,0
	Total	203	87,9	**100,0**	
Missing		28	12,1		
Total		231	100,0		

7.4.4 Summary of the ethics-based assessment for AI airport allocation of airlines to a terminal

The ethics-based assessment for the case of *AI airport allocation of airlines to a terminal* was **4,88** on a rating scale of 7 points. Clearly positive overall, the highest positive from the three dimensions is *comfort* (5,17) followed by *acceptance* (4,82), and finally the dimension *trust* (4,67). This case shows the aviation professionals' positive ethical position. It is, however, important to note that the case is not directly linked to aviation safety matters.

7. Annex: The results of the eight cases

Figure 27: Case 04 — Overall evaluation



7.4.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering AI airport allocation of airlines to a terminal?

The aviation professionals that placed their opinion on the negative part of the scale from 1 to 3, meaning from 'will not accept this situation' to 'will tend not to accept this situation', were asked the following two questions:

1) What would be necessary for you to change your position to acceptable?

2) Do you see any other ethical concerns? If yes, please shortly explain.

These were open-ended questions and the responses were analysed qualitatively.

The level of non-acceptance was **24 %** (59 % acceptance and 17 % no opinion) of the **211** responses provided. The criteria for representing at least 10 % of each category and representing at least 10 comments were considered for the presentation of the following results:

Figure 28: Case 04 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
AI-based systems n = 99	Ensuring system performance	31	31 %
	Ensuring human oversight	27	27 %
	Ensuring continuous safety monitoring	10	10 %
total against the category:			69 %

Examples for *AI-based systems* of case 04

Ensuring system performance; Ensuring human oversight; Ensuring continuous safety monitoring; Ensuring proper operational domain definition; Ensuring system transparency; Ensuring system security; Compensating for mistrust of AI technology; Ensuring operational mitigations; Gaining experience; Managing accountability.

7. Annex: The results of the eight cases

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
Unfair bias n = 63	The system should ensure fairness	16	25 %
	Bias monitoring and correction in the system	12	19 %
	Bias-specific rules when designing the system	10	16 %
total against the category:			60 %

Examples for *Unfair bias* of case 04

The system should ensure fairness; Bias monitoring and correction in the system; Bias-specific rules when designing the system; Human check and correction; Risk of bias is unacceptable; Fear of corruption; Reality has a certain bias; System should be transparent; Unfair situation; Testing period verification; Bias total removal; Unbiased contractual conditions; Definition of a percentage of bias acceptable; Managing accountability.

Market n = 36	Fear of commercial manipulation and corruption	10	28 %
	Economic impact on operators	10	28 %
total against the category:			56 %

Examples for *Market* of case 04

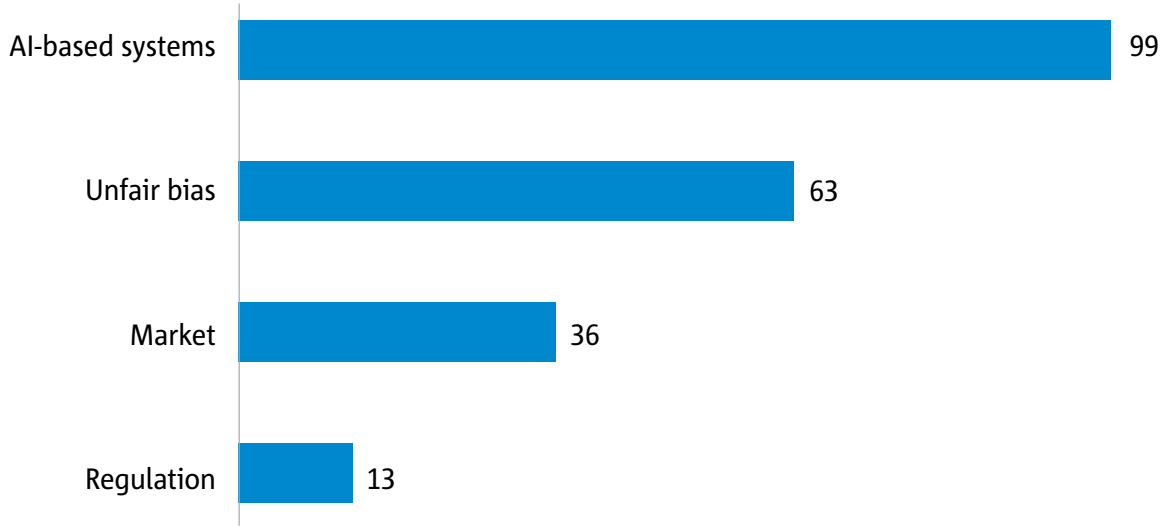
Fear of commercial manipulation and corruption; Economic impact on operators; Airport operations are complex; Positive discrimination of an operator; AI should address the airport needs; Discrimination of passengers versus operators; Managing accountability; Change of crew; Supervision exercised by the operators; Considering specific public; Discrimination of operators versus passengers; Compensate operators subject to AI bias.

Remaining 6 % left explained by:

Contents on the need for regulation.

The number of content items distributed per category level 01 is as follows:

Figure 29: Case 04 — Number of content items per category



7.4.6 Summary of non-acceptance feedback for AI airport allocation of airlines to a terminal

The main reasons for the ethical non-acceptance for *letting an AI system take over the allocation of location and gates without human intervention to change the AI decision* are firstly linked to the AI-based systems themselves, namely related to ensuring system performance, human oversight and continuous safety monitoring of the activity. Secondly, the reasons relate to potential unfair bias: the respondents are of the opinion that the system should ensure fairness, the bias of the system must be monitored and corrected if/when necessary, and specific rules/criteria concerning bias should be implemented into the system itself. Thirdly, the reasons for the ethical non-acceptance are related to market; for example, the fear of commercial manipulation and corruption and the economic impact (both positive and negative) on operators. Further reasons are linked to the need to regulate such activity.

The following are some examples shared by the aviation professionals concerning the case *AI airport allocation of airlines to a terminal* that illustrate their non-acceptance:

'To ensure fairness in AI decisions. To lower fees to those airlines affected by biased decisions of AI.'

'Need to introduce a 'fairness/equity' parameter that can be adjusted either manually or randomly to avoid unfair allocation.'

'The human should still have the last authority to make sure, the AI has not learned unfair allocations. Once the system runs smooth and seems to be fair, there would usually be no need for intervention.'

'Human intervention must be possible if obviously someone/an airline runs into disadvantages.'

'In the AI-based system, there should be NO acceptable residual risk that the system can give advantage to some airlines by allocating better gates with shorter walking distance over other airlines, despite paying the same fees.'

'The planning can be done automatically, if afterwards check for fairness can be conducted and a new planning or manual allocation afterwards is possible. It is not acceptable for me as it sounds as if unfairness of the planning is known but I am responsible for fair planning.'

'Introduce the requirement for such systems to embed regular allocations analysis (would require timeframe definition to ensure enough data is gathered for analysis relevance) in order to detect unfair location/gates and allow the system continuous improvement (can also be achieved through AI).'

'I would prefer a system where AI makes suggestions (gives advice), but where qualified staff has the last say.'

7.4.7 Need for regulation regarding AI airport allocation of airlines to a terminal

Question:

Do you think that ethical matters concerning aviation market fairness linked to the usage of AI-based systems should be regulated?

It was a clear, common opinion of most of the respondents (186 of 231) that the **cases involving aviation market fairness linked to the usage of AI-based systems should be regulated**.

Figure 30: Case 04 — NEED FOR REGULATION

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	No	45	19,5	**19,5**	19,5
	Yes	186	80,5	**80,5**	100,0
	Total	231	100,0	**100,0**	

7.4.8 Oversight authority for AI airport allocation of airlines to a terminal

Question:

In case of yes, which authority should exercise oversight?

Concerning the authority that would have the responsibility for oversight, **more than half of the respondents pointed to EASA as the competent authority (58,6 %)**. Concerning NAAs: **20 %** considered that NAAs should exercise oversight. **19,4 %** of the responses were open to other types of organisations.

Figure 31: Case 04 — OVERSIGHT AUTHORITY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	EASA	112	48,5	**58,6**	58,6
	NAAs	42	18,2	**22,0**	80,6
	Others	37	16,0	**19,4**	100,0
	Total	191	82,7	**100,0**	
Missing		40	17,3		
Total		231	100,0		

7.4.9 Other oversight authorities

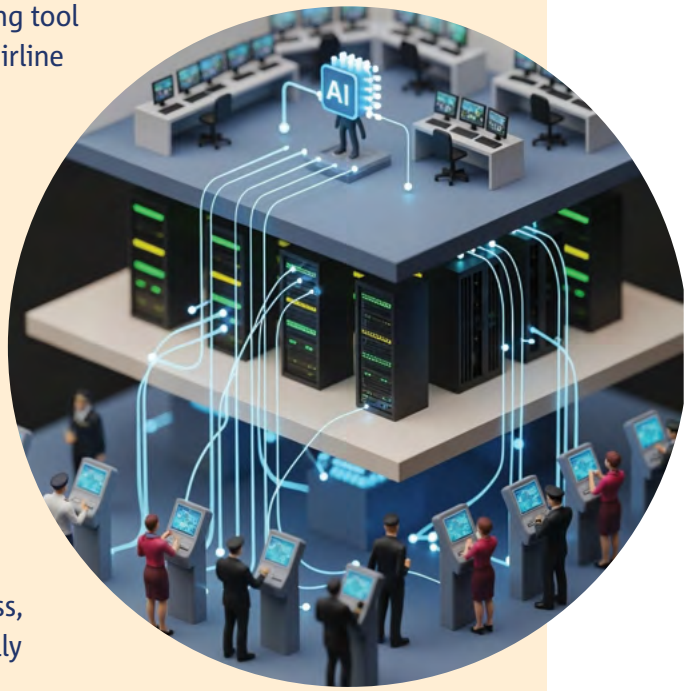
When asking about what other types of authorities other than EASA or whether NAAs would be, in the respondents' opinion, the authorities best suited to exercise oversight for case 04, **37 responses** indicated that an **organisation regulating the market and the consumers should be the main competent authority**, followed by a joint effort between EASA and other organisations like NAAs, the FAA or other European Union institutions.

7.5 AI airline crew member attribution to flights

The fifth case was about a situation where the AI-based system gathers personal data from air crews in order to optimise the rostering process. Aviation professionals were asked to imagine the following situation and rate it on a *type* Likert scale of 7 points, where 1 was the minimum and 7 the maximum.

CASE 05

You are a pilot working for a specific airline. Up to now the airline operations centre is developing and publishing the monthly duty rota through a planning tool operated by airline personnel. The airline is offering family-friendly rosters (selecting which crew member to put on what flight) and supports all dimensions of diversity.



Accordingly, you have voluntarily provided information on your individual and personal situation concerning, e.g. family care times during which you would need to be at home, certain times you want to spend with your partner, preferences related to schedules, etc. To optimise the rostering process, the airline decides to introduce a fully automated and AI-based tool.

The tool needs to build an internal model of your personal social environment including family status, constraints due to medical appointments, care times, family times, and personal interests. The AI-based tool would eventually derive social and behavioural patterns of your behaviour in accepting schedules and your openness for potential roster changes, using this information to allocate you to certain flights.

The AI-based tool optimises the crew roster on the basis of this model without any further human intervention. Your employer confirms that all data will be stored in a secure environment.

7.5.1 Level of *comfort* for AI airline crew members attribution to flights

Question:

Your level of comfort of having a fully automated AI-based system defining your roster?

