SMSWG - *SMS Terms & Definitions Committee (SMSTDC)*

February 2, 2021

Systems Modeling and Simulation*:
The use of interdisciplinary functional, architectural, and behavioral models (with physical, mathematical, and logical representations) in performing MBSE to specify, conceptualize, design, analyze, verify and validate an organized set of components, subsystems, systems, and processes.

*SMSWG – Terms & Definitions: https://www.nafems.org/about/technical-working-groups/systems_modeling/smstermsdefinitions/s-u/

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Purpose

The Systems Modeling and Simulation Terms and Definitions Committee is to be the **authoritative** source for systems modeling and simulation terms and definitions and provide ongoing strategic direction for the initiative.

Members Update

- Ed Ladzinski (chair)
- Paul Barnard
- Frank Popielas
- Joe Walsh
- Rod Dreisbach (new member)

Results

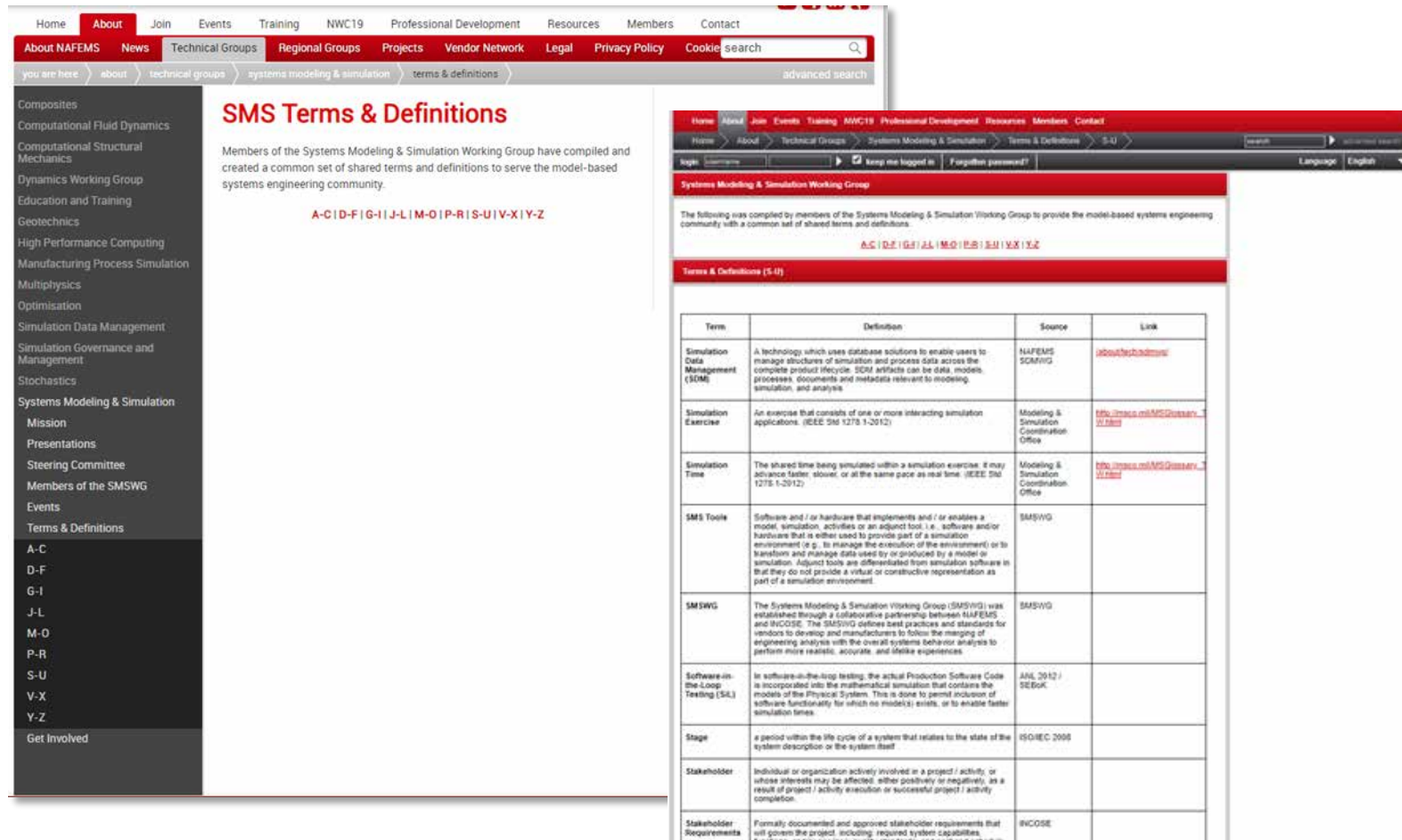| Proposed Term	Definition Proposal	Source	Comments	Sign-off
Model Based Development (MBDev)	The systematic use of models and modeling techniques as an integral part of the overall development engineering process.	NAFEMS SMSWG T&D Focus Team	Model-Based Development (MBDev) is a subset of Model Based Engineering (MBE).	7/21/2020
Democratization of Simulation	Expanding significantly the user community of Engineering Simulation capabilities that result in benefits of reduced time and cost, and more reliable product lifecycle studies.	NAFEMS SMSWG T&D Focus Team		7/21/2020
Engineering Simulation	The use of physics-based mathematical (numerical) models and/or logical models, including relevant data derived from their physical model counterparts, as representations of a conceptual or real-world system, phenomenon, or process in studying its technical requirements and operational behavior.	ASSESS and NAFEMS SMSWG T&D Focus Team		7/21/2020
Digital Twin	A digital surrogate that is a description of a physical asset such as one or more products, processes, systems, people and devices that can be used for various purposes. It makes use of data to/from its real-world asset and may change in tandem throughout the lifecycle of the physical asset.	NAFEMS SMSWG T&D Focus Team		7/21/2020
Generative Design	The use of algorithmic methods to create feasible designs of assemblies and components or outcomes from a set of performance requirements, objectives, constraints and specified use cases.	ASSESS inititive and NAFEMS SMSWG T&D Focus Team		7/21/2020
Simulation Governance	Executive management policies and procedures assuring that the business benefits of engineering modeling and simulation across the product lines are aligned with the strategic vision and goals of a company.	NAFEMS SGMWG Flyer		7/21/2020

