# OptimiSE

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Adapting the Product Life Cycle for Complexity Using proven systems engineering methods

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Engineering Life Cycle Management Exploring the IBM® toolset

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Success in the Rail Industry Mitigating risk and reducing overspend





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# Letter from the MD



Msrk Williamson Managing Director SyntheSys Technologies

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#### **Re-evaluating Personal and Professional Objectives**

At this challenging time for all, we view the communities in which we operate more important than ever. With that in mind, I'd like to take this opportunity to wish our readers, subscribers, customers, suppliers and other stakeholders the very best.

One of the few positives to come out of prolonged lockdown conditions is that we have all been given an opportunity to re-evaluate, readjust and reset personal and professional priorities. At an organisational level, companies have had to adjust to a new normal with teams adapting to working from home, reduced staffing levels and new operational processes. For individuals, the last few months have been tough. Many have been catapulted from busy working and family norms to a situation which has been testing for many both mentally and physically.

Roy T Bennett said that 'Every challenge, every adversity contains within it the seeds of opportunity and growth' and this is the sentiment to which I would like to introduce Issue 5 of OptimiSE Magazine.

Our magazine aims to keep you informed with the latest from our organisation, together with providing some light-hearted technical insight. We aim to provide some 'food for thought' if you are looking for new ways of improving efficiency at an organisational level or extending your skills at an individual level.

In this latest issue, we feature an article on how to adapt the product life cycle for complexity (Page 6) which leads into an article looking at the latest IBM<sup>®</sup> Engineering Lifecycle Management toolset (Page 8). We are also pleased to offer the 'Continuous Engineering for Dummies' on Page 12.

So it can be seen that SyntheSys has the tools and expertise to help organisations and individuals adapt and respond to change. We hope OptimiSE Magazine continues to prove to be useful and enjoyable within the engineering, systems and software development communities.

Very best regards,

Mark Williamson

Managing Director SyntheSys Technologies

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# SyntheSys News

### Systems Engineering Training Customer Satisfaction Results

Whether you are new to the world of Systems Engineering, or an experienced member of the community, we build our courses to meet all levels of experience.

Gathering customer feedback is fundamental to how we design, deliver and improve our training courses, so we are thrilled to publish the 2019 customer feedback results from our SyntheSys Technologies group.

After completing the course, delegates are asked to complete feedback questionnaires which are designed in line with requirements outlined in ISO9001:2015 to capture insight around trainer performance, course material, operational context and overall course feedback. We are thrilled to receive many positive comments and feedback which helps us build on strengths and adapt and improve our courses.

For more information about engineering courses delivered through our SyntheSys Technologies group including our 2020 course schedule, course datasheets and syllabi visit:

http://www.synthesys-technologies.co.uk/training.html

or contact: cet@synthesys.co.uk



Matt was excellent, extremely knowledgeable, adaptable and accommodating - I learned a lot.

Instructor has good knowledge of subject and good use of examples from his own career.

Announcement for our Systems Engineering Training Course Customers

#### We are delighted to announce that we will be delivering the remaining 2020 training courses in line with social distancing requirements.

If you were due to attend either a Systems Engineering Foundation or Certified Systems Engineering Professional (CSEP) preparation course, you may be pleased to know that we have confirmed the Training calendar for the remainder of 2020 (see Page 2). We will be directly contacting customers who were affected by the recent course cancellations.

If you are interested in Systems Engineering training and would like some more information about how we can assist in developing your skills, please visit: https://bit.ly/3esBPFB or contact us via email: cet@synthesys.co.uk



# Adapting the Product Life Cycle for Complexity



As the pace of change increases, development processes have adapted to a world where requirements can change at any stage of the life cycle, with a strong focus on the streamlined development of individual subsystems and iterative testing. But this can give leaders a hard time keeping focus on the big picture.

When a system failure is a matter of life and death, or when a system is heavily integrated with few plug-and-play components – in other words, when the cost of an undetected defect is very high – having an approach to the life cycle which emphasises the whole system throughout can be critical to success.

Often, such defects can arise from an emergent property of the system, like an unexpected feedback loop between different components. Just a 15-minute walk in central London takes you from the site of an art installation that gave off harmful porcelain dust, across a bridge that had to be closed for two years because of a resonant vibration, to a building that focused sunbeams and melted cars. In each case, by failing to look at the system as a whole, and to treat users or the environment as part of the system, the result was a costly failure.