The **200** valid responses represented **86,6 %** of all the respondents. **62 %** of the responses are on the positive part of the scale from 'a bit comfortable' to 'totally comfortable', and **22,5 %** on the negative part of the scale from 'not at all comfortable' to 'a bit uncomfortable'. The results show that the **respondents have a tendency for *comfort*** considering *AI supporting airline crew member attribution to flights*. The mean of all responses is **4,82** on a seven-point Likert scale, supporting the tendency for *comfort*; the median is 5,00.

Figure 32: Case 05 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	19	8,2	**9,5**	9,5
	Mostly not comfortable with the situation	9	3,9	**4,5**	14,0
	A bit uncomfortable with the situation	17	7,4	**8,5**	22,5
	Not comfortable nor uncomfortable with the situation	31	13,4	**15,5**	38,0
	A bit comfortable with the situation	37	16,0	**18,5**	56,5
	Mostly comfortable with the situation	42	18,2	**21,0**	77,5
	Totally comfortable with the situation	45	19,5	**22,5**	100,0
	Total	200	86,6	**100,0**	
Missing		31	13,4		
Total		231	100,0		

7.5.2 Level of *trust* for AI airline crew member attribution to flights

Question:

Your level of trust that the system is recognising your constraints appropriately?

A total of **200** valid responses, representing **86,6 %** of the respondents, were provided to this question. **57 %** of the responses is on the positive part of the scale from 'feeling a bit of trust' to 'feeling total trust', whilst **23,5 %** is on the negative part of the scale from 'not feeling any trust' to 'a bit not feeling trust'. The results show that the **respondents tend to trust that the system will recognise their constraints appropriately**. Also, the mean for the *trust* question was **4,68** (median of 5,00).

Figure 33: Case 05 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	14	6,1	**7,0**	7,0
	Mostly not feeling trust	15	6,5	**7,5**	14,5
	A bit not feeling trust	18	7,8	**9,0**	23,5
	Not feeling trust nor untrust	39	16,9	**19,5**	43,0
	Feeling a bit of trust	40	17,3	**20,0**	63,0
	Feeling monstly trust	37	16,0	**18,5**	81,5
	Feeling total trust	37	16,0	**18,5**	100,0
	Total	200	86,6	**100,0**	
Missing		31	13,4		
Total		231	100,0		

7.5.3 Level of *acceptance* for AI airline crew member attribution to flights

Question:

Your level of acceptance having an AI-based system analysing and using your personal data related to family conditions, social habits, and free time preferences?

The **194** valid responses represented **84 %** of the respondents. **45,4 %** of the responses is on the positive part of the scale from 'will tend to accept this situation' to 'will accept this situation', whilst **38,1 %** is on the negative part of the scale from 'will not accept this situation' to 'will tend to not accept this situation'. There seems to be a tendency for *acceptance* but not that much strongly stated. The average of the question concerning the level of acceptance of having an AI-based system analysing and using personal data related to family condition, social habits, and free-time preferences is **4,20** on a seven-point scale (median of 4,00).

Figure 34: Case 05 — ACCEPTANCE

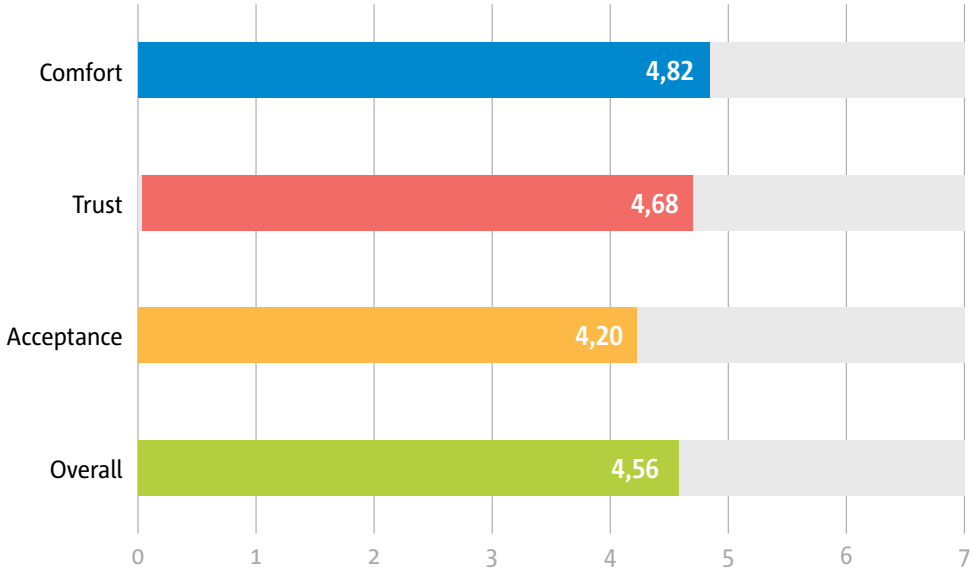
		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	31	13,4	**16,0**	16,0
	Will mostly not accept this situation	15	6,5	**7,7**	23,7
	Will tend to not accept this situation	28	12,1	**14,4**	38,1
	No opinion about this situation	32	13,9	**16,5**	54,6
	Will tend to accept this situation	22	9,5	**11,3**	66,0
	Will mostly accept this situation	30	13,0	**15,5**	81,4
	Will accept this situation	36	15,6	**18,6**	100,0
	Total	194	84,0	**100,0**	
Missing		37	16,0		
Total		231	100,0		

7.5.4 Summary of the ethics-based assessment for AI airline crew member attribution to flights

The first conclusion is that the level of ethics-based assessment for the case concerning *AI airline crew member attribution to flights* stands at **4,56** in a maximum of 7 points. Considering that the midpoint of the scale is 3.5, **aviation professionals tend to have a positive but an ethically low assessment of this case**.

The highest value is shown for *comfort* (4,82), followed by *trust* (4,68), and finally the level of *acceptance* is the lowest (4,20).

Figure 35: Case 05 — Overall evaluation



7.5.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering AI airline crew member attribution to flights?

The aviation professionals that placed their opinion on the negative part of the scale from 1 to 3, meaning from 'will not accept this situation' to 'will tend not to accept this situation', were asked the following two questions:

1) What would be necessary for you to change your position to acceptable?

2) Do you see any other ethical concerns? If yes, please shortly explain.

These were open-ended questions and the responses were analysed qualitatively.

The two questions were treated together as one and are presented here with the criteria of explaining at least 10 % of the category to which the content belongs to and representing at least 10 frequencies.

Case 05 resulted in a **38,1 % non-acceptance** (45,4 % acceptance and 16,5 % no opinion). This 38,1 % represented a sum of **340** content items (approximately 14 % of the overall comments received in the study).

From the most frequent to the least frequent motives, the results for non-acceptance of having an *AI-based system analysing and using personal data related to family condition, social habits and free-time preferences* are as follows:

7. Annex: The results of the eight cases

Figure 36: Case 05 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
Data = 115	Mistrust of data usage	19	17 %
	No personal data	14	12 %
	Lack of privacy	13	11 %
	Managing data privacy	13	11 %
total against the category:			51 %

Examples for *Data* of case 05

Mistrust of data usage; No personal data; Lack of privacy; Managing data privacy; Data usage to a good intent; Secure storage environment; Data protection assurance; If used, then only on a voluntary basis; Confidentiality assurance; Respecting the GDPR; Minimum information; Deletion of data management; Compensation/sanctions in case of fraud; Show more benefits than risks; Pilot to decide on the data; Pilot availability data only; Only if forced by regulation; Data update management; Ethical data management; Respecting human rights; Data misuse; Work–life separation; Focus on effectiveness; Not an aviation safety matter; Data should be anonymous; No other collection of data than it is the case today; No tracking assurance.

Human impact n = 89	Personal invasion	19	21 %
	No personal data shared with the employer	13	15 %
	Professional discrimination	13	15 %
	Mistrust of AI usage	11	12 %
total against the category:			63 %

Examples for *Human impact* of case 05

Personal invasion; No personal data shared with the employer; Professional discrimination; Mistrust of AI usage; Need for explainability and availability of data to the employee; Professional pressure; No personal data shared with AI; Managing competence training; Human intervention if needed; Negotiation with employees needed; Managing accountability; Lack of accountability; Ensuring flexibility; Unfair bias; Reduced data; Personal information is not relevant for work; Only subject to contractual agreements; Voluntary action; Trade unions needed; Instrument for employees only; Ensuring human rights; Balance between personal rights and organisational needs; Just culture implementation; Need for a borderline between work and private life.

AI-based systems n = 81	Ensuring human oversight	22	27 %
	Ensuring system transparency	15	19 %
	Ensuring operational mitigations	10	12 %
	Compensating for mistrust of AI technology	10	12 %
total against the category:			70 %

Examples for *AI-based systems* of case 05

Ensuring human oversight; Ensuring system transparency; Ensuring operational mitigations; Compensating for mistrust of AI technology; Ensuring system performance; Ensuring continuous safety monitoring; Tailoring system to end-user profiles; Ensuring system security; Ensuring proper operational domain definition; Managing data privacy; Managing ethics in organisations; Managing accountability; Gaining experience.

7. Annex: The results of the eight cases

Fairness n = 45	Definition of fair criteria/controls	10	22 %
	Ensuring fair decisions	10	22 %
total against the category:			44 %

Examples for *Fairness* of case 05

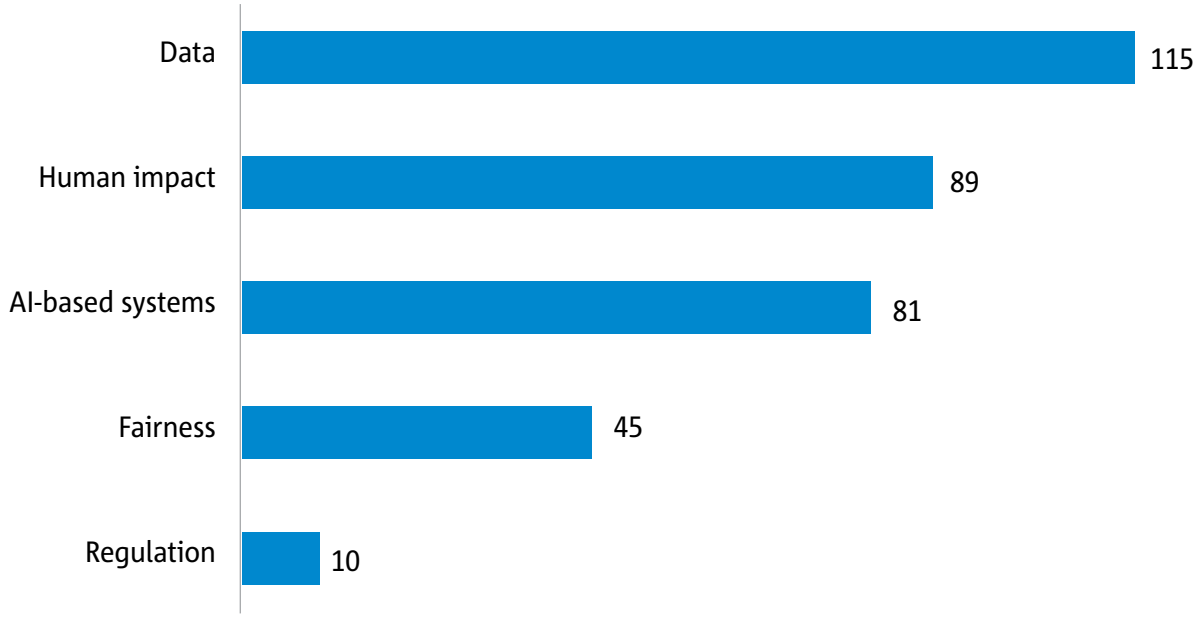
Definition of fair criteria/controls; Ensuring fair decisions; Risk of discrimination; Ethical assessment needed; Risk of giving advantage to some; Definition of workload criteria; Unfair bias; Human intervention in case of unfair bias; Need for transparency; Information sharing imposition; Possibility of refusal; Immune to manipulation.

