Framing a Guideline for Balancing Task Delegation of Human-Robot Collaboration in Automation processes

Case Study on Automatic Passenger Boarding Bridge in Amsterdam-based Airport Autonomous Airside Operation

Abstract

As automation technology continues to transform various industries, achieving both high operational reliability and high efficiency emerges as a critical challenge in task delegation between humans and Automated Systems (ASs). This project, conducted in collaboration with the Royal Schiphol Group (RSG), investigates the intricate dynamics of Human-Automation Collaboration (HAC) in the context of Passenger Boarding Bridge (PBB) operations at the Amsterdam Airport Schiphol. The design goal is for organizations to strike a balance between the decision-making authority retained by humans, and that can be transferred to ASs.

Through a combination of literature study, context research, in-depth interviews, and surveys, this study synthesizes insights to understand the changing nature of tasks, identify influential factors, and determine the appropriate level of human involvement in task delegation with the main research question:

> **"In the different PBB operation types (e.g., semi-auto controlled in a PBB, semi-auto controlled outside PBB), which tasks can be delegated to automated systems, and which tasks should be performed by humans?"**

The main insights (Figure A) indicate that high-precision tasks are identified as potential candidates for AS delegation, while tasks requiring clear communication and meticulous inspection align better with human management. The study underscores the significance of effective information exchange, emphasizing the multifaceted roles of humans beyond mere data exchange.
