

Optimise

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ISSUE 12

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SyntheSys Technologies' Formal and Bespoke Training Packages

An Introduction to Systems Engineering with Requirements Writing

This two-day course provides a high-level foundation to the principles and practices of systems engineering with specialist Requirements Writing modules. The course content is aligned with the International Council on Systems Engineering (INCOSE) Systems Engineering Handbook and provides an introduction and overview of the processes required for successful systems engineering delivery of projects.

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Our scheduled United Kingdom (UK) courses are held in Lincoln, centrally located on the university campus at the Think Tank. The cost of all courses includes a copy of the relevant manual, copies of the presentations as handouts, lunch, and refreshments throughout.

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-  **INCOSE SEP Exam Preparation Taster Session**
-  **Systems Engineering Fundamentals**

For prices, further information or to book on any of our courses, contact us by emailing: training.sys-eng@synthesys.co.uk or telephone +44 (0) 1947821464

Letter from the MD



Mark Williamson, Managing Director
SyntheSys Technologies

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Exploring Model-Based Systems Engineering and the Next Era of Engineering & Manufacturing

I'd like to extend a warm welcome to the latest edition of Optimise Magazine which aims to present an array of articles, features, and insights that we have carefully curated for your enjoyment and enlightenment.

In this issue, we deal with a pertinent theme which will no doubt be of interest to manufacturing & engineering organisations across a breadth of sectors. On Page 6, we explore how Systems Engineering catapults Engineering & Manufacturing organisations operating in the next era of industry, Industry 4.0. Some call this 'The Fourth Industrial Revolution'.

I'd like to extend my personal thanks to Managing Consultant, Mark Best from Frazer-Nash Consultancy for his contributions to our latest customer story on Page 9. Model-Based Systems Engineering (MBSE) has been the subject of many of our customer conversations recently, and we wanted to pay tribute to this growing area by highlighting how high profile organisations such as Frazer-Nash are shifting their approach to that of a model-based systems development one.

And for those new to the concept, our very own Matt Hirschfield offers some insights into MBSE on Page 8, which we hope acts as a useful support act to the Frazer-Nash feature.

I'd like to take this opportunity to extend a personal invitation to IBM® Engineering Lifecycle Management users (namely those using tools such as DOORS® Classic, DOORS® Next, Engineering Workflow Management, Engineering Test Management and Rhapsody®) to our next User Day, which will be hosted by Telent, in Warwick on 25th April 2024.

Further information can be found here:
<https://synthesysystemsengineersltd.mydportal.com/elmuserevent1>

We detail information about our upcoming Systems Engineering training throughout the magazine, and I would be thrilled to hear from individuals and teams at any level who may be looking to upskill in systems engineering.

I would like to express my sincere appreciation for the unwavering support of our clients, partners, and stakeholders. Your trust and collaboration have been instrumental in our achievements, and we look forward to fostering these relationships as we navigate the exciting path ahead.

Very best regards,

Mark Williamson, Managing Director
SyntheSys Technologies

Issue 12

To subscribe go to:
www.optimiseSE.co.uk

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SyntheSys Technologies Presents.....

IBM® ENGINEERING LIFECYCLE MANAGEMENT

FUTURE FORWARD USER DAY

25th April 2024 | Warwick | Hosted by Telent

A day dedicated to the ELM user community

Visit: <https://bit.ly/3uDupMX>



SyntheSys News

Mark Williamson Maintains IBM® Champion Status

We are thrilled to announce Mark Williamson's continued 'IBM® Champion' status.

IBM® Champions demonstrate practical expertise in IBM® technologies while providing extraordinary support and advocacy in IBM® digital and local communities.

The IBM® Champions program recognises these innovative thought leaders in the technical community and rewards their contributions by amplifying their voice and increasing their sphere of influence. IBM® Champions are enthusiasts and advocates, IT professionals, business leaders, developers, executives, educators, and

influencers, who support and mentor others to help them get the most out of IBM® software, solutions, and services.

Congratulations Mark!

Here's to another fun year of enablement, customer engagements and the delivery of IBM® technical services.

