



34th Annual **INCOSE**
international symposium

hybrid event

Dublin, Ireland
July 2 - 6, 2024



Ian Symington, Chief Technical Officer, NAFEMS

Trends in Engineering Simulation

2-6 July 2024

www.incose.org/symp2024 #INCOSEIS



What is NAFEMS?



NAFEMS - The International Association for the Engineering Modelling, Analysis and Simulation Community

40 YEARS
OF NAFEMS
Setting Simulation Standards



2-6 July 2024

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NAFEMS - The International Association for the Engineering Modelling, Analysis and Simulation Community

>25,000 individuals

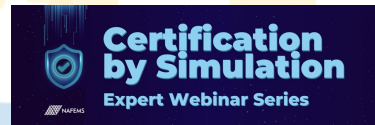
>1,500 organisations

1 community



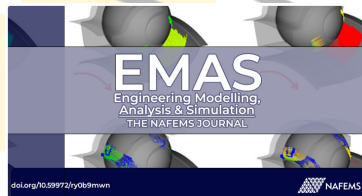
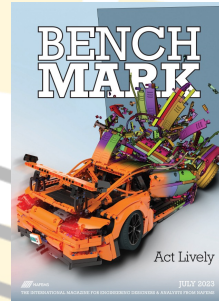
What we do

Events



Publications

Resource Centre
Magazines
E-Library
Whitepapers
Blogs
Student website
Journal



Trainings



On-demand
Online
On-site
Customized

...

Certification



Committees

Working Groups
Regional Groups
Council
Technical
Communities



Membership

Company
Academic
Student

Collaboration, networking
knowledge and information
exchange.



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Systems Modelling & Simulation Working Group

- Systems Modelling & Simulation Working Group was launched in 2013
- Bridging the worlds of Systems Engineering and Engineering Simulation

SMS Working Group Acts as a steering committee	Focus Teams Tasked with specific activities	SMS Community
<ul style="list-style-type: none"> • Roger Burkhart Thematix • Alexander Busch Ansys • Peter Coleman Airbus (Chair) • Hans Peter de Koning DEKonsult • Rodney Dreisbach NAFEMS Technical Fellow • Greg Garstecki Garstecki Modeling Solutions • Alexander Karl Rolls-Royce • Eric Landel ELC • Phyllis Marbach INCOSE Assistant Director Transformational Enablers • Sandeepak Natu CIMData • Frank Popielas SMS_Thinktank (Vice Chair) • Ian Symington NAFEMS Chief Technical Officer • Hubertus Tummescheit Modelon Inc • Mark Williams PDES-LOTAR • Kelly Zimmermann Boeing 	Roadmap & Best Practices Frank Popielas	631 registered (July) 547 NAFEMS 113 INCOSE >300 different organisations 37 different countries US & Canada = 40% Europe = 43% Asia = 14% Rest of the world = 2%
	Refining understanding of SMS Alexander Busch	
	SMS Standards Ecosystem HP de Koning	
	Terms & Definitions Greg Garstecki	
	SE Handbook 5E MA&S HP de Koning	
	SMS Models & Metadata Peter Coleman	
NAFEMS & INCOSE Members Small engaged team. Membership approved by existing SMSWG members	Lead by SMS Working Group member Community members encouraged to participate	Open to all INCOSE and NAFEMS members



Trends in Engineering Simulation



Trends



- Machine Learning
- Simulation Supporting Certification
- Upfront Simulation
- Compute Platforms

#1 – Machine Learning



- High level of submissions in this area at NAFEMS conferences
- Engineering Data Science Working Group formed in 2021
- Collaborate survey between McKinsey and NAFEMS launched in 2023
- AI Maturity survey launched in 2024



