

# IMPROVING OVERALL PRODUCT, SYSTEM AND ASSET QUALITY IN RAIL

## Ensuring the Best Quality Outputs at all Tiers of the Rail Supply Chain



Rail systems, from the remotest level crossing to the network as a whole, are getting much more complicated. Every little piece of infrastructure, every part of a train, increasingly needs to be looked upon as a detail in a big picture rather than as something more discrete, with its own discrete maintenance schedule and separately identifiable requirements.

Ensuring quality in this environment requires the ability to see the big picture, not just of your own product but of the context in which it is going to operate.

Rail systems aren't just getting more complicated because they need to do their existing job better, the future is (rightly) making greater demands of the present than ever before. In rail, work to meet a net zero carbon target by 2050 needs to begin very urgently. Accessibility needs to accelerate to accommodate an aging population and make up for the failings of the past. As the world around us gets smarter through the Internet of Things, rail needs to be able to adapt.

What systems engineering brings to the table in this changing rail context, is a scientific approach to requirements and quality management, which can help ensure development is done right every time.

Systems engineering is about drawing on the science of finding patterns in organised complexity, and the analysis of the emergent properties of a whole rather than the specific behaviour of individual components. It's a fundamental shift in perspective, based on the idea that looking at the structure of a complex system gives you a better understanding of how the system will behave, than you would get from focusing only on the mechanical details.

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As such, the outputs of the whole system, in terms of passenger and other user satisfaction, the operating environment and interaction with other systems – in short, the value derived from the whole system throughout its life cycle – are at the front-and-centre of quality.

A systems engineering development process starts with the broad needs of the client, turns that into specific requirements for the system as a whole, creates an architecture at the system and then the subsystem level, and only then produces a detailed design for the individual elements. Ensuring quality of a whole system is about going through that hierarchy in reverse: testing the reliability of individual components or modules against specifications; verifying the performance of subsystems against requirements; then validating the outputs of the system in terms of customer need. This is coupled with a clear recursive process for when standards are not met, to ensure definitions are revisited at the most specific level possible.

Ensuring quality throughout the whole life cycle of a product is baked into systems engineering and the tools that support it. A huge part of that is in its scientific approach to requirements engineering, which generates specific, unambiguous and testable requirements, using the same method as a scientist uses to generate the hypothesis of an experiment. Black box models of how the elements of a system interact with one another also significantly reduce the risk of an emergent defect not being detected until the system has been integrated.

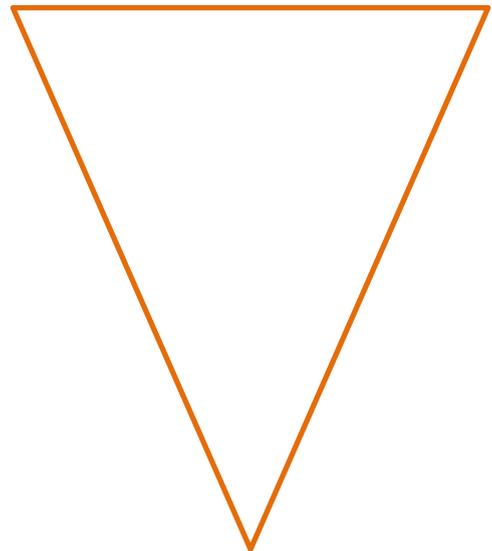
The effect of all of these processes is to dramatically reduce change latency in an engineering project. Major rail industry players like Network Rail have been directly applying systems engineering techniques for some time, but those techniques have not yet reached much of the rail supply chain.

### About SyntheSys

SyntheSys provides defence systems, training, systems and software engineering and technical management services over a spectrum of different industry sectors. Along with distinct support and consultancy services, our innovative product range makes us first choice provider for both large and small organisations. Established in 1988, the company focus is on fusing technical expertise with intuitive software applications to solve common industry challenges.

Thinking about quality like a systems engineer, is about thinking in terms of a hierarchy of complexity, in a way that begins and ends with the big picture of the system. It may be time to consider that the ever-increasing complexity of rail systems requires everyone involved to have an eye on the big picture.

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This technical article is an excerpt from SyntheSys Technologies White Paper about Managing Complexity in Rail Supply. Read the full White Paper [here](#).