To speak to Mark directly about how he and the team can support your current IBM® Engineering Lifecycle Management licence implementation and technical infrastructure, contact us via: cet@synthesys.co.uk



Kicking off 2024 with our First INCOSE Systems Engineering Professional (SEP) Exam Preparation Course

It is no secret that passing the International Council on Systems Engineering (INCOSE) SEP examination and certification process is no mean feat. With 338 pages of literature to acquaint yourself with, followed by a two-hour examination, it's clear that proper preparation is the key to success.

Which is why delegates from Cavendish Nuclear, Leonardo, and Metrea Mission Data joined us at the first of our 2024 exam preparation courses at the Think Tank, on Lincoln University campus.

Our course combines real-world scenarios with theory presented in the INCOSE Systems Engineering handbook to provide delegates with a unique learning experience focused on the examinable content.

On successfully completing the course, students will be able to confidently sit the INCOSE SEP Examination.

Our thanks go out to our students on this latest course, and we invite those working towards certification to reach out via: cet@synthesys.co.uk, if you would like to hear more about course dates, prices and content.



For more general information, visit: <https://www.synthesys-technologies.co.uk/training.html>

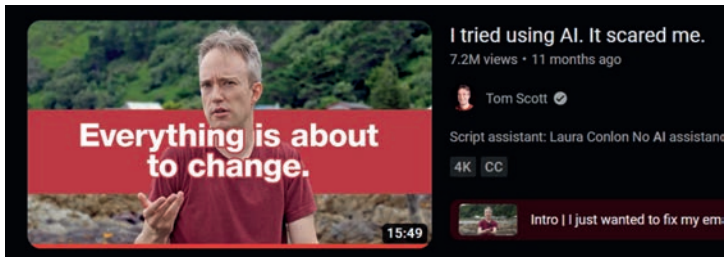
Everything is About to Change: Embracing Industry 4.0 and the Crucial Role of Systems Engineering

Introduction

I'm sure that everybody has gone through 'that moment' by now. That moment when you first started playing around with your first Artificial Intelligence (AI) capability and were left stunned by the results.

For me it was putting requests into ChatGPT for some database scripts and thinking back to my early days of working as a junior database engineer. The impact on roles like that will be massive. It's scary. I was left asking lots of questions about the role of AI and the changes it will make on society.

These kinds of emotional journeys came to mind recently when I heard the news that popular technology YouTuber Tom Scott is to 'retire' from making videos after 10 years. One of Scott's videos that has really stuck with me was the one titled 'I tried using AI. It scared me'¹. It really encapsulates that phenomenological effect of discovering AI for the first time, and the daunting questions we have in front of us.



Tellingly, the story that Scott tells about his use of ChatGPT to fix his email problem reveals that the issues he encounters is more about the commands he issues to the AI, and the sources that the AI uses, rather than ChatGPT itself. To truly put my systems engineer hat on: by being able to specify the right requirements, the AI can engineer the solution correctly. This kind of framing makes me think about exactly the kind of role that systems engineering will play in the industrial AI world – now sometimes dubbed 'Industry 4.0', and how crucial it will be to ensure that our engineering processes are harmonised to fully utilise this technology.

In the era of Industry 4.0, where the convergence of digital technologies and physical processes is transforming the landscape of manufacturing and production, systems engineering emerges as a critical player in orchestrating the seamless integration of complex systems.

Industry 4.0 represents the Fourth Industrial Revolution (4IR), characterised by the extensive use of automation, data exchange, artificial intelligence, and other cutting-edge technologies. This paradigm shift demands a holistic approach to design and operation, and systems engineering stands at the forefront of this transformation.



Author: Matt Mendell
Senior Consultant

Matt began his career in the healthcare industry working as a database engineer, then expanding his role in systems management, training and agile development.

To read Matt's full professional bio, visit: <https://www.synthesys.co.uk/our-people.html#m-mendell>

4IR has ushered in an era of unprecedented technological advancements, transforming the way we live, work, and produce. At the heart of this revolution lies systems engineering, a discipline that plays a pivotal role in orchestrating the integration of cutting-edge technologies and ensuring their seamless functioning. As industries across the globe grapple with the complexities of 4IR, understanding and embracing the principles of systems engineering becomes imperative for sustainable success.