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- Seminars and Webinars

20 Nov 2024	Artificial Intelligence and Machine Learning in CAE-Based Simulation	Lund, Sweden
	Seminar	

29 May 2024	Introduction to Causal AI	Webex, Online
	Webinar	

14 Feb 2024	Data-Driven Engineering: AI/ML Trends and Insights for Engineering	WebEx, Online
	Seminar	

26 Oct 2023	AI & CAE: buone prassi ed esempi applicativi	Webex, Online
	Webinar	

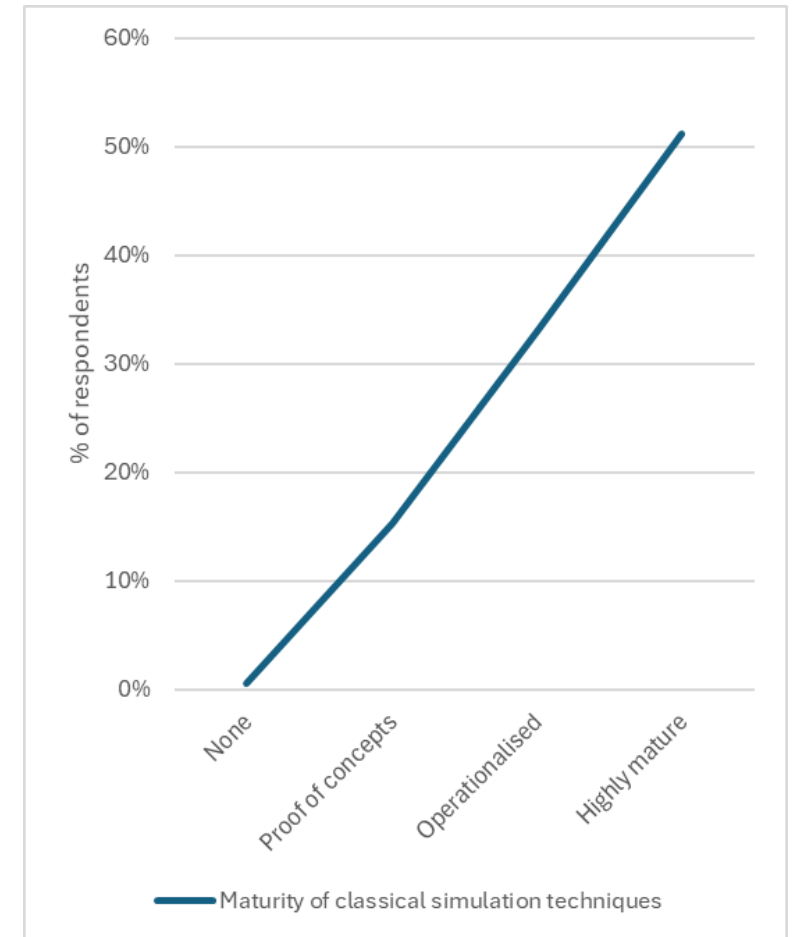
23 Oct 2023	Artificial Intelligence und Machine Learning in der CAE-basierten Simulation	München, Germany
	Seminar	

20 Sep 2023	Artificial Intelligence and Machine Learning for Manufacturing	Online, Online
	Seminar	

#1 – Machine Learning



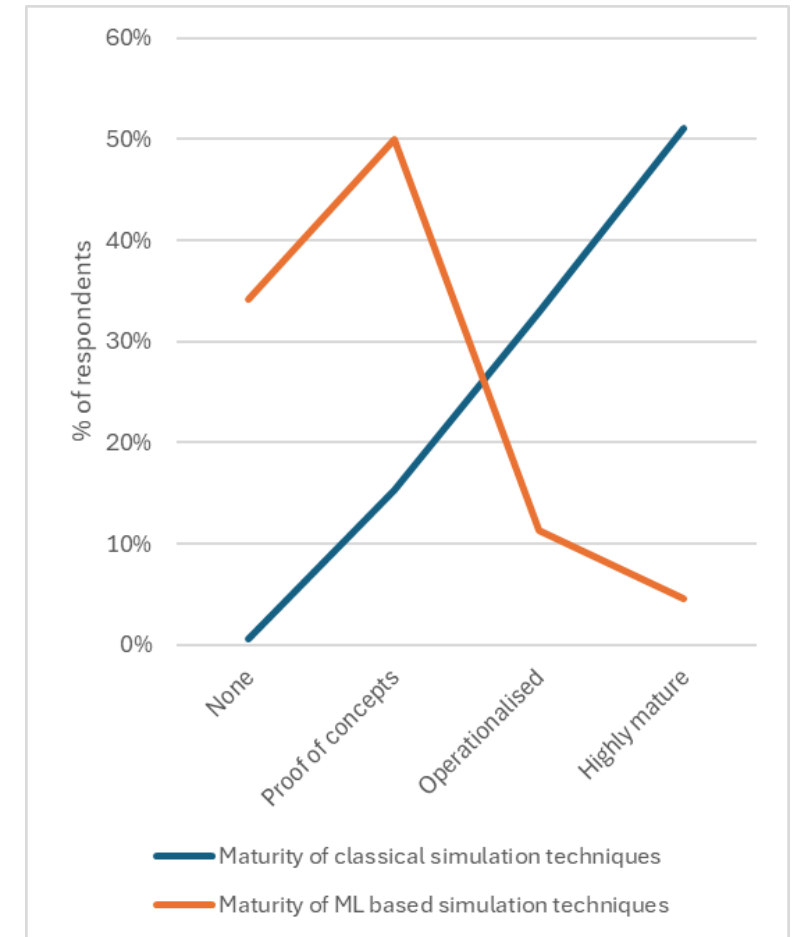
- Data from the 2023 Survey with McKinsey
- State of play maturity of physics-based modelling approaches



