A system of systems

How the best laid plans within an organisation can be kept plane and simple! By **Mike Richardson**.

I f only the process of building an entire aircraft was as easy as putting together a model; just take the kit out of the box and follow the assembly instructions every step of the way. Work through each layer of the plastic parts to build the subassemblies, before finally assembling the sum of the aircraft's parts into its whole. If you've followed the instructions correctly, then the finished model should bear more than a passing resemblance to its to its real world counterpart.

But imagine if you were building that same model kit with a group of people in different locations? Each person would

need to work within an agreed system to ensure they were building their part of the assembly correctly. Each subsystem would need to be linked to the overall system to ensure each unit fits together to make one final assembly.

For any organisation, designing and building electronic systems with multiple components increases the challenge manifold, especially with multiple design teams involved. The philosophy of designing an entire aircraft system compared with separate assemblies requires a 'system of systems' to manage the disparate entities and ensure they all meet the common goals.

Having a top down, high level visualisation of how the different levels of the business interact would be a 'god send' to everyone involved in the company. From a business perspective, this must be the motivation for any of its systems – which exist to support the organisation's goals and objectives. Therefore, the philosophy of enterprise architecture is emerging as a key technology for demonstrating the alignment of these systems with business goals.

Comprising a collection of 'views' across four architecture domains – strategy, operations, systems and technology – enterprise architectures provide a blueprint

that can help improve quality, efficiency and accountability and enable companies to respond rapidly to the opportunities and challenges presented by today's environment and to plan and adapt for the future.

"Enterprise architecture is a methodology and modelling technique that looks at high level interrelationships between an organisation's technology and flowing it down to the next phase of systems engineering that needs the modelling capabilities to look at levels below," explained Artisan Software's sales manager Peter Kibble. "Artisan has focused on providing a breadth of capability by being able to offer support within its software tools for UML, SysML and enterprise architectures."

Kibble says the idea is that, at an appropriate stage of the project, the customer can model and represent the system they are trying to build. They can then flow that information down to the next level at the appropriate time.

"Enterprise architecture helps the organisation make decisions such as how the system is structured, how it functions and what technology supports these functions. This is the big picture; it's very generic and it's a concept that can be applied to most organisations and industries. It involves understanding what the business requires and how to deliver that capability in order to fulfil their anticipated function. It's about people communicating with people in a consistent way and being able to reuse that information as much as possible. In essence, you are removing the potential to design in costly defects."

With textual based information, users have a requirements specification that's interpreted in a particular way. They will then elaborate on it and build their own specifications which are then passed onto a development team within the organisation, or to a third party supplier. But at each stage when passing on this information there is always opportunity for error.

"The benefit of using UML and SysML modelling techniques is that their graphical representation removes ambiguity, so you get consistency and the opportunity to exchange and reuse the information with third parties. Information reuse promotes accuracy, consistency and saves time and

money. Reuse works at all levels of the development lifecycle and whereas the industry used to think of it in terms of software, we're now adapting it for interface specifications. If organisations are able to build a library of this information then they will make significant savings."

Ultimately, organisations want to avoid 'stovepipe' developments, where projects run independently of each other but actually need to communicate and integrate. On both sides of this interface there are projects analysing and modelling exactly the same things, whereas if they understood that they were both trying to achieve the same goal then they would be able to share information and work much more closely.
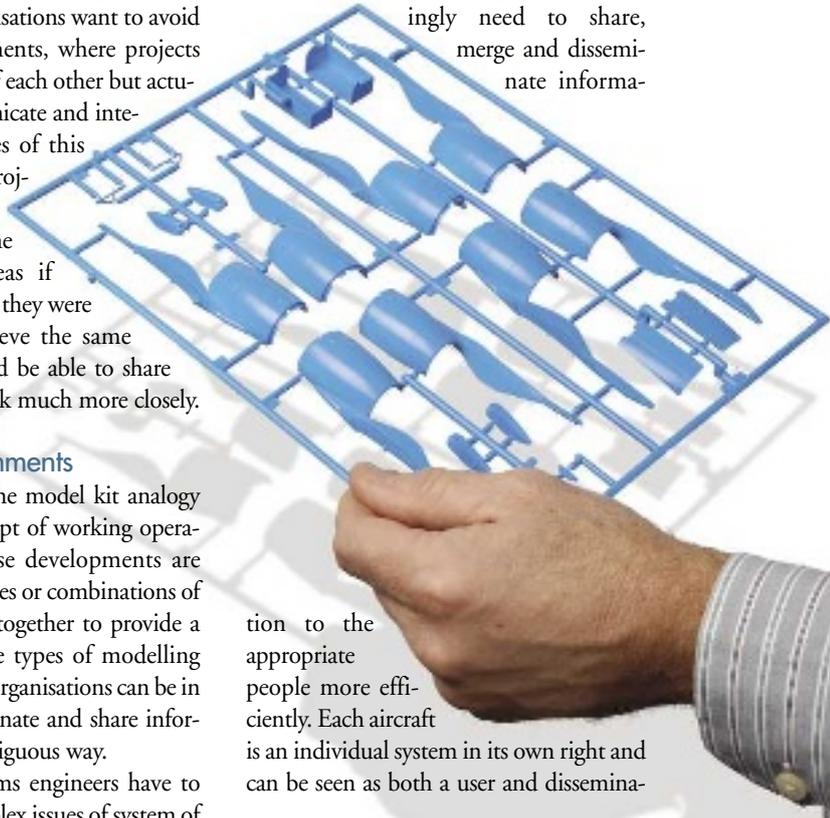
Modelling assignments

This leads back to the model kit analogy and the whole concept of working operationally. Often, these developments are multisite joint ventures or combinations of companies working together to provide a solution. With these types of modelling techniques in place, organisations can be in a position to disseminate and share information in an unambiguous way.

Very often, systems engineers have to understand the complex issues of system of systems in tandem with the enabling technology now available within organisations for the sophisticated communications being used. Organisations want to collate and exchange information, gather it, fuse it together and then disseminate it to where it can be most useful. Kibble says this sits perfectly within the philosophy of network enabled capability.

Systems engineers view an aircraft in terms of delivering the capabilities defined within the overall architecture. They've now moved below the enterprise architecture level to look at detailed implementation issues and consider the different architectures involved in building the capabilities into the equipment such as subsystems, longevity, new technologies and part availability. Their role means understanding the trade offs between providing the capability required by the customer, inter-

nal requirements such as productising different aspects of the system of manufacturing for other customers and considering obsolescence and cost.

Kibble ends: "Today's aircraft have a variety of sophisticated electronics equipment, which means companies increasingly need to share, merge and disseminate information to the appropriate people more efficiently. Each aircraft is an individual system in its own right and can be seen as both a user and dissemina-

> "It's about people communicating with people in a consistent way."
>
> Peter Kibble, **Artisan Software**

tor of information. As the organisation moves forward and purchases new equipment, it needs to plan how this equipment will fit into the new system of systems.

"Artisan provides a standalone toolset capable of working at the levels of enterprise architecture modelling, systems engineering and software engineering within the same modelling environment. In terms of scalability and robustness, it provides the capability for large scale multisite programmes to ensure they exchange information in a consistent way."