Results

Term Candidate	Definition Proposal from the T&D Focus Team	Origin
Model-Based Engineering (MBE)	An approach to engineering that uses models as an integral part of the engineering processes that includes the requirements, design, analysis, implementation, and the verification and validation of a capability, system, and/or product throughout its life cycle." It is the umbrella for many other MBx activities.	Derived from (Final Report, Model-Based Engineering Subcommittee, NDIA, Feb. 2011).
Model-Based Systems Engineering (MBSE)	"The formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases." MBSE is a subset of Model Based Engineering (MBE) and Systems Engineering (SE).	INCOSE SE Vision 2020 (INCOSE-TP-2004-004-02, Sep 2007
Model-Based Design (MBD)	The use of models and modeling techniques as an integral part of the design phase of a development process. Model-Based Design is a subset of Model Based Engineering (MBE).	SMSWG T-D Committee
Model-Based Definition (MBD)/(MBDef)	The practice of using 3D models (such as solid models, 3D PMI and associated metadata) within 3D CAD software to define (provide specifications for) individual components and product assemblies. The types of information included are geometric dimensioning and tolerancing (GD&T), component level materials, assembly level bills of material, engineering configurations, design intent, etc." Model Based Definition is a subset of Model Based Design.	Derived from Wikipedia
Model-Based Safety Analysis (MBSA)	"An approach in which the system and safety engineers share a common system model created using a model-based development process. By extending the system model with a fault model as well as relevant portions of the physical system to be controlled, automated support can be provided for much of the safety analysis." Model Based Safety Analysis is a subset of Model Based Engineering.	Model-BaseC1:C16d Safety Analysis, NASA, Feb. 2006
Model-Based Enterprise (MBE)	An organization where models serve as the authoritative information source for processes beyond engineering. Model Based Enterprise is the culmination of Model Based Engineering.	Derived from Wikipedia

New T&Ds in the Pipeline

Proposed Term	Definition Proposal	Source	Comments
Hardware In the Loop (HIL or HIWL)	Hardware-in-the-loop (HIL) simulation, or HWIL, is aA technique that is used in the development and test of complex real-time embedded systems. HIL simulation provides an effective platform by adding the complexity of the plant under control to the test platform. The complexity of the plant under control is included in test and development by adding a mathematical representation of all related dynamic systems. These mathematical representations are referred to as the "plant simulation". The embedded system to be tested interacts with this plant simulation.	Hardware-in-the-loop simulation - Wikipedia	[ROD] An approach for testing a real embedded controller running interactively with electrical emulations of any sensors and actuators acting as interfaces with a digital plant simulation.
Software in the Loop (SIL)	Software-in-the-Loop (SIL) simulation represents the The integration of a compiled production source code into a mathematical model simulation, providing engineers with a practical, virtual simulation environment for the developing and testing of detailed control strategies for large and complex systems.	www.opal-rt.com/software-in-the-loop/	[ROD] The integration of a compiled production source code of a controller into a mathematical plant model simulation, providing engineers with a practical, virtual simulation environment for developing and testing detailed control strategies for large and complex systems.
Model in the Loop (MIL)	Model-in-the-loop testing (MIL) and simulation is a A technique used to abstract the behaviour of a system or sub-system in a way that this the model can be used to test, simulate, and verify the model.	Model-in-the-loop Testing Applications & Concepts (add2.co.uk)	[ROD1] A technique used to abstract the behaviour of a system or sub-system in a way that the model can be used to test, simulate, and verify the model.
Human in the Loop (HITL)	Human-in-the-loop or HITL is defined as A model that requires human interaction.[1][2] HITL is associated with modeling and simulation (M&S) in the a live, virtual, and constructive taxonomy. HITL models may conform to human factors requirements as in the case of a mockup. In this type of simulation a human is always part of the simulation and consequently influences the outcome in such a way that is difficult if not impossible to reproduce exactly. HITL also readily allows for the identification of problems and requirements that may not be easily identified by other means of simulation.	Human-in-the-loop - Wikipedia	[ROD] A model that requires human interaction with modeling and simulation (M&S) in a live, virtual, and constructive taxonomy.
Processor in the Loop (PIL)	Processor-in-the-loop (PIL) is a A physical test technique that allows designers to evaluate a real controller code running on a dedicated processor in conjunction with a simulated of a plant which runs inrunning on an offline simulation platform. By the other side, Hardware-in-the-Loop (HIL) is an approach to test a plant or controller running in a digital platform which interacts with the real controller or plant.	Processor-in-the-loop and hardware-in-the-loop simulation of electric systems based in FPGA - IEEE Conference Publication	[ROD] A physical test technique that allows designers to evaluate a real controller code running on a dedicated processor in conjunction with a simulated plant running on an offline simulation platform.

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First issued in 2016

Thank You