

CONCEPT FOR A FUTURE DIGITAL CO-PILOT FROM A TEAMWORK PERSPECTIVE

Anne Papenfuß*, Carmen Bruder+, Elena Rankova*

German Aerospace Center, * Institut of Flight Guidance, + Institute of Aerospace Medicine



Which role should AI possess in the cockpit? What does it imply for the need for human oversight and required capabilities of the team partners? What is the adequate metaphor to shape expectations? Several requirements need to be considered to enable trustworthy AI by design when defining the role concept.

Trust Concept

Trust is a belief that some other entity works as predicted and will fulfill the claim it makes (e.g. Gambetta and Hamill, 2005). Trust (in automation) is an established human factors concept, identified as relevant for overall system performance more than a decade ago; so it is not unique to AI.

Due to AI methods inherent properties (e.g. rules are self-learned and not designed by humans, statistical behavior) trust is a relevant human factors concept for designing and evaluating AI and system incorporating AI right now.

Trust is a multi-dimensional concept, being dependent on personal attitudes, individual experience, features of the organizational setting and system features. End-users in the aviation domain, making use of technical systems incorporating AI, should develop calibrated trust, especially to mitigate AI inherent risks.

In human-human aviation teams, trust is omnipresent and a pre-requisite for efficient collaboration (Papenfuss and Bruder, 2022). It can replace explanations for decisions of other actors ("They are the experts"). Human operators monitor their human team partners for signs of trustworthiness, e.g. if they sound stressed or show signs of lack in confidence.

Concept for Digital Co-Pilot

Top-down approach - shaping requirements what would make a technical system a team partner in the cockpit:

- Define a role concept
- Shape functionalities and scope of Digital Co-Pilot
- Evaluate process to support human operators in building adequate trust in a Digital Co-Pilot

Literature

Dickinson, T. L., & McIntyre, R. M. (1997). A Conceptual Framework for Teamwork Measurement. In M. T. Brannick, E. Salas, & C. Prince (Eds.), *Team Performance Assessment and Measurement: Theory, Methods, and Application* (pp. 19 - 44). Mahwah, NJ: Lawrence Erlbaum.

EASA (2023). "EASA Concept Paper: First usable guidance for Level 1 & 2 machine learning applications. A deliverable of the EASA AI Roadmap". Retrieved from easa.europa.eu/ai

European Commission (2020) "White Paper on Artificial Intelligence - A European approach to excellence and trust", COM/2020/65 final.

Gambetta, D., Hamill, H. (2005) "How Taxi Drivers Establish Customer's Trustworthiness", Russel Sage Foundation

Papenfuss, A and Bruder, C. (2022) "Leitlinien für Kollaboration in Multi-Team-Systemen der Luftfahrt", DLR, Braunschweig.

National Academies of Sciences, E., & Medicine. (2022). *Human-AI Teaming: State-of-the-Art and Research Needs*. Washington, DC: The National Academies Press.

Shneiderman, B. (2020). Human-Centered Artificial Intelligence: Reliable, Safe & Trustworthy. *International Journal of Human-Computer Interaction*, 36(6), 495 - 504. doi:10.1080/10447318.2020.1741118.

Motivation

Systems incorporating artificial intelligence methods could bridge the gap of rule-based automation and human intelligence by providing **situation-adapted decision support** and **meaningful advise in unforeseen situations**. Furthermore, these systems might be able to adapt to the human, rather having humans adapt to the capabilities of machines.

The „Digital Co-Pilot“ is an umbrella term for these novel systems incorporating AI. They could be an enabler for future operational concepts, like single pilot operations (SPO). There is a need to design the role concepts of these socio-technical systems, consisting of human operators and AI.

Research Fields

Two research fields developed, addressing this need: **Human-AI-Teaming (HAT)** (National Academies of Sciences, Engineering and Medicine, 2022) provides a theoretical frameworks with the goal to enable teamwork processes between human and machine similar to human-human teams, for instance by bi-directional communication and shared situation awareness.

Within the field of **Human-Centered-AI (HCAI)** (Shneiderman, 2020), humans and their needs are the pivotal point This framework emphasizes that AI-based systems should be considered as super-tools which enhance human performance.

Legal Guidelines

The European Commission promotes the vision of a **trustworthy, ethical and human-centric AI** as well as – at the same time- accelerating the development of AI and embracing the economic value of AI (European Commission, 2020).