Remaining 3 % left explained by:

Contents on heavy regulation and oversight needed.

The number of content items per category level 01 is as follows:

Figure 37: Case 05 — Number of contents per category



7.5.6 Summary of non-acceptance feedback for AI airline crew member attribution to flights

The main reasons pointed out for the case of *AI airline crew member attribution to flights* are linked to personal data, respondents' mistrust of the way the data will be used, the issue of lack of privacy and that they have doubts about how data protection would be managed. These main reasons are clearly connected to the secondary reasons where aviation professionals mention personal invasion, that their personal data should not be shared with their employer, the risk of professional discrimination and mistrust of AI usage of their data. Further reasons for non-acceptance are directly linked to the AI-based systems themselves: aviation professionals stated that human oversight of the system should be ensured, the systems should be transparent, and operational mitigations should be put in place. Work to be done also in order to have measures in place to mitigate the mistrust felt towards AI technologies was also mentioned. Also, it was stated that both the system and the process should rely on the definition and application of fair criteria and fair controls in order to ensure final fair decisions regarding the attribution of airline crew members to flights. In addition, aviation professionals mentioned also the need for this activity to be regulated.

7. Annex: The results of the eight cases

The following are examples shared by the aviation professionals concerning the case of *AI airline crew member attribution to flights* that demonstrate their non-acceptance:

> *'I will never allow AI obviously if I know to check on my life or that of my family.'*
>
> *'Family status, constraints due to medical appointments, care times, family times, and personal interests are totally private topics which should never be used by any company under any circumstance.'*
>
> *'None. Private lives should be Private. No Employer should be able to analyze their employees lives to facilitate rostering efficiencies.'*
>
> *'The idea of having an AI system recording personal data is against human rights.'*
>
> *'Giving too much information to an AI may be really dangerous. The employers shouldn't have access to too many details about our private life. It's two different worlds.'*
>
> *'It is good to have someone on the other side that you can talk to when needed.'*
>
> *'Gathering data to 'punish' workers that aren't 'efficient' enough by not agreeing to have their life 100 % subject to the whims of the algorithm.'*
>
> *'Is it really necessary to explained why it is ethically problematic that a company holds sensitively behavioral data on its employees?'*

7.5.7 Need for regulation for AI airline crew member attribution to flights

Question:

Do you think that ethical matters concerning personal preferences gathered and processed by an AI-based system should be regulated?

It was easy to verify that almost **83 %** of the respondents have the opinion that personal preferences gathered and processed by an AI-based system should be regulated.

Figure 38: Case 05 — NEED FOR REGULATION

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	No	40	17,3	**17,3**	17,3
	Yes	191	82,7	**82,7**	100,0
	Total	231	100,0	**100,0**	

7.5.8 Oversight authority for AI airline crew member attribution to flights

Question:

In case of yes, which authority should exercise oversight?

Approximately **half of the responses show agreement that EASA should be the oversight authority**. However, **31,4 % of the responses propose other competent authorities for oversight**. Only 16,8 % is related to NAAs.

Figure 39: Case 05 — OVERSIGHT AUTHORITY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	EASA	99	42,9	**51,8**	51,8
	NAAs	32	13,9	**16,8**	68,6
	Others	60	26,0	**31,4**	100,0
	Total	191	82,7	**100,0**	
Missing		40	17,3		
Total		231	100,0		

7.5.9 Other oversight authorities for AI airline crew member attribution to flights

When asking about what other types of authorities other than EASA or whether NAAs would be, in the respondents' opinion, the authorities best suited to exercise oversight for case 05, **59 responses** indicated that the oversight of AI-based systems attributing airline crew members to flights **should be exercised by national bodies like local ministries concerning labour**. The second option would be a **joint effort between EASA and a national/ European organisation not directly related to aviation**, and a third option is that it **should be exercised by a data protection organisation/agency**.

7.6 AI and speech recognition in voice communications

Case 06 was about the introduction of an AI-based system interacting with an ATCO for the identification of misunderstandings or misinterpretation in voice communications. Aviation professionals were asked to imagine the following situation and rate it on a *type* Likert scale of 7 points, where 1 was the minimum and 7 the maximum:

CASE 06

You are an air traffic control officer (ATCO) with quite some years of experience. Voice communication is still a safety-relevant element in providing instructions and clearances to air traffic. Recent research has enabled systems to assess and interpret verbal communication between pilots and ATCOs.

A new function has been introduced that monitors the voice communication and identifies misunderstanding or misinterpretation in communication. The function is automatically analysing the audio channel by means of AI. In case such a misunderstanding is identified by the AI system, an intervention is initiated which requires the ATCO and pilot to confirm the appropriate understanding of the command.

Although the AI system has been trained on a representative set of real voice communication samples, some specific voice patterns are misinterpreted by the AI system more often than others. Different frequency patterns due to the individual physiognomy of the person or the specific pronunciation of non-native English-speaking persons may serve as an example.

As a result, specific individuals (pilots or ATCOs) may be affected more by intervention than others. It may happen that an ATCO colleague experiences no intervention over weeks, while you are regularly subject of this event.

7.6.1 Level of *comfort* for AI and speech recognition in voice communications

Question:

Your level of comfort of having an autonomous AI-based system listening to your communication and analysing it?

The **201** valid responses represented **87 %** of all the respondents. **62,2 %** of the responses are on the positive part of the scale from 'a bit comfortable' to 'totally comfortable', and **21 %** on the negative part of the scale from 'not at all comfortable' to 'a bit uncomfortable'. These results show that the **respondents have a clear tendency for *comfort*** in having an autonomous AI-based system listening to and analysing voice communications. The mean of all responses is **4,89** on a seven-point Likert scale, reinforcing this clear tendency for *comfort* (median 5,00).

Figure 40: Case 06 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	13	5,6	6,5	6,5
	Mostly not comfortable with the situation	10	4,3	5,0	11,4
	A bit uncomfortable with the situation	19	8,2	9,5	20,9
	Not comfortable nor uncomfortable with the situation	34	14,7	16,9	37,8
	A bit comfortable with the situation	42	18,2	20,9	58,7
	Mostly comfortable with the situation	35	15,2	17,4	76,1
	Totally comfortable with the situation	48	20,8	23,9	100,0
	Total	201	87,0	**100,0**	
Missing		30	13,0		
Total		231	100,0		

7.6.2 Level of *trust* for AI and speech recognition in voice communications

Question:

Your level of trust that data derived from your performance is kept private and confidential and not misused?

A total of **199** valid responses, representing **86,1 %** of the respondents, were provided to this question. **44,8 %** of the responses were on the positive part of the scale from 'feeling a bit of trust' to 'feeling total trust', and **35,7 %** on the negative part of the scale from 'not feeling any trust' to 'a bit not feeling trust'. The results show that the **respondents have a slight tendency to trust that their data will be kept private and confidential and not misused**. Also, the mean for the *trust* question was **4,11**, below the values for *comfort* (median 4,00).

Figure 41: Case 06 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	28	12,1	**14,1**	14,1
	Mostly not feeling trust	16	6,9	**8,0**	22,1
	A bit not feeling trust	27	11,7	**13,6**	35,7
	Not feeling trust nor untrust	39	16,9	**19,6**	55,3
	Feeling a bit of trust	36	15,6	**18,1**	73,4
	Feeling monstly trust	31	13,4	**15,6**	88,9
	Feeling total trust	22	9,5	**11,1**	100,0
	Total	199	86,1	**100,0**	
Missing		32	13,9		
Total		231	100,0		

7.6.3 Level of *acceptance* for AI and speech recognition in voice communications

Question:

Your level of acceptance using an AI system which performs differently depending on individual characteristics (gender, dialect, voice frequency, and voice tone)?

The **192** valid responses represented **83,1 %** of the respondents. **45,3 %** of the responses were on the positive part of the scale from 'will tend to accept this situation' to 'will accept this situation', whilst **28,7 %** was on the negative part of the scale from 'will not accept this situation' to 'will tend to not accept this situation'. A relatively high percentage (**26 %** of the respondents) replied that they 'do not have an opinion about this situation'. The average of the question concerning the level of acceptance of using an AI system which performs differently depending on individual characteristics (gender, dialect, voice frequency and voice tone) was **4,30** on a seven-point scale (median 4,00).

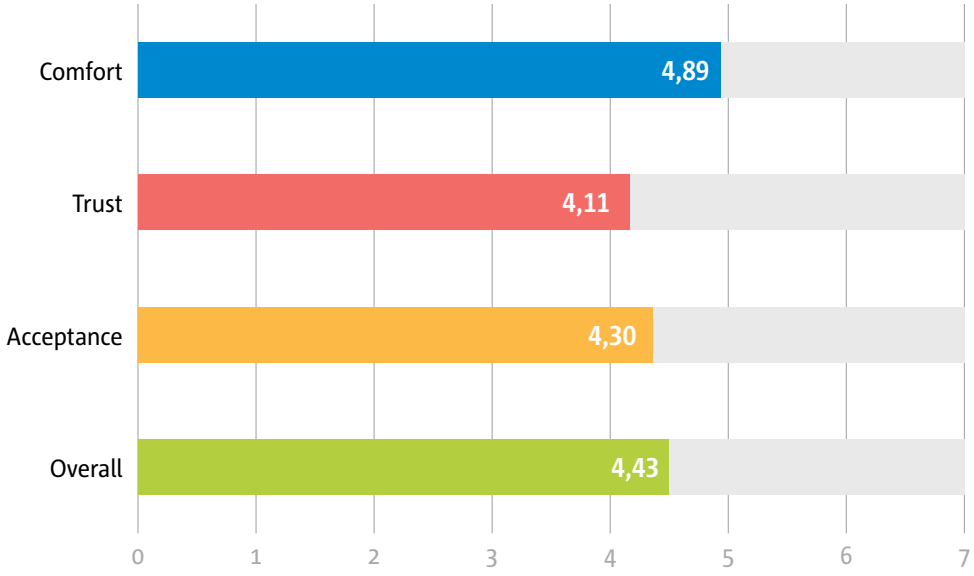
Figure 42: Case 06 — ACCEPTANCE

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	18	7,8	**9,4**	9,4
	Will mostly not accept this situation	10	4,3	**5,2**	14,6
	Will tend to not accept this situation	27	11,7	**14,1**	28,6
	No opinion about this situation	50	21,6	**26,0**	54,7
	Will tend to accept this situation	39	16,9	**20,3**	75,0
	Will mostly accept this situation	24	10,4	**12,5**	87,5
	Will accept this situation	24	10,4	**12,5**	100,0
	Total	192	83,1	**100,0**	
Missing		39	16,9		
Total		231	100,0		

7.6.4 Summary of the ethics-based assessment for AI and speech recognition in voice communications

The first conclusion is that the level of ethics-based assessment for the case concerning *AI and speech recognition in voice communications* stands at **4,43** in a maximum of 7 points. Considering that the midpoint of the scale is 3,5, **aviation professionals tend to have a positive ethical assessment of this case but not strongly stated**. Regarding the three dimensions, *trust* is the lowest (4,11), followed by *acceptance* (4,30). *Comfort* is the highest with 4,89.

Figure 43: Case 06 — Overall evaluation



7.6.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering AI and physiological data monitoring?

The aviation professionals that placed their opinion on the negative part of the scale from 1 to 3, meaning from 'will not accept this situation' to 'will tend not to accept this situation', were asked the following two questions:

1) What would be necessary for you to change your position to acceptable?

