Razorleaf

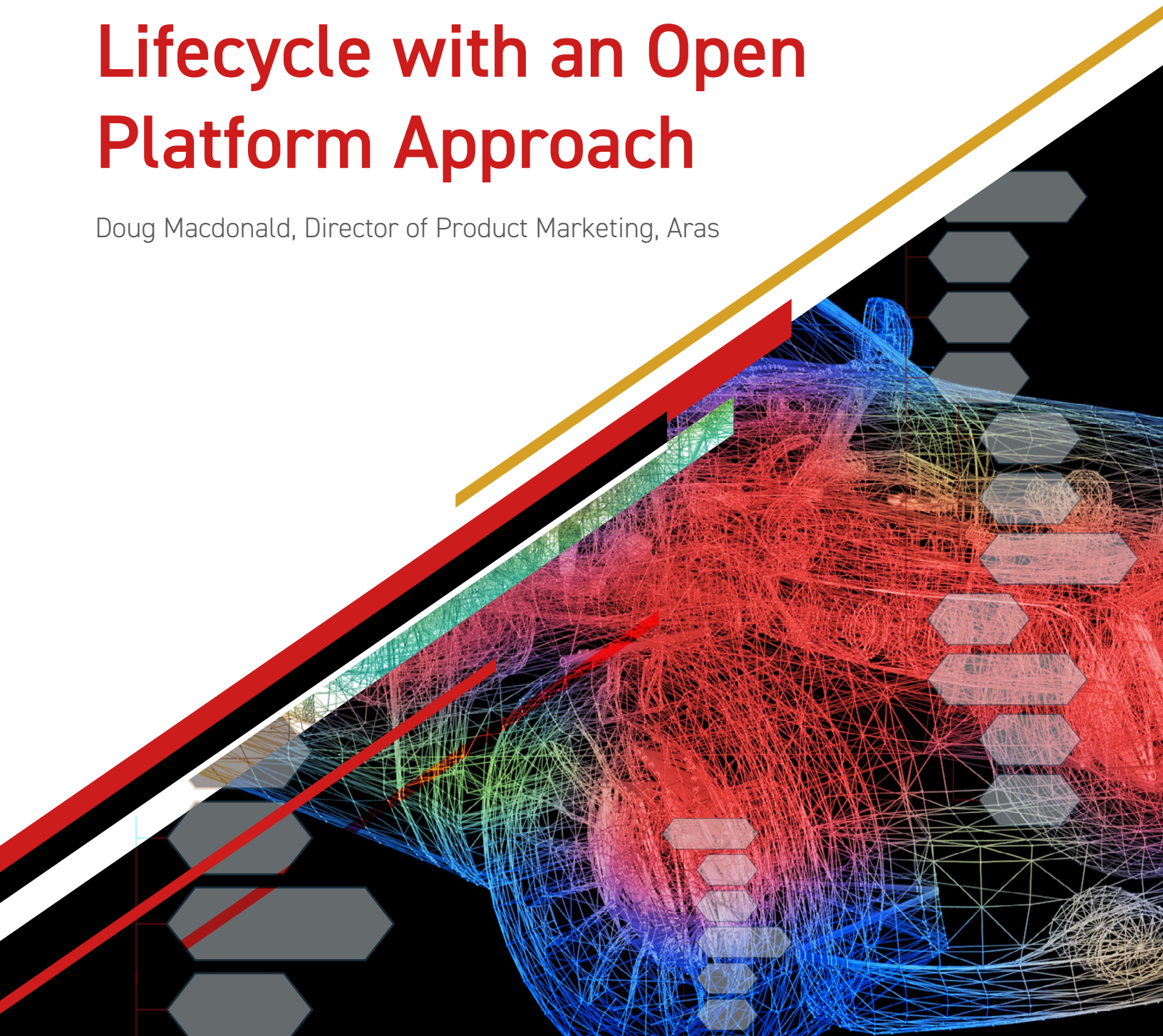
aras | GOLD CERTIFIED PARTNER 2020

aras

WHITE PAPER

Unlock Simulation's Value Across the Product Lifecycle with an Open Platform Approach

