Technological Solutions to Optimize Short-haul Rail Operator Workload
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Purpose: Identify potential solutions to moderate cognitive workload of locomotive engineers in short-haul freight rail.

We developed a model of workload, under a 5-hour shift of an engineer under nominal and contingency conditions. The contingency condition involved 3 unexpected events. Our models were validated by subject matter experts. We present potential technological solutions to reallocate tasks during periods of higher workload to alleviate the locomotive engineer in operational performance.

**Motion Planning**

- **Current Industry Standard**: Positive Train Control (PTC), fully implemented by 2018. Intelligent cruise control (i.e. GE’s Trip Optimizer).
- **New Tech**: Optimized motion planners (i.e. GE’s Movement Planner) and autopilot.
- **What’s Missing**: Connected network of rail traffic (i.e. vehicle-to-vehicle communication).

**Monitoring Inside**

- **Current Industry Standard**: Displays designed from legacy systems, not operator usability.
- **New Tech**: Next Generation Locomotive Cab (NGLC) sponsored by the FRA.
- **What’s Missing**: An ergonomic SA interface.

**Communication**

- **Current Industry Standard**: 2-way radio communication between dispatch and engineer.
- **New Tech**: Inward-facing cameras, outward-facing cameras, and Unified Train Control System (UTCS).
- **What’s Missing**: Dispatch capable of monitoring specific train information (GPS location, ETA, speed, live streams) and managing by exception. Motion planning updates pushed to PTC system.

**Paperwork**

- **Current Industry Standard**: Pre-printed pages to review and revise during shift.
- **New Tech**: Electronic Logging Devices (ELDs) mandated by FMCSA for trucks.
- **What’s Missing**: Test in freight rail environment. Predictive text support.

**Future Work**

The results of this research help identify sources of high workload as well as periods of low workload. However, limitations in our approach may affect the generalizability of the models. Additional observation and interviews would allow us to refine and expand the underlying data of the current models. To this effect, we are developing a discrete event simulation to rapidly investigate operator workload under a wider array of conditions to:

- Predict impact of new technologies on human operators
- Provide railroad stakeholders data to inform system requirements
- Ultimately get freight delivered safely and efficiently