Modern development processes like Agile are designed to be adaptable to changing requirements and to ensure quality at the subsystem level. But in practice they can be challenging to adapt to certain circumstances, like when external suppliers are heavily involved in the development process, or when products are complex or critical, in the sense of having emergent behaviour, high costs of maintenance and upgrading, or significant risks from failures while in operation.

While embracing the need for development processes to be iterative and recursive, systems engineering recognises there is still a need to model and develop products in a way that is first and foremost concerned with the behaviour of the system as a whole. Thinking in these terms has produced the 'V model', as a distinctive take on the product life cycle. Systems engineering methods strongly emphasise an ability to model the whole system, alongside a scientific methodology of requirements management, so its approach has to retain the clarity of project definition and process associated with a sequential life cycle model, while embracing the modern engineering reality of recursion, iteration, adaptability and change.

At the most basic level, the V model is built around the idea that projects both begin and end with a broad functional understanding of the system and its behaviour. The concept of operation – the understanding of stakeholder needs, system capabilities and performance measures – corresponds to how the whole system is evaluated once in operation and maintenance.

Moving further down the V increases the level of detail with which the process is concerned, with corresponding processes for definition and for test and integration on either side of the V.

Verification and validation are primarily conducted against the definitions provided by the equivalent stage. From the beginnings of the V model, recursion along those defined horizontals was encouraged as a clear process for achieving specified functionality.

The V model is about the engineering process for the system as a whole, and the 'requirements and architecture' stage is about translating customer needs into atomised and scientific requirements, and using those requirements to build a network model of the system which treats individual components as black boxes.



Because of this, the model is fairly agnostic about the process for controlling work in the implementation phase, and subsystem components can be built using a wide variety of processes. Systems engineering is about understanding and assuring the system as a whole.

Even with respect to the whole, the model has adapted to insights from Continuous Engineering and Agile to describe the engineering process more dynamically, by allowing for recursive interactions between adjacent life cycle stages, and allowing for iterated development of future phases.

Because systems engineering is focused on a clear process for the translation of needs into requirements and the development of adaptable whole-system models, investing in systems engineering activity in the first iteration of a development process can ensure the process of continuous improvement does not lose sight of the big picture.

We believe adapting systems engineering to your products is about building up skills, improving processes, and accessing the right tools. In business, what you don't know absolutely can hurt you, and understanding systems engineering gives a range of opportunities to engineer better throughout the life cycle. 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.

This article is part of SyntheSys Technologies six-part series exploring the fundamentals, principles and practices of systems engineering.

For the full series, visit: https://bit.ly/2AQWt3H

Systems Engineering Essentials

# Introducing Version 7.0 of Engineering Lifecycle Management

IBM<sup>®</sup>'s toolset has now been renamed to better reflect the capabilities of each application:

- IBM<sup>®</sup> Engineering Requirements Management DOORS<sup>®</sup> Next helps teams capture, trace, analyse, and manage requirements while complying with industry standards and regulations;
- IBM<sup>®</sup> Engineering Workflow Management helps teams manage development work, such as iteration and release planning, change management, defect tracking, source control, and build automation;
- IBM<sup>®</sup> Engineering Test Management helps teams plan, construct, and execute tests throughout the development life cycle;
- IBM<sup>®</sup> Engineering Systems Design Rhapsody<sup>®</sup> - Model Manager connects with IBM<sup>®</sup> Rhapsody<sup>®</sup> to help teams architect and design software and systems in an iterative and collaborative way;
- The IBM<sup>®</sup> Engineering Lifecycle Optimization applications provide reporting and process management functionality across the entire life cycle:
  - Engineering Insights helps teams
     visualise life cycle data to make the
     best engineering decisions;
  - Publishing automates the generation of document-style reports across deployed Jazz products and third-party tools;
  - Method Composer helps to define and publish process descriptions, critical to complying with standards such ISO 26262, ASPICE, and CMMi.



#### IBM® Engineering Lifecycle Management (ELM)

The toolset is collectively named IBM<sup>®</sup> Engineering Lifecycle Management, or ELM. It is a set of integrated tools that work together to offer full traceability across the engineering process.

