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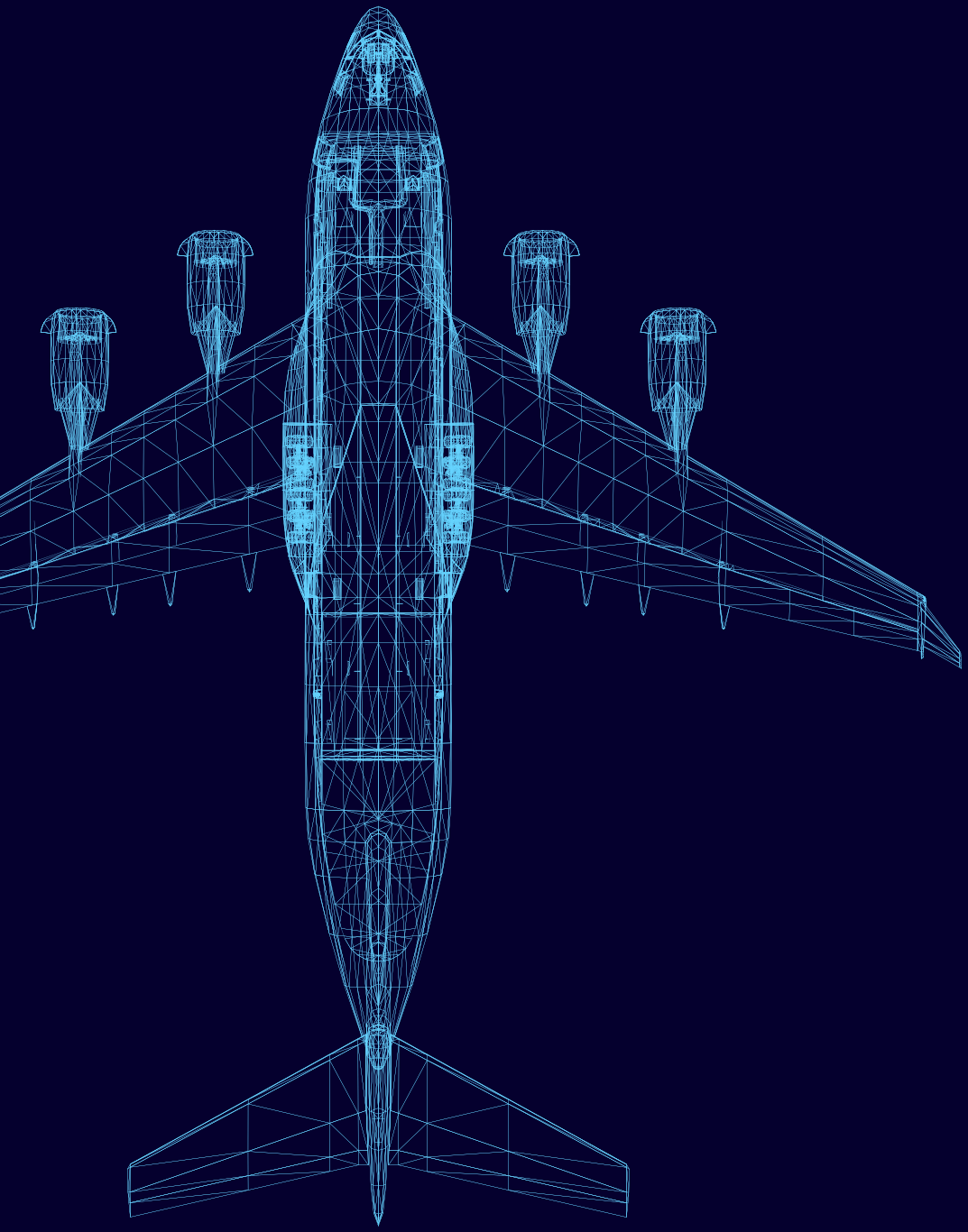
eBook

MANAGING THE CONTEXT OF PRODUCT COMPLEXITY USING THE DIGITAL TWIN



WHAT IS A DIGITAL TWIN?