2) Do you see any other ethical concerns? If yes, please shortly explain.

These were open-ended questions and the responses were analysed qualitatively.

The two questions were treated together as one and are presented here with the criteria of explaining at least 10 % of the category to which the content belongs and representing at least 10 frequencies.

Case 06 resulted in a **29 % non-acceptance** (45 % acceptance and 26 % no opinion). This 29 % represented a sum of **223** content items. Case 06 related to only 9 % of the overall 2 395 content items of the study.

7. Annex: The results of the eight cases

From the most frequent to the least frequent motives, the results for the non-acceptance of using an *AI system which performs differently depending on individual characteristics (gender, dialect, voice frequency, and voice tone* are as follows:

Figure 44: Case 06 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
AI-based systems n = 93	Ensuring proper operational domain definition	23	25 %
	Ensuring system performance	21	23 %
	Ensuring human oversight	11	12 %
	Ensuring continuous safety monitoring	10	11 %
total against the category:			71 %

Examples for *AI-based systems* of case 06

Ensuring proper operational domain definition; Ensuring system performance; Ensuring human oversight; Ensuring continuous safety monitoring; Gaining experience; Ensuring system transparency; Ensuring operational mitigations; Tailoring system to end-user profiles; Compensating for mistrust of AI technology; Data sets diverse and unbiased; Avoiding AI personification; Ensuring system security.

Human impact n = 88	Fairness assurance	18	20 %
	Discrimination	16	18 %
	Professional impacts	10	11 %
	Unfair bias	10	11 %
total against the category:			60 %

Examples for *Human impact* of case 06

Fairness assurance; Discrimination; Professional impacts; Unfair bias; Psychological impact; Workload increase for certain people; Blaming issues; Personal invasion; Correction of false cases; Ensuring just culture; Focus on efficiency; Possibility of training and developing; Individual rights protection; Assessment between efficiency and workload; Transparency; AI rejection; Managing accountability; Human oversight needed; Non-safety based on discrimination; Privacy; AI should serve people; Applied to pilots too; Accountability issues in case of incident; Punishment in case of misuse.

Data n = 25	Risk of data misuse	10	40 %
total against the category:			40 %

Examples for *Data* of case 06

Risk of data misuse; Data not to be shared; Data protection assurance; Need for transparency and explainability; Ensure data privacy; Secure storage environment; Ensuring data confidentiality; Need for oversight; Need for regulation; Data usage to a good intent; Risk in data collection; Risk of cybersecurity hacks; Data deletion after usage.

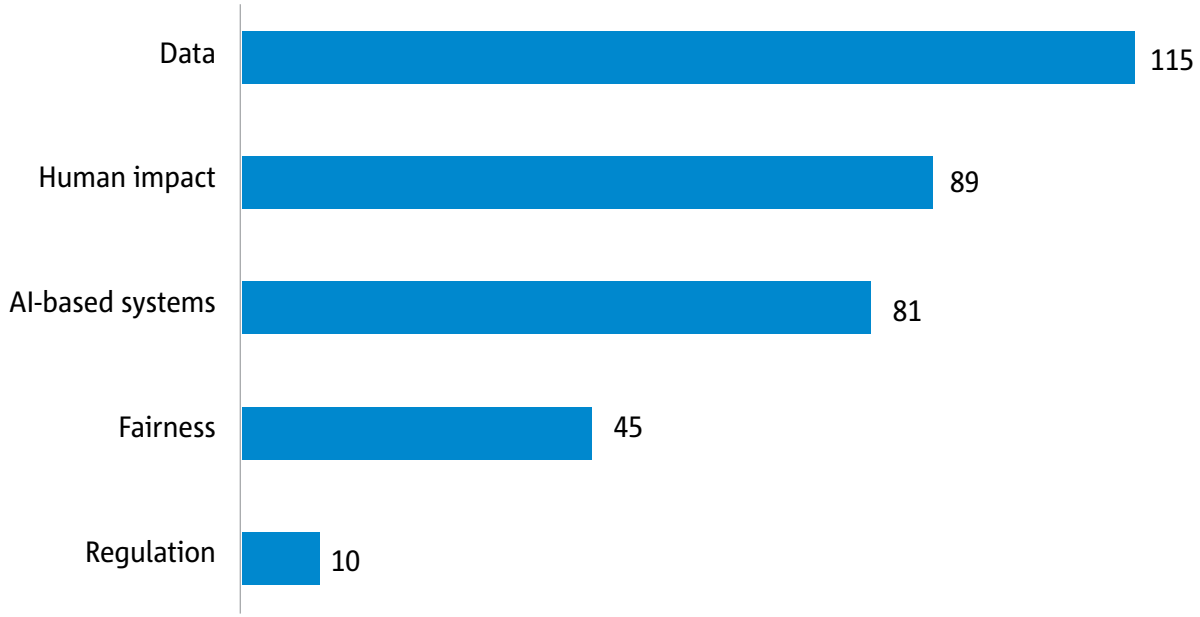
Remaining 8 % left explained by:

Contents on safety linked to the need of regulation and rejection of AI.

7. Annex: The results of the eight cases

The number of content items per category level 01 is as follows:

Figure 45: Case 06 — Number of content items per category



7.6.6 Summary of non-acceptance for AI and speech recognition in voice communications

The main reasons pointed out by the aviation professionals, considering their low level of acceptance of using an AI system which performs differently depending on individual characteristics (like gender, dialect, voice frequency and voice tone) are primary linked to the AI-based system itself. Aviation professionals stated that the proper definition of the operational domain should be ensured, together with proper system performance, proper human oversight and proper continuous safety monitoring of the activity of the system.

Further main reasons for their non-acceptance are related to consequent negative impacts on humans like unfairness, risk of discrimination, risk of professional impacts and possible unfair bias. Reasons concerning the risk of data misuse were also mentioned together with safety concerns and the resulting need for regulation. Finally, reasons concerning non-acceptance related to the rejection of AI-based systems in these situations.

The following are some examples shared by the aviation professionals concerning their non-acceptance of the scenario *AI and speech recognition in voice communications*:

'Such system could lead to pressure all non-native, non-standard individuals (as analyzed by the AI) and make them feel less worthy of their job through constant negative feedback.'

'Ethical concerns arise in the potential bias of the AI system, impacting certain individuals more than others. Issues include privacy infringement, unequal treatment based on voice patterns, and the need for transparent protocols to address unintended consequences and protect individuals' rights.'

'Transparency, Robustness, Moral agency'

'There should be a 'just-culture' for introducing AI.'

'Demotivation of individuals being corrected, sometime solely based on their pronunciation of the English language'

'What to change? Make it illegal to use such thing!'

'Safety should be more important than fairness and equity; however, if a new system makes my job harder, or causes me to be unsuccessful in my career because it does not tolerate characteristics of my ethnicity or gender, then the AI has been inadequately trained.'

'If the training data have a bias to have a good performance only with individuals with specific characteristics, so we have a big issue. The IA System will create unsafe situations based on social and racial prejudice.'

7.6.7 Need for regulation for AI and speech recognition in voice communications

Question:

Do you think that ethical matters concerning non-discrimination and fairness due to the usage of an AI-based system should be regulated?

Most of the aviation professionals (203 of 231, representing **87,9 %**) see the **need for regulation of the topics related to ethical matters concerning non-discrimination and fairness** due to the usage of an AI-based system.

Figure 46: Case 06 — NEED FOR REGULATION

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	No	28	12,1	**12,1**	12,1
	Yes	203	87,9	**87,9**	100,0
	Total	231	100,0	**100,0**	

7.6.8 Oversight authority for AI and speech recognition in voice communications

Question:

In case of yes, which authority should exercise the consequent oversight?

More than half of the responses (**58,8 %**) pointed to **EASA** as the competent authority to exercise oversight for *AI and speech recognition in voice communications*, while 17,6 % refers to NAAs and 23,6 % indicates other types of organisations.

Figure 47: Case 06 — OVERSIGHT AUTHORITY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	EASA	117	50,6	**58,8**	58,8
	NAAs	35	15,2	**17,6**	76,4
	Others	47	20,3	**23,6**	100,0
	Total	199	86,1	**100,0**	
Missing		32	13,9		
Total		231	100,0		

7.6.9 Other oversight authorities

When asking about what other types of authorities other than EASA or whether NAAs should exercise oversight for case 05, **22 responses** were received. The respondents named **national governments** and **organisations related to AI or ethics directly**.

7.7 AI and the risk of deskilling

The seventh scenario concerns an AI-based system that detects conflicts and determines conflict resolution in a fully automated way, the system suffers a cyberattack and the human ATCO must act. Aviation professionals were asked to imagine the following situation and rate it on a *type* Likert scale of 7 points, where 1 was the minimum and 7 the maximum.

CASE 07

In 2035 you are an ATCO that controls part of the air traffic over several European countries. A core function of an air traffic control centre is to ensure safe separation between aircraft. This function is provided by an AI-based system which can detect conflicts and determine conflict resolutions in a fully automated way and communicate with the cockpit via speech synthesis and speech recognition.

The AI-based system is supervised by an ATCO who is recurrently trained (every 3 months in a simulator) to intervene in case of safety related events, switching the task of maintaining separation from the AI-based system to the humans themselves. The system has been in place for a long time and generally does not require human intervention to manage and control air traffic.

Human intervention occurs with very low frequency, approximately once a year and only for non-significant events. Recently, the AI system suffered a severe cybersecurity attack resulting in a major system failure. The attack happened during daytime with high traffic load in the air.

As consequence, ATCOs have the need to take over responsibility of the airspace. You are one of the ATCOs, not working with the live system for a long period of time and now in need to act to restore airspace safety.

7.7.1 Level of *comfort* for AI and the risk of deskilling

Question:

Your level of comfort with your current skills to deal manually with this situation?

The **204** valid responses represented **88,3 %** of all the respondents. **31,9 %** of the responses is positive, from 'a bit comfortable' to 'totally comfortable', and **52,9 %** is negative from 'not at all comfortable' to 'a bit uncomfortable'. The results show that the **respondents have a tendency for discomfort** with their current skills to deal manually in the presented situation. The mean of all responses is **3,52** on a seven-point Likert scale, which is low considering the other cases of the survey (median is 3,00).

Figure 48: Case 07 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	36	15,6	**17,6**	17,6
	Mostly not comfortable with the situation	32	13,9	**15,7**	33,3
	A bit uncomfortable with the situation	40	17,3	**19,6**	52,9
	Not comfortable nor uncomfortable with the situation	31	13,4	**15,2**	68,1
	A bit comfortable with the situation	31	13,4	**15,2**	83,3
	Mostly comfortable with the situation	19	8,2	**9,3**	92,6
	Totally comfortable with the situation	15	6,5	**7,4**	100,0
	Total	204	88,3	**100,0**	
Missing		27	11,7		
Total		231	100,0		

7.7.2 Level of *trust* for AI and the risk of deskilling

Question:

Your level of trust in your skills without the support of the AI-based system?

A total of **205** responses, representing **88,7 %** of the respondents, were provided to this question. **37,1 %** of the responses was positive from 'feeling a bit of trust' to 'feeling total trust', and **48,7 %** negative from 'not feeling any trust' to 'a bit not feeling trust'. The results show that the **respondents tend to not trust their own skills without the support of the AI-based system**. Also, the mean for the *trust* question is **3,69**, close to the middle of the scale (median 4,00).

