Right the First Time

As the systems used in the rail network become more complicated, finding out that something needs to change in the middle of work, or that the task you were given in the first place wasn't exactly right, becomes an ever more expensive risk in construction and engineering.

According to the Project Management Institute's global 2020 'Pulse of the Profession' study, project managers (PMs) in the construction industry report poor upfront planning as the primary cause of project failure.[1]

In the same study, construction PMs reported that 41 percent of project budgets are lost in a case of project failure: more than any other industry. In all, the survey reported that 12.7 percent of total project and programme spending in the construction industry was wasted due to poor project performance.

Every industry faces its own unique circumstances and challenges, but industry insiders don't need a study (though there are several) to know that construction has underinvested in the skills and technology necessary to reduce that waste.

When supplying to the rail industry, these problems are particularly acute, and never more than now: as the rail network becomes more complex and high-tech, understanding what your project requires of you, and securing guarantees that your objectives at the start will still be your objectives at the end, has never been harder. In those circumstances, it can be very difficult to guarantee value for your customer.

The best way to mitigate these risks is to build a strong understanding of your project requirements at as early a stage as possible. The later in the project your requirements change, the more expensive that change will be, and those costs start accumulating very quickly. As the diagram below shows, life cycle costs of an engineering project tend to get locked in early in design and development, even if not yet expended. This can rapidly multiply the cost of changing design direction at a late stage. Naturally, this leads to budget and timetable overruns, or even cancellation.

Of course, getting to grips with this in the rail industry is no easy task. Depending on what you're building, the stakeholders who define what your project is supposed to achieve could include the Rail Safety and Standards Board, multiple Network Rail routes and regions, an end-user operating company, a rolling stock company, a wide variety of government and regulatory bodies, passenger groups, and many more. There's no magic bullet which can eliminate the need for these wide-ranging conversations.

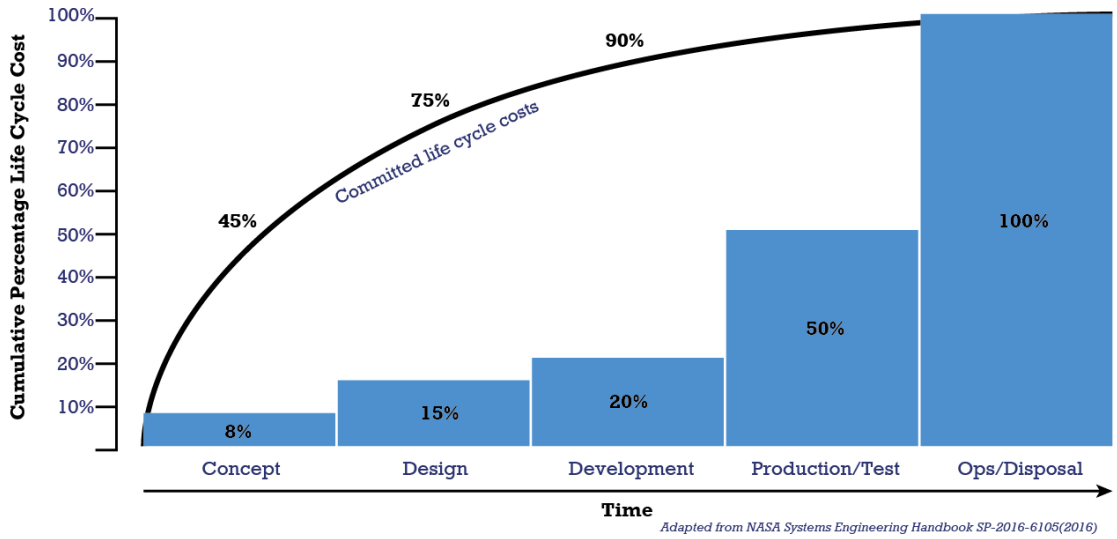
But what do exist are processes, skills and tools which can help project managers and others conduct this dialogue more efficiently, comprehensively and with scientific rigour. In industries which have had to solve these sorts of problems for longer, these practices will be familiar as the skills and technologies associated with the discipline of systems engineering (SE).

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. The critical shift in understanding that systems engineering brings to the table is that it is the structure of a system that generates its behaviour, more than the mechanical details. In rail construction and engineering, one of the things that SE can bring to the table is a formalised process for generating project requirements, and sophisticated tools to support that process, which together are designed to ensure the definition of your project is consistent, complete and feasible at the outset.

[1] PMI (2020). Research Highlights by Region and Industry 2020.

The sinking moment when you discover someone has forgotten to include something in your specifications, or that a vague instruction has led to your work not in fact meeting the required standards, can be left-shifted to the stage when as few costs as possible have been accumulated.

By knowing how to help your customer to give you what you need at the start of the project, you can ensure the value of your work isn't compromised by discovering a fault too late, and protect both yourself and your customer against unnecessary costs.



East London Rail Extension: Systems Engineering to Control Costs

The 1990s saw two major eastward expansions of the London rail network: the extension of the Jubilee Line to Stratford, and the first stage of the Docklands Light Railway (DLR) extension.

The projects began within a year of one another and were expected to take roughly similar amounts of time. The DLR extension was delivered within the agreed fixed price, and performance requirements were fully met, but the Jubilee Line extension took 21 months longer than planned and cost around two-thirds more than the original budget.

The DLR extension was delivered from the outset using an SE approach, including formalised system requirements, modelling and simulation, and a comprehensive set of integration tests.

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By contrast, the Jubilee Line extension made little effort to maintain a whole system view, and very little provision was made for the huge extent of work necessary on the existing Jubilee line for the project to succeed. The extension was regarded as a bolt-on to the existing railway, and the integration work was not understood until a late stage. Several key decisions were not taken until much later than would be recommended by SE practice, and an SE approach to stakeholder and interface management might have resulted in significant cost and time savings.

Of course, some of the differences between the projects can be attributed to the approach to management and external factors, but the evidence from authoritative accounts of the project suggests that the Jubilee Line extension could have avoided a number of late changes and delivered savings had good SE practice been adopted from the start.

This case study was adapted from those maintained by the INCOSE Transportation Working Group, available free at https://www.incose.org/incose-member-resources/working-groups/Application/transportation

Communicating Value

Keeping everybody in the loop in rail engineering used to be much easier but as stakeholders demand a more dynamic process to reflect better technology, greater assurance and more integrated systems, the process of sharing information and ensuring traceability across your team and with your own supply chain becomes much more error-prone and demanding.

When project managers and other leaders have to devote too much of their attention to the often tedious work of contract management, they have less time to focus on objectives like safety, innovation, quality and value maximisation.

Using SE requirements management techniques and technologies also enables much more efficient communication, by allowing all stakeholders, both up and down the supply chain, to work from the same single source of truth.

By joining in with these processes, your work can respond to change seamlessly, participate in complexity coherently, and provide greater and better understood value than ever before.

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

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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.