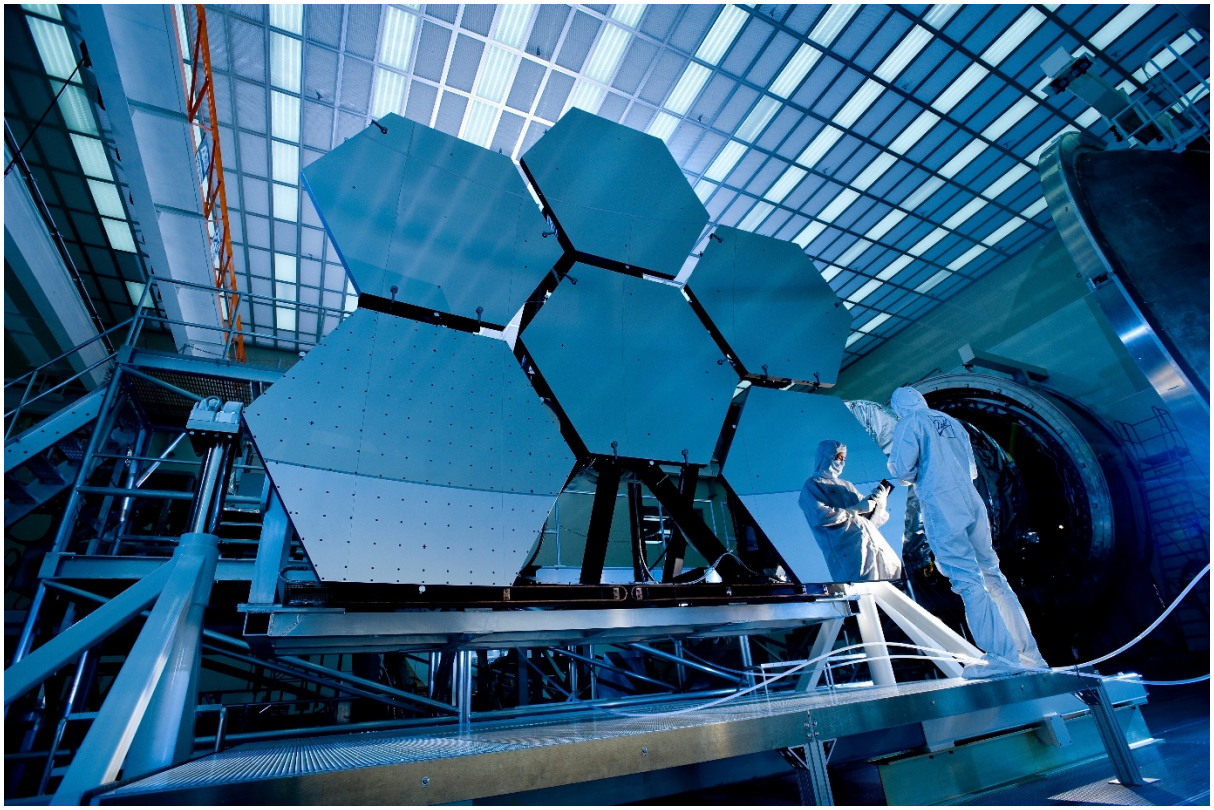
SYSTEMS ENGINEERING ESSENTIALS: *SyntheSys Technologies' six-part series exploring the fundamentals, principles and practices of systems engineering.*

Part Five: Bringing Models to Life



Every project manager knows how important it is to discover defects as early as possible in the development process. Most project costs are already committed at a very early stage, and discovering a defect, even in the implementation phase, can be extremely costly. If a defect happens because of an unexpected interaction between different parts of the system, it might even not be discovered until the system is in use, with no recourse but to reset all the way back to the broad architecture.

The original motivation for systems engineering, and still the core of its mission today, is to provide developers and managers with a way of thinking about projects that prevents precisely that sort of disaster. Scientific rigor in verification and validation is a part of that story, but the real performance benefit in systems engineering is in the way it models systems in the course of the design process. These models touch on every aspect of the product life cycle, and are designed to predict the behaviour of a system taken as a whole.

A formal systems engineering model is built out of black boxes, taking inputs from users and the environment, and outputting stakeholder needs. Until you reach the finest levels of detail, the model is not concerned with how individual components work, but rather with the structure of a system as a whole; the inputs, outputs and interactions of system elements. It's about recognising that the structure of a system, rather than the specifications of individual parts, are what determines its behaviour as a whole.

As such, the models are nearly always built from the top down, with the system as a whole taking inputs from users and the environment and outputting 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.

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As such, the benefits of a systems engineering model are not just confined to presenting a clear, coherent architecture to designers, testers and operators, it also allows the behaviour of the system as a whole to be anticipated prior to proceeding with development.

Specialised modelling languages for this process have been developed and have been in use for some time, enabling both the building of these models and their use in simulations. Proper knowledge management of these models is critical, as many elements could be redeployed on subsequent projects, and the retention of the model for midlife upgrades, support and retirement is a key part of its utility.

Because of this emphasis on modelling, along with the emphasis on effective requirements engineering, most systems engineering activity is concentrated near the beginning of the product life cycle, but the model has an impact from the concept stage all the way through to disposal.

In the implementation phase, having a systems engineering model enhances the ability of the project to cope with change. If requirements change in the course of development, or if problems emerge while building system elements, or assembling and installing the system, the model can be used to assess the impact of those changes or problems on the system as a whole, so the project can be redesigned quickly and assuredly.

Even while the product is in operation and maintenance, systems engineering models can be useful in preventing the loss of capability during in-life support, and if it is necessary to undertake a midlife upgrade, retaining the model allows you to hit the ground running.

Designing the model with configuration management expressly in mind can enhance this process, too.

Finally, in the retirement phase, systems engineering can ensure that disposal requirements are built into the project from the very beginning.

Systems engineering modelling should not be treated in isolation as an early-stage definition process; it is fed by effective requirements engineering, and referring back to the model throughout the life cycle can enhance the product for years to come. We believe that being able to model a whole system is critical for the management of the full spectrum of project risks.

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.

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