Figure 49: Case 07 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	29	12,6	**14,1**	14,1
	Mostly not feeling trust	31	13,4	**15,1**	29,3
	A bit not feeling trust	40	17,3	**19,5**	48,8
	Not feeling trust nor untrust	29	12,6	**14,1**	62,9
	Feeling a bit of trust	43	18,6	**21,0**	83,9
	Feeling monstly trust	17	7,4	**8,3**	92,2
	Feeling total trust	16	6,9	**7,8**	100,0
	Total	205	88,7	**100,0**	
Missing		26	11,3		
Total		231	100,0		

7.7.3 Level of *acceptance* for AI and the risk of deskilling

Question:

Your level of acceptance that you are ready to perform without the AI-based system support?

The **206** valid responses represented **89,2 %** of the respondents. **Aviation professionals tend not to accept performing alone without the AI-based system due to the risk of deskilling. 33,1 %** of the respondents stated a positive opinion from 'will tend to accept this situation' to 'will accept this situation', whilst **48,9 %** stated a negative opinion from 'will not accept this situation' to 'will tend to not accept this situation'. The average of the question concerning the **level of acceptance that the professional is ready to perform without the support of the AI-based system** is **3,65** on a seven-point scale (median 4,00).

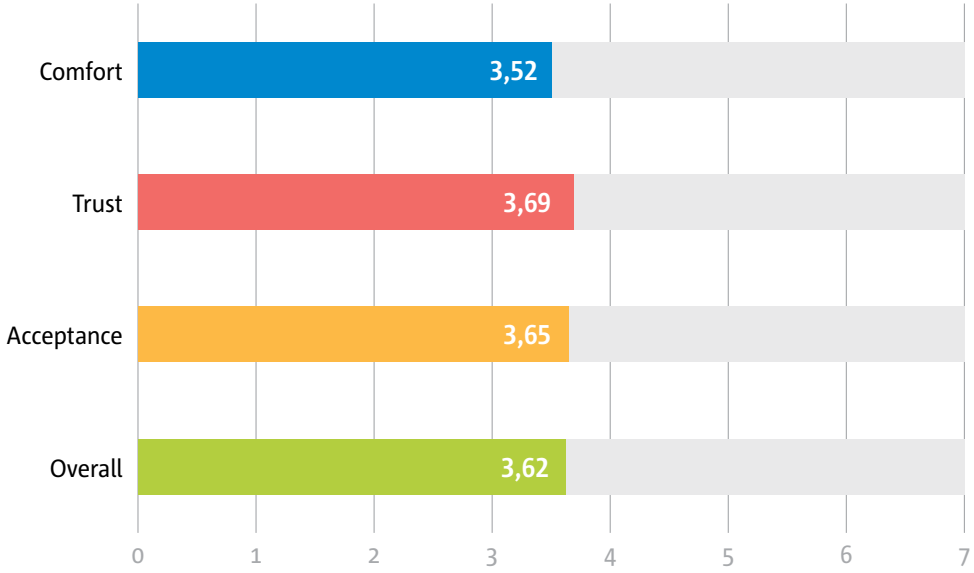
Figure 50: Case 07 — ACCEPTANCE

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	31	13,4	**15,0**	15,0
	Will mostly not accept this situation	32	13,9	**15,5**	30,6
	Will tend to not accept this situation	38	16,5	**18,4**	49,0
	No opinion about this situation	37	16,0	**18,0**	67,0
	Will tend to accept this situation	30	13,0	**14,6**	81,6
	Will mostly accept this situation	21	9,1	**10,2**	91,7
	Will accept this situation	17	7,4	**8,3**	100,0
	Total	206	89,2	**100,0**	
Missing		25	10,8		
Total		231	100,0		

7.7.4 Summary of the ethics-based assessment for AI and the risk of deskilling

The first conclusion is that the level of ethics-based assessment for the case concerning *AI and the risk of deskilling* is clearly the lowest compared to all eight cases of the study. The ethics-based assessment for case 07 remains at **3,62**, basically in the middle of the scale of 7 points. The three dimensions converge to the following tendency: *comfort* has a score of 3,52 (the lowest value), followed by *acceptance* with 3,65 and finally *trust* with 3,69. Clearly, aviation professionals have ethical concerns when introducing AI-based systems that impact on the possibility of de-skilling their ability to work successfully.

Figure 51: Case 07 — Overall evaluation



7.7.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering AI and the risk of deskilling?

These were open-ended questions and the responses were analysed qualitatively. The two questions were treated together as one and are presented with the criteria of 1) explaining at least 10 % of the category to which the content belongs, and 2) representing at least 10 frequencies.

Case 07 resulted in a **49 % non-acceptance** (33 % acceptance and 18 % no opinion). Almost half of the responses show non-acceptance, and 49 % represented a sum of 272 contents.

From the most frequent to the least frequent motives, the results for the non-acceptance of the *risk of deskilling of an ATCO after having an AI-based system performing the job without human intervention* are as follows:

Figure 52: Case 07 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
Competence impact n = 103	Ensure regular manual practice	30	29 %
	Attention to deskilling	14	14 %
	Managing competence training	10	10 %
	Skills to be kept at a level of comfortable performance	10	10 %
total against the category:			63 %

Examples for *Competence impact* of case 07

Ensure regular manual practice; Attention to deskilling; Managing competence training; Skills to be kept at a level of comfortable performance; No possibility of human successful performance; Human in the loop throughout the process; Training will not be enough; Applied only to low traffic cases; New competencies on AI interruptions; Experience should be maintained at a certain level; Weekly practice mandatory; Backup automation system; Human not supervising but doing the task; Ensuring competence proficiency; Performance depending on professional skills; Half of the time on manual performance; Loosing human soft skills when performing their job; AI supporting human performance and not replacing it; Humans should have no doubts about their skills; Practice at least twice a year; Risk of AI dependence; Skills to be kept at a level of normal effort; Contingency procedures in place; Moral agency; Competence development; Distribution of the task between humans and AI.

Training n = 60	Recurrent training	20	33 %
	On-the-job training	12	20 %
	Training in critical/failures situations	10	17 %
total against the category:			70 %

Examples for *Training* of case 07

Recurrent training; On-the-job training; Training in critical/failures situations; Ensuring proper quality training; Training proposed is not enough; Continuous training; Managing competence training; Training in line with the ATCO profile; Competence development; Adaptable contents training; Training without any AI support.

AI-based systems n = 53	Ensuring operational mitigations	19	36 %
	Ensuring human oversight	17	32 %
total against the category:			68 %

Examples for *AI-based systems* of case 07

Ensuring operational mitigations; Ensuring human oversight; Ensuring system performance; Ensuring system security; Gaining experience; Ensuring proper operational domain definition; Managing ethics in organisations; Ensuring continuous safety monitoring; Ensuring system transparency; Avoiding AI personification; Compensating for mistrust of AI technology.

7. Annex: The results of the eight cases

Human impact n = 50	Responsibility in case of failure	10	20 %
	Accountability for the failure	10	20 %
total against the category:			40 %

Examples for *Human impact* of case 07

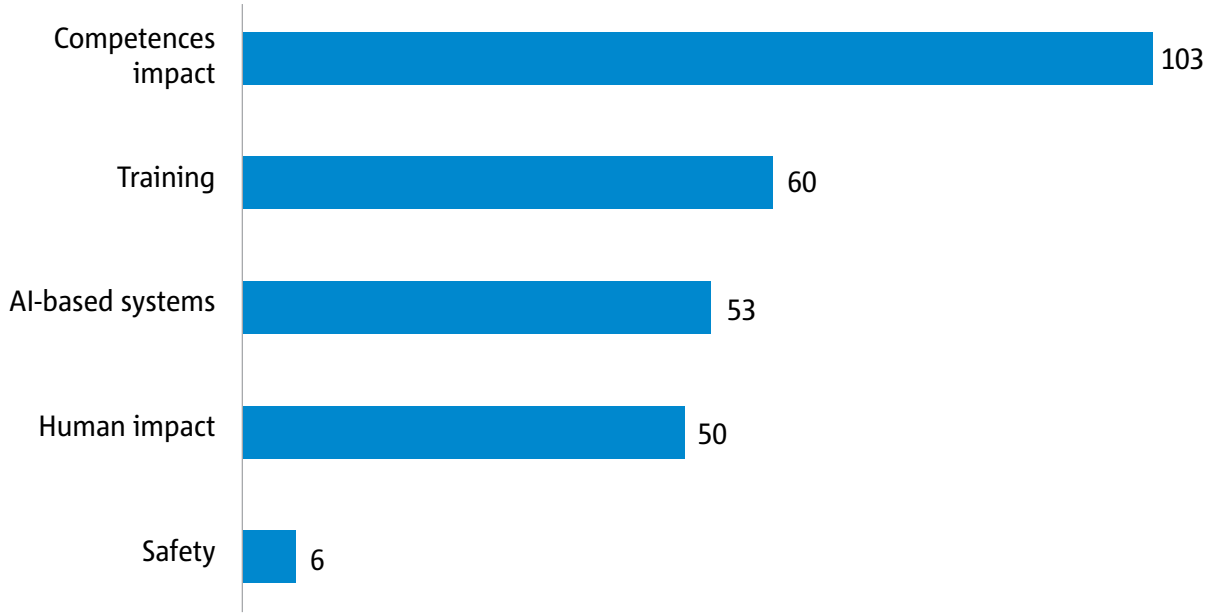
Responsibility in case of failure; Accountability for the failure; Managing accountability; Increasing pressure on professionals; Degradation of the ATCO profession; Mental health issues; Liability of the ATCO in case of failure; Unemployment social issues; Humans will be powerless in this situation; Blaming professionals for poor performance; Boredom; Loss of sense of empathy; Avoiding overreliance; Unacceptable responsibility; Decrease of motivation; Managing competence training; Fairness not warranted; Need to help juniors; Decrease job satisfaction; Level of workload not managed by humans in case of failure; Resilience (soft skills needed); ATCO to be comfortable with their skills; Situation not desirable.

Remaining 2 % left explained by:

Contents on safety and regulation.

The number of content items per category level 01 is as follows:

Figure 53: Case 07— Number of content items per category



7.7.6 Summary of non-acceptance for AI and the risk of deskilling

Aviation professionals expressed serious concerns about the importance of maintaining their work-related competencies in situations where AI-based systems are meant to mainly replace humans in ATC activities. They highlighted the need to continue practising regularly manual work, that attention should be drawn to the risk of deskilling and the need for a competence managing training programme, and they stated that skills and competencies are to be maintained at a comfortable performance level.

Further, reasons related to training are linked to the above: the respondents reinforce the need for recurrent training, on-the-job training and training in critical situations as well as in AI-based systems failure situations. Aviation professionals stated that AI-based systems should ensure operational mitigations and human oversight should be kept in place.

Further reasons for non-acceptance concern the negative impact on humans, namely the responsibility and accountability aspects in case of system failure. Other reasons mentioned were linked to safety and the need for regulation.

The following examples were shared by aviation professionals concerning the case of *AI and the risk of deskilling* demonstrating their non-acceptance:

'Skills should be used regularly in a live environment to keep them current.'

'After a while, people become dependent of automatisation, regardless of the training they receive. Their skill will be decreased no matter what!'

'If AI is designed to make people redundant then, when the AI fails, people will not be able to react.'

'The AI needs to be helpful but not make people redundant, e.g. bike electric assist. If they replace exercise, e.g. biking, then they are bad for the rider. Tech should be enabling not disabling.'

'It is really difficult to feel safe and capable of doing fluently a task that you don´t do regularly. Occasional training can´t replace at all a more regular practice (which think should be required).'

'As soon as people feels good with AI, will forget tasks now has been done with Ai and when needed, will be difficult to stay like first day when AI entered in system. Is a difficult situation.'

