

Scientific Analysis of the Effects of Automation on Work Design and Requirements for Employees in High Reliability Organizations Using the Example of Air Traffic Controllers

Theoretical Background

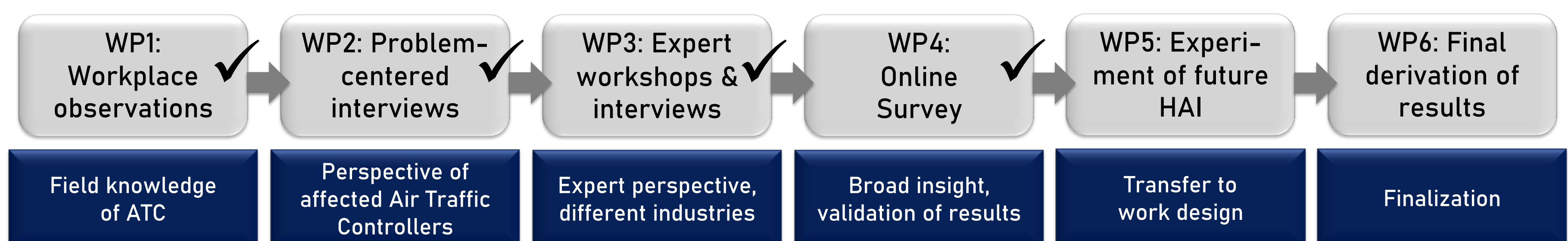
As a result of increasing automation, work processes and job roles are changing fundamentally. Besides the intended consequences of automation (e.g. increased safety and reliability), there are also unintended side effects for humans, such as a loss of situation awareness or skill degradation¹. Especially in High Reliability Organizations (HROs), in which employees have to work with very complex technologies² and very reliably due to their high responsibility towards others³, a successful Human Automation Interaction (HAI) is of particular importance.

Research Questions

To ensure a high reliable way of working in HROs with increasing automation, more research is needed to better understand the effects of increasing automation on work design and new (competence) requirements for employees:

- What kind of new requirements arise in HROs as a result of increasing automation?
- What kind of effects do these new requirements have on work design?
- How can automation be used as effectively as possible and how can the dangers of automation be averted?

Method



A mixed method approach with several work packages (WP) is applied. The field of Air Traffic Control (ATC) is used as a typical representative group of an HRO.

First Results

We identified the current **level of automation** in ATC (Fig. 1). Especially in the area of HROs, there is still a need for a **critical thinker** who is always aware of the situation in order to intervene at any time. The basic requirements therefore remain. In addition, there is now the requirement to **understand and operate the systems** and system processes. At the same time, the human role is becoming **more passive** (Fig. 2). Humans increasingly have to monitor the system and their **own creative contribution decreases**. These **restrictive working conditions** intensify with the transition to automated decision-aid (cf. Fig. 1). Consequently, employees are looking for other meaningful aspects in their work. The online survey showed that the need for competence, autonomy and relatedness play a major role. The expert study confirms the problem for many industries, e.g. the rail industry, and shows the importance of **automation as an equal team player** for humans with **key design elements**, such as **transparency and explainability**.

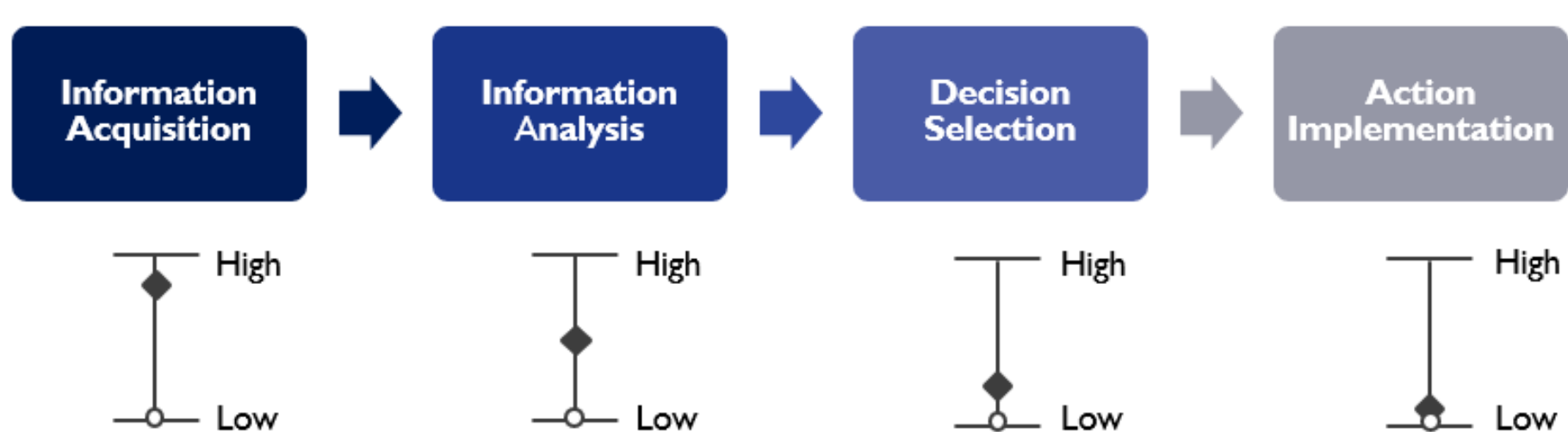


Fig. 1: Simplified depiction of the current level of automation (position of the diamonds) in air traffic control compared to the earlier manual paper strip system (position of the circles), identified on the basis of WP 1-2 (based on Parasuraman et al. 2000⁴).⁵