#1 – Machine Learning



- Data from the 2023 Survey with McKinsey
- State of play maturity of classical and ML modelling approaches
- 50% of respondents have a ML pilot study
- >10% have a operational ML capability



#1 – Machine Learning

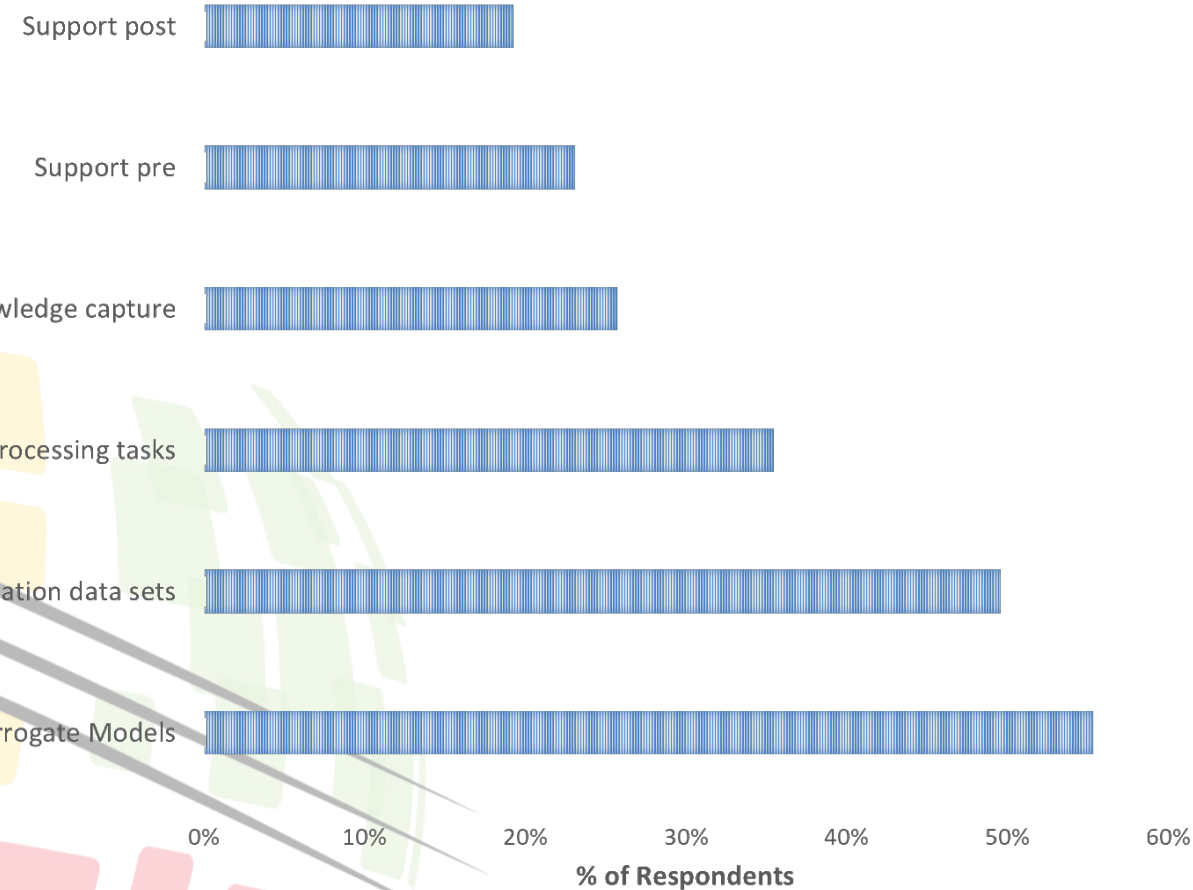


- Huge range of applications for ML in engineering simulation
 - Surrogate modelling for optimization
 - Reduced order modelling - bridge length scales
 - Geometric Deep Learning
 - Physics Informed Machine Learning
 - Real time applications
 - Supporting data processing
 - As an assistant