Learning about the Digital Twin can be a daunting task. There are many competing definitions out there. Where you work within the lifecycle of a product and your intent as to how you want to use it in your business, will greatly determine which definition resonates with you.

But let's make one thing clear—there is a difference between a Digital Model and the Digital Twin. As this eBook is dedicated to the value of the Digital Twin for the maintenance of products (assets), please do not let any vendor try to convince you that a Digital Model—an engineering picture, if you will—created during the development of a product that has not been made yet, is a Digital Twin.

Why? So many things have happened to that product before it's ever been installed at your site. It's been designed, re-designed, it's been through a manufacturing process, and things like exceptions, part replacements, supplier changes, and engineering design changes have occurred. Only when that product is done with its manufacturing process, and its configuration, including electrical, mechanical, and software has been recorded, can the first Digital Twin be created.

With that as a backdrop, let's explore the opportunity available for Operations and Maintenance for the Digital Twin.

KEEPING TRACK OF CONTEXT IN COMPLEX PRODUCTS IS DIFFICULT

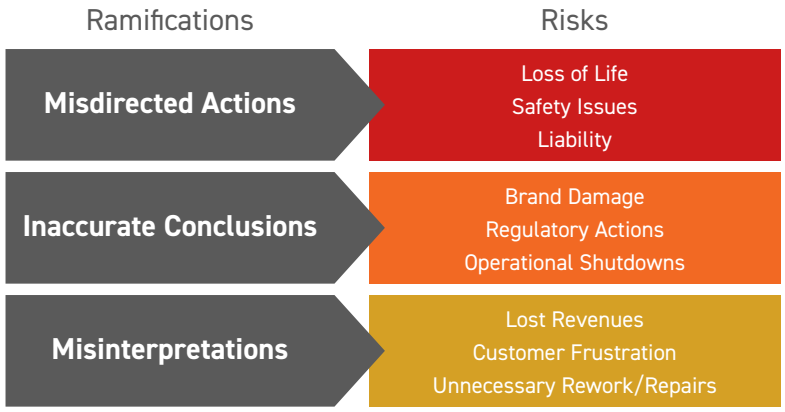
Keeping track of changes to complex products is difficult—think Aerospace & Defense equipment, new generations of commercial aircraft, and software based automobiles. Another layer to this is the complexity of systems that compound product complexity, such as in refineries, power generation facilities, and manufacturing plants.

Sure, there are maintenance solutions that build out a hierarchy of what a complex product, or system, should look like in order to perform maintenance. But often, after it has been implemented in these systems, it becomes out of date. Why? The configurations have been built with static data models which are rigid and cannot change as your asset changes over time. You want to change the configuration of a system, but this means rebuilding the configuration all over again—a costly exercise, and, more than likely, it will need to be built again by the time you are done. This leads to inaction and results in some maintenance processes occurring outside the system, causing problems in the future execution of work.

According to an Aberdeen Group report, "Asset Performance Management: Blazing a Better Path to Operational Excellence, November 2017",

The cost of unplanned downtime can be devastating, ranging from an estimated $10,000 to $250,000 per hour for industrial plants.

How often have you sent a crew out to do a job, based on what you think the product configuration is, only for them to come back because they have the wrong parts, tools, or expertise? This lack of configuration knowledge leads to excessive downtime.



This lack of visibility and upkeep is further compounded when some of the systems you are maintaining are supported by third party contractors, or you are working with manufacturers through product-as-a-service contracts. Each of these business scenarios may require a different view of a product's configuration that legacy maintenance systems cannot provide.

