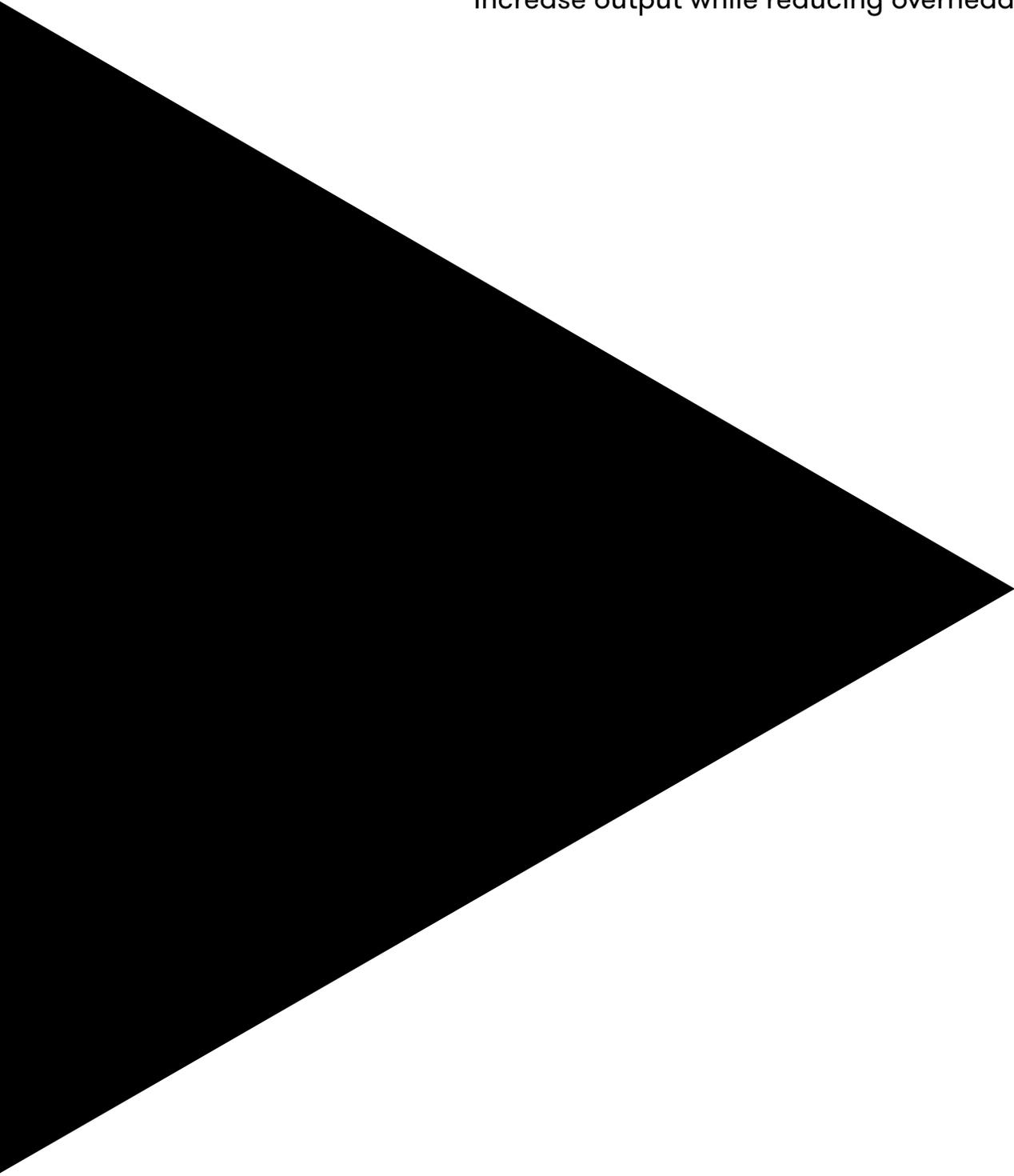# How digital thread can speed manufacturing throughput

Increase output while reducing overhead

A digital thread quickly moves a siloed applications environment suffering from an unwieldy "spaghetti architecture" to a dynamic, interactive ecosystem with appropriate data in play across the enterprise and its supply chain.

The term digital thread might bring visions of advancements in medical suturing techniques, but in reality, it involves data accessibility — a vital concept for architectural, organizational and operational effectiveness. Data is often considered the most critical asset of a modern aerospace manufacturing organization, and rightfully so. Access to the right data in the right place at the right time can make or break a company and its products and platforms.

Enterprises that start with a vision of information as a shared asset ultimately outperform their competition. Enterprises that don't effectively manage information may find themselves in trouble. In fact, we know of at least two organizations where not moving from Excel spreadsheets and Access databases to enterprise applications contributed to the organizations' demise. One of them had more than 34,000 spreadsheets containing business-critical information. It's no surprise that this organization had trouble making informed decisions, when the data that would support those decisions was spread across so many digital assets.

