rescale

Solving the Data Challenges of Digital Engineering

A guide to uncovering new insights and accelerating breakthroughs in product development with enhanced data management for simulation, digital twins, and AI/ML

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Executive Summary

Computing powers today's science and engineering innovations. From aerospace and automotive to life sciences and computational chemistry, nearly every industry is seeing explosive growth in the use of computer simulations to accelerate new product development.

The rise of computational science and engineering has been accompanied by an explosion of engineering and simulation data. Many enterprises are struggling to manage this data to effectively harness its value, even as they grapple with the transition to cloud computing and globally distributed workforces.

To successfully compete in today's world of computing-enabled product development, R&D leaders need to ensure that simulation data and insights are broadly accessible and contextualized. Making this transition while being mindful of people and existing processes is critical to success.

Shared access to data and shared context on data delivers increased engineering quality and velocity with improved collaboration, decision-making, and traceability. With these capabilities in place, organizations will have the data architecture necessary to support the promise of comprehensive digital threads.

This ebook synthesizes Rescale's experience working with leading global engineering-driven organizations. It examines their key challenges and the best practices for building data-driven engineering teams that accelerate innovation.

Shared data access and context delivers increased engineering quality and velocity with improved collaboration, decision-making, and traceability

The Rise of Computational Engineering

Increasingly, established companies and start-ups across industries are adopting new digital technologies and methods to carry out their research and product development efforts. Today, organizations are using computational techniques not only for validation of designs but to explore the design space and inform new possibilities. Many are also looking to adopt digital twins, AI, and other new approaches to power product innovation.

Factors Driving Growth in Engineering and Scientific Computing

The expanding adoption of computational science and engineering has been driven by three key factors:

» **Technology advancements for engineering**

» **New operating models for IT**

» **Competitive pressure to accelerate innovation**

In the R&D technology stack, a foundational development has been the advancement of computing power created by the Cambrian explosion of specialized hardware architectures beyond the traditional x86 CPU commonly used in high performance computing (e.g. GPUs, TPUs, ASICs, and new CPU architectures like RISC-V, etc).

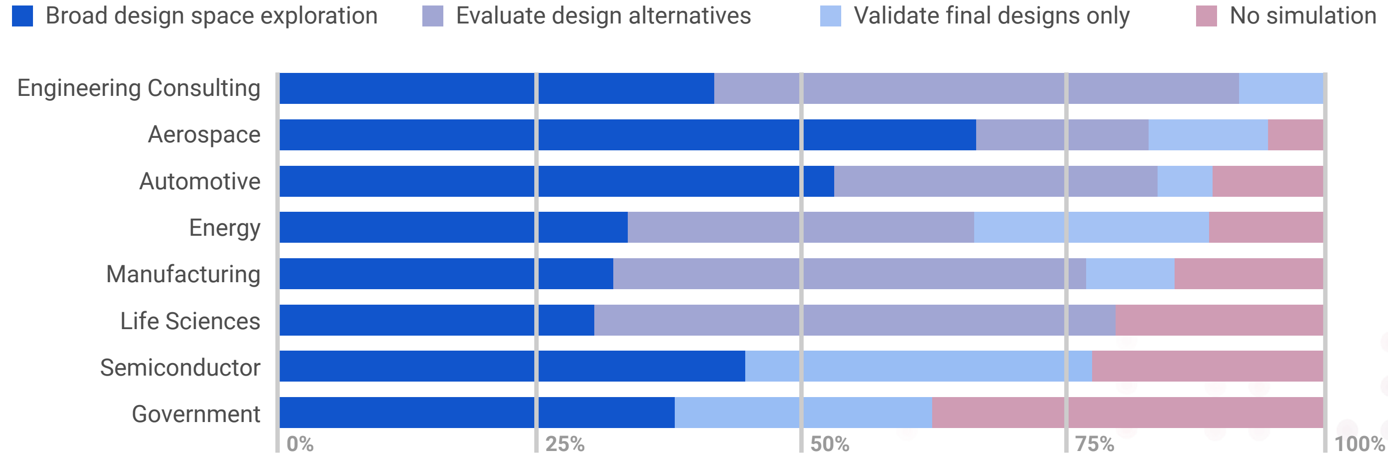
These steady improvements in high performance computing (HPC) are allowing R&D teams to run more simulations—and more complex simulations—even faster.

The value of these evolving technologies is clearly recognized by innovation leaders. For example, 75 percent say that digital product development is essential to their organization, while 84 percent say that faster computational speed increases engineering productivity.[1,2]

On the IT operations front, cloud computing, which has dominated e-commerce, CRM, and ERP workloads for well over a decade, has reached a critical mass for R&D computing. Not only are cloud providers offering the latest HPC computing architectures, but simulation software providers (who were traditionally hesitant about cloud) are now embracing cloud deployments. In fact, 78 percent of engineering-focused enterprises surveyed in 2022 reported the use of cloud HPC, with 53 percent reporting consistent use of cloud HPC.[3]

Today, R&D computing infrastructure—once only available from supercomputing centers—is instantly accessible to organizations that have developed cloud HPC expertise or are leveraging automation platforms.

Computational Engineering Usage Across Industries



Computational engineering is used today in most major industries to varying degrees across stages of research and development.