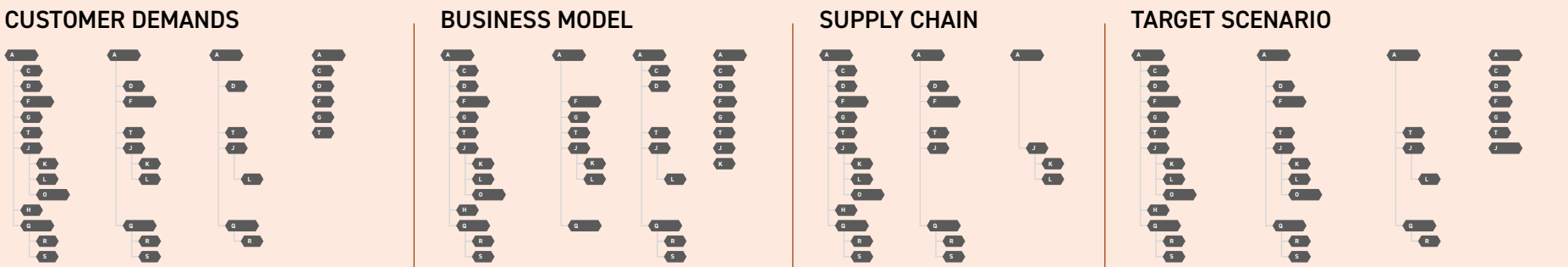
WHAT ARE THE DIFFERENT DIGITAL TWIN UPKEEP STRATEGIES?

We have seen a variety of approaches to creating and recording a Digital Twin Configuration. Your approach is largely determined by the number of products you are maintaining and the level of maintenance sophistication your organization is striving for. Some companies with few assets, and limited maintenance frequency are more than happy to periodically record the current state of their products' configurations once monthly, quarterly, or yearly.

Others in more complex industries need constant upkeep of their Digital Twin configurations. For example, in Oil & Gas, changes are frequent, products are many, and there are relationships between products—creating systems of systems. These companies need their configurations to be more automated to keep up with the pace of change.

Others may provide maintenance with their products, such as Renewables or Robotics. They want to keep a product's configuration up-to-date in order to support service level agreements—keeping their customers happy. This coupled with the related information "coming off" their products, will provide insights so they can have in-depth business opportunity discussions with their customers for upgrades and future product developments.

But, what if you have millions of products like the Automotive Industry? In that case, it may make more sense to assemble Digital Twin Configurations when they are required—for example, to simulate what happens if I send an over the air (OTA) software update to certain configurations of product.



Some of the many use cases for different digital twin configurations.

ONCE YOU HAVE THE FOUNDATION, MAKE THE CONNECTIONS USING THE DIGITAL THREAD

For the Digital Twin, context is key. To create next level business value, content will be king. For this, you need to tightly couple the Digital Twin configuration with its related content—traceable across the product lifecycle.

This is created by implementing a sustainable Digital Thread—allowing you to track a product and its digital assets all the way from concept through design, manufacturing, quality, and service. The unbroken flow of information will help your organization gain crucial insights that can inform decisions throughout every aspect of the product lifecycle—improving communication and collaboration and resulting in the creation of better products, with a shorter time to market.

48%
Computer-Aided Engineering (CAE) Software

47%
Enterprise Resource Planning (ERP) Software

45%
Maintenance, Repair, and Overhaul (MRO) Data

44%
Sensor Data

44%
Systems Engineering Software

44%
Business Intelligence/ Analytics Software

43%
Product Lifecycle Management (PLM) Software

According to the Gartner Survey "Survey Analysis: Digital Twins Are Poised for Proliferation," at least 40% of organizations implementing Digital Twins reported at least seven sources of data captured and monitored as part of their Digital Twin efforts.

Every company needs traceability as a capability for each product or system they maintain. If you have issues such as lower than average maintenance productivity, or your maintenance workforce is spending too much time searching for information on parts, job plans, service bulletins to name a few—then connecting your Digital Twin Configurations to the Digital Thread is your path forward.

What's the Business Value of the Digital Thread?

