Quality without Overdelivering

As the rail network starts to rely on ever more sophisticated technologies, the risks associated with project change become more difficult to manage. Different systems in the network interact in increasingly complicated ways. Not understanding how your work fits into this ever-changing big picture can be a huge risk; never more than now. It can be hard for rail suppliers to guarantee their product can retain its quality throughout the whole of its life cycle while avoiding the excess costs of overdelivering on what is actually needed.

These risks don't just arise as the network changes around your project while it is underway, but also in terms of how what you're building will react as the network changes in the future. The digital railway initiative demonstrates clearly that even the remotest level crossing needs to be able to adapt to the changing systems of the network, to say nothing of future pressures from accessibility and decarbonisation.

Delivering value in this environment isn't just about understanding your stakeholder needs as fully as possible, it's about having an approach to quality that puts the outputs of your work in terms of user satisfaction, the operating environment and how it integrates into the broader network both now and in the future -- in short, the value derived throughout the full life cycle of your product -- at the front and centre.

Your approach to quality, therefore, needs to be closely tied to your approach to value, and in rail your approach to value needs to be increasingly tied to how the network will change around your product in the course of its life cycle, and when change is likely to bring your product's life cycle to an end. Failing to look at it this way exposes both you and your rail customer to significant risks that undermine the value of your work.

Taking a whole-system view of quality allows you better calibrate your project objectives to stakeholder needs, not just in terms of raising the bar, but also in terms of preventing waste and improving project control. By left-shifting when you think about quality and tying how you think about it explicitly into stakeholder needs, you can better guard your project against doing too much as well as doing too little.

The saying that quality cannot be "inspected into" products, has become a cliché at this point but the more complicated your products and the network around them get, more and more quality activities need to be left-shifted to the earliest possible stage, not just to minimise the cost incurred when something doesn't come up to standard, but also to maximise value when quality is as much about what's going on around what you've built as it is what's going on inside it. Without proper consideration of the emergent properties of the 'system of systems' formed by your product and the other systems around it, a defect may not emerge until after it has already been integrated into the network, when it is most costly to correct, to say nothing of how dangerous that could be.

Thinking about quality like a systems engineer is about thinking in terms of a hierarchy of complexity. When designing the system, we start with the broad needs of the client, turn that into specific requirements for the system as a whole, create an architecture at the system and then the subsystem level, and only then produce 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.

Managing quality in this way rests on project requirements being as specific and measurable as the hypothesis of a scientific experiment, with a clear and unambiguous difference between compliance and failure. When the definitions of individual components are derived from the context of a definition of the whole system, far more of the potential emergent defects in the whole can be detected in testing the individual parts. This means rework can be anticipated earlier and performed more easily and cheaply.

In other words, you start with a design and modelling process that is engineered to assure that stakeholder needs are being precisely met before your costs are sunk.

Thinking about quality as a question of adherence to robustly defined stakeholder needs minimises waste and improves project control, by guarding against scope creep and overengineering. It's not about getting above the line, it's about hitting the bullseye, and systems engineering tools and skills can help you ensure quality without overdelivering and generating excess costs.

West Coast Route Modernisation: The Spiralling Costs of Poor Change Control

The West Coast Main Line is the busiest mix-use railway in Europe, connecting many of the largest cities in the United Kingdom (UK). In the course of a vast modernisation programme between 1998 and 2008, Network Rail worked with partners to deliver reduced journey times, increased capacity and refreshed infrastructure.

The project was beset with problems, and spiralling costs not only significantly contributed to the collapse of then-privatised Railtrack, but required the intervention of the Strategic Rail Authority (SRA) in 2002 to rescue the programme's objectives, after the forecast cost had risen from £2.5 billion to £14 billion.

A later review by the National Audit Office concluded there had been several failures in the management of the project prior to the SRA's intervention, including a lack of clear governance arrangements and direction, failure to engage stakeholders, and the use of untried and unproven new technology.

But it also identified scope creep from a lack of tight specification and change control as a major source of spiralling programme costs. Although the project was trying to apply good requirements management even from its early stages, in practice the project design and scope had been largely left to the management of Alliance contractors, because Railtrack lacked the engineering expertise to participate in alliances as an informed and equal partner, and to challenge contractor-developed ever-escalating scope. The change in project definition was out of control and nobody was competent to control it.

By the time the SRA intervened, the wrong requirements, and requirements that did not correctly balance cost with other business objectives, were being managed. A key part of restoring the programme to a relative success in subsequent years was refreshing the project requirements to be better aligned to objectives, and in the end significant savings were achieved by focusing the project on its core aims.

Big Picture Thinking

Systems engineering allows the rail supply industry to take a whole life cycle view of its products, and better understand how they integrate with the rail network as a whole. The main driver of value that it brings to the table is helping you precisely target your project at stakeholder needs, no matter how complex: doing no more, and no less, than you need to.

For that reason, it has a strong focus on good practice in requirements engineering and is using that to develop models of a system which can be used for simulation and anticipation of potential emergent issues ahead of time. Left-shifting quality is about embedding calibrated standards at every stage of the process.

In other words, systems engineering is about getting it right from the start when you're dealing with complexity. It comprises a series of processes and techniques for analysing the properties of a whole as more than the sum of its parts, but more than that, it is a way of thinking about a project which keeps focus where it should be: what the value of your work is as a part of the big picture.

Systems engineering needs the right skills, the right process and the right tools. But with these in place, rail supply could respond to the complex challenges of the industry's ever more demanding needs by building its products more efficiently and reducing project risks.

This information sheet is an excerpt from SyntheSys Technologies White Paper about Maximising Value in Rail Supply. Read the full White Paper [here].

INFORMATION SHEET

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.