[1] "Unveiling the next frontier of engineering simulation," McKinsey Quarterly, June 12, 2023, https://www.mckinsey.com/capabilities/operations/our-insights/unveiling-the-next-frontier-of-engineering-simulation

[2] "2022 State of Computational Engineering Report," Rescale; https://about.rescale.com/rs/285-WFD-495/images/2022_State_of_Computational_Engineering_Report.pdf

[3] "2022 State of Computational Engineering Report," Rescale; https://about.rescale.com/rs/285-WFD-495/images/2022_State_of_Computational_Engineering_Report.pdf

Thanks to these technology advancements, computational engineering is allowing product development teams, scientists, and researchers to greatly accelerate their innovation efforts beyond what was previously possible with traditional engineering methods.

Iterative prototyping and physical testing are increasingly costly and expensive. Digital simulations used in computer-aided engineering allow engineers to virtually test and refine designs before creating physical prototypes, leading to significant cost and time savings in the product development process.

Overall, these methods of computational engineering allow R&D teams to much more quickly explore a greater range of design options, helping them come up with better products or solve more challenging design issues faster. Organizations with a strategy for managing their growing data sets (from synthetic simulation outputs or real-time sensor outputs) will be able to deploy AI-assisted engineering processes with greater accuracy and agility.

Digital simulations are proving especially helpful for reducing risk and addressing regulatory requirements. Rapid and extensive virtual testing allows engineers to more quickly and accurately identify potential points of failure in a design. Such capabilities are especially critical in industries like aerospace, automotive, public sector, and life sciences.

Evolution of Engineering Process and Data Management

COMPUTER-AIDED DESIGN ERA	COMPUTER-AIDED ENGINEERING ERA	AI-ASSISTED ENGINEERING ERA
The degree of design exploration and optimization is constrained by the cost and complexity of physical testing and manual documentation for each design candidate.	Broad design exploration and fine-tuned optimization for high-fidelity prototyping are supported by digital simulation and high performance computing.	Generative and predictive AI/ ML capabilities increase speed and efficiency of evaluating more design candidates across multiple physics.
Documentation started with digital CAD models then moved to physical testing with mixed manual documentation (e.g. field notes, lab journals, table data entry) for each design candidate, with additional revisions in CAD or physical mediums (e.g. clay).	Documentation started with digital CAD models ingested by CAE tools to produce mathematical models of performance characteristics in multiple digital formats, which were used in conjunction with physical testing	Documentation combines all individual product and part models into a system-of-systems model that is continuously updated, enhanced by AI/ML, and validated by multi-physics-based simulations and real-world sensor data.

Data Management Complexity

Each engineering evolution brings with it increased data complexity from greater file sizes, volumes, and variety.

Digital R&D Data Explosion

While computational science and engineering provides a host of advantages, it has also created new challenges in how organizations manage the data related to these R&D activities.

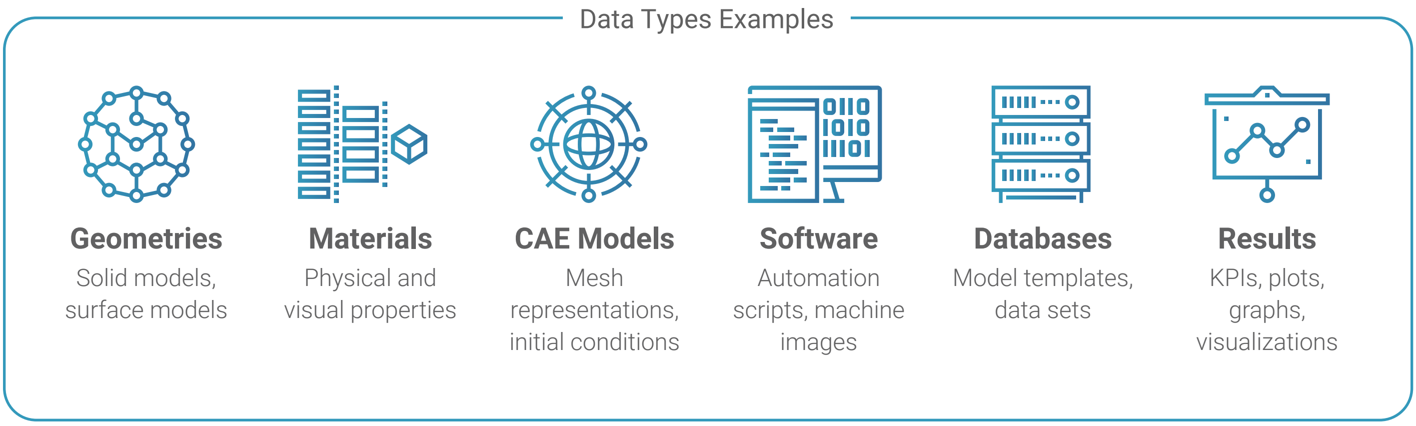
Product development teams are now facing a surging influx of data, not only from product design but also from a broad range of simulation, modeling, and machine learning applications. This is generating uniquely complex data and file types.

