

2025 PLM Market & Industry Forum

Model-Based Systems Engineering: Optimizing Systems of Systems

Advanced engineering dates back to the Roman Empire. Growing cities needed potable water and roads to connect their expanding empire. Per capita water usage in ancient Rome approximated today's use in modern cities like New York City or Rome. Many roads and viaducts constructed in the distant past still exist, and some are still in use. Romans engineered, in part, through trial and error. Their vast resources and access to labor helped make their engineering goals a reality.

Over the centuries, practitioners used models to study "product" performance. Before the advent of computers, wind tunnels with streamers attached to surfaces of interest helped us understand and improve aerodynamics. Ship model basins have been used to test hull designs. The advent of digital computing enabled the construction of virtual models, with model tests virtually indistinguishable from tests using the physical product.

Technological advances enabled the development of more complex products that often interact with the environment (or each other). The notion of systems engineering emerged at Bell Laboratories in the 1940s. They had to consider and manipulate many elements when engineering a complex national telephone system. More broadly, others, such as the U.S. military and the aerospace and defense (A&D) industry, faced the same issue. The U.S. space program in the 1960s used the Mercury and Gemini programs as test beds for technologies and practices needed to achieve their ultimate goal, landing on the Moon. But, practitioners were reaching the limits of improvement through design iteration and needed a better way. Systems engineering required new methods and modeling techniques. In 1990, the

National Council on Systems Engineering (NCOSE) was founded to address the need to improve systems engineering practices and education. As more practitioners outside the U.S. participated, the organization's name was changed to the International Council on Systems Engineering (INCOSE).

Models are still at the core of this evolving engineering discipline. The notion of model-based systems engineering (MBSE) arose not long after INCOSE's founding. According to INCOSE, MBSE is 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 now moving out of its roots in A&D and automotive into a wide range of industries that are faced with designing, building, and managing smart connected products. CIMdata works with organizations like INCOSE and the International Association for the Engineering Modelling, Analysis, and Simulation Community (known as NAFEMS) to help advance the state of the art and practice of MBSE, but much work remains. How should we think about MBSE? What enables it? What use cases are important? What kind of benefits can we expect?

Since our founding over 40 years ago, CIMdata has helped to moderate such discussions for the betterment of the industry, and we have been actively promoting this topic for years. This year's PLM Market & Industry Forum theme, *"Model-Based Systems Engineering: Optimizing Systems of Systems,"* is a natural complement to last year's focus on the digital twin. MBSE presentations from

CIMdata will leverage research being conducted for the Aerospace & Defense PLM Action Group (AD PAG) and insight from our work with industrial organizations worldwide.

The first presentation will provide background on the work to date, clearly define MBSE and related topics, and provide the framework for the following sessions. The following two presentations will consider MBSE from the industrial perspective and the “PLM Economy” perspective focused on the software and service providers to help industrial companies reach their MBSE objectives. The afternoon session will close with a discussion of sustainability and “News from the Field” with highlights and learnings from CIMdata’s industrial consulting work since last year’s Forum.

We will also share CIMdata’s perspective on the current state of the PLM market and future trends in detail, including the first public release of CIMdata’s 2025 global PLM market analysis results. Attendees will gain access to valuable data and insights, including in-depth analyses and forecasts spanning PLM domains, industries, and regions, as well as

leading PLM solution providers’ performance by revenue and market share. Much of this information will not be publicly available until the 2025 MAR reports are published in late Spring and Summer.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise’s ability to design, deliver, and support innovative products and services by identifying and implementing appropriate digital initiatives. For nearly forty years, CIMdata has provided industrial organizations and providers of technologies and services with world-class knowledge, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) solutions and the digital transformation they enable. CIMdata also offers research, subscription services, publications, and education through certificate programs and international conferences. To learn more, visit www.CIMdata.com or email info@CIMdata.com.