

Wipro's NIMBLE Approach to Accelerating MBSE Adoption

CIMdata Commentary

Key takeaways:

- *Model-based system engineering (MBSE) is a methodology to manage complexity. It is being more broadly adopted for developing smart, connected products.*
- *Adopting MBSE across domains beyond software is difficult, but the potential benefits are inspiring more and more companies to start the journey.*
- *Successful MBSE adoption requires people, process, data, and technology issues to all be addressed strategically.*
- *Wipro's NIMBLE framework provides a solution that brings together diverse MBSE and application lifecycle management (ALM)¹ tools and necessary processes into a seamless platform and Wipro's extensive implementation experience can help clients get superior benefits faster.*

Systems engineering emerged as a way to manage complexity in the 1940s. It was originally used in early U.S. defense and missile programs, and has steadily evolved since then. Over the decades it has expanded to be used on non-defense products due to the growing complexity of products, especially as they incorporate more and more software and dynamically interact with the physical world.²

Systems engineering is an interdisciplinary approach to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design elaboration and synthesis and system validation while considering the complete problem: operations, cost and schedule, performance, training and support, test, manufacturing, and disposal. When implemented correctly systems engineering integrates all the necessary disciplines and specialty groups into a team, enabling a structured development process that proceeds from concept to production to operation. Systems engineering considers both the business and the technical needs of all customers and stakeholders with the goal of providing a quality product that meets their needs.³

Model-based systems engineering (MBSE) is the formalized application of various levels of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout development and later lifecycle phases.⁴ Models are used from very early stages to validate that the system will function as conceived and defined by its requirements.

Our modern human existence is dependent on complex interactions of systems of systems. We depend on transportation, communication, energy, food production, and shelter to survive. The economic system drives continuous innovation to improve these systems, and much of the innovation comes from the integration of functions within and across systems often driven by

¹ Application Lifecycle Management (ALM) is the set of solutions used to support software development throughout the product lifecycle.

² Research for this commentary was partially supported by Wipro.

³ INCOSE. What is Systems Engineering? <http://www.incose.org/practice/whatisystemseng.aspx>. 14 June 2004.

⁴ INCOSE Systems Engineering Vision 2020. INCOSE-TP-2004-02. San Diego, CA. September 2007.

the application of electronics and software. In many if not all of these systems, no single individual or company understands the complete system.

A good example of growing complexity is the automobile radio. For decades, car radios received signals on the AM frequency band and five or six mechanical presets could be configured to recall stations without digital electronics or software. Over time, the radio advanced to support FM frequencies, then digital displays with time and outside temperature and electronic presets. Today's infotainment system is a touch screen display that still receives AM signals but also other frequencies including satellite, wireless signals from smart phones, reads data on USB memory sticks, runs mapping software based on GPS coordinates, displays video from cameras and other car systems including HVAC and engine management. Modern infotainment systems can have millions of lines of software code. A failure in a wire or worse, a bug in the software, can render a vehicle inoperable. The number of use cases that need to be tested in a modern vehicle cannot be executed physically, there is not enough time. Using software-based test cases on models (i.e., digital representations) is the only way to realistically validate modern products let alone handle the increasing complexity as innovation continues its exponential growth.

At CIMdata, we see significant interest in adopting MBSE, but progress is slow. While aerospace and defense did much of the pioneering work, the automotive industry has taken over and in many ways is leading MBSE adoption progress. The best examples of MBSE success are primarily for software systems, but the need to address all systems is driving the inclusion of non-software domains including mechanical, electronics, and the physical operating environment of the product.

MBSE Adoption Challenges

A recent report from Systems Engineering Research Center (SERC) provided some insight into the issues associated with adopting MBSE. Figure 1 shows survey results from the SERC report and the results illustrate the typical people, process, technology, and data dimensions most enterprise processes struggle to address.