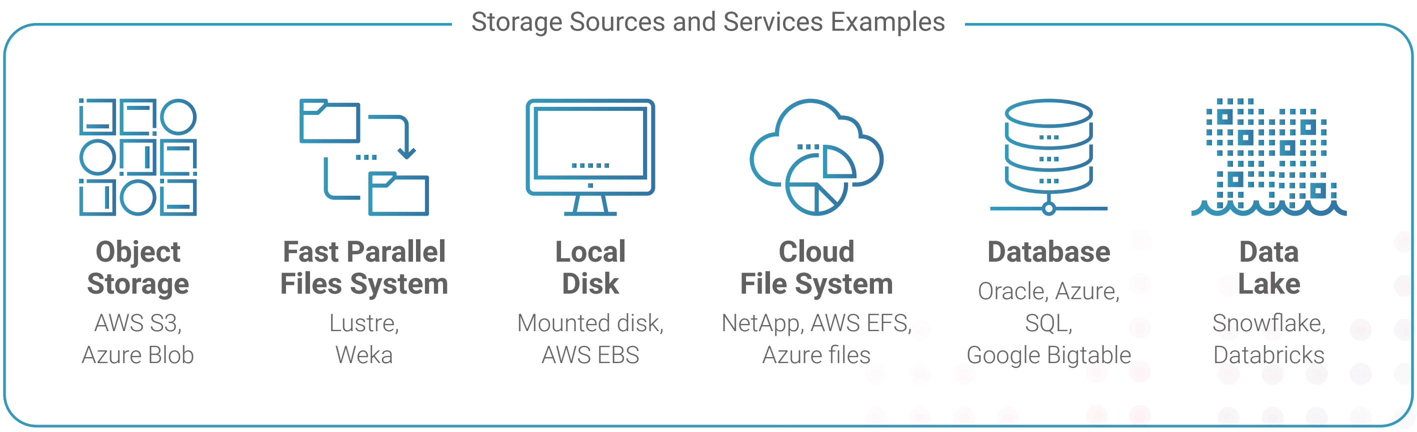
These files hold essential information about the assumptions and parameters of testing for simulations, as well as the results of any simulation. Without the right data management practices, R&D teams struggle to track and share both the content and the context of this simulation data.

In fact, it is not uncommon for companies to have several terabytes or petabytes of data from historical computational science and engineering activities that they struggle to access and share (because no one knows what's in there), but they also can't delete (for the same reason). This makes it extremely challenging to ensure the "reproducibility" of any simulation to understand what was done, as well as its implications on design decisions.

To help organizations gain mastery of this growing array of complex yet essential data for product development, it is critical we understand why these problems exist and identify the changes organizations must make in order to turn their engineering and simulation data management practices from ad hoc and fractured to unified and strategic.

Complexity of Data Types and Sources in Simulation, Modeling, and AI/ML





Engineers utilize and generate a wide variety of data types and store them across a variety of services.

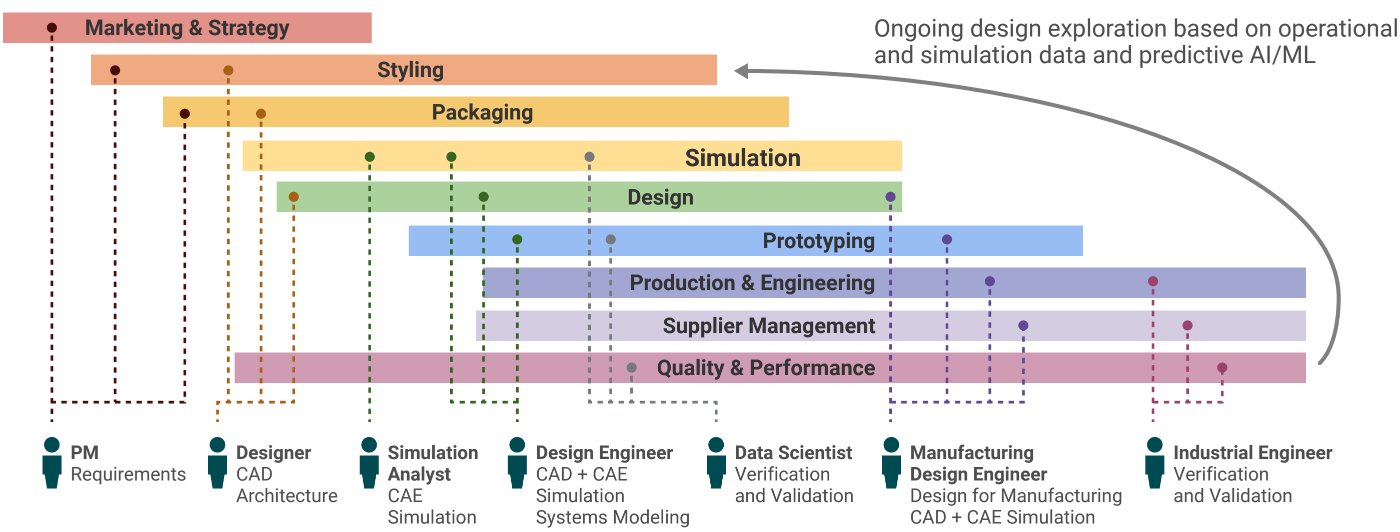
Data Management Challenges in Product Development

While digital approaches to engineering are becoming mainstream, the digital transformation of R&D programs (establishing consistent digital practices across teams and processes involved in new product development) are still held back by data management challenges.

There are several reasons for this. Historically, the move to digital engineering tools happens in silos for different teams, centered on specific physical phenomenon. But the digital transformation of R&D processes requires a broader view, mapping how data needs to flow through a system to deliver the greatest impact.

Second, solutions meant to address this problem, such as simulation process and data management (SPDM) software, have generally proven to be prohibitively complex, with low adoption rates. But the challenges of data management go far beyond SPDMs. According to Gartner, 80 percent of organizations seeking to scale digital business will fail because they do not take a modern approach to data and analytics governance.[4] And the Harvard Business Review reports that 80 percent of analysts' time is spent simply discovering and preparing data.[5]

People and Processes of New Product Development



Modern product R&D involves a large number of teams, requiring continuous collaboration and data sharing.

Common Data Management Challenges

Effective engineering and simulation data management is critical to any R&D digital transformation initiative. But establishing effective data management practices for computational engineering is no simple task. Organizations must address two fundamental issues that inhibit successful R&D process improvements.

