RETHINKING TO CLOSE THE GAP: APPLYING A SYSTEMS APPROACH TO RESILIENT TRANSPORT

ABSTRACT Across the transport sector, resilience is often weakened by fragmented decision making and assurance processes that operate in isolation. Different disciplines and contractors interpret requirements independently, leading to variable outcomes, duplicated effort, and gaps in traceability. This siloed approach obscures how local design choices affect overall performance, sustainability, and community benefit.

This paper draws on work carried out across major rail and mobility programmes in the UK, Canada, and Australia to demonstrate how a systems approach can close these gaps. On each project, structured systems-engineering and progressive-assurance processes were implemented to connect requirements, risks, and evidence across disciplines and delivery phases. This integrated perspective enabled clients to view infrastructure as a single system, quantify trade-offs, and make decisions that optimised performance, safety, and wider system value.

Applying this approach helped bring complex programmes over the line, saving many millions of pounds through reduced rework, faster assurance closure, and stronger compliance confidence. The mindset shift requires engineers to think across boundaries, linking design, delivery, and operation within one continuous feedback loop. Figure 1 illustrates this whole-lifecycle thinking, showing how early design decisions influence downstream assurance, maintenance, and renewal outcomes.

Figure 1: Whole-Lifecycle Thinking

The use of a generic digital requirements management tool during delivery provided valuable lessons, while effective for product or software-based projects, it struggled to accommodate the data complexity, user diversity, and operational realities of major infrastructure programmes. These lessons directly informed the development of SEMPx, an infrastructure-specific environment designed to better integrate requirements, risks, and assurance evidence while improving visibility, reducing technical debt, and supporting collaborative, informed decision-making.

By rethinking delivery through a connected systems lens, these programmes demonstrate how transport networks can become resilient, adaptive, sustainable, and socially valuable, future-proof systems that deliver beyond their technical function.