Understanding Systems Engineering

Systems engineering is an interdisciplinary approach that focuses on designing, integrating, and managing complex systems over their entire life cycles. In the context of Industry 4.0, it becomes the linchpin for aligning diverse technologies, processes, and stakeholders to create intelligent, interconnected systems capable of adapting to dynamic environments.

Key Components of Systems Engineering in Industry 4.0

Holistic Approach to Design:

In this new era, technology is not siloed; it's integrated into every aspect of industrial processes. Systems engineering takes a holistic approach to design, considering the entire life cycle of a system. From concept and development to implementation and decommissioning, this approach optimises efficiency and minimises risks throughout the system's existence.

Interconnectedness and Interoperability:

Systems engineering addresses the challenge of connecting diverse components within the manufacturing ecosystem. By fostering interoperability, it enables seamless communication between different devices, machines, and software applications. This interconnectedness forms the foundation for efficient data exchange and real-time decision-making. One of the defining features of 4IR is the convergence of digital, physical, and biological systems. Systems engineering provides the framework for designing and managing these interconnected systems. Whether it's the Internet of Things (IoT), artificial intelligence, or advanced robotics, systems engineering ensures

these technologies work in harmony, fostering a cohesive and synergistic industrial ecosystem.

Data-driven Decision Making:

Industry 4.0 relies heavily on data analytics and machine learning. Systems engineering ensures the integration of data sources and analytics tools, allowing organisations to derive valuable insights. This data-driven decision-making capability enhances efficiency, reduces downtime, and enables predictive maintenance strategies. Data is the lifeblood of the Fourth Industrial Revolution. Systems engineering facilitates the integration of data analytics, machine learning, and artificial intelligence into industrial processes. This data-centric approach enhances decision-making capabilities, enabling organisations to derive meaningful insights, predict trends, and optimise performance.

Adaptive and Agile Systems:

The dynamic nature of Industry 4.0 requires systems that can adapt to changing conditions swiftly. Systems engineering principles facilitate the creation of adaptive and agile manufacturing processes, allowing companies to respond to market demands with flexibility and speed.

Security and Resilience:

With increased connectivity, cybersecurity becomes a paramount concern. Systems engineering addresses the security challenges associated with Industry 4.0, implementing robust measures to protect data integrity, confidentiality, and system availability. Moreover, it emphasises building resilient systems that can withstand cyber threats and recover quickly from disruptions. With the increased connectivity of devices and systems, cybersecurity becomes paramount.

Systems engineering addresses the challenges of securing cyber-physical systems, implementing robust measures to safeguard against cyber threats. This ensures the reliability, integrity, and confidentiality of data in an interconnected industrial environment.

Life Cycle Management:

Industry 4.0 systems have extended life cycles, and effective management throughout these stages is crucial. Systems engineering ensures a comprehensive approach to the entire life cycle, from concept and design to operation and eventual decommissioning. This holistic perspective optimises performance, reduces costs, and minimises environmental impact.

Benefits of Implementing Systems Engineering in Industry 4.0

Enhanced Efficiency:

The integration of systems engineering principles optimises processes, leading to increased efficiency and productivity. Automation and data-driven decision-making contribute to streamlined operations and resource utilisation.

Systems engineering optimises industrial processes, leading to increased efficiency and resource utilisation. By integrating disparate technologies seamlessly, organisations can streamline operations and reduce waste.

Innovation and Competitiveness:

Systems engineering fosters a culture of innovation by encouraging collaboration between different disciplines. This interdisciplinary approach enables organisations to adapt quickly to technological advancements and market changes. The interdisciplinary nature of systems engineering encourages collaboration and innovation. Companies that embrace systems engineering principles are better equipped to stay ahead of the curve, leveraging emerging technologies to maintain a competitive edge.