- **Data Fragmentation:** Information is stored in different systems and therefore is difficult to access (e.g. shared drive that is used by one team in a particular geography for a particular simulation software is not accessible to anyone else).
- **Data Disconnection:** Accessed data lacks context to make the information useful (e.g. a random simulation output file with no history of analysis).

[4] "Our Top Data and Analytics Predicts for 2021," by Andrew White, Jan. 12, 2021, Gartner blog; https://blogs.gartner.com/andrew_white/2021/01/12/our-top-data-and-analytics-predicts-for-2021/
[5] "What's Your Data Strategy?" by Leandro DalleMule, Thomas H. Davenport; Harvard Business Review; https://hbr.org/2017/05/whats-your-data-strategy

75 percent of organizations do not yet have a complete architecture to manage an end-to-end set of data activities, including integration, access, governance, and protection, with 79 percent of organizations reporting they use more than 100 data sources, with 30 percent using more than 1,000 sources.

Source: IDC Global Survey of the Office of the Chief Data Officer

Data Fragmentation

Many organizations lack a coherent strategy on where to store engineering data. This then leads to data fragmentation. The lack of a storage strategy means teams use their preferred services or use whichever system was recommended by each simulation software vendor. As the organization adopts various cloud computing services, HPC and simulation storage will also likely transition to the cloud, further exacerbating the data challenge.

Beyond organizational silos, the data related to a given research effort and simulation analysis are typically scattered across various file systems and data storage environments.

While an array of data storage services are available based on performance, geography, cloud provider, and other factors, these options often unintentionally block effective collaboration.

Data Disconnection

One fundamental challenge with R&D data is that computer simulation data on its own, without context, is generally not very useful beyond the moment in time the data is generated or beyond the individual performing the analysis. So capturing the intention and history of the simulation is critical to data and knowledge management. This presents a fundamental process challenge, as simulation engineers are typically focused on their research and development tasks and less on metadata capture and enforcement.

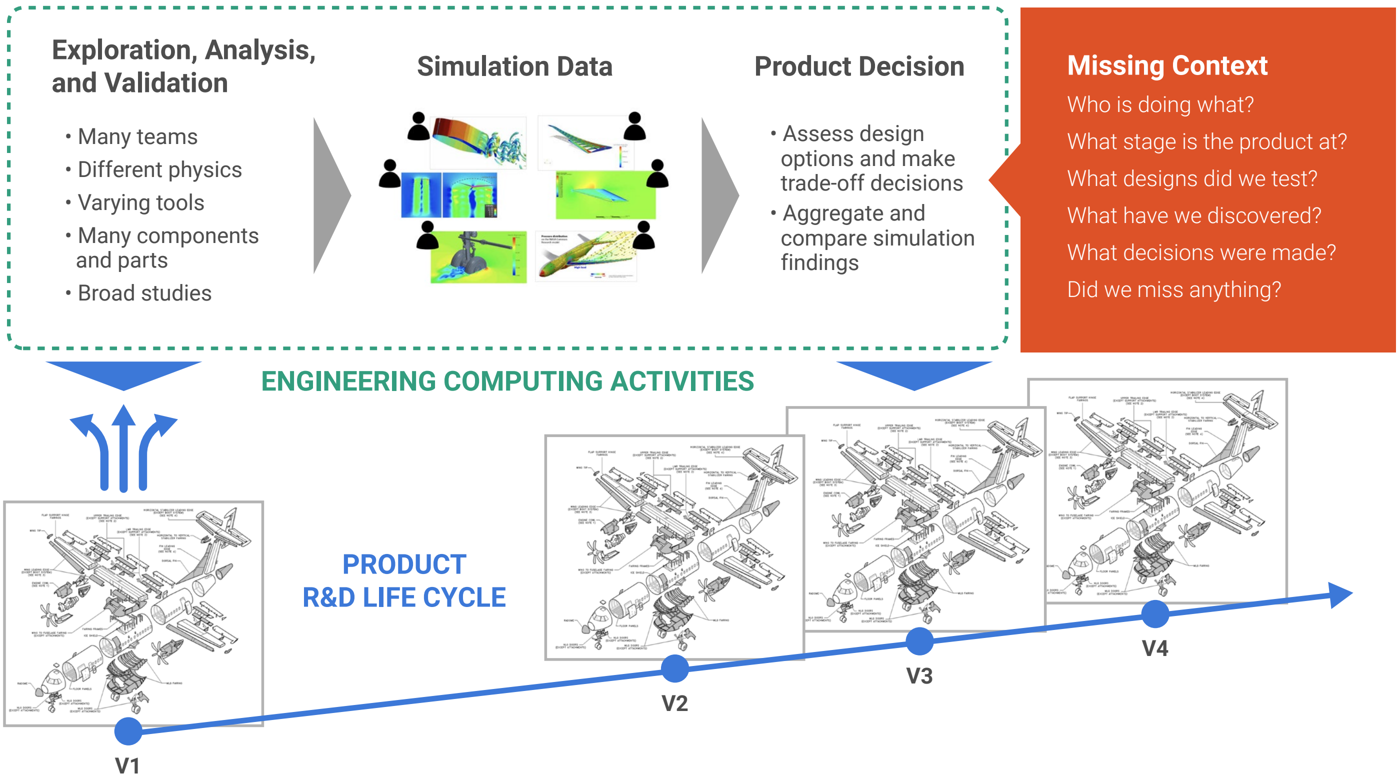
While SPDM tools can in theory address this gap, in practice many organizations have struggled to overcome this challenge. Typically, this approach means capturing the activities and outputs of computational engineering efforts, with the intent of referencing the insights from the simulation data at some later date.

