eBook

A Systems-Centric Approach for Modern Product Development

5 Concepts for Engineering Leaders

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The complexity of products continues to grow exponentially across every industry. This presents a significant challenge for manufacturers faced with bringing these smart, connected products to market. More specifically, engineering leads are tasked with evolving how their teams will design these "systems of systems."

Systems engineering is now too important to be left to the systems engineering department.

Developing next-generation, in many cases, even current generation products, requires unprecedented cross-discipline collaboration. Notably, the growing amount of electronic and software content is perhaps the largest contributor to up-ending traditional design processes. Departments must also consider how they'll collaborate with specialized disciplines such as simulation whose contribution will only increase with advanced product development techniques.

With this backdrop, there should be two conclusions for engineering leads: previous design processes are not sustainable and a systems-level approach must take shape across the engineering department to connect both specialized and mainstream disciplines to align design work. The new foundation for engineering success is enabling a systems engineering approach anchored by the system architecture.

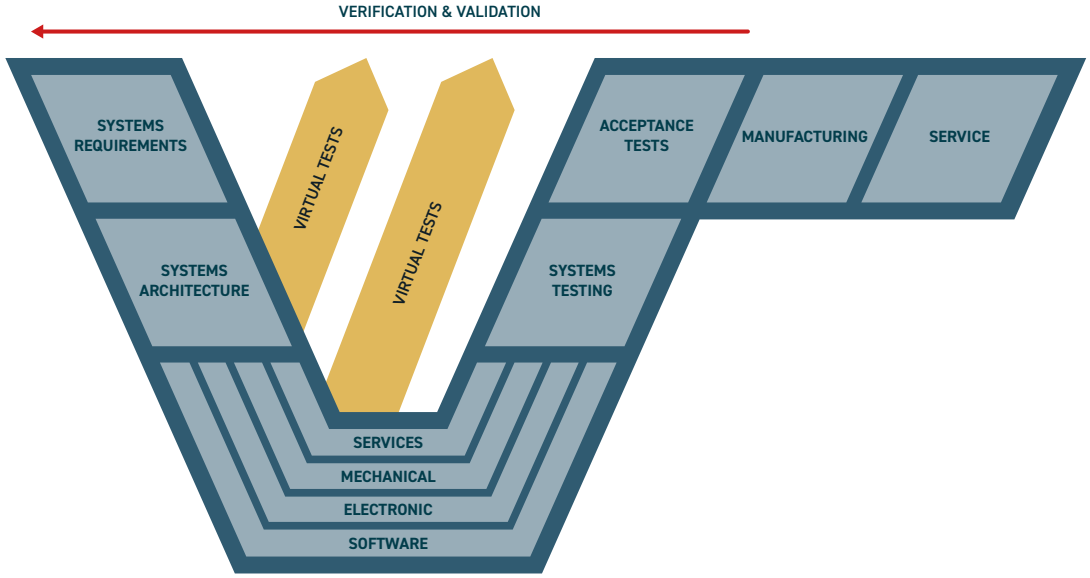
To paraphrase a famous quote—systems engineering is now too important to be left to the systems engineering department. (The original David Packard quote referred to Marketing). That is, product complexity now dictates that system design become a shared objective no longer left solely to those with a systems engineering title. Engineering leads must take action to bring systems engineering thinking from a niche discipline to a department-wide philosophy that aligns specialists and mainstream designers.

This eBook explores five concepts to help engineering leads develop system-centric design processes, align teams, master product complexity, and drive innovation.

1 THE INEVITABILITY OF SYSTEMS ENGINEERING

Systems engineering was born out of the need to manage very large and complicated product development programs in defense and aerospace. Today, this level of product complexity has crossed to nearly every industry from automotive and suppliers to industrial equipment, medical devices, and certainly high tech electronics. New product designs require the behavioral and physical integration of hardware, software, electronics, firmware, and embedded software that can receive in-service upgrades.

Systems engineering offers the ability to improve the precision and efficiency of engineering. It can also improve communications among engineers in different functions and disciplines within an organization. This holds true for engineers with similar functions in the supply chain as well. As such, systems engineering is a requisite foundation for modern cross-discipline collaboration.



The V-Model is the classic graphical representation of the systems development lifecycle—from requirements, to cross-discipline design, to testing, and verification and validation. The left side of the "V" represents the creation of requirements and system specifications. The right side of the "V" represents integration of parts and their validation. Organizations must use the V-Model as the anchor for communication and design work in complex products.

2 APPLICATION OF MODEL-BASED SYSTEMS ENGINEERING

Model-based systems engineering (MBSE) enables the depiction of systems engineering information as a visual model and allows systems engineers to define four aspects of the product: Requirements, Functional, Logical, and Physical. The result is a more effective systems model (i.e., visual depiction and design intent) that abstracts the product's behavior in an easily understood manner.

However, there are a number of challenges that can prevent organizations from fully using MBSE capabilities to their greatest advantage. MBSE tools and the resulting behavioral models can become "islands of automation" that are disconnected from the rest of the engineering organization and processes.