Cost Reduction and Risk Mitigation:

By providing a systematic and holistic view, systems engineering helps in identifying redundancies, eliminating inefficiencies, and optimising resource allocation, ultimately leading to cost reduction. The comprehensive approach of systems engineering allows for thorough risk assessment and mitigation. By addressing potential issues at the design stage, organisations can minimise the likelihood of disruptions and failures during operation.

Improved Quality and Reliability:

Rigorous testing and validation processes inherent in systems engineering result in improved product and process quality. The reliability of interconnected systems is ensured, reducing the likelihood of failures and defects.

Sustainability:

The life cycle approach of systems engineering contributes to sustainable practices. By optimising resource use, reducing waste, and considering environmental impact throughout a system's life, organisations can align with the principles of corporate social responsibility and environmental sustainability.

Conclusion

As Industry 4.0 continues to reshape the manufacturing landscape, systems engineering emerges as a vital catalyst for success. Its holistic and interdisciplinary approach facilitates the seamless integration of advanced technologies, ensuring that organisations can thrive in the dynamic and interconnected world of Industry 4.0. Embracing systems engineering principles is not merely an option but a necessity for companies aspiring to remain competitive, innovative, and resilient in the rapidly evolving industrial landscape.

As we navigate the Fourth Industrial Revolution, systems engineering emerges as the guiding force, enabling organisations to harness the full potential of advanced technologies. By embracing a holistic and interdisciplinary approach to design, implementation, and management, companies can not only survive but thrive in the dynamic landscape of 4IR. Systems engineering is the key to unlocking the true potential of the technological marvels defining our era, paving the way for a future where innovation, efficiency, and sustainability coexist harmoniously.

¹ **Reference:** *I tried using AI. It scared me. (2023) YouTube video, added by Tom Scott [Online]. Available at: <https://youtu.be/jPhJbKBuNnA> [Accessed January 2024]*

Model-Based Systems Engineering - A Fitness Plan

The beginning of a new year is generally the time that we set our targets for the coming year, be they personal or professional. For me 2024 has started in the usual vein, by assessing my previous year's performance. On the personal side, comes my annual re-evaluation of my personal fitness levels, taking stock of the number of mince pies and how much alcohol I consumed over the holiday period and considering whether another attempt at dry January would be an effective counter measure?

**Author: Matt Hirschfield
Consultant**

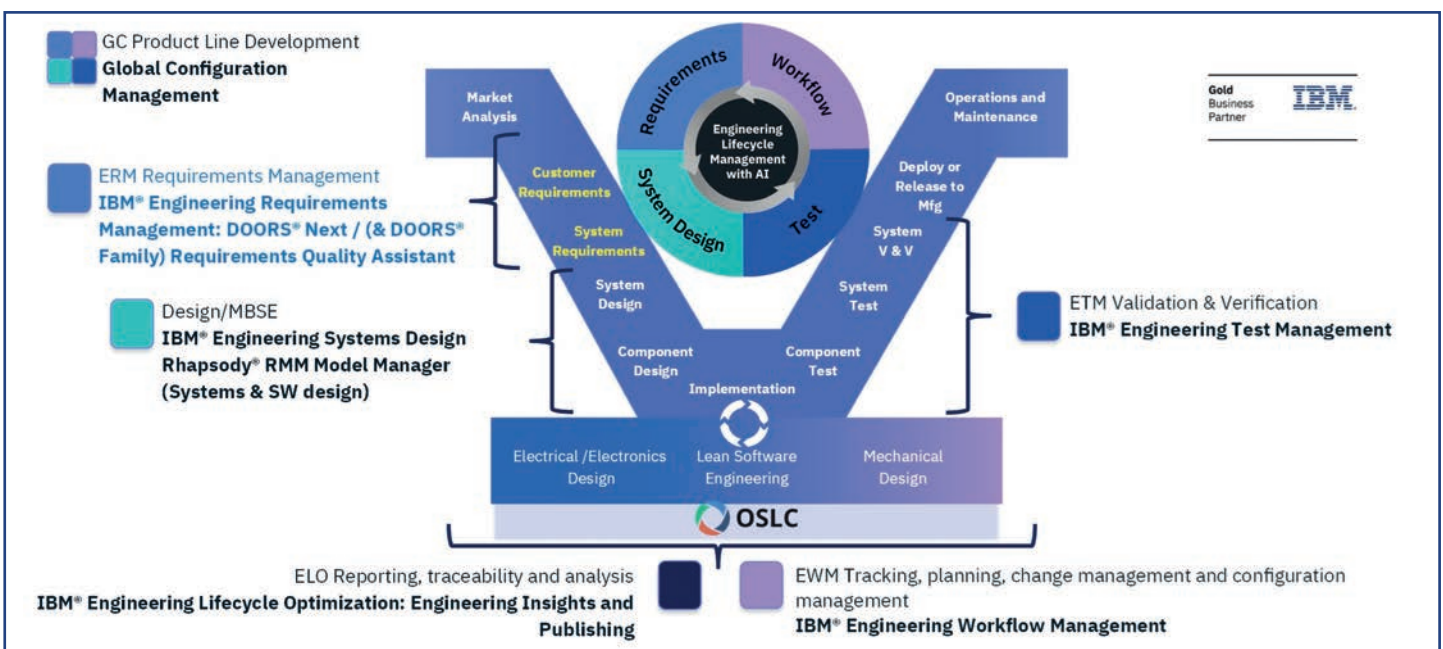
Matt started his working life as a trainee electronic engineer and explored various engineering disciplines.