While some organizations with best-in-class practices are keeping good track of their simulation data, these organizations are in the minority. The majority of organizations see the benefits of SPDM not worth the complexities they entail, while others are years into their SPDM program development and have yet to make meaningful progress.

Without a reliable means of capturing intent, engineering data remains disconnected from the activities that generated it. The result is that the data is only as useful as the memory of the user who created it. And if that engineer leaves (or can't be identified), then all context on their work is lost. For example, the departure of just one engineer led to substantial production delays for a new product at a defense contractor.[6]

[6] "How to Safeguard Institutional Knowledge in the Face of the Great Resignation," by Laura Reul, April 22, 2022; Gartner Insights; https://www.gartner.com/en/articles/how-to-safeguard-institutional-knowledge-in-the-face-of-the-great-resignation#:~:text=When%20employees%20leave%2C%20they%20take%20with%20them%20the%20insight%20into,a%20defense%20contractor%20told%20us.

The Data Challenge in Engineering Computing



A broad range of engineering computing activities take place in silos of analysis, which contain important context that is often lost between R&D phases.

Data Fragmentation and Disconnection Implications

Fragmented data sources and missing engineering context create three major challenges for organizations looking to improve their data management practices.

» **Islands of Analysis:** A lack of data sharing leads to duplication of efforts and isolated insights.

» **Incomplete Visibility:** A lack of a holistic view on overall progress makes insights on product performance and dependencies difficult.

» **Opaque Product Decisions:** Without a clear or accessible record of how product design decisions were made, organizations have difficulty assessing and improving product development processes.

Islands of Analysis

When collaboration or access to data across teams becomes difficult, teams look inward to solve problems. This leads to inefficiencies in R&D collaboration including manual handoffs, duplicated work, and ineffective use of data.

Manual data requests, conflicting duplicate data, and siloed sources lacking the latest data versions create inevitable delays or mistakes that require revisions and extended project timelines.

In some cases, well-meaning teams seek to solve product design issues but don’t share their data and insights widely. As a result, cross-functional teams struggle to gain a complete picture of all product efforts and don’t have an easy way to review simulation outputs from other teams (lack of data access and lack of context). Teams can also use different simulation tools to investigate the same question, making data sharing even more difficult.

Effects of Fragmented and Disconnected Engineering Data Management

Traditional Engineering Approaches

- **Fragmented** - Simulation data stored in silos making access difficult (tech stack, locations & clouds)
- **Disconnected** - Simulation goals not captured or captured separately from where work is performed

Impact to Engineering Processes

1. **Islands of Analysis**
   Siloed work, manual handoffs, duplicated work, and ineffective use of data
2. **Incomplete Visibility**
   Findings shared via presentations and ad hoc discussions on separate aspects of product decisions
3. **Opaque Product Decisions**
   Design decisions are ad hoc and their justification is undocumented or unclear to other teams

Based on interviews by Rescale with leading R&D executives, as much as 30 percent of R&D computing activities are either redundant or unnecessary. Critically, these executives say they also lack the means to mitigate these challenges.

Islands of analysis are not only keeping companies from developing their best innovations, but they are also extremely wasteful of expensive high performance computing resources, software, and engineering talent.

As more organizations make the shift toward AI-generated designs and AI-driven decision-making, data quality and traceability will be even more important to ensure AI models are based on accurate simulations.

Incomplete Visibility

Throughout the R&D life cycle, engineers and leaders need a holistic view of the product—both the work being performed and the work outputs. However, a lack of adequate data access and data context makes this goal extremely difficult to achieve. Engineers and product leaders cannot gain a holistic real-time view of the product, including its latest design specifications, performance measures, and overall development status.

For example, multiple engineers might work on the aerodynamics of a vehicle body, each using different layout and file formats updated asynchronously and intermittently (e.g. requirements matrices in spreadsheets vs. visual presentation vs. written notes).

Simulation outputs can be visually dynamic, but when shared, they are often reduced to static screenshots and separated from their related files (e.g. a compiled visual presentation). This makes it difficult to share simulation results in their full detail, which hinders cross-team understanding and the consistent preservation of knowledge. Effectively, this means there is no practical source of truth on the product being developed. Without a consolidated reference library for product analysis data, product managers face challenges making and justifying decisions when balancing trade-offs between designs with various performance attributes. In addition, this lack of visibility makes executive communications and reporting extremely difficult.

Opaque Product Decisions

When simulation data lacks context, it becomes impossible to tie specific engineering decisions to the studies that informed those decisions. This means that at the end of an R&D process, the path of decisions toward the final product can be murky to explain or impossible to reproduce.

Additionally, newly added team members are often unable to gain a full understanding of all previous decisions and trade-offs, which can slow production, especially when defects or material changes occur. Lacking a clear digital paper trail can be problematic when collaborating internally (e.g. change orders, user acceptance testing, and ongoing validation and optimization) and externally (e.g. supplier integration and industry certification audits).

In regulated industries, it is common to require documentation on the simulation hardware configurations and software version history to verify accuracy, especially as most industries move toward R&D processes with less prototyping and physical testing. In cases of warranty claims and litigation, it is critical to be able to ascertain a clear and comprehensive digital picture of product design decisions.

As more organizations make the shift toward AI-generated designs and AI-driven decision-making, data quality and traceability is even more important to ensure AI models are based on accurate simulations.

With up to 80 percent of the cost of a product's development determined by the decisions made early in the design process, it is critical to properly allocate downstream resources. This is best done by making design decisions that consider relevant engineering input from many sources, with simulation being one of the most important.