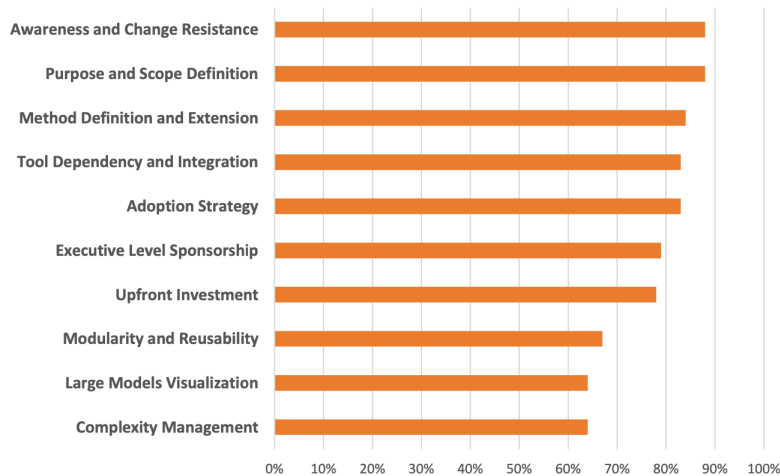


Figure 1—MBSE Adoption Challenges⁵

The shift to smart, connected products is a significant driver in MBSE adoption. Companies with any significant legacy in mechanical design struggle with process and cultural changes as

⁵ A Survey on MBSE Adoption Challenges, Chami, et. al. Systems Engineering Research Center. November 2018. https://www.researchgate.net/publication/328118976_A_Survey_on_MBSE_Adoption_Challenges

electronics and software become part of the product core, and are often the highest value elements of the product. Processes such as requirements allocation, deciding if features should be implemented in hardware, electronics, or software, become more complex, as do manufacturing, supply chain, and support processes.

MBSE technology is still evolving rapidly adding to complexity. A wide variety of tools are used to model systems and data interoperability standards are incomplete. This makes it difficult to assemble a system of systems model needed to fully assess the product. It also complicates consumption of system data by CAD and other software to create product designs. While the interoperability issue is understood, standards by their nature take a long time to develop and usually require several iterations before they are fully functional.

Wipro's NIMBLE Approach

Wipro is a leading global information technology, consulting, and business process services company and has a long and successful history of providing engineering consulting services, as well as PLM-related systems integration and large-scale data migration. They have been at the forefront of supporting the development of smart, connected products. CIMdata previously wrote about their [ALM-PLM framework capabilities](#),⁶ and their approach to [digital twins](#).⁷ Wipro recently reviewed their latest update to cyber-physical system support known as **Next Generation Integrated Model-Based Lifecycle Engineering** or NIMBLE with CIMdata. It is the topic of this commentary.

Wipro's NIMBLE framework identifies four areas that companies need to address in their journey to MBSE competency: process (Wipro refers to this as organizational) readiness; people readiness; technology readiness; and information (data) readiness. Wipro has developed a best practice-based process architecture that maps system-level processes through functional processes into a modern agile approach for product realization. The processes are solution neutral and have been implemented on multiple cPDM technology stacks.⁸ This element of the framework addresses the method definition and extension issue shown in the SERC survey.

People readiness or organizational change is identified by nearly 90% of the respondents to the SERC survey. It is arguably the most difficult aspect of successfully bringing MBSE to a company. Wipro's Organizational Change Management (OCM) methodology takes a holistic view of the necessary changes that recognizes the issues that will happen and helps to ensure that the whole organization will be brought into alignment so benefits can be realized. CIMdata believes proper OCM is critical to MBSE success due to the scope of process and technology change that most organizations require.

Wipro's ALM-PLM framework is critical to making MBSE work in the real world. Their integration architecture and data model are solution-independent so they can link a wide variety of common tools and solutions, including those from Dassault Systèmes, IBM, PTC, Siemens, and Sparx Systems, spanning requirements, system architecture, mechanical, electronic, and software authoring tools. Data is managed by a common process across a single logical source of truth. Rounding out this environment is best-in-class data migration technology. Wipro

⁶ See: <https://www.cimdata.com/en/industry-summary-articles/item/6156-wipro-unites-software-development-with-plm-a-cimdata-commentary>

⁷ See: <https://www.cimdata.com/en/resources/complimentary-reports-research/commentaries/item/12838-wipro-s-product-process-and-factory-digital-twins-commentary>

⁸ collaborative Product Definition management (cPDM) is CIMdata's term for the data and process management solutions at the core of most company's PLM strategies. Solutions in this category include Dassault Systèmes' 3DEXPERIENCE platform, PTC's Windchill, Teamcenter from Siemens Digital Industries Software, and their many competitors.

acquired ITI,⁹ a data interoperability and migration specialist, several years ago and has made good use of their technology and knowledge to ensure that Wipro's clients' data investment is protected and leveraged.