Doug Macdonald, Director of Product Marketing, Aras



EXECUTIVE SUMMARY

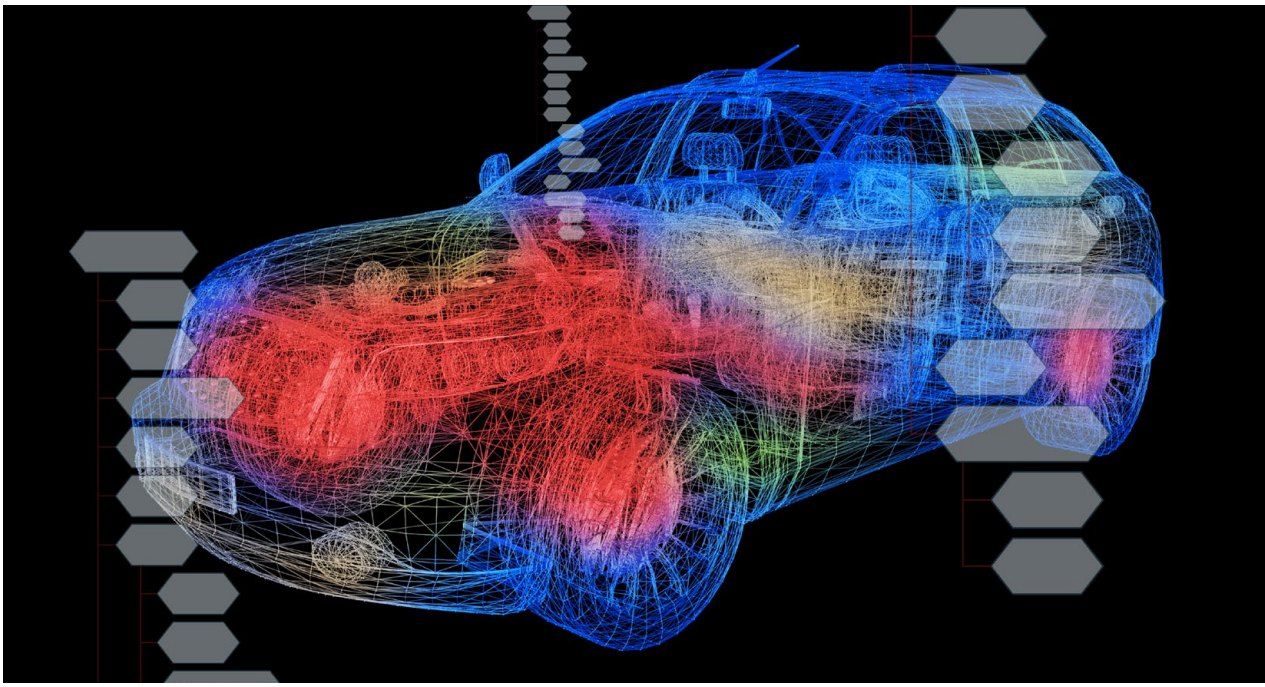
The benefits and rationale for broader use of simulation for early design validation and reduced reliance on physical prototypes are well documented and an opportunity that manufacturers must pursue for both pragmatic and competitive reasons. As product complexity increases and businesses seek opportunities for growth, simulation moves to the forefront for strategic capabilities around the Digital Twin, for predictive maintenance and closed-loop development, as well as additive manufacturing, and generative design.

Although access to simulation tools and their high-performance computing requirements has always been limited by the deep domain and technical knowledge required, the greater barrier to mainstream use of simulation has been the failure of existing simulation process and data management (SPDM) tools. Without an effective SPDM capability, design teams are not able to efficiently incorporate simulation into existing design processes or connect the evolving product configuration to validate results during development, much less simulate an asset in service. An enterprise approach to managing simulation is rapidly becoming fundamental to future product success.