Engineering.com, Engineering Design Platforms and Simulation in-CAD Benefit Product Development Teams

The Path Toward Data-Driven Engineering

As simulation, modeling, AI, and other digitization initiatives generate a growing volume of complex data, organizations must shift to a new approach in how they manage their R&D computing data.

Prerequisites for Data-Driven Operations

Digital engineering and product development teams need to create a cohesive data-driven approach to their workflows and processes. This starts with two foundational practices that bring teams and insights together to produce better products and operate more efficiently.

- **Shared Access to Data:** Information is accessible to authorized users regardless of where the data is stored or how it is stored.
- **Shared Context on Data:** Product data is accompanied by information on how and why the data was created, what elements were in scope, and how the data was used.

Shared Access

As information becomes more abundant and scattered in functional silos and storage services, IT teams must build a unified data architecture that supports simple and efficient shared data access between R&D team members. Providing aggregated data search capabilities from within the simulation workflow can deliver information in the moment of analysis and decision-making.

Building a scalable and accessible data architecture means working backwards to connect together a variety of data sources while standardizing and centralizing how teams access and use various storage options.

While no single data storage approach can meet all R&D needs, standardization ensures teams are using the best-fit storage services for their use cases while limiting the costs and complexities of managing too many storage services. IT teams should establish a data strategy that supports a blend of storage services to meet the diverse data of full-cycle product development.

Best Practices for Shared Access

Additionally, as simulation, modeling, and AI/ML activities increase, it's important that an organization's storage architecture can scale cost-effectively with data and user growth. Key recommendations include establishing a data architecture that is:

- **Multi-Tiered:** Each engineering team can utilize a variety of data management services to meet specific digital R&D needs and business objectives. For example, use file-based systems when broad collaboration is needed. When cost, scalability, and durability are your main concerns, object storage is likely your top choice.
- **Federated:** Multiple teams can easily access and share commonly used files across an array of independent storage platforms, which can be centrally managed by an R&D or IT team.
- **Governed:** IT and engineering leaders can set policy-based storage automations for regional data locality and industry compliance requirements or cost-performance requirements.
- **Durable:** Critical data is persisted (moved out of ephemeral storage) to ensure continuous access for multiple users, as well as being regularly backed up in multiple regions to support quick data recovery and mitigate the risk of data loss.

Context for an Expanded View of Engineering and Scientific Computing

Engineering Factors	**Details** • On related project or study • On related components • For collaborators and approvers	**Intent** • Early discovery • Optimization • Verification or validation • Re-work	**Findings** • Analysis success (or not) • Performance measures • Trade-offs	**Actions** • Retain or delete • Use for ML model training • Publish or share • Tag as 'source of truth'
Security Factors	**Permissions** • To intellectual property • To customer data	**Access** • Login history and failed attempts • IP and MFA requirements	**Localization** • With data geofencing • With data sovereignty	**Compliance** • With industry standards
IT Factors	**Capacity** • Of infrastructure • Of software licensing	**Cost** • Of infrastructure • Per workload/job • Of software licensing	**Performance** • Time-to-solve • Throughput	**Reliability** • Of hardware • Of applications
	Engineering Computing Tasks e.g. Simulation, Modeling, AI/ML Workloads			

Organizations tend to focus more on operational factors and less on engineering context. Additional context through proactive data management (e.g. metadata) delivers a holistic view.

Shared Context on Data

Shared context between teams means that anyone can easily access details about engineering data they have access to. Metadata management for simulation, modeling, and AI/ML analysis can be accomplished in different ways based on organizational preferences: free-form commenting, flexible tagging, controlled taxonomies, and prescriptive forms.

This additional information ensures that the intention of each digital activity is captured consistently and the interpretation of data (particularly simulation results) is accurately depicted for clear handoffs to other teams.

Best Practices for Shared Context

Organizations that want to improve the accuracy and agility of their R&D efforts should aim to integrate these five capabilities for bringing greater context to their engineering data.

- **Seamless:** Metadata that captures the intention of every simulation and analysis needs to be added seamlessly within end users' existing tools and workflows.
- **Schema-Less:** Metadata should provide flexibility in data capture and searchability. Unlike traditional approaches that entail defining a rigid data model of how simulation data should be managed (which has not proven widely effective), teams should explore what fits best with their workflows and provides the opportunity to apply structure when appropriate.
- **Governed:** Organizations need to enforce specific metadata requirements to establish process consistency and ensure data quality. This information can include critical contextual details such as development stage, design specifications, and performance results—whatever information is most important to the organization.
- **Transparent:** Teams should be able to search, filter, and perform analytics on metadata from related studies to support model-based systems engineering (MBSE) for streamlined assessment of design trade-offs.
- **Extensible and Interoperable:** R&D teams should be able to import and export metadata using APIs for third-party tools to further extend the data management architecture to other teams or supply chain partners.

Applying Data-Driven Principles to Unlock Engineering Potential

Traditional Engineering Challenges:

- **Fragmented** - Simulation data stored in silos making access difficult (tech stack, locations & clouds)
- **Disconnected** - Simulation goals not captured or captured separately from where work is performed

Outcomes

1. **Islands of Analysis** - Siloed work, manual handoffs, duplicated work, and ineffective use of data
2. **Incomplete Visibility** - Findings shared via presentations and discussions ad-hoc on specific aspects of product design
3. **Opaque Product Decisions** - Design decisions are ad-hoc and their justification is undocumented or unclear to other teams

Data-Driven Engineering Transformation:

- **Shared access** - All teams have ability to access data, regardless of where or how the data is stored
- **Shared context** - Intentions of every simulation seamlessly captured along with the user's workflow

Outcomes

1. **Seamless Collaboration** - Findings are easily accessed for use in subsequent studies, enabling continuous integration and accelerating velocity
2. **Unified Visibility** - Latest simulation insights accessible instantly in aggregate to facilitate holistic comparisons of alternative designs
3. **Traceable Product Decisions** - Design decisions and dependencies are visible and traceable to all related simulation data

The Data-Driven Engineering Advantage

Organizations that are able to effectively manage engineering and simulation data are positioned to digitally transform their R&D processes. This transformation can improve not only R&D velocity but also efficiency and product quality. It empowers scientists and engineers with the information they need, when they need it. In this new world of connected and contextual collaboration, all teams have access to the shared insights they need to innovate, regardless of where or how the data is stored.

