eBook
SYSTEMS THINKING IS DIGITAL TRANSFORMATION
INTRODUCTION

Systems Thinking is digital transformation since both focus on how OEMs (Original Equipment Manufacturers) transform the way people think, data models, tools, and processes to manage the opportunities and challenges of product complexity.

The constantly increasing complexities of today’s and tomorrow’s intelligent and connected products lead to exciting new market opportunities. Unfortunately, complexities can also derail those market opportunities, increase costs, and challenge resources. For example:

- Identifying existing car configurations for “over the air” software updates and subscription enabled features
- Delays in medical devices regulatory compliance across geographical and political landscapes
- Incompatibility with consumer electronics countless hardware versions and third-party apps and services
- Traceability of product family platform variants to specific subsets of requirements for the latest product revisions

This is because complex products form an interconnected system of interacting products. Managing that system perspective challenges traditional product design methodologies because of the growing need to coordinate and optimize across multiple systems, disciplines, and domain expertise silos within the OEM and across its distributed network of partners and suppliers.

This eBook discusses the reasons why digitally transforming your engineering processes is essential to managing exploding complexity, and why Systems Thinking is a critical part of getting there.
THE RISKS

Today’s products constitute a complex system (e.g., a self-driving car) that functions within a broader system (e.g., other self-driving cars) and interacts with many other related systems (e.g., car-as-a-service or CaaS). This creates new industry-specific risks that could result in significant threats to the OEM’s overall business if not managed properly. The traditional engineering IT environments, particularly in the case of legacy PLM solutions, were never designed to explore, identify, and manage risks such as:

- Catastrophic functional failures that arise at the boundaries of these systems during deployment
- Overdesign that comes from reductionism, which is an approach to studying complex systems by reducing the overall system to a set of simpler standalone components
- Overconfidence that comes from overreliance on the perceived advantages of legacy product, such as established designs, manufacturability, supply-chain, or branding practices
- Inadequate compliance with regulatory requirements across different geographical and political boundaries
Traditionally engineering delivered results of their work as a BOM-centric (Bill of Materials) view of the product to meet manufacturing’s needs. But these views are inadequate to effectively manage complex interactions with the surrounding systems resulting from:

- Migration of functionality to software
- Supply chain and partner provided sub-systems
- Impact of the IoT (Internet of Things) feedback
- Impact of changing regulations
- Flexibility and scope of services and subscriptions
- Compatibility with third-party app ecosystem, and others

To manage this effectively requires engineering and manufacturing to establish traceability in context with the design intent expressed as a set of system-centric views. Views that include requirements hierarchy, functional breakdown, architecture, product platform features and options, simulation models and results, and others; including traceability to BOMs in the context of variants and revisions.

The engineering V-model provides a very good visualization of why Systems Thinking is digital transformation. The model shows key relationships and dependencies between various product representations. BOM-centric views are created at the bottom of this model and progresses to the right of it. The system-centric views of the same design start on the upper left of this model and progress down to the bottom where they integrate with the BOM-centric view. Enabling the connection between both sides of the V-model is where Systems Thinking and digital transformation become inseparable.
Systems Thinking should be a permanent aspect of an OEM’s approach to product conception, design, manufacturing, asset operation, maintenance, and disposal, and the continuous feedback between all of these. Systems Thinking allows digital transformation to be strategically applied to areas in which it makes the biggest impact with the least disruption. In other words, OEMs don’t need to do it all at once or even complete it 100% since it’s an ongoing journey with an evolving vision driven by the OEM’s needs and opportunities.
THE BENEFITS

Systems Thinking and a reliance on system-centric views is central to achieving measurable, long-lasting digital transformation benefits such as:

- Exploration and leveraging of system behaviors to gain a market advantage
- Identification and mitigation of system behaviors to eliminate costly functional failures
- Maximizing reuse of a 150% product family platforms through efficient configuration of 100% product variants
- Elimination of overdesign through system functional and architectural optimization across implementation domains
- Better process for validating design results against the related requirements
- Faster insertion of new technologies during new implementations of existing systems
- Saving time, resources, and costs, lowering CoQ (Cost of Quality)

THE KEY PRIORITIES

Systems Thinking driven digital transformation must reflect business priorities since transforming everything at the same time would be a costly and disruptive overreach. These priorities are always specific to the OEM and often involve the following objectives (the list is not exhaustive):

- Enabling traceability in context across all design representations and lifecycle states during engineering, manufacturing, deployment, changes and maintenance across the OEM, partners, and supply chain
- Eliminating systems engineering silos created by MBSE (Model-Based Systems Engineering) authoring tools and data models
- Providing pervasive and easy access to simulation services, results, and interpretations at every stage of the product’s lifecycle
THE KEY ENABLERS

While the many OEMs, products, and markets are vastly different there is a core uniformity in the underlying Systems Thinking driven digital transformation when addressing the key priorities. This uniformity allows users to define the key enablers of this process and assign implementation priorities based on the OEM’s specific needs.