NIMBLE's benefits according to Wipro are shown in Figure 2. Beyond support for people, process, technology, and data, CIMdata views Wipro's focus on compliance and functional safety as critical. So many of the big system failures in recent decades ultimately trace back to lack of process discipline, data integrity, and compliance support. As systems get more complex, failure modes grow exponentially and the cost to validate systems also grows exponentially. MBSE is a proven path to mitigating the risks added by the increased complexity.

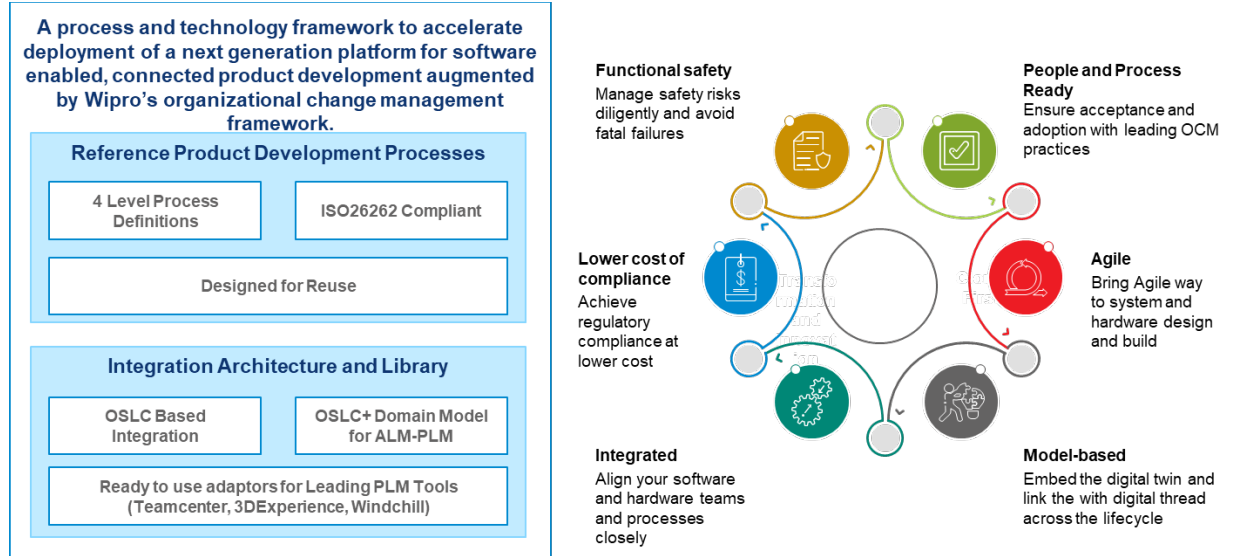


Figure 2—NIMBLE Benefits According to Wipro
(Courtesy of Wipro)

Wipro's NIMBLE solution demonstrates a deep knowledge of how to apply MBSE to solve modern product development problems that is built on a proven ALM-PLM framework. CIMdata sees two major areas of benefits for customers: the application of technology to system engineering problems helping ensure that solutions meet their requirements and best-practices to implement and speed the adoption of an MBSE environment. A leading automobile association has partnered with Wipro to develop a platform based on a previously-developed concept to exchange MBSE data with their OEM and supply chain membership. CIMdata sees this partnership as a vote of confidence in Wipro's NIMBLE approach.

Conclusion

MBSE is a proven approach to address system complexity. Unfortunately, it is not available out-of-the-box from solution providers and the variety of solutions used to develop products are almost always from multiple solution providers, creating significant integration issues. Furthermore, to be successful people, process, technology, and data all need to be addressed holistically.

NIMBLE from Wipro is a holistic framework that combines their technology and system integration skills into a solution that makes MBSE work. It leverages earlier work on ALM-PLM integration and packages best practices and consulting to address MBSE solution design,

⁹ See: <https://www.cimdata.com/en/industry-summary-articles/item/12134-wipro-to-acquire-international-technegroup-incorporated-iti-a-global-interoperability-solutions-company>

implementation, and operation. Companies looking to adopt MBSE or improve existing MBSE operations should consider reaching out to Wipro to learn more about NIMBLE.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata provides world-class knowledge, expertise, and best-practice methods on PLM. CIMdata also offers research, subscription services, publications, and education through international conferences. To learn more about CIMdata's services, visit our website at <http://www.CIMdata.com> or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.