Simulation-Driven Systems Development Consulting Practice

Realizing the Benefits of Model-Based Engineering via Systems Modeling, Simulation, and Analytics

Simulation-Driven Systems Development (SDSD) is an interdisciplinary set of processes, best practices, and technology solutions that enable the realization of successful systems (i.e., innovative, profitable, socially responsible, and safe). This includes the digital definition, simulation, and validation of systems performance through the use of modeling, simulation, empirical data analytics, and AI/ML (machine learning) strategies applied to both products and manufacturing systems, providing decision support over the entire product lifecycle from requirements to ideation, realization, and operation throughout the lifecycle including the utilization of physics-based digital twins.

SDSD must consider both the business and the technical needs of consumers and society, with the goal of providing high quality and innovative systems that meet the users' needs and develops products in an optimal manner that maximizes an organization's return on investment while ensuring compliance with regulations.

A full system lifecycle is much more than just the product design; it encompasses the whole of product development, product production, maintenance, and support, through product life, to retirement (e.g., recycling, disposal, repurposing). A model-based systems engineering[1] (MBSE) approach focuses on identifying and capturing customer needs and quantifying engineering requirements in terms of required product functionality early in the development cycle, digitally documenting and tracing those requirements, then proceeds with design synthesis and system simulation and verification/validation while continuously considering the complete system and all of its many facets (hardware, electronics, software, controls, formulas, etc.). The SDSD approach seeks to integrate all of the engineering disciplines involved in a system's development into a team effort forming a structured development process.

SDSD is an integral element within Product Lifecycle Management (PLM) enabling solutions and is widely adopted in manufacturing companies as a strategic business approach that puts products and services, and the processes by which they are defined, at the heart of the company. PLM is directly linked to business strategy and empowers the business, enables product and process innovation, and enhances both top- and bottom-line business benefits. In its early days, PLM created competitive advantages for manufacturers. In today's global economy, PLM is a competitive necessity as is MBSE.

The CIMdata Consulting Approach

CIMdata's methodology recognizes that the successful planning, selection, and implementation of new business strategies and solutions involves ongoing, cyclical processes comprised of six phases.

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[1] The International Council on Systems Engineering (INCOSE) defines Model-Based Systems Engineering as: "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 lifecycle phases."

This applies to every organization—whatever the industry, whatever the particular requirements or applications, and whatever the desired end result. Each of the six phases (as illustrated below) is separate and unique. Each is equally important, and for the outcome to be successful, each requires a set of targeted activities. CIMdata tailors its services to the specific business and operational needs of its clients and is ready to provide support during each of the six phases.

CIMdata's SDSD consulting services concentrate on how to best leverage the full range of model-based engineering technologies and industry best practices by integrating these into an organization's daily work processes. Many companies are using MBSE-enabling solutions separately in their existing systems engineering and manufacturing design processes with positive impact. At the same time, a huge potential remains in leveraging MBSE-enabling technologies and processes integrated with PLM platforms for end-to-end manufacturing workflows for design, engineering, bidding, fabrication, and customer service integration across the value chain.

CIMdata's approach is to help our customers assess and understand where they stand today in terms of digital engineering maturity ("As-Is"), define the vision and objectives for where they need to be in their use of model-based engineering tools and processes ("To-Be"), and help them define an

implementation strategy and roadmap to get them to the desired to-be state. This SDSD digital engineering plan is defined with the end objectives of the business in mind since enterprise digital transformation should and must be an enabler for innovation and corporate gain.

Strategy Development

Strategy is derived from the business objectives. It defines what is required for transparency, accountability, execution velocity, and effective value chain collaboration. Defining the purpose is a crucial step in accelerating adoption of new processes and associated enabling technologies closely aligned with the desired cultural attributes.

It is also critical to recognize that strategy is not just about deploying technologies, but also about people, culture, and an organization's existing engineering processes. Success is driven by clarifying internal and external collaboration requirements and enabling the robust decision-making processes and capabilities needed to achieve near-term business objectives as a critical first step.