According to McKinsey, "Industry 4.0: How to navigate digitalization of the manufacturing sector:"

You can expect process improvements that can increase productivity (3.5%)

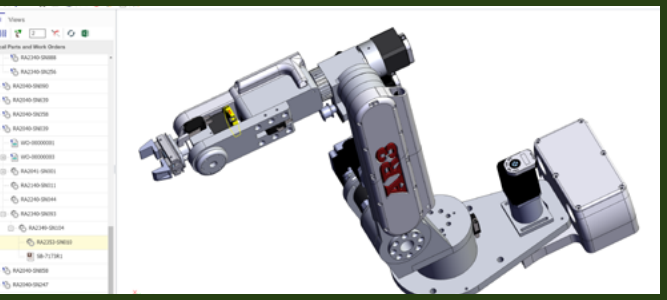
Lower productivity costs through information access (45-55%)

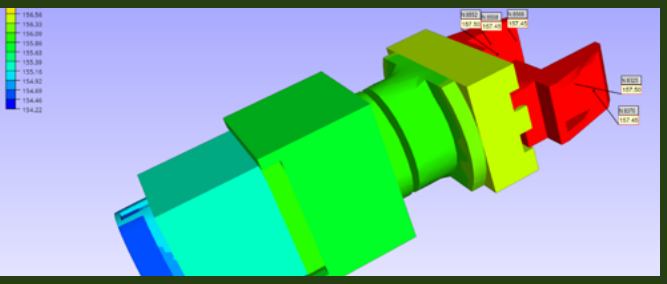
THE MAINTENANCE USE CASE(S) FOR DIGITAL TWIN(S)

Maintenance is all about keeping products working and prolonging their life. To do this organizations must be effective at maintenance which is defined as performing work according to a defined plan in order to mitigate the consequences of failure and doing the work in a cost-effective manner. An effective Digital Twin configuration, connected to critical information using the Digital Thread, will provide the context you need to avoid some common issues that Maintenance Management systems of the past, could not solve.

Your existing Maintenance system and processes have not done a good job related to capture and the housekeeping as to what the product or system is digitally. Without this context it is difficult to be effective at maintenance. Over time, as work is performed with the physical product, some if this information about how it has changed, is lost. This loss of context results in sending the wrong people, parts, or tools out to a job, which results in an increased cost of maintenance, less work being performed, longer downtimes that raise production costs, all of which reduce a maintenance organization's effectiveness.

Once Digital Twin configuration is in place, here are a few ways to use that context to support Maintenance.





Visualization: Information Access/User Experience. Information accuracy to perform work management, right people, tools and parts for the right product for diagnosis and information access.

Operational Simulation: Get at those simulations from the supplier. Make your own based on its current context, try to repeat operational anomalies to get at workable solutions.

Predictive Analytics: Improve accuracy of your predictions with context. 92% believe that the use of a Digital Twin with predictive maintenance capabilities would have prevented unplanned outages.

- Unplanned failures: 45% related to hardware failure or malfunction
- 39% cite software failure or malfunction
- Others (overload 30%, user error 19%, security breach 14%, humidity 11%)

VanBourne Research, "After the Fall"

CANNOT HAVE	PLATFORM REQUIREMENTS	MUST HAVE
Proprietary, Closed APIs	INGEST DATA	Full + Open APIs
Proprietary Data Models	INTEGRATION	Open Data Model
Obfuscated Data	EXFILTRATE DATA	Open Data Access
Static/Hard Coded Data Model	EXTENSIBILITY	Dynamic Data Model

The key characteristics for Digital Twin configuration that will not degrade over time/lose shelf life over time.

HOW DO I MAKE AND MAINTAIN A DIGITAL TWIN CONFIGURATION?

Anyone interested in creating Digital Twins for products they maintain need not rely on the supplier of these products to provide its Digital Twin. In a perfect world, the supplier would be providing this Digital Twin configuration as part of the purchase—that was captured when manufacturing was complete, and already started linking Digital Thread data related to its parts used, whether electrical, mechanical, or software.