'I would assume that motivation levels are sinking and that ATCOs working under these conditions might as a consequence even suffering from mental health problems, e.g. loosing the purpose of their job.'

Once you remove an individual from a certain environment, he/she may not identify with it and the job as much anymore, thus losing the ability to make the right decisions and/or keeping some sense of empathy, which may make the difference of life and death in a distress call.'

7.7.7 Need for regulation of the case AI and the risk of deskilling

Question:

Do you think that ethical matters concerning the risk of deskilling of aviation professionals due to the introduction of highly automated / AI-based systems should be regulated?

Almost **90 %** of the responses were positive, therefore **there is a need for regulation concerning AI and the risk of deskilling**.

Figure 54: Case 07 — NEED FOR REGULATION

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	No	25	10,8	**10,8**	10,8
	Yes	206	89,2	**89,2**	100,0
	Total	231	100,0	**100,0**	

7.7.8 Oversight authority for AI and the risk of deskilling

Question:

In case of yes, which authority should exercise oversight?

EASA was clearly chosen to be the competent authority to exercise oversight concerning *AI and the risk of deskilling*. 76,5 % of the responses supported this option. Approximately 15,7 % of the respondents pointed to NAAs and 7,8 % to other organisations.

Figure 55: Case 07 — OVERSIGHT AUTHORITY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	EASA	156	67,5	**76,5**	76,5
	NAAs	32	13,9	**15,7**	92,2
	Others	16	6,9	**7,8**	100,0
	Total	204	88,3	**100,0**	
Missing		27	11,7		
Total		231	100,0		

7.7.9 Other oversight authorities for AI and the risk of deskilling

When asked about what other types of authorities other than EASA or whether NAAs should exercise oversight for case 07, the respondents referred to **a joint effort between EASA and other organisations**, followed by **national government bodies** and **professional associations**.

7.8 New competencies when teaming with an AI-based system

The last scenario comprised two parts. The first part was about an ATCO having to develop new competencies for teaming up with an AI-based system. Aviation professionals were asked to imagine the following situation and rate it on a *type* Likert scale of 7 points, where 1 was the minimum and 7 the maximum. The second part of the case focused in particular on responsibility and accountability.

CASE 08

In 2035 a control centre is responsible for the safe, orderly and expeditious flow of air traffic over a large part of the upper airspace over Germany. Up to now, a pair of ATCOs were responsible for controlling the air traffic in their sector to ensure that all aircraft fly through the airspace safely separated from each other. You are one of the ATCOs working for the centre for 7 years.

The centre has been developing an AI-based system for future air traffic control. The system is called 'Digital Executive ATCO' and will automatically control air traffic for certain sectors. The Digital Executive ATCO automatically detects conflicts and implements conflict solutions. It communicates with aircraft and other ATCOs via speech synthesis and speech recognition, and system supported messaging.

The second part of the team is the Human Planner ATCO who is responsible for coordinating traffic into and out of the sector. The Digital Executive ATCO is capable of communicating with the Human Planner ATCO, as per current day human team operations.

As the introduction of the system is expected in about 3-5 years, the centre will have to prepare the ATCOs for the new working conditions by means of training and competence development.

7.8.1 Level of *comfort* when teaming with an AI-based system

Question:

Your level of comfort of having a highly automated AI-based system teaming with you?

205 valid responses were provided representing **88,7 %** of all the respondents. **61,4 %** of the responses were positive from 'a bit comfortable' to 'totally comfortable', and **20 %** negative from 'not at all comfortable' to 'a bit uncomfortable'. The results show that the **respondents have a clear tendency for comfort of having a highly automated AI-based system teaming with them**. The mean of all responses is **4,78** on a seven-point Likert scale (median 5,00).

Figure 56: Case 08 — COMFORT

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not at all comfortable with the situation	14	6,1	**6,8**	6,8
	Mostly not comfortable with the situation	12	5,2	**5,9**	12,7
	A bit uncomfortable with the situation	15	6,5	**7,3**	20,0
	Not comfortable nor uncomfortable with the situation	38	16,5	**18,5**	38,5
	A bit comfortable with the situation	50	21,6	**24,4**	62,9
	Mostly comfortable with the situation	37	16,0	**18,0**	81,0
	Totally comfortable with the situation	39	16,9	**19,0**	100,0
	Total	205	88,7	**100,0**	
Missing		26	11,3		
Total		231	100,0		

7.8.2 Level of *trust* when teaming with an AI-based system

Question:

Your level of trust that the AI-based system can ensure safety as much as a human ATCO?

A total of **206** responses, representing **89,2 %** of the respondents, were provided to this question. **56,3 %** was on the positive part from 'feeling a bit of trust' to 'feeling total trust', and **24,3 %** on the negative part from 'not feeling any trust' to 'a bit not feeling trust'. The results show that the **respondents demonstrate a slight tendency for trust that the AI-based system can ensure safety as much as a human ATCO**. Also, the mean for the *trust* question is **4,59**, below the values for *comfort* (median of 5,00).

Figure 57: Case 08 — TRUST

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Not feeling any trust	16	6,9	**7,8**	7,8
	Mostly not feeling trust	11	4,8	**5,3**	13,1
	A bit not feeling trust	23	10,0	**11,2**	24,3
	Not feeling trust nor untrust	40	17,3	**19,4**	43,7
	Feeling a bit of trust	48	20,8	**23,3**	67,0
	Feeling monstly trust	37	16,0	**18,0**	85,0
	Feeling total trust	31	13,4	**15,0**	100,0
	Total	206	89,2	**100,0**	
Missing		25	10,8		
Total		231	100,0		

7.8.3 Level of *acceptance* when teaming with an AI-based system

Question:

Your level of acceptance using an AI-based system teaming with you?

A total of **201** valid responses represented **87 %** of the respondents. The results show **a tendency for *acceptance***. **57,7 %** of the responses were positive from 'will tend to accept this situation' to 'will accept this situation', whilst **20 %** were negative from 'will not accept this situation' to 'will tend to not accept this situation'. The average of the question concerning the level of ***acceptance*** **using an AI-based system teaming with you** is **4,78** on a seven-point scale (median of 5,00).

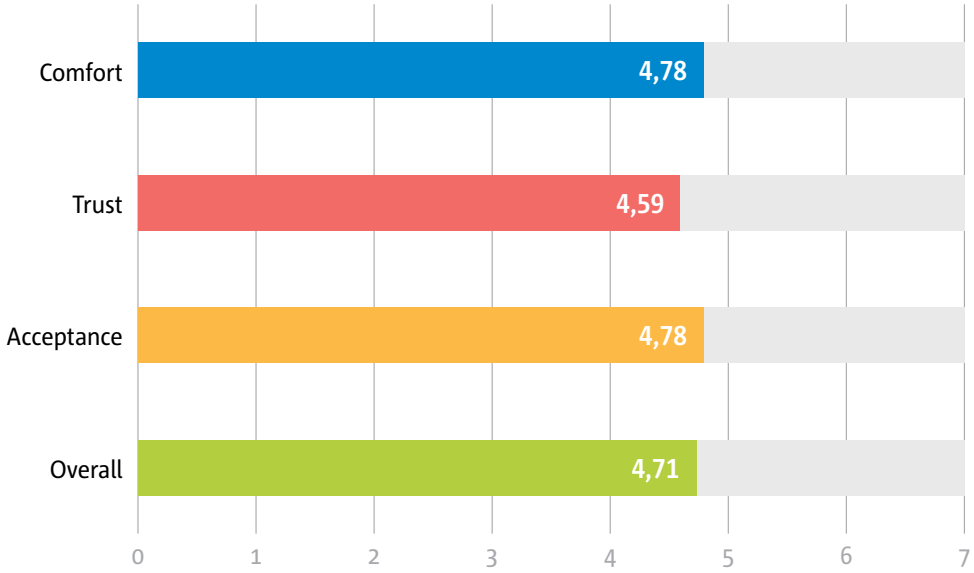
Figure 58: Case 08 — ACCEPTANCE

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Will not accept this situation	12	5,2	**6,0**	6,0
	Will mostly not accept this situation	9	3,9	**4,5**	10,4
	Will tend to not accept this situation	19	8,2	**9,5**	19,9
	No opinion about this situation	45	19,5	**22,4**	42,3
	Will tend to accept this situation	39	16,9	**19,4**	61,7
	Will mostly accept this situation	41	17,7	**20,4**	82,1
	Will accept this situation	36	15,6	**17,9**	100,0
	Total	201	87,0	**100,0**	
Missing		30	13,0		
Total		231	100,0		

7.8.4 Summary of the ethics-based assessment concerning new competencies when teaming with an AI-based system

The first conclusion is that the level of ethics-based assessment for the case concerning *new competencies when teaming with an AI-based system* stands at **4,71** on a seven-point Likert scale. The three dimensions are closely clustered, with *comfort* and *acceptance* both scoring 4,78, and *trust* slightly lower at 4,59. The respondents tend to have a **positive ethics-based assessment for teaming with an AI-based system**.

Figure 59: Case 08 — Overall evaluation



7.8.5 What would be necessary for the professionals to change their position to acceptable? And what other ethical concerns do they want to point out considering using an AI-based system teaming with a human?

The aviation professionals that placed their opinion on the negative part of the scale from 1 to 3, meaning from 'will not accept this situation' to 'will tend not to accept this situation', the following two questions were asked:

1) What would be necessary for you to change your position to acceptable?

2) Do you see any other ethical concerns? If yes, please shortly explain.

These were open-ended questions and the responses were analysed qualitatively. The two questions were treated together as one and are presented here with the criteria of explaining at least 10 % of the category to which the content belongs and representing at least 10 frequencies.

Case 08 resulted in a **20 % non-acceptance** (58 % acceptance and 22 % no opinion); this 20 % represented a sum of **156** content items.

From the most frequent to the least frequent motives, the results for non-acceptance of *using an AI-based system teaming with a human* are as follows:

7. Annex: The results of the eight cases

Figure 60: Case 08 — Non-acceptance reasons

Category level 01	Category level 02	Category level 02 nr of responses	% against category level 01
AI-based system n = 67	Ensuring human oversight	24	36 %
	Gaining experience	12	18 %
	Ensuring system transparency	10	15 %
	Ensuring proper operational domain definition	10	15 %
total against the category:			84 %

Examples for *AI-based system* of case 08

Ensuring human oversight; Gaining experience; Ensuring system transparency; Ensuring proper operational domain definition; Ensuring system performance; Ensuring continuous safety monitoring; Compensating for mistrust of AI technology; Ensuring operational mitigations; Ensuring system security; Avoiding AI personification.