Digital thread can connect critical information — whether you're in shipbuilding, aerospace or ground defense. Think of digital thread like an amped up "find and replace" feature. Manually changing "Assembly X" to "Assembly Y" in a paragraph is relatively easy and quick, but changing it one by one throughout a 10,000-page document would take a lot of time and immense rework. "Find and replace," however, can update every instance of Assembly X to Assembly Y in seconds.

Worse yet, think about having 15 to 20 versions of the data, all housed in different systems, from different suppliers and with constantly changing names, part numbers or specifications. The best way to manage all this data is by using a central repository or data hub to store or translate all the different variations into one version of the truth.

Applied to shipbuilding, for instance, if a part for an assembly in operation needs to be changed because it failed and caused a fire, "find and replace" would make sure the update is reflected in the configuration baselines of all previous and subsequent builds of that specific class of ship.

That is digital thread.

The challenge of connection amid complexity

On the face of it, universal change doesn't sound hard to achieve. The problem is that few, if any, manufacturing organizations have only one system of record managing every application they need for building products and platforms. Normally manufacturers have a range of product data management systems covering enterprise resource planning (ERP), product life cycle management (PLM), material requirements planning (MRP), enterprise asset management (EAM), pipe spools, work orders and more. These systems usually have some level of data exchange and interoperability. That level can vary significantly, but it typically fits into one of three connection categories:

- **Tightly coupled**. Applications that are very dependent on each other and are therefore well connected and interoperable are usually native, built in conjunction with other application vendors and provided out of the box.

- **Loosely coupled**. Applications that have a minimal level of data exchange are sometimes overlooked during upgrades and can lead to broken connections. More often than not, these connections cause issues because they are bespoke (customized), hand-coded or involve generic database connects.

- **Swivel chair**. Applications that have some level of data dependency, but no digital connection, require a human operator to "swivel chair" between two applications and manually transfer information between them. At scale, this would be termed data migration. Imagine the benefit of avoiding this swivel chair effect and replacing it with a digital data hub that would accomplish the same goal. Data descriptions, vendor part numbers, etc., would be aligned across multiple systems automatically.

The other challenge some organizations face is deploying different instances of the same application for different phases of a program. For example, a 30-plus-year aircraft manufacturing program may be broken down into three distinct phases — design, manufacture and service. If an organization has a different instance of an application for each phase, often the only form of data exchange happens through migration from one phase to the next.

In addition, implementing a different application for the same capability in each phase – for instance, PLM app 1 for the design phase, MES app 2 for the manufacture phase and Maintenance app 3 for the service phase — further compounds the complexity.

Together, these issues start to evolve into what you might call "spaghetti architecture" or a true "data hairball."
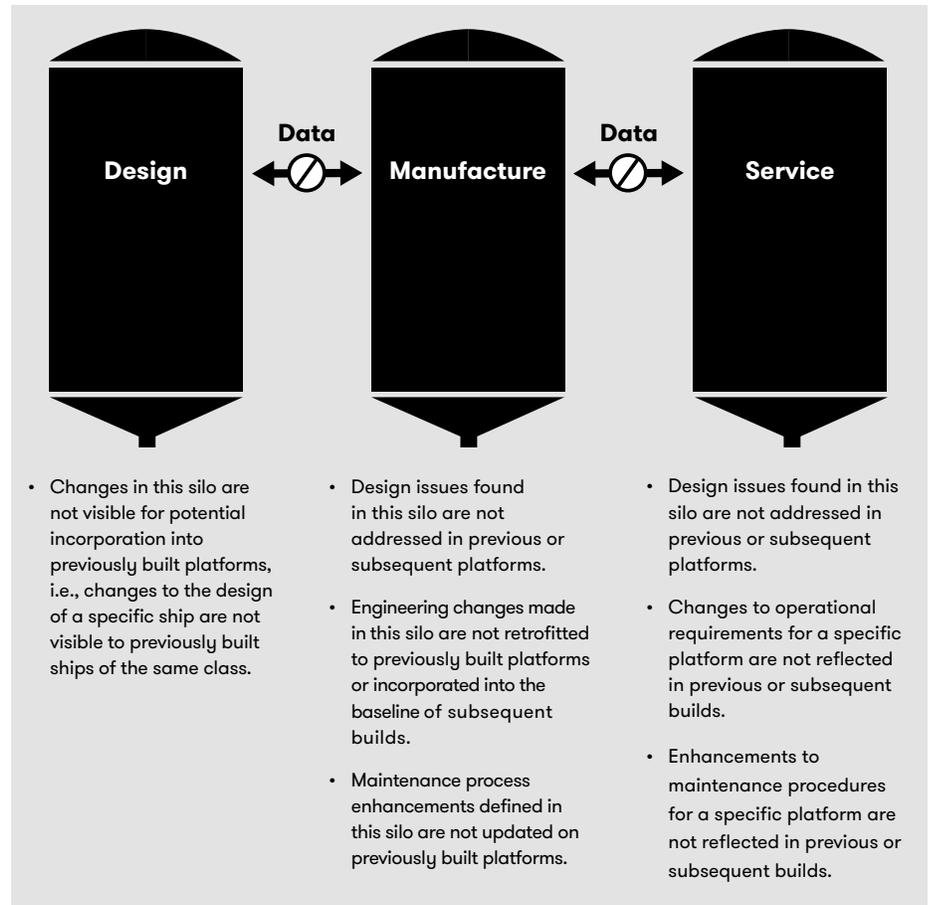
Unfortunately, this digital mess happens in every industry, especially in medium-sized to large enterprises. In fact, it is so common that organizations hire individuals specifically tasked to create and update interfaces between applications. In our experience with IT projects, these and other types of workarounds for product data management account for around one-third of a project's cost, on average. That is a lot of migration dollars. The situation could be avoided if digital thread, along with a corresponding data hub which eliminates the need for the many complex interfaces, was a part of the architectural mantra from the start. tectural mantra from the start.