This paper proposes a platform-based approach, guided by key tenets, to create a sustainable SPDM capability, paving the way for simulation to fully enter the mainstream and deliver the value required to drive future growth and market success.

THE EVOLVING IMPORTANCE OF SIMULATION

Simulation software has long held an important place in the development of complex products. In fact, many products today in industries such as automotive and aerospace would not exist without the ability to run thousands of simulations. Today, competitive pressures are necessitating that market leaders better utilize simulation and find ways to apply its value across the product lifecycle. As a result, simulation's value is advancing on several fronts.



For example, the need to bring products to market quickly and cheaply is pushing manufacturers to find ways to avoid building and testing physical prototypes. As product complexity continues to rise, involving more disciplines like software, optics and materials in almost every product, simulation becomes the only way to optimize product designs and ensure they meet their intended goals. And in regulated industries (meaning almost everything today), simulation can be a critical component in demonstrating compliance.

But the need for simulation doesn't end once a product is manufactured and in the hands of the customer. The availability of IoT data offers potential insight into how products are actually used, allowing simulations to predict how long components and systems will last and to trouble-shoot failures eventually leading to better designs in the future.

In parallel, as the uses cases for simulation expand, the sophistication of analysis done by simulation specialists, many of whom have advanced degrees in engineering, physics or materials science, is advancing as well. Developing system of systems products results in increasingly complex use of multi-physics (noise, vibration, heat, optics, etc.), mixed fidelity (e.g., 0D to 3D) and co-simulation tools. A greater number of product variants and frequent configuration changes are also increasing the simulation workload, putting more pressure on the productivity of simulation specialists. And rapidly emerging and evolving technologies including, sensors, new materials, generative design, additive manufacture, are making further demands on the simulation experts.

All of these factors are combining to drive the market for simulation software and services to $8.5B in revenue by the end of 2022 with a CAGR of 8.3% according to CIMdata, an Ann Arbor, MI research firm that tracks the Product Lifecycle Software (PLM) market, which includes simulation. Despite its size, the market is dominated by a small number of vendors: Dassault Systemes, Siemens PLM, Ansys, MathWorks, and Altair, who between them control 75% of the market (CIMdata numbers).

...these factors are combining to drive the market for simulation software and services to **$8.5B** in revenue by the end of 2022...