Here are some processes to consider when defining the scope of digital transformation using Systems Thinking:

**Understand** how product complexity affects the future of the business, in particular opportunities vs. risks.

**Determine** which system-centric views are essential to capturing design intent and to act as a connective tissue across the product lifecycle and across all internal and external teams (requirements, system models, simulation, variability, etc.).
Define system definitions and data models that support the essential system-centric views and capture these definitions in the digital thread in a way that provides design intent context to the subsequent detailed design domains and the resulting BOMs.

Establish a process for cross-domain and cross-functional teams that allows all stakeholders to access all relevant information for optimizing allocation of the system elements to the specific implementation domains.

Provide your organization with the most efficient collaboration platform capable of supporting and providing design intent context by giving cross-team access to all relevant data during the optimization process.

Consider the long-term costs of technical debt and digital thread obsolescence from the point of standalone authoring tools, their tool specific data models, and the fixed functionality built around that.
As OEMs shift their engineering focus to Systems Thinking, they need a PLM platform capable of supporting the key enablers; a platform that is architected to embrace the entire engineering V-model and capable of evolving with the various phases and maturity levels of the OEM’s digital transformation journey. This includes the moving targets of best-in-class tools, the latest technology insertions, e.g., the Internet of Things (IoT) or AI (artificial intelligence), changing regulatory environments, and the evolving OEM-specific needs. It simply can’t be a legacy PLM system rooted in the management of BOM-centric mechanical structures.

Modern PLM platforms enable Systems Thinking by extending their core PLM services to the left side of the engineering V-model. This includes the flexibility to generate various system-centric views from the underlying system models, integrating them with the tool-agnostic digital thread that already includes BOMs, and managing their lifecycle using the same proven PLM services.

Finally, cloud-based PLM platforms provide the ultimate collaboration environment for cross-domain optimization. This is because cloud-based functionality can be accessed under permission controls by anybody from anywhere across the OEM, partners, and suppliers. This gives the globally dispersed teams equal access to the system-centric views of design intent in context and when needed.
**BENEFITS OF THE ARAS INNOVATOR PLATFORM**

Aras PLM platform continuously expands the number, and the scope of interrelated applications built on its PLM platform that act as key enablers of Systems Thinking. Embracing all of them at the same time may be overwhelming, and OEMs have the freedom to focus on any one of these applications, one at the time, as part of their digital transformation journey and priorities.

**Aras applications directly related to Systems Thinking**

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<thead>
<tr>
<th>Value</th>
<th>Key Features</th>
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<tr>
<td><strong>RE</strong></td>
<td>Creating and managing requirements across the entire engineering V-model in a tool agnostic environment</td>
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<td></td>
<td>• Coexists with all third-party requirements content</td>
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<td>• Part of the Aras platform managed digital thread</td>
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<tr>
<td><strong>SA</strong></td>
<td>Setting a system-centric context for the entire product line and all design abstractions using a tool agnostic definition of a system model</td>
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<tr>
<td></td>
<td>• Coexists with all third-party MBSE tools</td>
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<td></td>
<td>• Part of the Aras platform managed digital thread</td>
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<tr>
<td><strong>SM</strong></td>
<td>Managing a repeatable simulation process and an extraction of simulation models on any design abstraction</td>
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<td>Key to design space exploration and collaborative cross-domain optimization of the design parameters</td>
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<td><strong>VM</strong></td>
<td>Maximizing design reuse across all variants of a product platform</td>
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<td>Independent definition and management of variant features, options and rules from the related product structure on any product abstraction layer (functional, architectural or physical)</td>
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<td><strong>PE</strong></td>
<td>Managing the entire engineering process</td>
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<td>Core PLM platform capabilities including management of digital thread</td>
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CONCLUSION

Systems Thinking together with digital transformation enables businesses to create lasting competitive advantages in the marketplace by managing and leveraging exploding product complexities to their advantage.

Aras offers an industry leading enterprise low-code PLM platform that encompasses all the key Systems Thinking enablers as an integral part of a digital transformation and beyond.

OEMs can benefit from Systems Thinking as part of their digital transformation journey by taking advantage of Aras Innovator or Aras Enterprise SaaS.

Visit www.aras.com to learn more about the Aras PLM platform.
Aras provides the most powerful low-code platform with applications to design, build, and operate complex products. It’s technology enables the rapid delivery of flexible, upgradeable solutions that build business resilience. Aras’ platform and product lifecycle management applications connect users in all disciplines and functions to critical product data and processes across the lifecycle and throughout the extended supply chain. Airbus, Audi, DENSO, Honda, Kawasaki, Microsoft, Mitsubishi, and Nissan are using the platform to manage complex change and traceability. Visit www.aras.com to learn more and follow us on Twitter and LinkedIn.

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