Seamless Collaboration

The benefit of shared access and shared context for R&D data is that collaboration becomes far easier, faster, and more efficient. Teams can view a single "source of truth" that is accessible and contextualized to help make decisions quickly—regardless of where the data is sitting. As many modern products have an increasingly complex set of requirements and interdisciplinary systems, engineering teams are implementing model-based systems engineering (MBSE) frameworks to streamline data sharing.

Using an MBSE approach means engineers can quickly discover the related information they need from the model, as opposed to documents, to perform their design explorations and analyses faster. Handoffs of information between teams are more predictable and key findings remain intact for everyone involved in product development.

When the coordination of cross-team collaboration is improved, organizations increase their overall resource efficiency, from reducing duplicated efforts and avoiding unnecessary costs to speeding product development and increasing engineering productivity.

Unified Visibility

Shared access and shared context are critical in helping teams establish a holistic view of their product development projects.

As relevant product information becomes available, engineers and their stakeholders can aggregate insights from a variety of associated design explorations, experiments, and optimizations to facilitate comparisons of all possible designs.

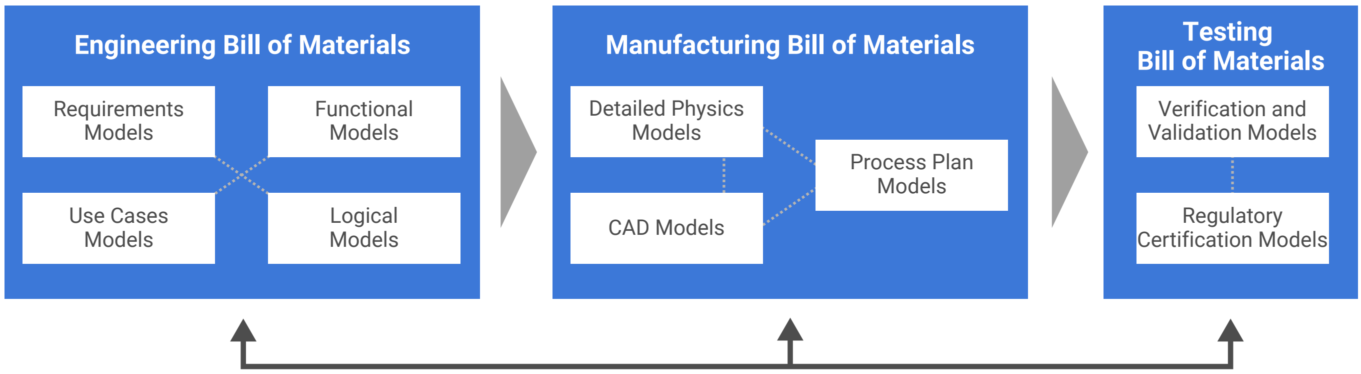
To make this possible, organizations need to ensure data is both accessible and contextualized for all authorized users. Federated storage management and metadata on all simulation outputs can help organize data sets, provide traceability to the models being used, as well as reducing the reliance on anecdotal and ad-hoc document sharing.

Model-Based Systems Engineering Unifies Data and Automates Data Sharing

Conceptual Models
Diagrams illustrating functions of every component in a product and their interactions, connections, and dependencies

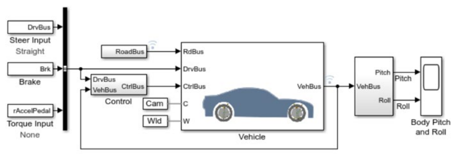
Detailed Models
High-fidelity numerical and visual representation of complete products or components and their behaviors under specific conditions

Test Models
Set of many simulations of product behavior in real-world scenarios as an alternative to physical tests

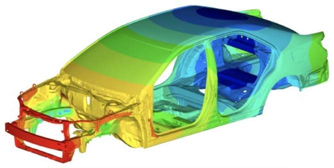


Product data is updated and shared automatically in real-time

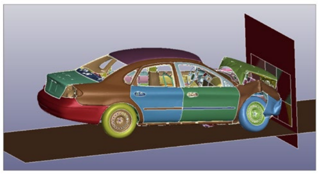
Example Model
Steering functional requirements



Example Model
Vehicle stiffness / rigidity analysis



Example Model
Frontal crash structural analysis



Model-based systems engineering leverages dynamically updated models to reduce the need for ad-hoc document sharing.

Traceable Product Decisions

At the core of building digital threads is the need to trace product decisions through the entire design and manufacturing life cycle. With coordinated collaboration and a holistic view of product development, companies can establish a traceable digital thread in their R&D decision-making process.

The benefits of traceability are far-reaching, from making it easier to validate design decisions to consistently capturing comprehensive testing details (for internal design assessment or external auditing).

Having a digital thread ensures alignment with product requirements, aids in change management, facilitates defect detection, speeds root-cause analysis, and can help predict maintenance timelines.