To read Matt's full professional bio, visit: <https://www.synthesys.co.uk/our-people.html#m-hirschfield>



Anyway, let's stop there and move on to my professional reflections! At the beginning of 2023, I set myself a number of goals, one of which was to develop my understanding of Model-Based Systems Engineering (MBSE). This was mainly driven out self-interest at the time, but as it turned out, many of our customer engagements during 2023 involved some desire, no matter how distant, to embrace the concept of MBSE. For those of you reading this who have no idea what MBSE is, it's essentially developing, verifying and validating system design requirements, using diagrams and can allow a business to produce a digital prototype of a system or process being developed.

It seems like a good point in proceedings to reuse the Systems V model SyntheSys uses in our training material, to illustrate where MBSE sits from the IBM® Capabilities perspective.



MBSE, delivered through the IBM® Rhapsody® application, is the step on the left-hand side of the 'Systems V' between the Requirements effort and the implementation of the Design.

Even a clearly written set of textual design requirements can become overwhelming for many engineering teams. Indeed, managing hundreds or thousands of textual requirements becomes a difficult task even with state-of-the-art Requirements Management software. The perceived value from MBSE or any aspect of systems engineering for that matter, is that increased understanding of a system's properties and behaviour, as early as possible in the development stages of the project, will ultimately improve the chances of a successful project outcome. Some may know it as 'left shifting', or 'front loading' development costs to avoid the costs of rework or redesigning late in the development cycle, to deliver a high quality product or service to customers. In its simplest form, MBSE allows engineering teams to design and define systems design diagrammatically rather than textually, and as an organisation's maturity with the modelling approach develops, MBSE techniques can be further extended to simulate system operation, risk evaluation and even generate software code and test effort, directly from the model data.

Should you wish to learn more about MBSE in your organisation, reach out to talk to us by emailing: cet@synthesys.co.uk or check out the SyntheSys Technologies website at: www.synthesys-technologies.co.uk

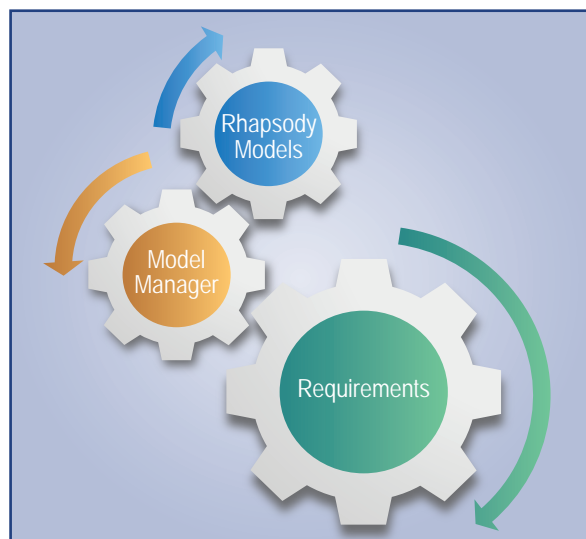
Frazer-Nash Consultancy Transitions to a Defacto Model-Based Approach