Solution Definition

CIMdata's consulting methodology includes a number of tailored activities that support the development of a detailed solution definition. For example, CIMdata conducts a maturity assessment to understand existing barriers and gaps to collaboration based on leadership behaviors; organizational design; the processes and techniques for knowledge sharing, discovery, and acquisition; and the existing culture. The assessment provides insights into the current state from which to develop a roadmap to the future vision.

CIMdata brings the most comprehensive view of PLM tools, processes, and techniques that can meet specific business objectives. CIMdata also assists our clients in aligning functional organizations such as sales, estimating, engineering, procurement, project management, operations, customer service, and information technology to a common solution that

satisfies the business needs of each organization individually and collectively.

Solution Evaluation & Selection

CIMdata's methodology supports the evaluation of solutions based on critical aspects of user adoption of new processes and associated enabling technologies. These include speed, seamless integration, ease of use, and alignment to existing processes, to name a few.

CIMdata's extensive understanding of the commercially available solutions dramatically reduces the time needed to evaluate and select the most appropriate solutions. CIMdata's evaluation and selection methodology helps an organization focus on the business and technical issues that are most critical to achieve its strategy and vision. By leveraging CIMdata's knowledge of the available solutions and our clients' specific requirements, we are able to provide a short list of appropriate solutions for further evaluation utilizing a number of technical and business-oriented templates and methodologies.

Implementation Planning

Upon the selection of the appropriate enabling solutions, CIMdata's support continues through implementation planning. Over the years, CIMdata has provided a significant amount of strategic advice and counsel during this critical, but often overlooked phase of a project. CIMdata offers best practice support for statement of work development, contract negotiation, implementation team structuring, "to-be" process definition, systems definition, cultural and organizational change management, training, and more. CIMdata provides support tailored to our client's implementation planning needs.

Implementation Support

Any new strategic solution implementation requires both active implementation support and leadership engagement. CIMdata assists with creation of a team of change agents, representing different disciplines and lines of business that must be assembled to push adoption deep into the organization.

Implementation success requires executive sponsorship. CIMdata assists leadership with developing clear, simple, and straightforward guidelines. The emphasis is on innovation and business improvement as the primary drivers, but with the recognition that personalization is necessary to foster trust, as well as willingness to share and connect.

CIMdata assists with defining and establishing a group of communities representing various interests and functions within the organization and leveraging them effectively toward the organizational goals. It is crucial that people enjoy the experience and work to gain quick wins. As these quick wins diffuse throughout the organization the implementation will gain momentum.

Monitoring & Continuous Improvement

Early on, the primary means of measuring adoption is to identify and celebrate successes and "smart" failures that lead to organizational learning. At this stage, it is also important to recognize the power of collaborators and innovators, and their positive impact on solution adoption. CIMdata leverages a set of assessment techniques and other best practice experiences to identify areas requiring improvement and then recommends roadmaps to move forward.

SDSD Consulting Services

The Simulation-Driven Systems Development Consulting Practice provides essential support for both engineering software and services solution providers as well as for product manufacturing enterprises.

Consulting services provided for manufacturing enterprises include:

- Systems engineering process assessment and key performance metrics vs industry peers
- SDSD vision, strategy, and goals definition
- SDSD requirements definition

- SDSD implementation roadmaps

- SDSD implementation ROI models

- Evaluation and selection of commercial software solutions

- Education

- Process and cultural change management

Consulting services provided for solution providers include:

- Strategic market opportunity analysis

- Product and services strategy

- Competitive positioning and go to market strategy and sales channel development

- Strategic partner identification including mergers and acquisition due diligence

- Thought leadership whitepapers and eBooks

- Participation in solution provider events and conferences

- Commentaries on solution provider offerings

- Webinars

- End user surveys

- Annual Simulation and Analysis (S&A) Market Analysis Report and trends overview

To learn more about CIMdata consulting services provided in the area of Simulation-Driven Systems Development and Model-Based Systems Engineering, please contact CIMdata at +1.734.668.9922.

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 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.