BLOCKERS TO SIMULATION LAND

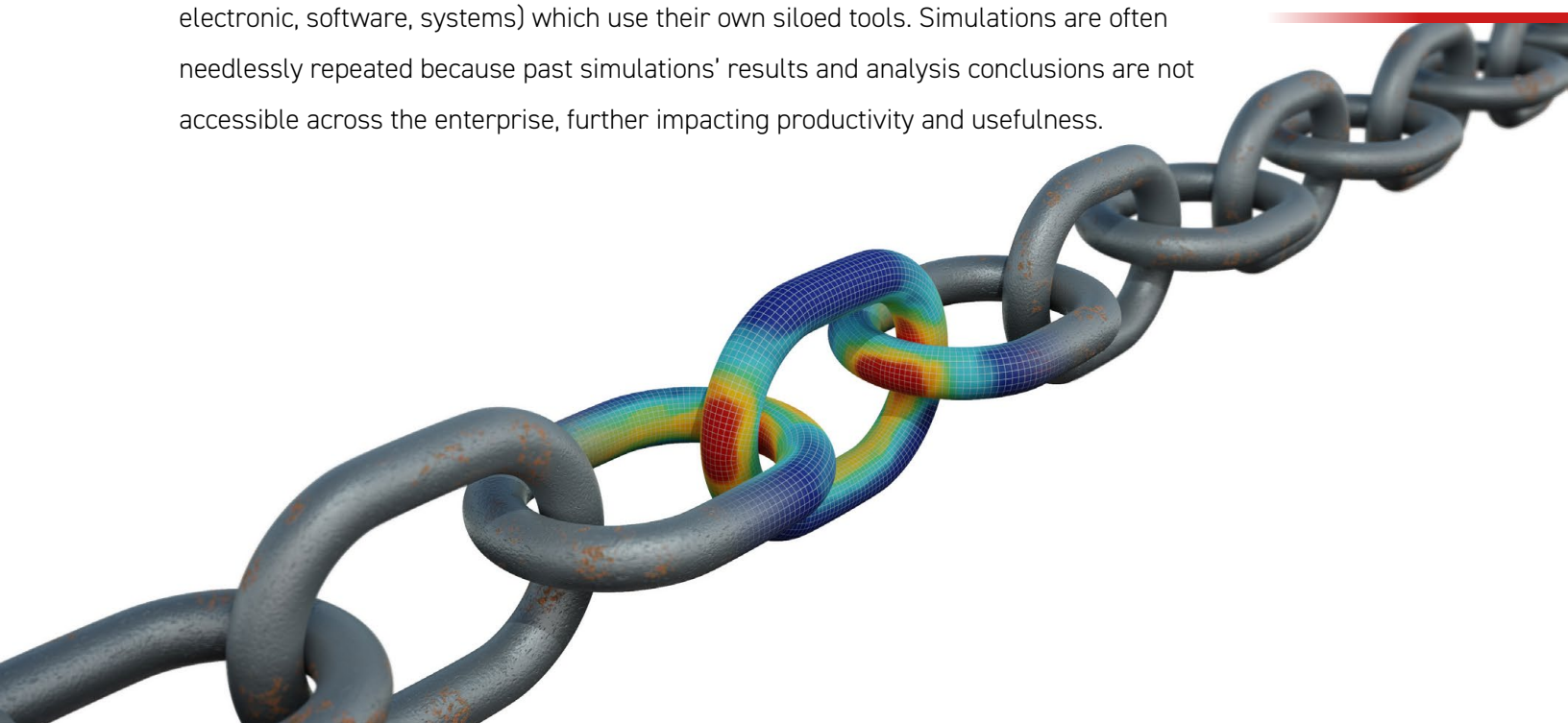
The realm of simulation holds massive promise and potential benefit for manufacturers. However, to unlock value at the intersection of expanding simulation use and advances in simulation analysis, IT and engineering teams must effectively connect simulation to mainstream design. Existing SPDM solutions do not enable this collaboration. Availability of an effective, open, and flexible solution that manages simulation input and output is the greatest barrier to broader application of simulation across the product lifecycle. Current challenges include:

Volume of simulation is limited by analyst availability.

Existing analysts are already at capacity. Simulation tool set-up requires experience, and new simulations studies must often be created from scratch despite similar simulations having run previously. Despite this, most companies don't capture simulation best practices that can be scaled across the organization for consistency, repeatability or reuse. And simulation specialists often spend too much time managing administrative tasks and resources such as high performance computing (HPC) environments.

Simulation is disconnected from mainstream design.

These productivity challenges are compounded by poor collaboration between simulation and mainstream design process. Simulation tools do not readily support collaboration or cross-functional decision-making, often leaving simulation out of the loop. Even within simulation, there are domain specializations (e.g., mechanical, electronic, software, systems) which use their own siloed tools. Simulations are often needlessly repeated because past simulations' results and analysis conclusions are not accessible across the enterprise, further impacting productivity and usefulness.



Poor productivity and collaboration mean organizations are not able to maximize simulation's value. Simulation tools often can't be used to support time-constrained activities such as urgent design changes, bid processes, early costing, concept investigations, etc. Perhaps more significantly, lack of traceability of simulation results impacts confidence in simulation compared to physical testing, undermining the case for using simulation in the first place. Things are not much better when simulating in-service assets as these are often not based on the exact configuration of the asset, making the results of questionable value.

Simulation has Limited Repeatability.

The underlying causes of these issues are not hard to find: lack of focus on making simulation tools easier and more repeatable to use; limited deployment of tools intended to simplify the management of the large volumes of data created; and absence of a cross-enterprise focus to integrate simulation into processes across disciplines and the lifecycle from systems engineering to field operations.