Additionally, without established procedures that create a traceable link between MBSE model elements, hardware and software design work, authoring tools and data models, MBSE information can lack traceability with mainstream design. This lack of integration with mainstream design also means that MBSE lives outside the standard change control process. This becomes a problem when synchronizing and reconciling multiple systems in product development and managing configurations.

While MBSE offers a powerful starting point for multiple discipline collaboration, MBSE information must be available to the mainstream disciplines.

3

THE CASE FOR PLM & SYSTEMS ENGINEERING

Systems engineering emphasizes early-stage product development activities—requirements development, systems architecture, modeling, analysis, and simulation. Traditionally, product lifecycle management (PLM) has begun later in the process with a focus on physical design, modeling, and part structures as represented in bills-of-materials (BOMs). So, while both disciplines claim the entire lifecycle, they are complimentary in their coverage.

Listed below are some of the often cited challenges of systems engineering which can be addressed by integrating PLM:

- Systems models are often difficult to manage and reuse.
- Previously used designs may be difficult to locate. So they can't be reused.
- Systems models aren't integrated with disciplines. Development isn't synchronized and often results in significant re-work.
- Poor cross-discipline communication between systems engineers, hardware engineers, and software developers often results in integration issues being identified late in the development cycle—resulting in late design changes.
- Teams are unable to stay in sync regarding changes—some of which are happening in parallel.
- The lack of traceability for test verification results in slowed product development and potential risks with regulatory compliance.

Organizations require modern, open PLM systems to connect data silos. Many enterprises are held back by their own legacy PLM systems, which were built to manage mechanical design data, and introduce their own silos. These systems are not adept at managing system-level design, particularly electronics and software. Open PLM with systems engineering paves the way to a pragmatic systems-level design approach.

4

SYSTEM-LEVEL DESIGN WITH AN OPEN PLM PLATFORM

An open PLM platform breaks down the silos of disparate systems and processes for more efficient and effective cross-discipline design work. CIMdata and Gartner have defined this capability as a product innovation platform. This platform approach connects data and processes from requirements all the way through the actual manufacturing process, and into service and maintenance in the field, to create a complete Digital Thread and enable the creation of a Digital Twin. It is also the foundation for mastering the V-Model by integrating systems engineering and PLM.

Aras provides an open PLM platform that meets CIMdata's product innovation platform requirements with an open, flexible, scalable, and upgradeable approach for long-term sustained value.

With Aras, companies can transform their processes by building an innovation layer that overlays legacy systems while enabling the development of the modern systems engineering processes needed to handle the toughest design problems such as MBSE, ALM-PLM, test management, and simulation.

5

WHERE TO START

Engineering teams can take several steps to evolve existing processes to embrace system-level design using the V-Model. An open PLM platform can power various design phases based on the common V-Model framework without disrupting existing processes and systems.

There are several areas teams should consider to get started:

- Connect requirements to design. Make product requirements accessible to design teams. Whether stored in the PLM system or in other systems, the key is to connect them for design visibility. Making them available is essential for efficient verification and validation.
- Anchor cross-discipline work with the systems architecture. Connect MBSE and PLM to share information for downstream design. This is a key example of connecting specialist tools to your mainstream data backbone.
- Create a systems engineering framework. This provides teams with a common systems engineering context and visibility.
- Integrate legacy systems with a PLM platform. The PLM system must serve as the data backbone, connecting the right information to the right person at the right time. But, it needs to connect data silos in order to effectively manage engineering change and variants across disciplines and systems.
- Connect simulation. To reduce costs of prototyping, testing, and maintenance, simulation is becoming increasingly important for advanced product design. An open approach to simulation process and data management (SPDM) running on a PLM platform connects simulation analysts to the right product configuration and version and provides traceability of results.
- Enable clear traceability for verification and validation. Teams need to be sure they are testing the correct product version or variant. Your PLM platform is that single source of product information for the accurate version, variant, and BOM. Test bench data must connect with requirements while factoring configuration changes and variants. Clear traceability for verification and validation are enabled by a PLM platform and critical for compliance and regulation.

CONCLUSIONS

The old approach—using disconnected, legacy PLM systems, outmoded tools like spreadsheets, and one-of-everything IT architectures, simply won't work when it comes to making products to meet tomorrow's demands. A systems engineering approach, powered by PLM that is platform-based, will enable your organization to collaborate earlier, tackle increasing product complexity, validate earlier, and re-use designs to gain a competitive advantage.

The Aras PLM Platform is an open, scalable, flexible, and upgradeable approach to PLM that allows companies to deploy quickly, iterate rapidly through agile development, and achieve long-term sustained value. It is the only PLM system that truly enables companies, like yours, to integrate Systems Engineering and PLM, connect disparate systems for full-lifecycle traceability, and transform product development processes to master the V-Model.

Aras enables the world's leading manufacturers of complex, connected products to transform their product lifecycle processes and gain a competitive edge. Aras' open, flexible, scalable, and upgradeable PLM platform and applications connect users in all disciplines and functions to critical product information and processes across the extended enterprise. Aras customers include Airbus, BAE Systems, GE, GM, Hitachi, Honda, Kawasaki Heavy Industries, and Microsoft.

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