Human impact n = 56	Ensure transparency on the responsibility of the parties	18	32 %
total against the category:			32 %

Examples for *Human impact* of case 08

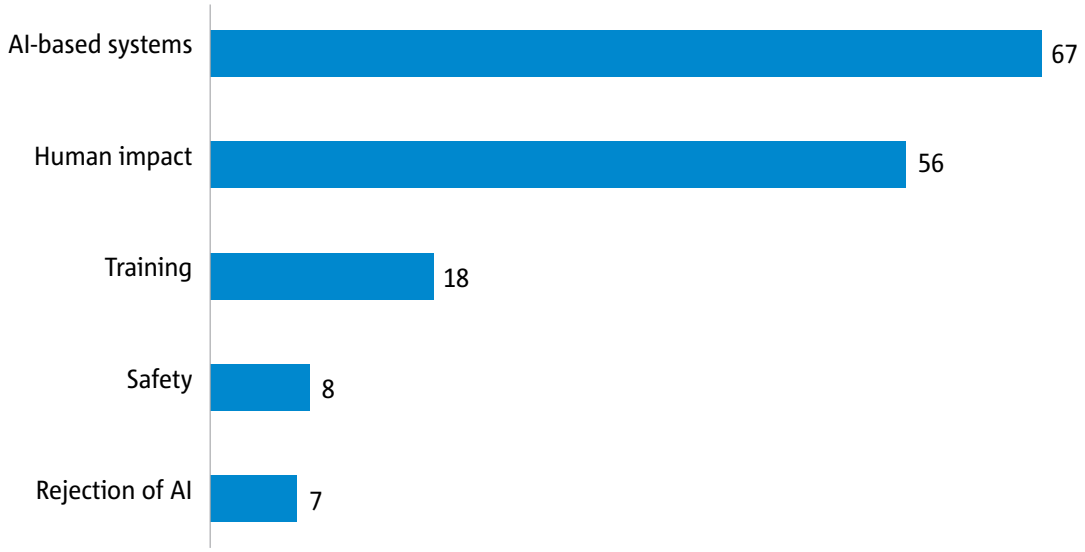
Ensure transparency on the responsibility of the parties; Unemployment social issues; Not attributing human characteristics to AI; Explainability of the AI system; Trust building; Ensure fairness of the decisions; AI can propose but human has to decide; Managing accountability; Explainability on the required competencies; Well-being at risk; Explainability on how to deal with AI errors; Job changes; Benefits in terms of time management; Dehumanisation of the work relationship; Moral agency; Managing competence training; Risk of discrimination; Robustness of AI; AI should not perform ATCO tasks alone; Unethical for pilot to comply with AI; Loss of non-verbal communication; Not a team as both are not doing the same task; Practising more on interaction with AI; Explainability of AI system accuracy; Explainability of AI system development; Human in the loop; How to communicate to the crew.

Remaining 21 % left explained by:

Contents on training, for example on extensive training with the AI-based system, on practising on competence keeping; contents on safety, namely regulation and responsibility and accountability, and contents on rejection of AI for teaming.

The number of content items per category level 01 is as follows:

Figure 61: Case 08 — Number of content items per category



7.8.6 Summary of non-acceptance of using an AI-based system teaming with you

The reasons for the ethical non-acceptance of *using an AI-based system teaming with a human* firstly concern the AI-based system itself, meaning that humans should oversee the system, humans should gain experience in working with the system, the system should be transparent, and there is the need for a clear definition of the operational domain in which the system is expected to work. Further reasons have to do with the impact on humans, in particular the need to ensure transparency on the responsibility of the parties (meaning human versus AI).

Several other types of reasons were also stated, for example: contents on training, on practising on competence keeping; contents on safety where the need for regulation was identified, including reasons concerning accountability and rejection of AI for teaming.

The following are examples shared by the aviation professionals concerning the case of *using an AI-based system teaming with them* demonstrating their non-acceptability:

'I would need a system that keeps me 'in the loop', with possibilities to override automated decisions'

'More experience is needed before introducing any of these tools. A fast introduction will lead to problems and lack of acceptance, if not to more serious issues.'

'Algorithms may not be prepared enough to interpret all factors in situations. Humans are there and can capture issues (e.g. voice inflections, irony on comms...) that may be relevant'

'I would fear that any mistakes made by the automation would be made mine'

'Who is responsible in the event of an accident or an incident: the AI-based system developed, its integrator, the ANSP who provided the training data, the human 'teaming' with the AI, the operational supervisor?'

'In a safety-critical, highly stressful activity the dehumanisation of the operators working relationship will obviously have a severe impact on the human operator well-being and mental-wealth.'

'The AI would look to me as any other tool in this case. Naturally, proper training of how to use ('partner') with that tool is needed.'

'Healthy scepticism of new technology until it has proved itself is not unreasonable.'

7.8.7 Types of new competencies needed when teaming with an AI-based system

Case 08 concerned human–AI teaming and the competencies needed to be acquired by humans to perform efficiently. A list of competencies was put together and the respondents were asked to rate them from 1 (less needed) to 7 (most needed) concerning their relevance and importance.

The competencies listed were the following:

- **cognitive skills** (a person's ability to process thoughts, e.g. attention, memory or reasoning),
- **data literacy** (a person's competence to handle data, e.g. understand or apply data),
- **sensory competencies** (a person's ability to receive stimuli, such as vision, light, heat, sound and touch),
- **physical skills** (a person's capacities related to the body, strength, balance and fine motor skills),
- **communication skills** (a person's competence to communicate by speech, non-verbal and written ways),
- **social skills** (a person's skills to get along with others, e.g. understanding and cooperating),
- **IT competencies** (a person's technical skills, e.g. operating computers and using software tools),
- **general AI knowledge** (a person's knowledge about machine learning and AI-based systems).

Question:

Which type of new competencies you think you will need to team up with an AI-Based system?

The competencies considered to be needed the most are those linked to AI knowledge, data literacy and IT competencies, together with cognitive skills. Competencies linked to communication and sensory aspects followed in the rating. Social competencies and lastly physical skills were considered by the respondents to be less important.

Figure 62: Case 08 — Distribution of new competencies

	General AI knowledge	Data literacy	Cognitive skills	IT competencies	Communication skills	Sensory competencies	Social skills	Physical skills
N	231	231	231	231	231	231	231	231
Mean	**5,53**	**5,52**	**5,47**	**5,34**	**5,09**	**4,84**	**4,10**	**3,43**
Median	6,00	6,00	6,00	6,00	5,00	5,00	4,00	3,00
St dev.	1,686	1,576	1,744	1,754	1,772	1,744	1,981	1,905
Rating place	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**

As the list was limited, aviation professionals were given the opportunity to highlight other competencies that would be important for them to team with AI-based systems in the future. As a result, **24 new competencies** were proposed.

7. Annex: The results of the eight cases

These 24 proposed competencies were placed into **eight new competence groups**. The first group (eight competencies) is concerned with the **technical competencies of an AI-based system**, the second group is related to **emotional intelligence** (six competencies), **just culture** is the third group (three competencies), human autonomy (two competencies), human–machine interaction (two competencies), and finally with one competence each: problem solving, cybersecurity and ethics.

The second group of competencies (six competencies) concerning **emotional intelligence** is noteworthy, where aviation professionals highlighted the need to develop the following competencies: emotion regulation; dealing with boredom; assertiveness; gaining trust in AI; resilience: how to handle AI disruptions; and mental strength to deal with environment/relationship dehumanisation.

List of new competencies proposed by aviation professionals:

Figure 63: Case 08 — List of proposals for new competencies

Competence group	Description
Technical competencies	• Knowledge of the system behaviour/reaction as it differs from a human • Understanding of system design to support failure analysis • A good AI system should require minimal new competencies • Legal aspects: who is responsible for what • Prompt engineering skills • Identify when an AI decision needs checking • Protection skills: identify abnormal situations by detecting bad signs • Automation interface
Emotional intelligence	• Emotion regulation • Dealing with boredom • Assertiveness • Processes to train and gain trust in AI • Resilience: How to handle AI disruptions • Mental strength to deal with environment/relationship dehumanisation.
Just culture	• Person's willingness of full transparency without need of saving face • Knowledge of human performance and its limitations • Understand/react on personal limitation
Human autonomy	• Independence from AI • Command ability
Human–machine interaction	• How to collaborate with AI • Human–machine cooperation
Problem solving	• How to face problems and construct solutions
Cybersecurity	• How to face cybersecurity hacks
Ethics	• Ethics awareness

7.8.8 Responsibility and accountability when teaming with AI-based systems

Whilst the first part of case 08 dealt with the acquisition of new competencies to efficiently team with an AI-based system in the future, the second part of the case dealt with responsibility and accountability. Aviation professionals received further information on case 08 and were asked to indicate who should be held responsible and accountable for the consequences of the following situation:

Considering the case that you were reading before, imagine now the following: In an air traffic centre, each sector has a Digital Executive ATCO and a Human Planner ATCO. Human-AI teaming consists in collaboration towards a common goal of controlling conflict-free trajectories through the sector. As you know, the Digital Executive ATCO detects conflicts and implements conflict solutions automatically. It communicates with aircraft and other ATCOs via speech synthesis and speech recognition, and system supported messaging. The second part of the team is the Human Planner ATCO who is responsible for coordinating traffic into and out of the sector. You are one of the Human Planner ATCOs working for the centre and experienced a loss of separation due to a failure of the Digital Executive ATCO, which had no consequence but needs to be reported and investigated.

7. Annex: The results of the eight cases

Question:

Who in your opinion should be held responsible for the loss of separation caused by a failure of the Digital Executive ATCO?

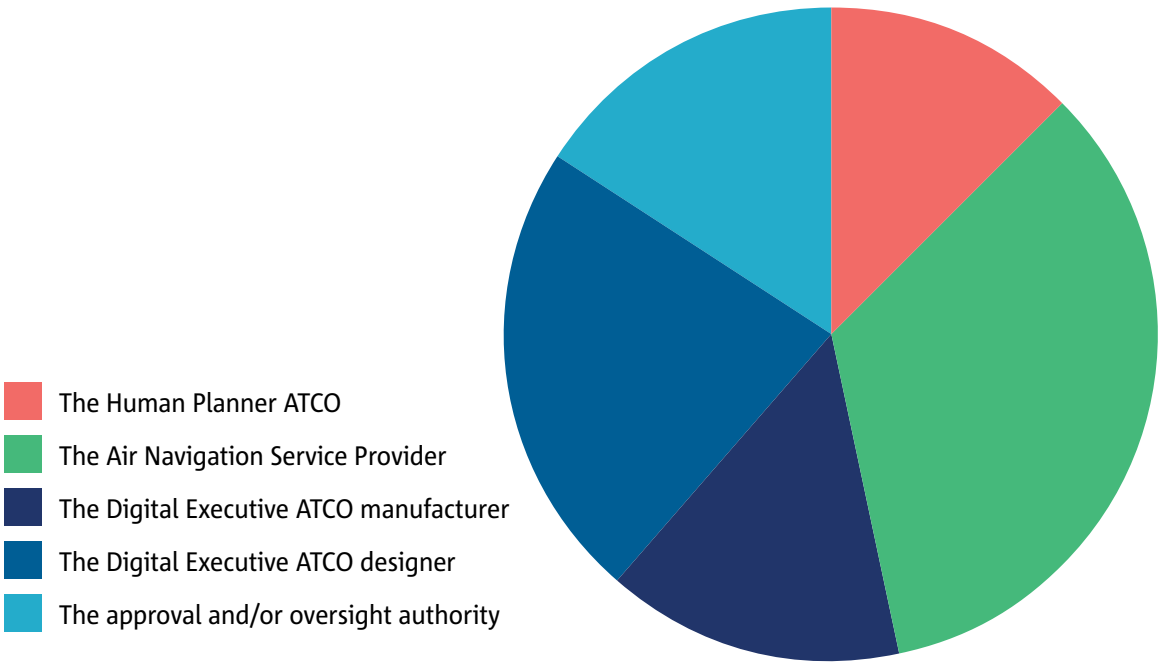
The **entity named first to be held responsible** was the **Air Navigation Service Provider** with **34,2 %**, followed by the **Digital Executive ATCO designer**. The entity considered **to be held less responsible** for the loss of separation caused by a failure of the Digital Executive ATCO was the **Human Planner ATCO** with **12,6 %**.

Figure 64: Case 08 — RESPONSIBILITY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	The Human Planner ATCO	29	12,6	**12,6**	12,6
	The Air Navigation Service Provider	79	34,2	**34,2**	46,8
	The Digital Executive ATCO manufacturer	34	14,7	**14,7**	61,5
	The Digital Executive ATCO designer	53	22,9	**22,9**	84,4
	The approval and/or oversight authority	36	15,6	**15,6**	100,0
	Total	231	100,0	**100,0**	

The chart below illustrates the distribution of the element 'responsibility'.

