Human Factors and the Digital Railway: Effecting and Managing Change through Innovation and Integration

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THE WORK IN CONTEXT

With an infrastructure operating at full capacity, a testing political climate, and a mix of government, regulatory and public pressures, the GB railway is under more strain and scrutiny than ever before. Currently, more than 4.8 million journeys are made across the network every day, a number which is forecasted to increase by around 40% over the next 20 years. As such, the complex socio-technical system that makes up Britain's railway is in a constant state of flux, continually evolving to meet the ever-changing demands of today, whilst anticipating the myriad needs of tomorrow.

Without proactive interventions, the predicted growth in passenger journeys will erode the resilience of the railway, especially on the busiest parts of the network that are already characterised by an extreme density of train services. Passengers expect, and should receive, a right-time rail service all day, every day. However, minor disruptions frequently lead to congestion and delays, and result in losses to public satisfaction and confidence.

Technological interventions to optimise system performance, whilst maintaining a continuous focus on passenger, workforce and public safety, require a robust and coordinated approach from the ergonomics and human factors (E/HF) community. E/HF practitioners, in collaboration with front-line rail staff, engineers, system architects and policy makers, can innovate through practice and research to integrate Digital Railway (DR) technologies, and reduce environmental stressors, whilst maximising the return on investments at every level of the socio-technical system.

This work illustrates the application of systems ergonomics to the delivery of DR technologies within safety-critical environments. The DR project is focused on deploying new technology to maximise train capacity on the existing infrastructure. To do this requires a comprehensive programme of human factors integration to effect the necessary cultural and organisational changes, and in doing so develop appropriate policies, regulations, standards and plans.

KEYWORDS

Systems Ergonomics, Automation, Safety, Human-Machine Interaction, Human Factors Integration, Digital Railway

Brief outline

Network Rail's Ergonomics team have been working to define the human factors integration scope for the DR programme and to produce an overarching E/HF DR management and implementation strategy. In parallel, the team have informed the architectural design of the DR system of systems

(SoS) and are currently involved in a range of activities to ensure E/HF considerations are not only at the core of all DR delivery projects, but are also central to operations and maintenance functions.

This work highlights some of the successes and challenges of human factors integration in the architectural design, development and implementation of the DR SoS, by:

- Outlining the activities that have been undertaken to identify the depth and breadth of the E/HF scope.
- Describing the E/HF work completed within the DR Systems Integration and Requirements project, including specifications for the basis of design, system architecture, requirements, and safety case, for the GB end-state DR.
- Demonstrating why a holistic socio-technical systems approach is required, and why field observation studies to uncover and document 'work as done' provide an essential foundation for developing next-generation skills, processes and decision support technologies.

Findings

Designing new technology for safety-critical applications is difficult, slow and expensive. Automation technology (designed to improve railway planning, control and reporting processes) must integrate systems and data from disparate sources. In doing so, previously ad-hoc transactions and flexible business processes are formalised and new dependencies are created. Technology led projects effectively manage the software and data interfaces between systems, but the human interfaces, and job and task design activities, require deep E/HF expertise and domain knowledge to predict and optimise alterations to the nature of work.

Such business change activities are inherently uncertain, with technical, procedural and teamwork outcomes that are hard to predict, and psychosocial and economic costs that are difficult to measure and control. For these reasons, E/HF DR work draws on the principles of constructive ergonomics (Falzon, 2014), taking a long-term view, and a participatory approach, to support ongoing processes of human adaptation, capacity, resilience, skill development and learning, thereby anticipating and managing socio-technical risks in complex systems (Rasmussen, 1997).

Impact

E/HF DR work is driving innovations in the interactions between people, processes and technology, and helping to deliver the improvements in performance, safety and efficiency required for an affordable and sustainable rail industry. Strategic work to deepen human factors integration in deployment projects, and to enhance the usability of systemic cognitive engineering methods, will continue to deliver advances in the design and management of complex work.

References

Falzon, P. 2014. Constructive Ergonomics. CRC Press.

Rasmussen, J. 1997. Risk Management in a Dynamic Society: A Modelling Problem. Safety Science 27 (2–3): 183–213.