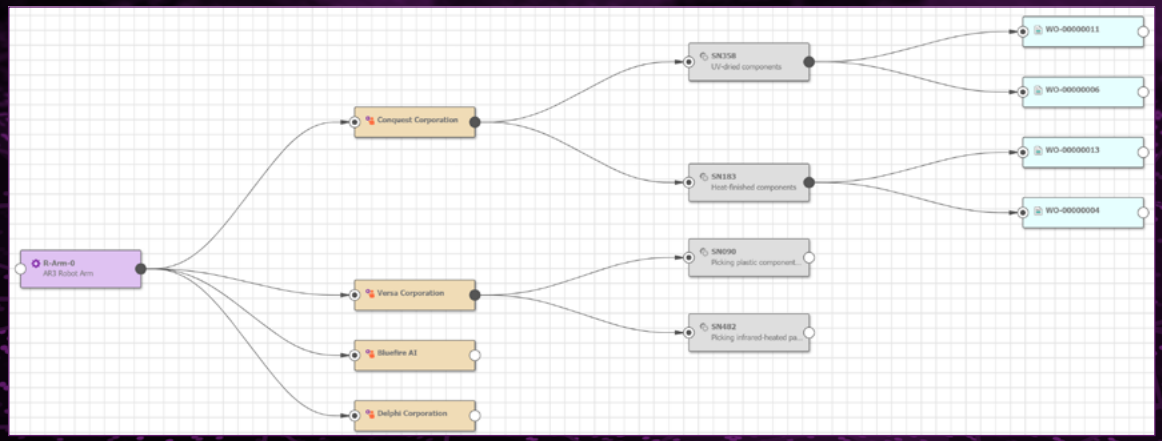
The reality is that many of your products, lasting many years, did not come with Digital Twin configurations. This means you will need technologies and processes that enable you to record configurations, based on their maintainable components, down to their serial number. Doing this creates that foundational traceability. This means that when a serialized component is replaced through maintenance activities, that change can be recorded with the new serialized component information, keeping the Digital Twin configuration up-to-date, as well as showing the old component as part of its Digital Thread traceability.

RECOMMENDED NEXT STEPS IN YOUR DIGITAL TWIN JOURNEY

This is sounds great right? But how can you apply it today and make measurable progress. How do you get started?

If you are a manufacturer, what you should be doing is making sure your "As-built" configuration is as accurate and as detailed as you possibly can. This means capturing all serialized electrical, mechanical, and software components, and linking them back to engineering parts and the related history such as CAD models, simulations, requirements, change orders, and on and on—based on the value they can provide.

