

# Remote train operation (RTO): Human-centred design of a workplace



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## Background

- **Digitalisation & automatic train operation (ATO)** → changes in the activities of railway employees
- Example of a **new role: Remote train operator (RO)**

## Aim

- Develop a **human-centred RO workplace and job profile** [1]
- Account for **operational requirements** and individual and social requirements to work

## Preparatory research work

- Compilation of **human factors requirements** [2, 3]
- Definition of **operational scenarios** for RTO [1]
- Description of a **sensor concept for RTO** [2]

## Results: Workplace design concept

Task Design		Framework	
Operational scope	<b>ATO Fallback + signal-guided op. on sections not equipped for ATO</b>	Allocation of supervision & control tasks	<b>Each operator does both, supervision and control</b>
Area of responsibility	<b>Several RO for all trains in a sector</b>	Takeover/handover rights	<b>RO must enquire with rail traffic controller for control</b>
Monitoring needs	<b>None: RTO upon notification, other tasks in meantime</b> [4]	Staff on the train	<b>Present (passenger transport)</b>
Multitasking: train + other task	<b>RO can perform other tasks during waiting times</b>	Train protection	<b>Available</b>
Multitasking: train + train	<b>RO controls only one train at a time</b>	RO affiliation	<b>new business segment</b>
Task assignment locus	<b>System assigns tasks (trains) to RO</b>	Place of work	<b>Decentralized control rooms near stations</b>
Autonomy in task prioritization	<b>System proposes, RO decides</b>	Training	<b>New, adapted training</b>
Train speed at ATO - RTO handover	<b>At standstill v = 0</b>	Required knowledge: route	<b>Route knowledge required</b>
Mode of train control	<b>Direct control</b>	Required knowledge: train types	<b>RO may only control train types they are trained for</b>
Speed control element	<b>Drive-brake lever</b>	Add. sensor information: environment	<b>Available (e.g. obstacle detection, infrared cameras)</b>
Control elements: switches	<b>Often used: switch, other: touch display</b>	Add. sensor information: infrastructure	<b>Available (e.g. temperature from hot box detection)</b>
Communication: general	<b>Data link (voice + standardized text)</b>	Communication: RTC-RO	<b>Data link standardized text</b>
Technology			

## Design method

- **Morphological box:** Elaboration of **25 workplace attributes** + design options [5]
- **Workshop with train drivers (TD) and rail traffic controllers (RTC), n = 10**  
(1) **Select most attractive option** individually for each attribute  
(2) **Discuss and agree** on one most attractive RO work design

## Workplace Evaluation

- **Online survey with train drivers and rail traffic controllers, n = 100,** on perceived job characteristics and acceptance
- **For 2 RTO variants: ATO fallback and dispatching/stabling**
- **Around two thirds** of TD and RTC report **moderate or high likelihood** of undertaking **RO training**
- Detailed results will be available shortly

## Conclusions

- **RTO workplaces offer opportunities** to improve safety and working conditions of railway personnel
- **In the development of ATO and RTO technology, the HMI design** must be taken into account just as much as a **holistic task design** in order to create an attractive new job

## References

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