Allowing the data from the different application areas to be connected seamlessly together helps to break down the traditional engineering silos and enhance collaboration between and within teams.

Users can easily access their data through the secure web-based interface to quickly see the single source of the truth.

Cross-application reporting and traceability allows engineers to analyse the impact of change and understand the current status of projects using live data.





The difference in navigating modules is immediately noticeable and the interface feels more responsive than ever.

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Log in to IBM Engineering Lifecycl

The applications have undergone a huge makeover. IBM®'s Carbon design system has been applied across the toolset to provide a clear design philosophy and more consistency across the platform. As part of the rehaul, menus have been tweaked to allow easier navigation throughout the system and the interfaces have been simplified to help improve performance.

IBM<sup>®</sup> DOORS<sup>®</sup> Next has seen a huge boost in performance and scale. 9x improvement in data scale for each Requirements Management (RM) application server based on release testing. Support for 20 million artefacts per-server (Oracle) and 10 million artefacts per-server (DB2) for 500 concurrent users with a smaller server footprint. The difference in navigating modules is immediately noticeable and the interface feels more responsive than ever.

The use of Link Validity has been greatly expanded. Previously restricted to configuration-aware projects, Link Validity is the simple way of dynamically tracking the state of change across a project. Reports can also now utilise Link Validity data to more appropriately filter results.

Get more notifications than ever before. Twenty-six new events have been added in the applications to allow users to get messages when relevant actions are happening, further enhancing collaboration within the system.



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### Momentum is your Friend - Speed your Ally

SyntheSys Supports Major Rail Player

SyntheSys Technologies has been working with a major tier-one rail organisation to mitigate risk and reduce overspend by applying systems engineering techniques with the use of powerful IBM® Requirements Management software.

All engineering in the rail industry, from signalling to rolling stock, involves managing complex technical and regulatory requirements. This complexity creates huge cost and timing risks.

Research shows that lacking clear requirements is the most common reason why complex projects come in late or over budget. Understanding requirements at an early enough stage to reduce risk needs the right skills, the right process and the right tools.

No complex project is without surprises and unexpected costs, but the later those surprises come, the more expensive they will be. We're helping customers address those risks going forward by using IBM Watson IoT™ DOORS® to manage their requirements.

IBM<sup>®</sup> DOORS<sup>®</sup> Family and IBM<sup>®</sup> DOORS<sup>®</sup> Next are collaborative requirements management tools designed to optimise, communicate and verify your requirements while providing an automated way of collaborating with your team. They allow you to capture, trace, analyse and manage changes to information and demonstrate compliance to regulations and standards.

As an IBM Watson IoT<sup>™</sup> Gold Business Partner, SyntheSys provides a unique blend of application knowledge, experience and a flexible delivery mechanism. With deep experience in the rail industry and others, we provide bespoke implementations and can help you manage the transition to better requirements management tools. We offer flexible licensing options, training and mentoring services, and can deploy solutions either on premise or in the cloud.

If you would like to hear more about how we are assisting engineering organisations working in fast-paced industries such as Rail, Automotive, Energy and Aerospace, contact us via: cet@synthesys.co.uk or telephone: +44 (0) 1947 821464.

### **IBM® Engineering Requirements Quality Assistant**

### Bringing Artificial Intelligence (AI) into your requirements management processes to improve the quality of your requirements as you write them.

Requirements are the cornerstone of your engineering developments. Any errors contained in your requirements will translate to your end product. When added to other IBM® Requirements Management tools, Requirements Ouality Assistant provides intelligent functionality which increases the quality of your requirements as you write them. The tool ensures you are writing complete, clear and testable requirements by using Watson Natural Language Service and Al.



To discuss how you or your organisation may utilise IBM® Engineering Requirements Quality Assistant, contact: cet@synthesys.co.uk

# Free Resource

# Continuous Engineering for Dummies

Continuous Engineering DUNIE

Courtesy of IBM<sup>®</sup>, we are able to offer readers this foundation level publication which aims to explore what is meant by 'Continuous Engineering' and the merits of continuously improving complex product designs. The useful E-BOOK shares methods for anticipating and responding to markets and clients and suggests ways of getting the most out of your engineering resources. 110V-

### visit: http://bit.ly/30rL8iH to download the FREE E-BOOK