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A person with narrow vision has a restricted horizon; a person with wide vision has plentiful opportunities

From Late-Stage Assurance to Immersive Testing: Designing a Human Factors (HF) Lab to Test Future Rail Infrastructure

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Abstract

In the past, human factors (HF) in infrastructure projects was often applied later through design reviews and standards-based checks after important design decisions had been made. As transport systems become more complex, HF practice is moving toward earlier, more immersive, and more evidence-based testing of designs before infrastructure is built.

This presentation describes the development of a HF Lab Implementation Plan for a large transport infrastructure project. The plan was developed through document review, workshops, analysis of users and key activities, and a targeted literature review. HF lab methods and tools were assessed using a rating framework covering both the robustness of evidence for measuring design against success outcomes and whether each method was fit-for-purpose for the project and Human Centred Design (HCD) topic area.

The approach connects three user groups (customers, staff, wider stakeholders) with eight HCD topic areas (wayfinding and spatial navigation, passenger flow and crowd management, information and communication, emergency safety, accessibility and inclusive design, environment and customer experience, operations and maintenance, wider stakeholder engagement). Rather than beginning with a fixed facility or predetermined technology, the plan starts with a flexible pop-up lab and progressively develops into a dedicated HCD lab, an extended lab, and future operational integration.

Depending on the design question and maturity level, testing may combine virtual reality (VR), three-dimensional (3D) modelling, eye-tracking, physical mock-ups, behavioural coding, psycho-physiological measures, surveys, interviews, and computer modelling.

The lesson is that a HF lab should be driven by user needs and purpose, rather than led by technology. This model positions HF as a proactive design capability that can test assumptions, involve users, and generate evidence while design changes remain feasible. The presentation offers a framework for moving HF from late-stage assurance towards earlier testing, supporting safer, more inclusive, and usable rail infrastructure.