Figure 65: Case 08 — RESPONSIBILITY representation



7. Annex: The results of the eight cases

Question:

Who in your opinion should be held accountable for the loss of separation caused by a failure of the Digital Executive ATCO?

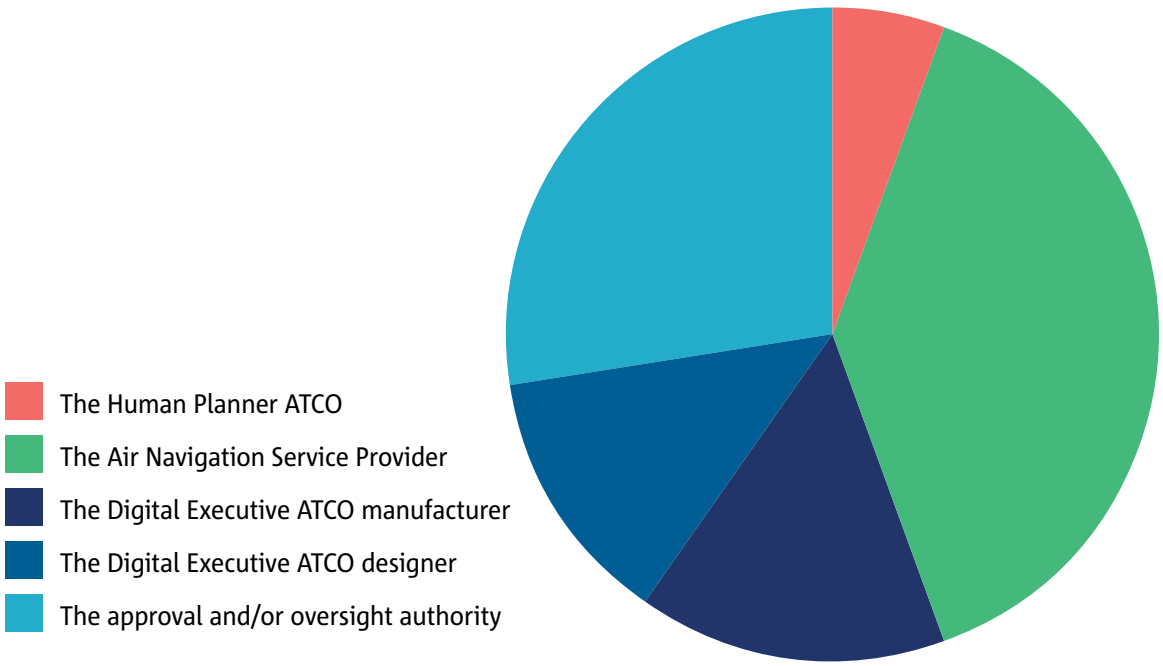
The **entity named first to be held accountable** was the **Air Navigation Service Provider** with **39,0 %**, followed by the **approval and/or oversight authority** with **27,3 %**. The entity considered **to be held less accountable** for the loss of separation caused by a failure of the Digital Executive ATCO was the **Human Planner ATCO** with **5,6 %**.

Figure 66: Case 08 — ACCOUNTABILITTY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	Human Planner ATCO	13	5,6	**5,6**	5,6
	Air Navigation Service Provider	90	39,0	**39,0**	44,6
	The Digital Executive ATCO manufacturer	35	15,2	**15,2**	59,7
	The Digital Executive ATCO designer	30	13,0	**13,0**	72,7
	The approval and/or oversight authority	63	27,3	**27,3**	100,0
	Total	231	100,0	**100,0**	

The chart below illustrates the distribution of the element 'accountability'.

Figure 67: Case 08— ACCOUNTABILITTY representation



Concerning *accountability*, aviation professionals were asked whether there were other entities not listed but could be considered to be accountable. The respondents provided **16 new responses** as per the following table. **Shared accountability of all parties**, with the exception of the Human ATCO, was highlighted and also the **shared accountability of two major roles: the manufacturer and the designer**.

Figure 68: Case 08 — Other ACCOUNTABILITY responsibilities

General shared accountability	Manufacturer and designer	AI and Human (definition of roles)	Regulators and government authorities
All but the Human Planner ATCO	The manufacturer needs to assure safe function and backup at all times	The Human Planner if it is 100 % clear that AI is there as an aid to the Human Planner	EASA
Responsibility/ accountability should be shared by all except the Planner	If the manufacturer and the designer are different, assume implementation requirements	The Digital Executive ATCO	The politicians who thought this was a good idea should be held accountable
I think the designer, the manufacturer and the authority	Whoever makes a profit from selling the DE ATCO?!	Software is a tool that should not be fully autonomous without control	
Responsibility and accountability to be shared among all involved parties	The manufacturer and the ANSP are also accountable		
I don't know, shared responsibility? The real question is 'How?' and 'Why?'	Part of the responsibility should rely upon the system designer negligence		
The ANSP together with manufacturer, the designer and the oversight authority			
n = 6	**n = 5**	**n = 3**	**n = 2**

7.8.9 Need for regulation concerning responsibility and accountability when teaming with an AI-based system

Question:

Do you think that accountability matters concerning the introduction of highly automated / AI-based systems should be regulated?

It is a clear, common opinion from almost all the respondents (227 of 231, representing 98,3 % of all the respondents) that accountability matters concerning the introduction of highly automated / AI-based systems should be regulated.

Figure 69: Case 08 — NEED FOR REGULATION

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	No	4	1,7	**1,7**	1,7
	Yes	227	98,3	**98,3**	100,0
	Total	231	100,0	**100,0**	

7.8.10 Main authority concerning responsibility and accountability when teaming with an AI-based system

Question:

In case of yes, which authority should exercise oversight?

Concerning the authority that would have the responsibility to exercise oversight, **68,0 %** pointed to **EASA** as the **competent authority**. **17,1 %** considered that NAAs should exercise oversight, and the rest of the responses (representing 14,9 %) named other types of organisations.

Figure 70: Case 08 — OVERSIGHT AUTHORITY

		Frequency	Percentage %	Valid percentage %	Cumulative percentage %
Valid	EASA	151	65,4	**68,0**	68,0
	NAAs	38	16,5	**17,1**	85,1
	Others	33	14,3	**14,9**	100,0
	Total	222	96,1	**100,0**	
Missing		9	3,9		
Total		231	100,0		

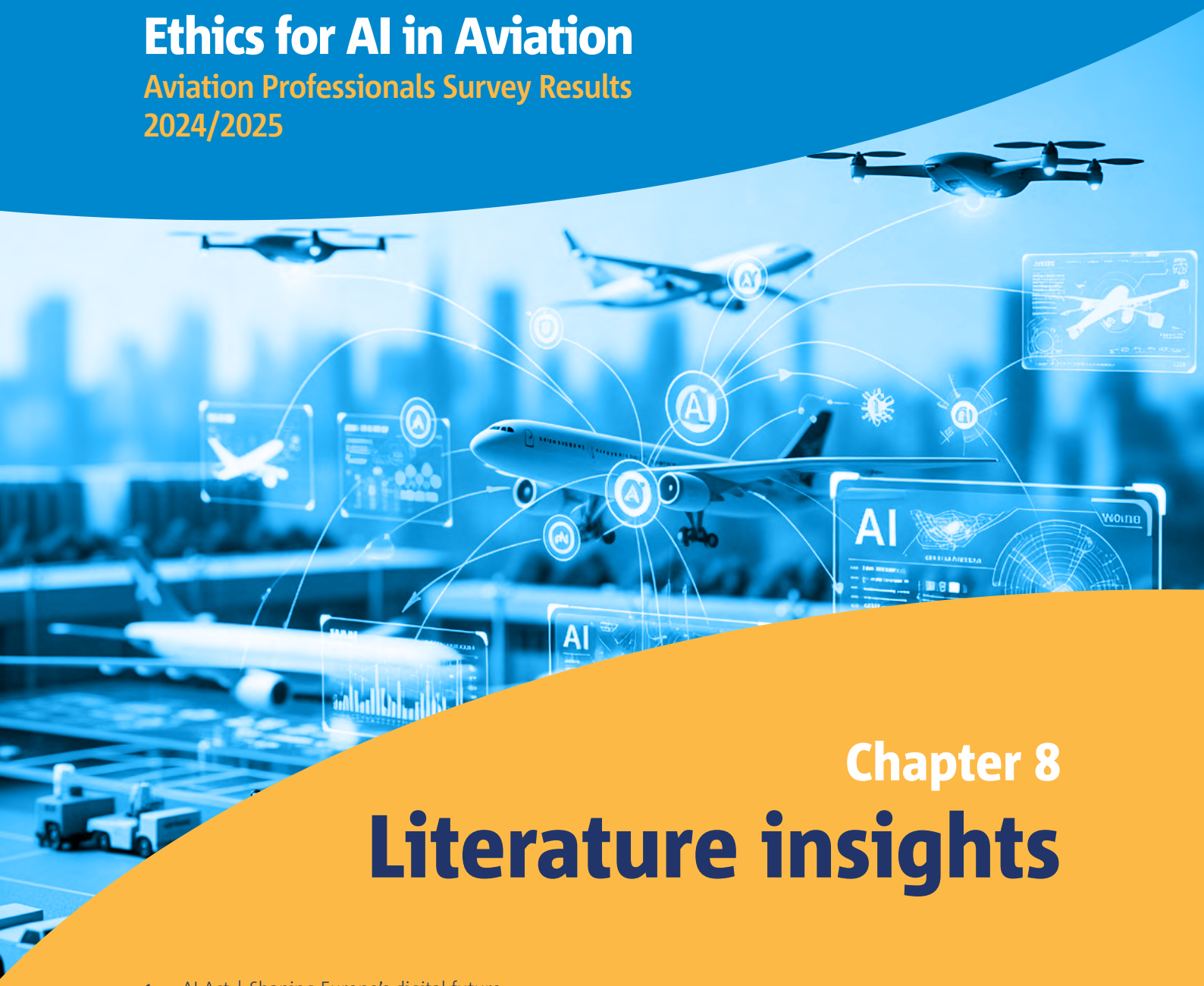
7.8.11 Other oversight authorities for AI as well as responsibility and accountability when teaming with an AI-based system

When asking aviation professionals about what other types of authorities other than EASA or whether NAAs should be responsible for oversight, the **37 responses** provided were distributed in three main groups: the first group comprised **national bodies like governments, ministries of justice and national courts**, the second group comprised an **AI agency responsible for regulating and enforcing the use of AI**, and the third group concerned **oversight to be exercised jointly by different national and European Union authorities/agencies**.

EASA
European Union Aviation Safety Agency

Ethics for AI in Aviation

Aviation Professionals Survey Results 2024/2025



Chapter 8

Literature insights

1. AI Act | Shaping Europe's digital future
2. Assessment List for Trustworthy Artificial Intelligence (ALTAI) for self-assessment | Shaping Europe's digital future
3. EASA Artificial Intelligence Concept Paper Issue 2 - Guidance for Level 1 & 2 machine-learning applications | EASA
4. EASA Artificial Intelligence Roadmap 2.0 - A human-centric approach to AI in aviation | EASA
5. Ethics of Artificial Intelligence and Robotics (Stanford Encyclopedia of Philosophy)
6. Justice and fundamental rights (europa.eu)
7. Phenomenological Approaches to Ethics and Information Technology (Stanford Encyclopedia of Philosophy)
8. Your fundamental rights in the EU - European Commission

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For any questions or comments you wish to make, please use the email address AI@EASA.EUROPA.EU

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