Reducing Risk in Complex Rail Project Developments

Information Sheet

Using a Development Process which is Better Able to Anticipate Risks

For rail suppliers, every positive development seems to come with a corresponding risk. There's a huge amount of investment to be won right now, but in rail, every feast costs you a famine. Ill-considered long-term investment in your engineering capabilities can leave you exposed when the good times stop.

The British rail network is being transformed by technologies like cab signalling and condition-based maintenance. The opportunities are there for those ready to step up and take them, but cutting-edge engineering has never been more important.

Improved technology is driving a lot of current growth, but with this comes pressure to look to the bleeding edge and make difficult decisions about unproven innovations. *Which technologies are going to make the most progress toward decarbonisation? Is the industry going to be ready to embrace the full potential of augmented reality and automation? Will the pace of change in smart cities, the Internet of Things and 5G be so fast that rail will have to adapt very soon?*

In this ever more complicated context, rail needs a development process which is better able to anticipate project risks, and prevent incurring costs when a failure is spotted too late.

The risks of engineering in an environment like this are huge, especially because without proper consideration of the emergent properties of the system as a whole, a defect in a new product may not emerge until after it has already been integrated into the network.

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Engineering processes that focus on the detail need to be complemented by an approach that, first-and-foremost, is concerned with the system as a whole. Systems engineering is a discipline in its own right, concerned precisely with the insights, processes and tools to enable you to look at a product in this way.

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.

This process starts with a scientific approach to stakeholder engagement and requirements management. When you're developing complex systems that have to integrate into a broader network, involving all your stakeholders at a very early stage can be absolutely critical for the success or failure of a project.

According to the Project Management Institute's global 2019 'Pulse of the Profession' study, project managers in manufacturing industries overwhelmingly report inaccurate requirements gathering, and poorly defined opportunities and risks, as the primary causes of project failure.

Therefore, getting all of your stakeholders on board – and more than that - understanding what they *really* want, and sorting the necessary from the dispensable – is increasingly seen as a critical mitigation of risk as projects become more complex.

More than this, a scientific approach to requirements management allows you to build a systems engineering model of your product. These models treat the parts of the system as black boxes, 'system elements', which take their inputs from their environment and produce outputs. These 'system elements' are organised into systems, and then even into a 'system-of-systems', which is a model for systems with very independent components and a function that firmly rests on emergent behaviour, like a railway network, or a supply chain.

These models are generally built from the top down, defined first in terms of broad stakeholder needs. As requirements get clarified and detailed, the model progresses down equivalent layers of complexity, at each stage fundamentally treating subsystems and individual elements as black boxes that transform inputs into outputs.

As such, using a systems engineering model allows the behaviour of the system as a whole to be anticipated prior to proceeding with development. In rail systems, where components are so heavily integrated into a network with complex behaviour, this capability can give you the assurance you need against the cost and timetable of your project being multiplied by discovering a defect too late.

Systems engineering is about drawing on the science of finding patterns in organised complexity.

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

INFORMATION SHEET

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