In highly regulated industries, traceability can accelerate regulatory approvals and speed commercialization. By fostering transparency, accountability, and structured development, traceability leads to faster innovation, better decision-making, and, ultimately, higher quality products.

Traditional simulation reporting methods waste resources and create bottlenecks as CAE analysts can spend up to 30% of their time manually creating reports.

Digital Engineering 24/7, "Transforming CAE Reporting, Design Reviews and Decision Time with 3D Digital CAE Information"

Best Practices for Successful R&D Transformations

The digital transformation of an R&D program to become more data-driven requires process and technology improvements. But most importantly, it requires an understanding of people and how they work. Done correctly, the digital transformation of your computational engineering program brings far greater productivity to your R&D teams.

Without careful thought and equally savvy implementation, efforts can come up short. For example, it's estimated that 50 percent of product life cycle management (PLM) implementations fail. But this isn't a technology issue. They fail because the engineering teams who were tasked with data entry were not properly trained and incented to ensure data is captured properly.[8]

ITERATE	INVEST	PARTNER
Start and incrementally improve processes or technologies to bring about biggest impact	Invest in people, understand your organizational readiness, and focus on user experience to maximize adoption and build momentum	Learn best practices with like-minded organizations, integrating their tools that support iteration and the user experience

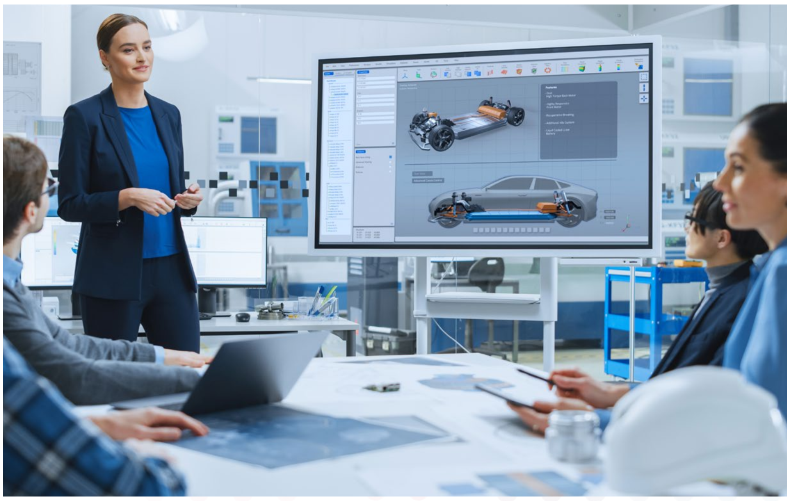
For innovation leaders to maximize their chances of success, they should focus on three areas to bring a data-driven approach to R&D operations.

Given the unique nature of R&D organizations, simply rolling out best-in-class practices to existing operations is not likely to have the desired effect. The key is to examine your existing activities and identify what is working and what needs improvements. Then prioritize your efforts. This may involve experimenting with new technologies, testing out new practices for creating and using metadata, or implementing process adjustments. There is no ideal data model or process, as the best approach will depend on many factors, including the maturity of the organization and the type of product being developed.

Most importantly, the researchers, designers, engineers, and scientists who drive the innovation for an organization need to be at the center of any R&D transformation initiative. Given this, any attempt to capture metadata on R&D computing activities should be entirely seamless to the user workflow—without having to log in to yet another data input system.

Critically, data quality management should be done when the data is being recorded. Additionally, this data needs to be immediately useful to innovation teams to ensure their ability to respond to other data in real time.

Lastly, navigating the fast moving landscape of engineering and scientific computing, cloud, digital engineering, AI, and more can be difficult for any organization. Advances in high performance cloud services, ascendent AI and ML technologies, and SaaS tools are radically changing how organizations run their digital R&D efforts. It will be important to develop partnerships with experts who have navigated these transitions.



[8] "Product Lifecycle Management in the Digital Twin Era," 2019; https://books.google.com/books/about/Product_Lifecycle_Management_in_the_Digi.html?id=HGXTDwAAQBAJ

Conclusion

Modern research and development is becoming increasingly digital, resulting in a rapidly expanding array of complex data from high performance computing, digital twins, simulations, and AI-driven physics.

To benefit from these cutting-edge technologies for powering modern engineering and research, R&D leaders need to develop a new data management approach to help ensure shared access and context across teams.

With the right data management architecture, organizations can unlock the true potential of their research, design, and engineering efforts to drive unprecedented innovation through greater collaboration, holistic visibility into the product development process, and full traceability of digital threads.

Rescale partners with organizations around the world and across industries to help them harness the power of the cloud to transform their R&D operations.

In the same way Rescale unlocks the potential of these essential computing resources for our customers, we are using the intelligence of our HPC management platform to help organizations create new efficiencies and unlock new insights from their R&D data.

Innovation in science and industry will continue to drive the proliferation of data and the need for more strategic and comprehensive data management. Rescale can help you thrive in this new era of computational research and engineering through automated and centralized control of your digital R&D efforts.

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Digital Engineering | Workload Optimization | Intelligent Automation | Security & Compliance

About Rescale

Rescale provides high performance computing built for the cloud to empower engineers while giving IT security and control. The Rescale platform makes it simple for engineers and scientists to harness the most advanced software and computing architectures for cutting-edge simulation and AI-driven innovation. For IT, the Rescale platform provides full-stack security and support, and delivers policy-based financial and architectural controls to maximize performance and efficiency. Rescale powers the world's leading companies to accelerate innovation across industries including life sciences, automotive, energy, semiconductor, aerospace, and manufacturing.