In fact, fewer than 5% of simulation specialists use a simulation process and data management (SPDM) environment (industry estimates quoted by CIMdata). To be fair, most vendor-specific SPDM solutions don't work well because companies typically use a heterogeneous set of simulation tools (including in-house developed) and the number is increasing. But the current situation where simulation data is stored on specialists desktops, limiting its ability to be found by others in the enterprise, is clearly untenable in the future.

Effective SPDM offers organizations the ability to alleviate these challenges around scale and collaboration to maximize simulation's utility. However, to date, SPDM has been significantly underserved and limited to closed, vendor-specific solutions that do not reflect the reality of today's heterogeneous IT environments.

CORE TENETS FOR MANAGING SIMULATION AT SCALE

A Platform-based approach connecting simulation to multi-discipline design, and ultimately, to the full product lifecycle provides the means to solve the current barriers bringing to simulation mainstream design. Specifically, to support simulation across the lifecycle and meet the needs of manufacturers across a range of industries, SPDM must adhere to the following core tenets:

- Embrace heterogeneous vendor systems and in-house custom tools, including spreadsheets
- Support simulation use cases through the product lifecycle; most importantly, those that cross lifecycle stages such as from operational feedback to design or simulation of in-service performance
- Enable and support multi-discipline scenarios, mixed-fidelity models, and different data types that comprise the range of simulation expertise
- Integrate simulation processes fully with model-based engineering processes to create and maintain the Digital Thread for today's complex cyber-physical systems
- Be transparent and "invisible" to users in managing the pedigree of a simulation model and any associated geometry, performance parameters, and results.

By improving the efficiency of experts and making collaboration across the enterprise more effective, companies could reduce the effort associated with data acquisition, model creation, solving, reporting and other tasks by up to 90%. More significantly, these changes open the door to wider use of simulation across the enterprise leading to the real benefits:

- Eliminating or reducing the number of expensive physical prototypes
- Optimizing product designs for market success and customer satisfaction
- Incorporating feedback from products in service into the next generation
- Reducing maintenance costs and avoiding product/asset downtime

AN OPEN, PLATFORM-BASED APPROACH TO SIMULATION PROCESS AND DATA MANAGEMENT (SPDM)

Today's SPDM approaches are failing – because they continue to isolate simulation specialists and their work from the mainstream development and support processes. In contrast, building SPDM capabilities into an open platform (that meets the definition of a Product Innovation Platform—see bar below), breaks down the barriers and allows simulation to become an integral part of the process of developing, manufacturing and supporting complex products.

A Product Innovation Platform, defined by analyst firms CIMdata and Gartner, is an enabling business platform that supports all product-related disciplines and users through the entire product lifecycle. Product Innovation Platforms must meet five (5) Strategic Imperatives and seven (7) Foundational Characteristics. CIMdata's detailed framework is available in their research note, "Product Innovation Platforms: Definition, Their Role in the Enterprise, and Their Long-Term Viability."

There are three key aspects to managing simulation in a Platform environment:

Manage the Simulation Tool Chain

Running a simulation task often involves invoking several tools in sequence—specifying parameters correctly and funneling the output from one tool correctly into the next. Vendor-specific approaches typically favor their own tools, making it difficult for companies with heterogeneous tool sets. Enterprises need a better way to manage simulation tool scripts, capture expert knowledge and make complex simulation tasks repeatable, efficient and scalable. Support is needed for multi-discipline, multi-physics and mixed fidelity models with an ability to manage the use of HPC clusters. Doing so will make simulations reusable across product families, variants and design changes and allow companies to respond quickly to time-constrained activities.

