

From in-cabin driving to remote interventions – Train driver tasks change with railway automation



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1 Motivation

Increasing Grades of Automation [1] (GoA) alter the remaining tasks of the train driver. Assisted by GoA1 systems, the driver is prevented from excessive speeds. GoA2 systems take over the speed control, while the driver is continuously monitoring the train ride in the cabin [2]. GoA3 and 4 systems “drive” unattended trains without a driver on-board (GoA3 includes on-board service staff, while GoA4 means completely unstaffed trains).



Figure 1: Grades of Automation 1, 2 and 3/4; sources: DLR e.V., Railwaygazette and Ansaldo STS.

While unattended service is in place in several metro systems, it fundamentally challenges the way railway safety is ensured in mainline service. This especially holds for events of technical malfunction of unattended trains or infrastructural failures.

We advocate the role of the train operator (TO; Figure 2), a remotely placed member of staff, taking over safety-relevant tasks during non-routine events that are traditionally executed by the train driver in non-automated railways. The notion of the train operator is thought to enhance a scientific discussion on what human tasks are imperative to maintain system resilience in the context of increasing grades railway automation. We present a possible allocation of safety-relevant tasks for the train operator in GoA3 operation, which is based on current German operational regulations.

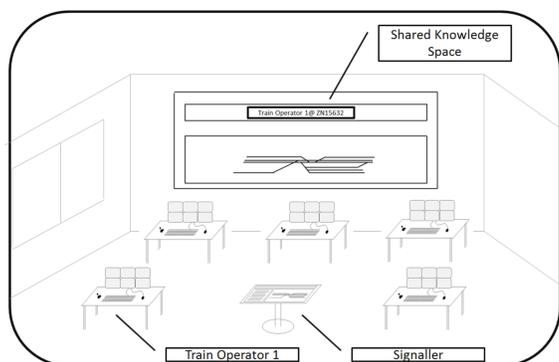


Figure 2: Illustration of TO work environment in GoA3 operation [3]

2 Methodology

In a first step, an expert panel (n= 4) from Human Factors and railway operation extracted a complete set of obligatory tasks from the regulations underlying today mainline service in Germany.

In consecutive steps, these tasks were allocated to the domain of one of three actors: the automation, the train operator, or customer service staff on-board.

The tasks were allocated based on majority opinion within the expert panel to derive a first set of tasks to be performed by the train operator.

3 Results

The extracted set of tasks resulting from the first methodological step included 79 distinct tasks that are currently executed by the train driver according to the regulation.

These tasks were then allocated to the three actors in question (automation = 47 tasks; train operator = 24 tasks; customer service staff = 8 tasks) and aggregated into categories. Figure 3 depicts the current categories of tasks of a German train driver (GoA1), while Figure 4 shows the assigned categories for the TO (GoA3).

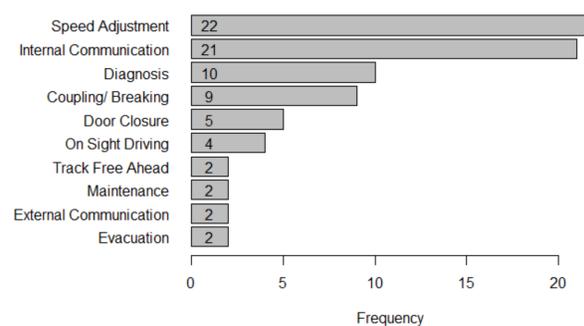


Figure 3: Categorized number of tasks of train driver in GoA1

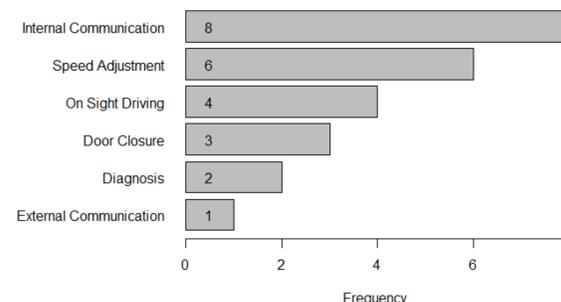


Figure 4: Categorized number of tasks of train operator in GoA3

4 Conclusion & Further Work

Changes in task allocation due to increased GoAs shape a TO role characterised by situation assessment and coordination in case of non-routine events.

A prototypical workplace has been set up to quantitatively compare performance, fatigue and situation awareness of the TO with train drivers in lower GoA environments.

By the TO notion, we can further investigate the human contributions to automated railway resilience.

5 References

- [1] International Association of public Transport. (2012). *Metro Automation Facts, Figures and Trends: A global bid for automation: UITP Observatory of Automated Metros confirms sustained growth rates for the coming years*. Retrieved from www.uitp.org/metro-automation-facts-figures-and-trends
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- [3] Brandenburger, N., & Naumann, A. (2018). Enabling automatic train operation through human problem solving. *SIGNAL + DRAHT*, (3), 6-13.