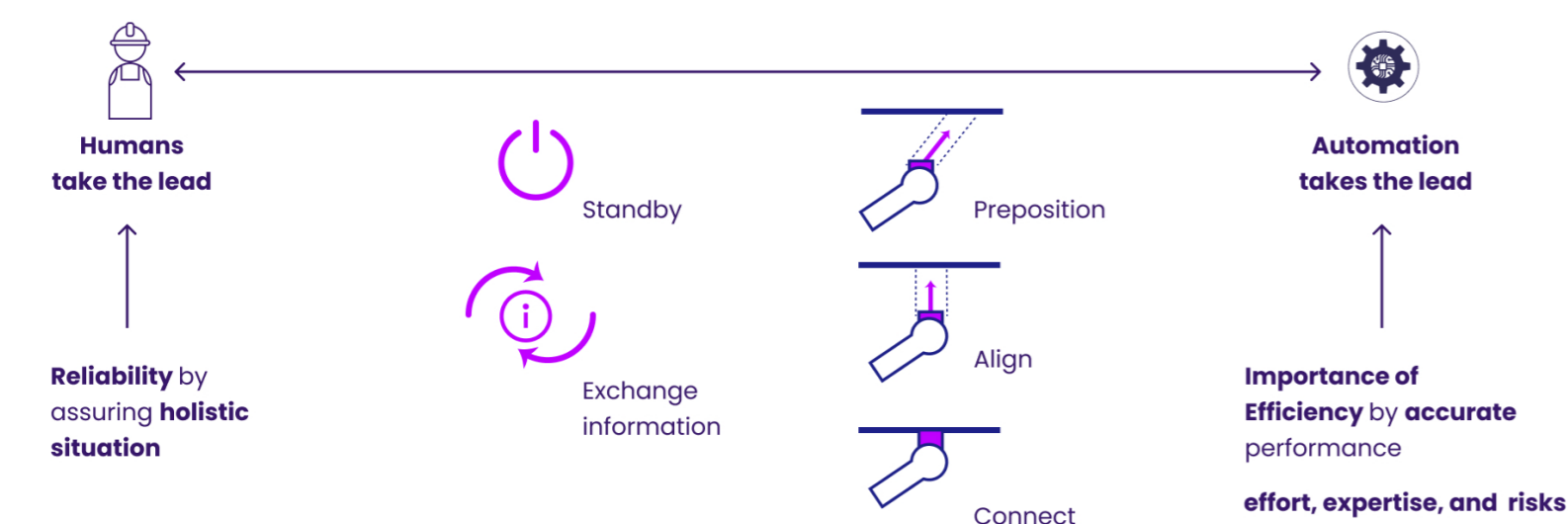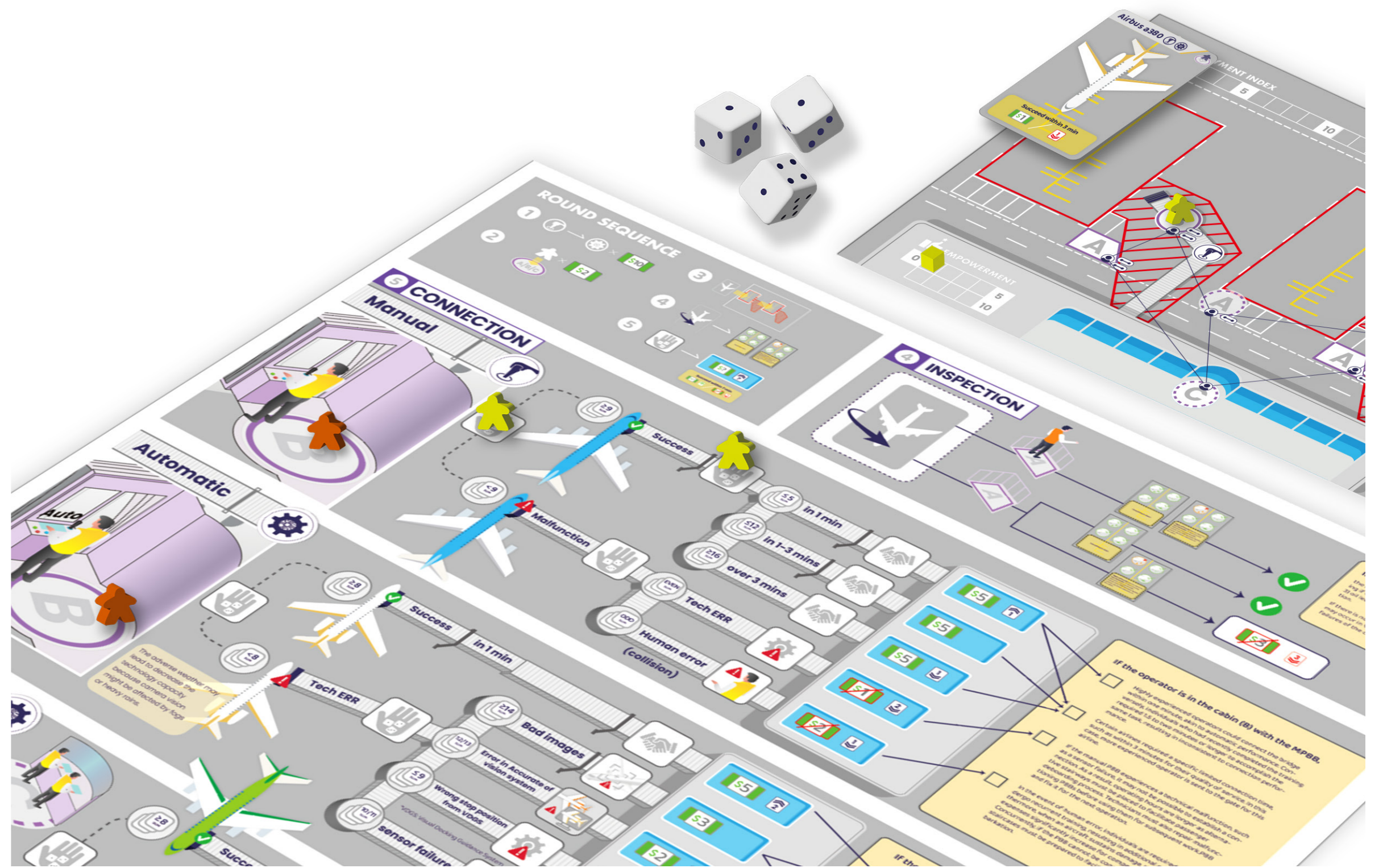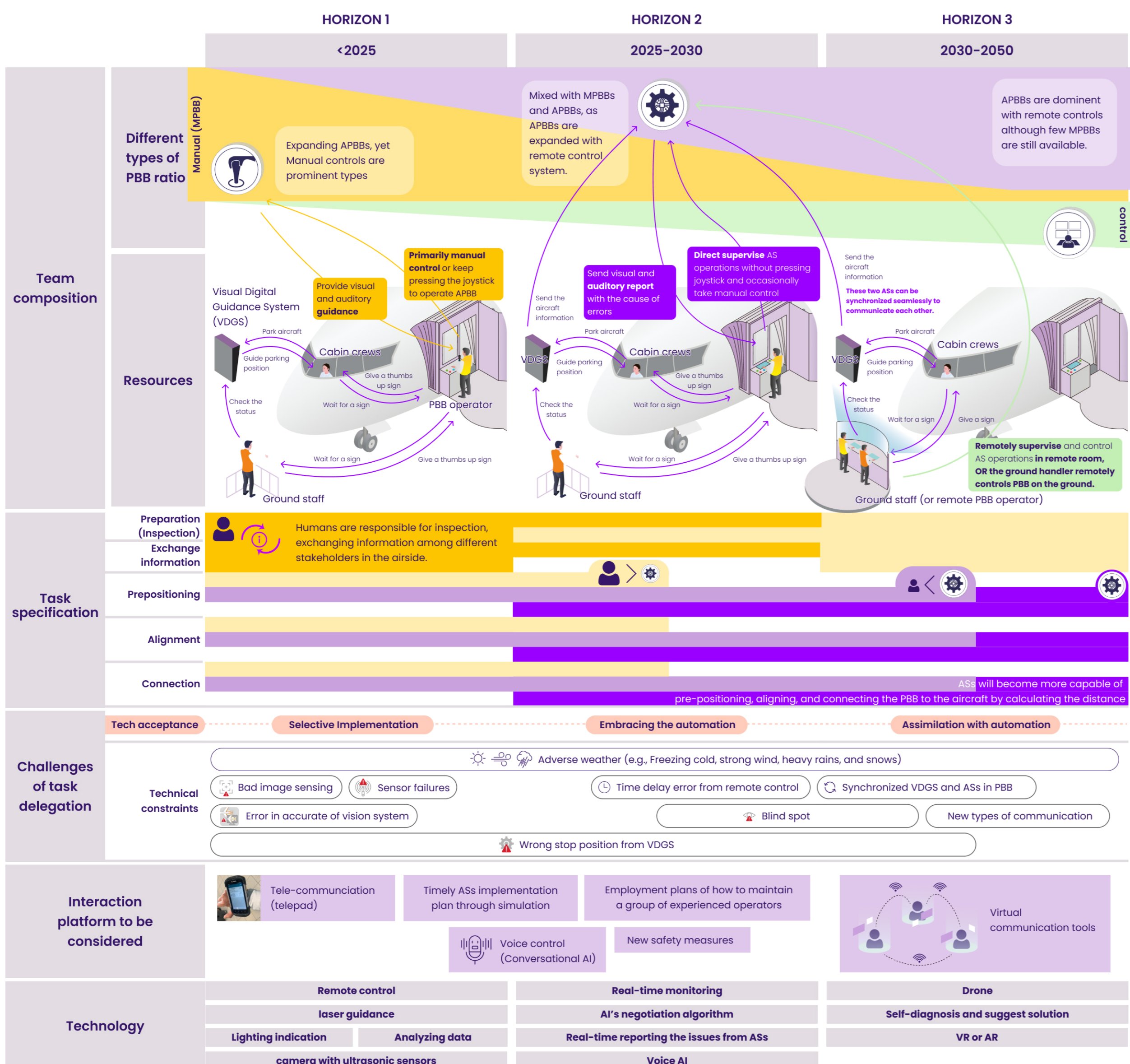

Figure A. The main insights from primary research

1) A speculative probe: A Decision-making game, PBB

To address this, two main outputs were introduced: **1) a decision-making board game as a speculative probe called PBB, 2) a roadmap for RSG's future vision,** which can empower organizations with insights into the evolving nature of tasks for both humans and ASs. The PBB game is expected to allow diverse stakeholders to enact multiple scenarios in various decision pathways aligned with different levels of automation. Further, the roadmap will envision the optimal future scenario, leading to actionable plans for organizations with a holistic understanding of HAC.

2) Future Roadmap envisioning hybrid automation with virtual spervision of APBB connection remotely

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