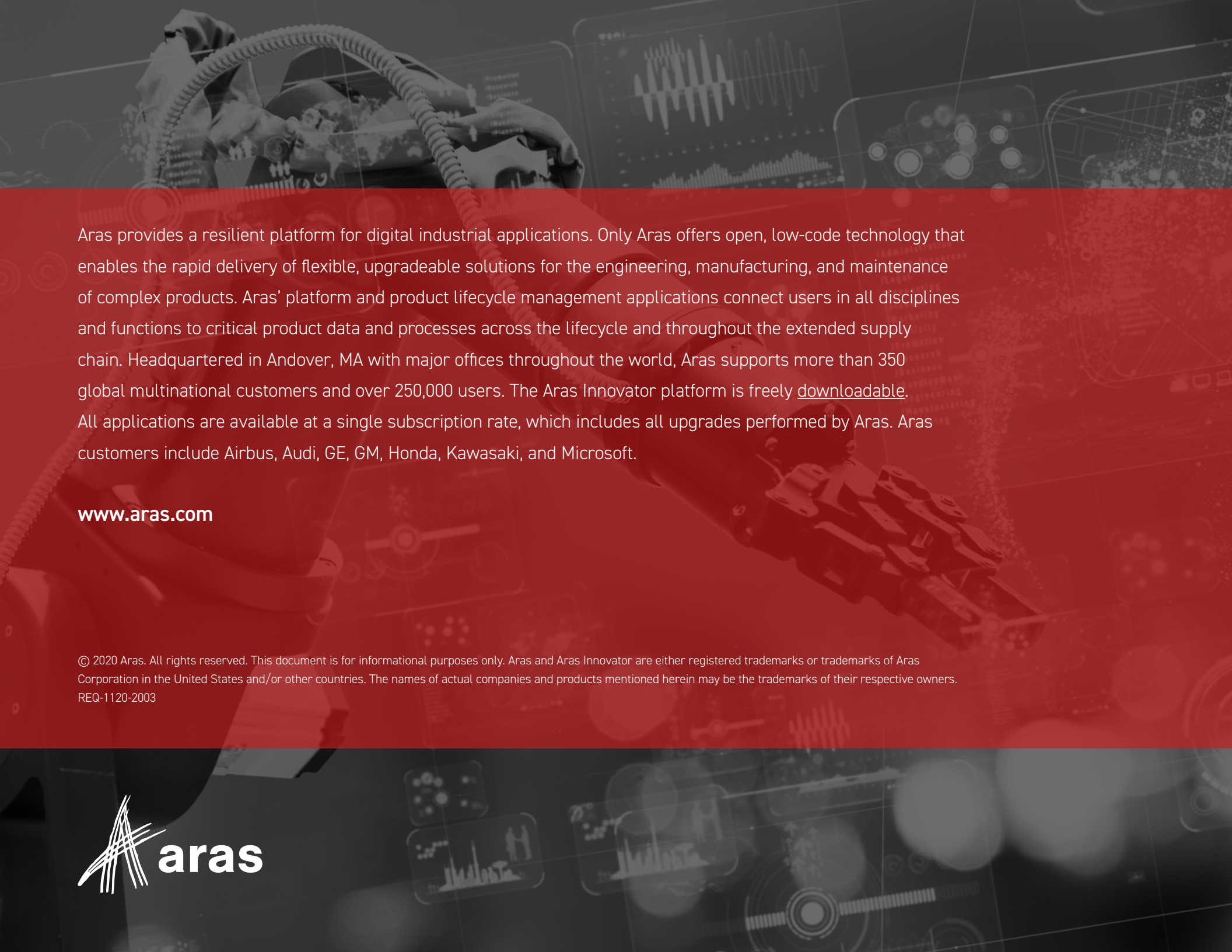
If you are in operations and maintenance, you can start by keeping accurate records of your inspections—track what a product's configuration looks like when it arrives, and making sure this information is digital, not paper based. It should be in a database that is searchable, inspectable, and maintained.



Whatever the business case, the Digital Twin configuration should then be able to extend out to installation, commissioning, and operation at a customer site, allowing it to update the configuration as things change. Then from there, hopefully you're able to start capturing additional data from the field when your product is maintained.

The ultimate goal is for manufacturers of product to have a Digital Twin configuration from when it is built and continuing that configuration forward with that individual physical product until it is retired and recycled. If you can achieve that vision you are going to get a very significant amount of value in how you maintain and operate complex products over time.

This is what every company that maintains a complex product or a system of complex products should strive for.



Aras provides a resilient platform for digital industrial applications. Only Aras offers open, low-code technology that enables the rapid delivery of flexible, upgradeable solutions for the engineering, manufacturing, and maintenance of complex products. 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. Headquartered in Andover, MA with major offices throughout the world, Aras supports more than 350 global multinational customers and over 250,000 users. The Aras Innovator platform is freely downloadable. All applications are available at a single subscription rate, which includes all upgrades performed by Aras. Aras customers include Airbus, Audi, GE, GM, Honda, Kawasaki, and Microsoft.

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