In recent years, the continued growth of systems engineering across a wide range of industries, has led to a wealth of software tooling options becoming available to support organisations wishing to adopt a systems engineering approach to developing and delivering their products and services. Whilst this is a welcome driver for improvements in capability and performance for the software on offer, this can pose a challenge for organisations such as Frazer-Nash Consultancy.

As an organisation providing systems engineering services across a wide breadth of industries and customers, Frazer-Nash Consultancy invests in a wide set of Requirements Management and modelling software tools such as IBM® DOORS® Next, Dimensions RM, Jama Connect, Cameo and Enterprise Architect, to support the needs of their clients with their systems engineering requirements.

The 'tool-to-use' decision is often driven or constrained by the needs of their clients, leading to cost challenges around training staff on a wide range of the tools, as well as the difficulty in demonstrating traceability from requirements to systems models across tools from different vendors.

By expanding their existing toolset, Frazer-Nash enriched the decomposition of stakeholder requirements through systems modelling techniques whilst avoiding the manual transfers between different requirements and modelling tools.



In the face of these challenges, the team at Frazer-Nash determined there was a case for redefining their business model to adopt Model-Based Systems Engineering (MBSE) as their 'default way of working', through a standard set of tools. The business driver for this change, was ultimately to reduce the time and cost of delivering their core services, with the caveats of not impacting the overall quality of the services delivered whilst maintaining the flexibility to exchange data across vendor solutions.

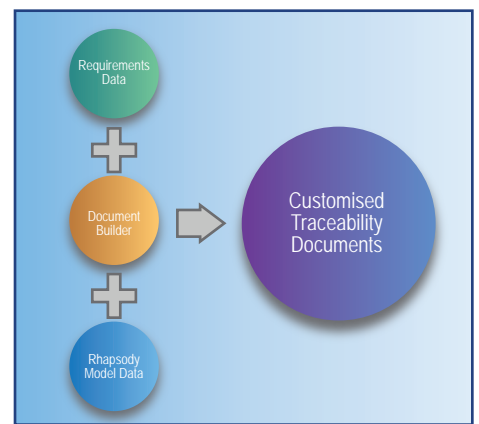
As a long-standing business partner to Frazer-Nash Consultancy, SyntheSys Technologies was tasked with supporting the Frazer-Nash team through this transition.

Frazer-Nash already had the IBM® Engineering Lifecycle Management DOORS® Next tool, as part of their current

tool-scape, as well as Rhapsody® and IBM® Engineering Lifecycle Optimization Publishing as separate standalone applications. These tools were seen as the foundations for a more standardised approach to adopting MBSE as the applications form a single platform solution.

By expanding their existing tool-scape to include IBM® Rhapsody® - Model Manager, the Frazer-Nash team are now able to link their existing DOORS® Next data to their Rhapsody® Models, allowing the team to enrich the decomposition of initial stakeholder requirements and system requirements through systems modelling techniques. Rather than exporting requirement data into another format, then importing the requirement data into the modelling tool, live traceability links are established between data in the requirements management domain and model elements in the Rhapsody® domain. Adding the IBM® Lifecycle Optimization - Document Builder capability provided a method for DOORS® Next users to generate customised documentation and reports directly from the DOORS® Next interface, without the need for deploying additional local instances or purchasing more licenses for the Publishing application.

Over a series of remote consultancy and training sessions, key stakeholders within the Frazer-Nash team received Rhapsody® training and enablement, allowing them to not only become a key component in the development of the Frazer-Nash MBSE process, but also gaining valuable insight and hands-on expertise in using IBM® Rhapsody® to streamline the MBSE process. This enabled the team to develop tool specific process documentation, to help others within the organisation to use the IBM® solution to deliver MBSE. The same stakeholders received enablement on using the IBM® Publishing Engine to develop their own templates to create documentation and develop Frazer-Nash Consultancy branded document templates.



