Why Use Systems Engineering?

Datasheet

Developed by the defence industry and in continuous, evolving, use since World War II, the systems engineering process has a long-proven track record of reducing risk in contexts where reliability and performance are a matter of life and death. What's more, a study by the National Defense Industrial Association and Institute of Electrical and Electronics Engineers across a wide variety of industries, showed a clear and significant relationship between project performance – measured in terms of cost, schedule and satisfaction of technical requirements – and high levels of systems engineering capability.

When systems engineers talk about a 'system', they mean any collection of several parts working together to achieve something. This can be as small and simple as a ballpoint pen, or as large and complex as a multinational enterprise or even an entire society.

If the scope is so broad, you might ask why it needs a separate name from just 'engineering'. But what systems engineering brings to the table is a range of tools and processes for creating and sustaining products of high complexity and ever-changing requirements throughout their life cycle.

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. Thinking in this way has produced a robust and scientific approach to requirements management and verification, a greater focus on the full life cycle of a product, and novel modelling techniques for complex emergent behaviour.

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The most fundamental insight of systems engineering models is that the structure of a system is what generates its behaviour. As such, the atoms of a systems engineering model are 'system elements': individual components, which are treated as a black box, in an environment from which they take their inputs. These 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.

Using a model like this enables a systems engineer to focus on complex interactions within a system, and between the system and its environment, including patterns and trends in how the system changes over time, the impact of time delays in the system's operation, the circular nature of complex cause-and-effect relationships, the problem of where unintended consequences are going to emerge, and the ability of a system to address customer requirements.

Systems engineering methods are particularly well adapted to circumstances in which requirements change in the course of a development process, as they can much more straightforwardly assess the impact of those changes on the system as a whole. By modelling and planning the product as a system, it is also possible to anticipate many of these issues, and others, much earlier in the development process and, critically, prior to generating significant sunk costs.

A standardised and generalised approach to requirements management and systems modelling also allows systems engineering to improve supply chain management. Because most systems engineers use a uniform systems modelling language (SysML™), now enhanced by cloud-based solutions with synchronised requirements handling like IBM® DOORS® Next, systems engineering allows you to keep suppliers, quite literally, on the same page and speaking the same language.

Systems engineering also provides a much more robust process for integration, verification and validation. By using a scientific approach to requirements management with specifically enumerated constraints on what requirements can look like both individually and as a set, the systems engineering process ensures that verification and validation are conducted in relation to specific, measurable and consistent product goals.

Finally, by taking a whole life cycle approach to the product, systems engineering can help to ensure the success of midlife upgrades, prevent the loss of system capabilities during operation and avoid costly compliance failures and other losses during end-of-life disposal.

Although systems engineering was born in the aerospace and defence industry, its benefits are increasingly recognised on a cross-industry basis, with extensive utilisation in nuclear, automotive and rail, and increasing interest from oil & gas, logistics and renewable energy. But we believe that systems engineering techniques could be applied to almost any domain and achieve results.

To discuss how your organisation may use Systems Engineering to accelerate projects, improve quality and reduce costs, contact us via: cet@synthesys.co.uk or call us on: +44(0)1947 821464.

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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.