Manage Simulation Data

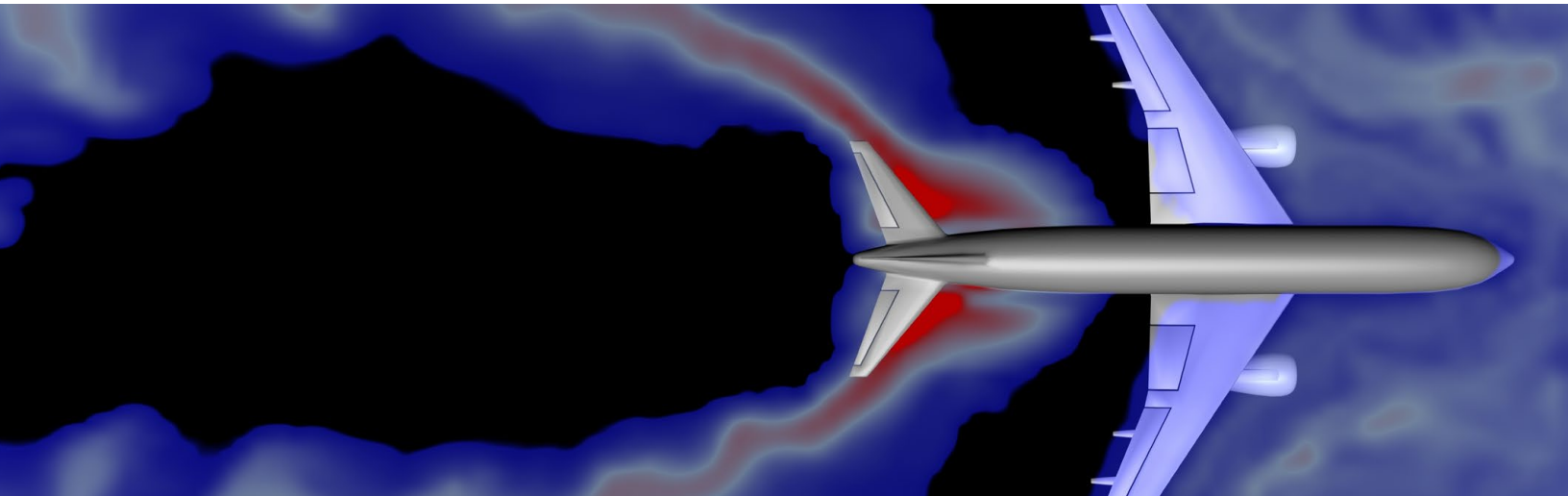
Today's approaches isolate simulation data and put the onus on the specialist to manage it securely. A Platform approach will manage and store simulation inputs, outputs and run parameters in designated secure locations—easy to find and review for reuse and available to be reviewed and discussed by a wide audience. Simulation results will be linked to requirements and design versions via the Digital Thread to support Verification & Validation and provide closed-loop traceability across the full lifecycle including linking to the Digital Twin.

Manage Simulation Processes

Using a Platform approach, simulation will be fully integrated with other processes for managing the product lifecycle—providing support for coverage analysis, defect investigation and simplifying regulatory compliance with an audit trail of simulation runs and analysis conclusions.