#1 – Machine Learning

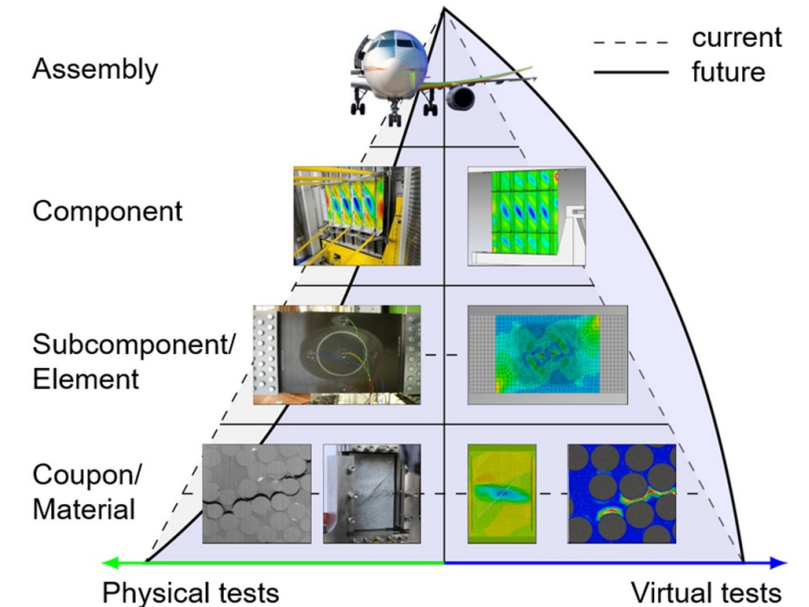


ENGINEERING SIMULATION USE CASES FOR ML



#2 – Simulation Supporting Certification

- Benefits of simulation
 - Speed
 - Cost
 - Enhanced understanding
 - Improved performance
- Relationship between simulation and physical test has evolved
 - More testing overall but tests are at a fundamental level
 - Reduction in the amount of physical testing carried out on component assemblies prior to final product testing
 - Reduction in the number of physical tests on the final product
- No appetite to see final product testing replaced by a virtual test
- Increased confidence during final product test as a result of simulation

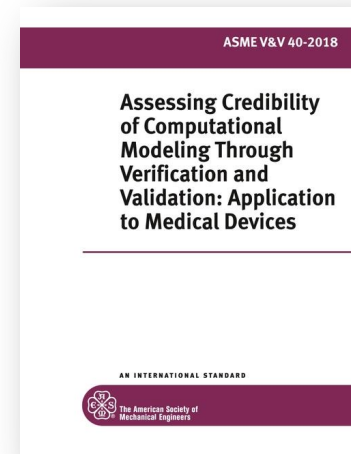


R. W. Hollmann, A. Schäfer, and O. Bertram et al., "Virtual testing of multifunctional moveable actuation systems," CEAS Aeronaut J, vol. 13, pp. 979-988, 2022.



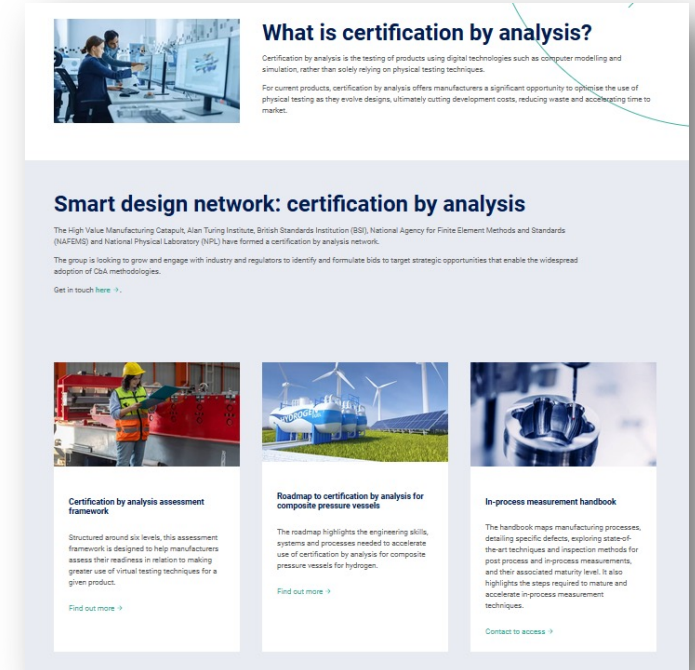
#2 – Simulation Supporting Certification

- Interest & activity in the use of simulation in the certification process
 - Medical Devices



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 - Biomedical
 - Aerospace
 - Automotive
- UK Smart Design Network
 - BSI
 - HVM Catapult
 - NAFEMS
 - NPL



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 - NAFEMS
 - NPL
- NAFEMS webinar series
 - 5 recordings available
 - Aerospace, Defence, Nuclear, Biomedical





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#3 – Upfront Simulation



- Simulation being used earlier in the design cycle
- Strong push from simulation vendors over the last two decades
 - Embedding simulation in CAD
 - Dedicated tools which were dumbed down version of general-purpose simulation tools
- Challenges with using simulation earlier
 - Ill defined product
 - Early simulation = more simulation = more users of simulation needed
 - Early simulation users may not be non-expert users
 - Simulation needs to be quick
 - Simulation needs to be tolerant of poor geometry

#3 – Upfront Simulation



- Recent years – progress has been visible
 - Sim Apps
 - Strong Governance
 - New Simulation Methods
- 2023 – NAFEMS formed the Upfront Simulation Working Group
- Appropriate skills, tools, hardware and V&V required at the appropriate time