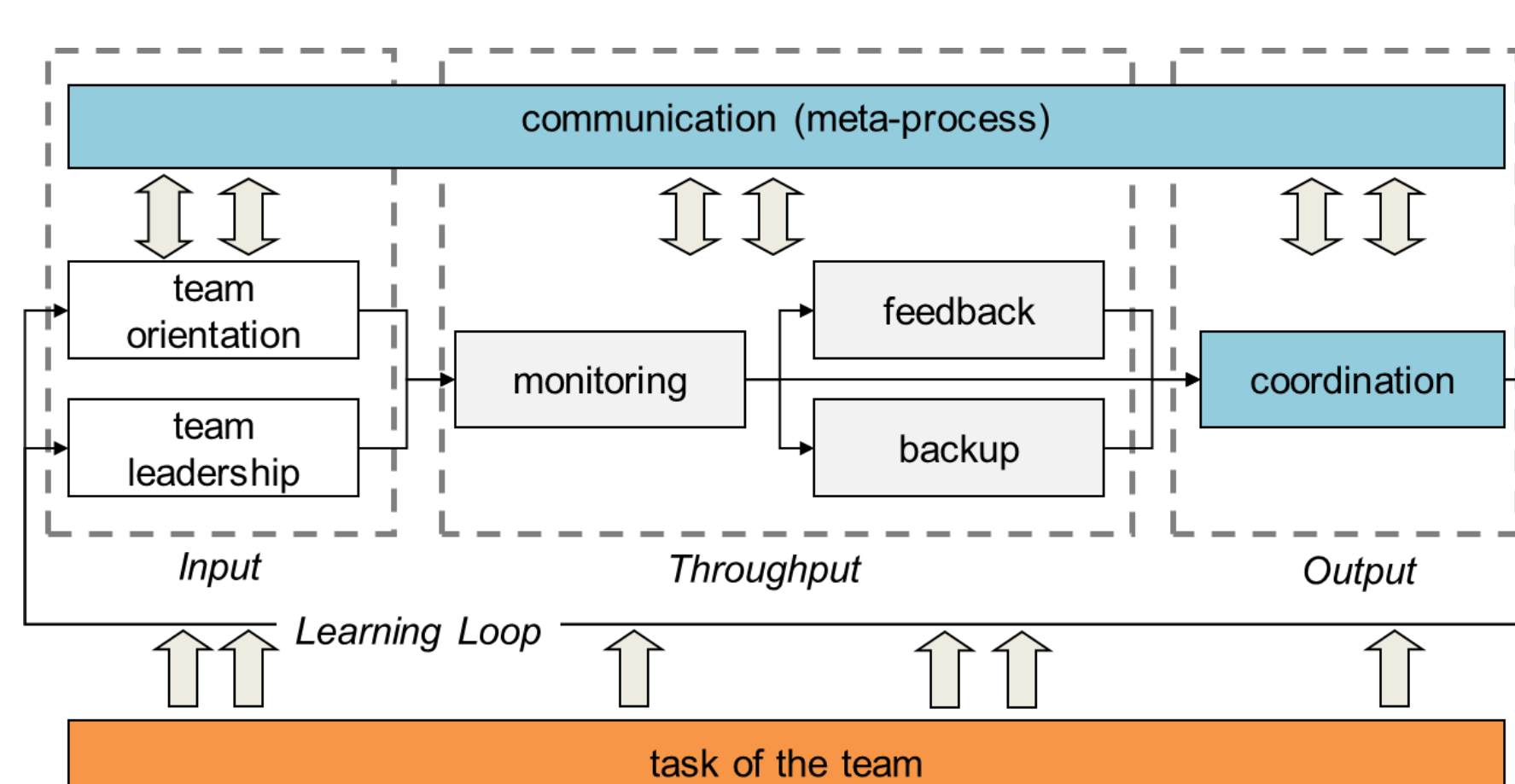
Trust in AI is a primary goal, leading to the top three requirements of **1) human agency and oversight 2) technical robustness 3) safety**.

AI development is also bound on European legislation on fundamental rights, e.g. data protection, privacy and non-discrimination.

The guidelines from EASA (EASA 2023) are based on these requirements, proposing means of compliance to verify the trustworthiness of AI in aviation.

Summarizing, **trust and human oversight** is seen as relevant for designing the Human-AI- teaming concept. The ALTAI list is proposed to systematically analyze AI developments, as well as a human-centric development of artificial intelligence.

Model of human teams teamwork processes which shape overall system performance



[Dickinson & McIntyre, 1997]