SYSTEMS INTEGRATION LABS MAKE IDEAL PROVING GROUNDS

This article explores how systems integration labs catalyze the development, introduction and integration of new products for rail program success.

Rail systems are becoming ever more complex. This complexity is not single plane but multiplanar—encompassing the physical, digital and socio-technical systems associated with the end state. How these systems interact, develop and drive behaviour will in turn drive the success or failure of the outcome. This is where the systems integration (SI) lab comes in.

What is a Systems Integration Lab?

An SI lab is a dedicated simulation, testing and diagnostics facility that enables separate systems to be brought together and integrated under controlled conditions.

These conditions can involve one or a combination of the following: pure systems integration; simulated or emulated components; normal, abnormal, degraded and emergency scenarios. The best systems integration labs provide the capability to test all aspects of the end-state system.

The output of this facility is a verifiable, repeatable and validated model of system performance including technical interactions and emergent behaviours.

How the Systems Integration Lab Works

SI is not a "do once" process—it is the bedrock of progressive assurance.

Creating an SI lab early in a project's lifecycle sets the scene for the lab to assure delivery of the system as a whole. To ensure an SI lab can evolve in alignment with the needs of a project, it should be supported by a robust but flexible system migration strategy—one that is scalable and migratable. The SI Lab would then test the migration strategy itself and integrate systems into one system in progressive stages.

The lab can be used to test proposed designs, proposed builds and configurations, and proposed testing procedures; and evaluate assurance evidence or develop acceptance criteria based on a real-world understanding of the system, how it behaves and what it is expected to deliver.

Systems Integration Lab Examples

Major projects already use SI labs. The Thameslink Programme in London has seen several iterations of the SI lab during its lifecycle. These labs de-risked critical elements of the program and allowed it to maintain pace. Not least of these is the ETCS National Integration Facility (ENIF), specializing in European Train Control System (ETCS) development.

ENIF has become a world-leading SI facility capable of hosting multiple suppliers and configurations of systems, including on-board, wayside, and central command and control systems. ENIF is now a national resource open to any project with an ETCS integration need. This facility is expected to be pivotal in the future East Coast Mainline and North City Line ETCS programs, the most advanced in the United Kingdom to date.

So highly regarded is the value of an SI facility that, in early 2019, Network Rail's Group Digital Railway engaged with the supply chain via the Joint Development Group to specify the next-generation SI lab. WSP was part of that team.

New Product Development and Introduction

A well thought-out SI lab provides the ideal test bed for new product introduction.

New Product Introduction (NPI) is the process of taking a product (system, technology or process) from concept through development and α *and* β testing, and to market.

Part of this process involves confirming the design is correct and testing the product in different circumstances to understand how it works and where it works best, and to identify any limitations.

The ability to test the product in multiple scenarios and configurations, with multiple interfaces, and get reliable, validated data for review and further development gives the developer the chance to refine their product and prepare it for market testing. The SI lab can also be used for validating market data during that testing phase; from here, issues can be resolved and the next round of development can be planned. In this way, an SI lab is the catalyst for product development and introduction, and

offers opportunities far beyond testing discrete interfaces.

Why the Design of the Systems Integration Lab is Key

The design of an SI lab determines its possible uses. If the lab is restricted to the systems under test, it can be very focused and used to aggressively test discrete interfaces. Such a model would be used in developing a GoA4, or Grade of Automation 4, metro system, for example. A holistic model would enable adjacent and ancillary systems to be tested as well. This kind of model would best serve a system with a large number of data-entry-and-exit points, where one system can directly affect many others, such as a route-wide traffic-management layer.

Do you need multiple vendors in the same lab and therefore segregated work areas joined through a common data backbone? Do you need a demilitarised zone for third-party testing? Do you need to simulate train movements, driver interfaces, or social media monitoring? How you design your lab determines what you can do with it—and whether you can use it for NPI.

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Rail system delivery depends on the complex interaction of the system's sheer number of moving parts. The continuous evolution of the system ecology introduces risk and uncertainty. The right SI lab—designed to capture and explore those interactions and draw out the opportunities as well as threats—can de-risk projects and seamlessly introduce a new product to market.

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