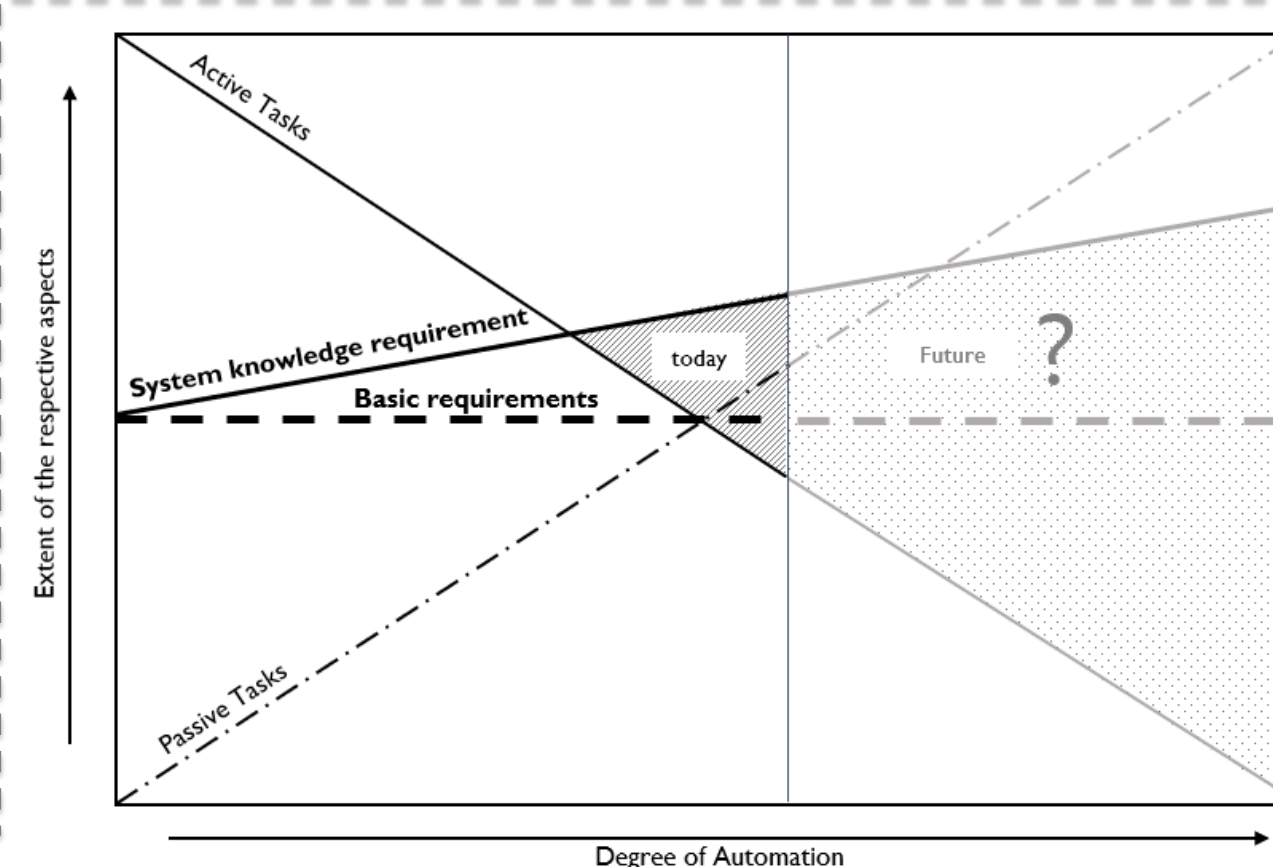


Fig. 2: The identified field of tension (shaded) between the overall increased requirements for employees in HROs and the reduced possibilities to actively use them as a consequence of increased automation, identified on the basis WP 2-3.⁵

Discussion and next steps

Increasing automation leads to increased overall requirement for employees in HROs. Consequently, personnel selection and training needs to be adjusted. The HAI must be designed in such a way that humans can continue to make a meaningful contribution to work as they are indispensable. This is a particular challenge for the transition to decision-support automation. How this can be achieved, especially in terms of Human Autonomy Teaming, will be analyzed in WP 5. WP 6 represents the derivation of results in a final model.

References

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