SyntheSys Technologies Helping to Drive Progression

The Frazer-Nash team continually strive to embrace new technologies and more efficient ways of working. Having a clear vision to get the right collaborators and stakeholders involved ensures this ongoing project progresses at speed and delivers all the intended benefits. We were very happy to support the team via our systems engineering and consultancy services, the deployment and extension of IBM® ELM tool licensing and our robust training and enablement offerings.

In systems engineering terms, Frazer-Nash have effectively 'left-shifted' their business model by investing in staff and tools, focusing on the value, rather than the cost of change.

Organisational and Engineering Value was delivered through the following key deliverables:

- Enhanced tool capability, delivering a one platform integrated solution for MBSE effort;
- Enhanced team capability through team MBSE enablement;
- An MBSE business process, developed to meet the needs of the business, that current and future team members can rely on to deliver consistent levels of service and value to existing and new customers;
- Reduced manual effort around delivering key project documentation through the deployment of standard automated document templates.

Managing Consultant, Mark Best, leading the project at Frazer-Nash Consultancy commented:

“As a consultancy we are tasked to work with many tool vendors depending on our clients’ needs, we wanted a number of base tool suites we could use in order to create a foundation for our expertise to reside with, so when I was challenged to modernise our IBM® tool chain, I reached out to SyntheSys Technologies for two reasons: one, I have worked with them for over 15 years in my previous role at IBM® and secondly, they deliver an effective service delivery in terms of tool and process support at a price that is fair, compared to other suppliers. We added both a modelling and publishing capability to enable a better choice of tools that we can use with our clients. SyntheSys deliver their services with a friendly approach and always remain flexible as tool induction can sometimes be drawn out when trying to introduce change to an organisation.”

IBM® Engineering Systems Design Rhapsody®

A robust solution for system design and modelling which facilitates the delivery of high quality systems and software.

IBM® Engineering Systems Design Rhapsody® and associated products, offer an effective solution for modelling and systems design activities that allows you to manage the complexity many engineering businesses face with product and systems development. You can:

- Analyse and extend project requirements
- Move from system design to implementation faster
- Generate system and organisation documentation in an automated manner, whilst also automating design review
- Validate early, through prototyping and simulation
- Work in a real-time, embedded and agile, engineering development environment

If you would like to know more about how Rhapsody® can transform your engineering system design and development contact us via: cet@synthesys.co.uk

Systems Engineering Resources Hints & Tips



What is the Purpose of Verification & Validation?

What is the Purpose of Verification & Validation within the Systems engineering Life Cycle?

<https://bit.ly/3SDekQv>



The Complexity Gap

Managing Complexity in rail supply using proven systems engineering methods.

<https://bit.ly/47Wakdu>

Requirements Management: Fundamental to Successful Collaborative Engineering

A high-level overview of Requirements Management.

<https://bit.ly/4bgzJq0>



Compliance with Standards and Legislation through Collaborative Engineering Management

SyntheSys' approach to systems engineering with expert personnel and appropriate tool support.

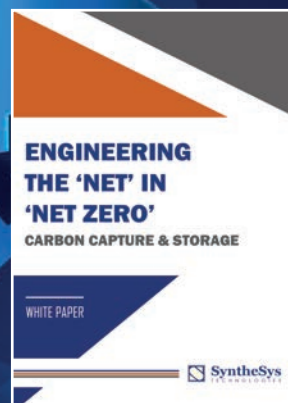
<https://bit.ly/3HEgHMQ>



Agile Delivery in a System-of-Systems Context

Agile delivery in a System-of-Systems context, more than the sum of its parts.

<https://bit.ly/43izSG5>



Engineering the 'Net' in 'Net Zero'

Carbon Capture and Storage.

<https://bit.ly/3SyF1G1>

For more reading resources around systems engineering, visit our resources page on our website: <https://www.synthesys-technologies.co.uk/downloads.html>

... And Much More!!



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