CONCLUSIONS

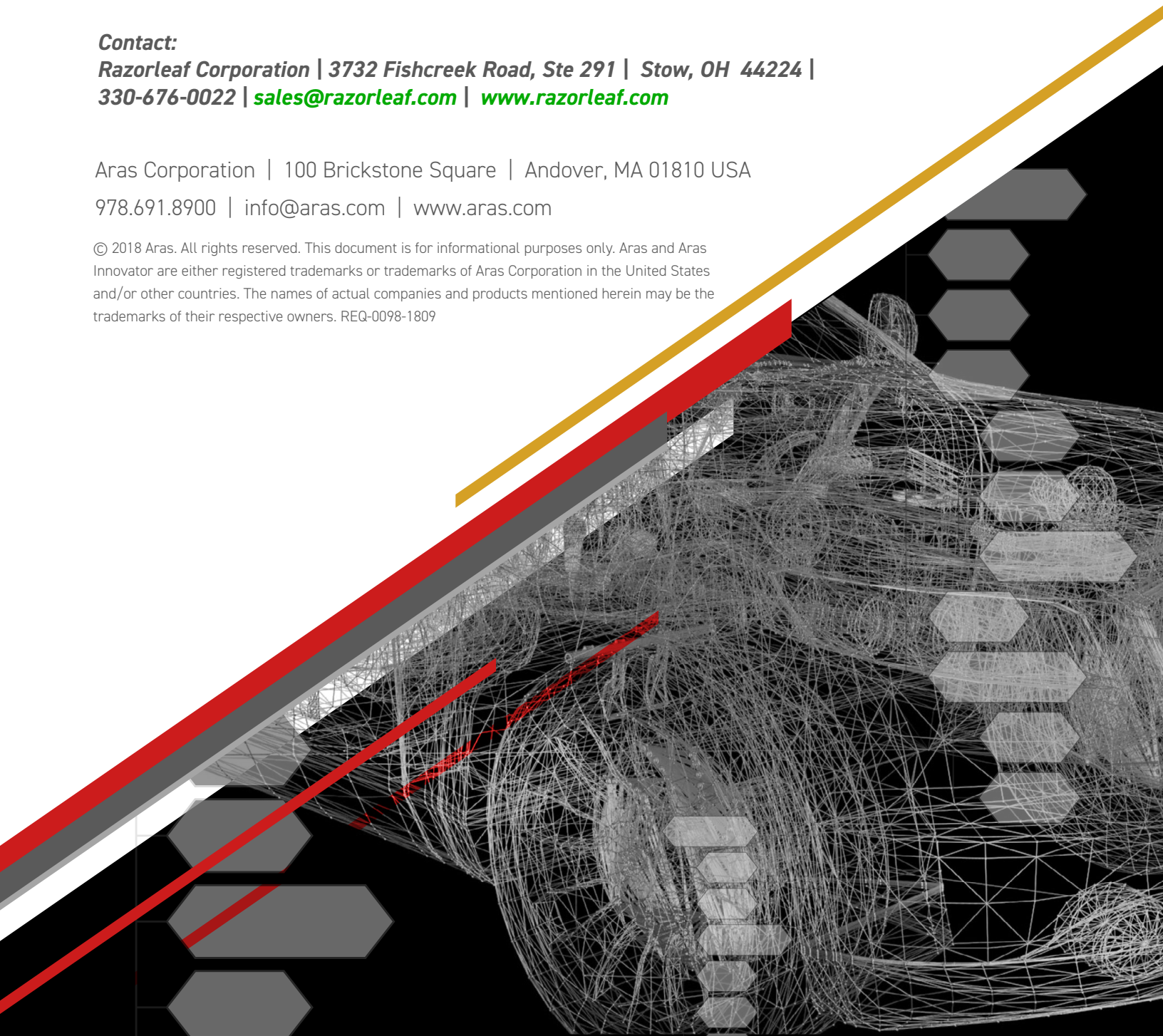
Bringing a platform approach to simulation processes is a step manufacturers must take to ready themselves for increasing demand for simulation. Effective SPDM that is open and tool agnostic is the key to unlocking simulation's value for systems engineering, configuration and variant management, verification and validation (V&V), design reuse, and compliance. In addition, simulation, connected to product configuration by the Digital Thread, is fundamental for emerging Digital Twin and IoT condition monitoring. Organizations can gain a competitive edge and advance their product development methods by fully harnessing their existing simulation resources and expertise, and connecting it with mainstream design.



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.

Download Aras Innovator today.

Contact:
Razorleaf Corporation | 3732 Fishcreek Road, Ste 291 | Stow, OH 44224 | 330-676-0022 | sales@razorleaf.com | www.razorleaf.com

Aras Corporation | 100 Brickstone Square | Andover, MA 01810 USA
978.691.8900 | info@aras.com | www.aras.com

© 2018 Aras. All rights reserved. This document is for informational purposes only. Aras and Aras Innovator are either registered trademarks or trademarks of Aras Corporation in the United States and/or other countries. The names of actual companies and products mentioned herein may be the trademarks of their respective owners. REQ-0098-1809