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Data and digitalization

A number of significant consequences result from data being siloed between the manufacturing phases of an asset's life cycle — some relatively insignificant and some potentially disastrous (**Figure 1**).

Figure 1. Consequences of siloed data and digital dread.

- Changes in this silo are not visible for potential incorporation into previously built platforms, i.e., changes to the design of a specific ship are not visible to previously built ships of the same class.

- Design issues found in this silo are not addressed in previous or subsequent platforms.

- Engineering changes made in this silo are not retrofitted to previously built platforms or incorporated into the baseline of subsequent builds.

- Maintenance process enhancements defined in this silo are not updated on previously built platforms.

- Design issues found in this silo are not addressed in previous or subsequent platforms.

- Changes to operational requirements for a specific platform are not reflected in previous or subsequent builds.

- Enhancements to maintenance procedures for a specific platform are not reflected in previous or subsequent builds.

Under a "spaghetti architecture" scenario, when a part on an aircraft fails, the PLM system typically issues a safety alert and creates a maintenance order to either check or replace that part on other aircraft of the same class. However, without a data hub to link all the systems together, there is no guarantee that the alert and part number will be updated in the system belonging to the manufacturer building new aircraft of that same class. This omission could lead to a subsequent part failure on a new plane — and a fire, injury or fatal crash.

There are many reasons that part might not get updated in the appropriate PLM systems, although it is most commonly due to a lack of the feedback loops you would find in a digital thread. If all relevant systems had a way to handle this digital thread, the change could easily be reflected in all systems across the supply chain — even if the new build is being carried out by a different organization.

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Deploying a digital thread is easier than you might think

So how can organizations involved in long, complicated programs implement a digital thread? This digitization is technically easier than you might think, although it requires a well-thought-out vision, a robust strategy, meticulous planning and experienced foresight. Preferably, these critical steps should be undertaken before the program is mobilized. To be economically viable, interoperability needs to be addressed early in the design of any type of asset. It is significantly harder to successfully deploy digital thread in the middle of or late in a program than it is at the start.

Although there are ways of creating application interoperability through enterprise application integration (EAI), more often than not, the nature of defense and security requirements makes that hard to achieve. It is seldom possible to simply open up the corporate firewall to an organization's supply chain and allow access to the crown jewels over the internet. And even if you could, every application is different, and interfaces would constantly require updating just to prevent connections from breaking.

A more intelligent way to achieve integration is to divulge only the information required to provide a digital thread, and then share that information centrally in a secure data ocean.

This data hub we call an "ocean" gives you the ability to ensure there is a digital thread not only across enterprise applications, but also across applications in the supply chain. A data hub is a hub-and-spoke approach to data integration where data is physically moved and re-indexed into a new system. This system supports discovery, indexing and analytics. That makes the value proposition far more compelling, as it provides a supply chain ecosystem with one version of the truth where data is dynamic and immediately accessible.

Under this digital manufacturing system, when a faulty part is updated with a new part number in the "in-service-support" PLM system, that record is also instantly updated in the data ocean and immediately accessible to any other relevant system across the aircraft supply chain.

As you can see in **Figure 2**, if a part number is changed in the operational/maintenance PLM system of an aircraft type, that change can then be reflected across all associated systems within the supply chain of that aircraft type through the digital thread's data ocean.

The role of digital thread becomes even more valuable when integrated into a supply chain tower (SCT). This relatively new concept leverages artificial intelligence (AI) and machine learning to amplify the power of intra- and inter-industry supply chain ecosystems.

Figure 2. How a digital thread leverages a data ocean.
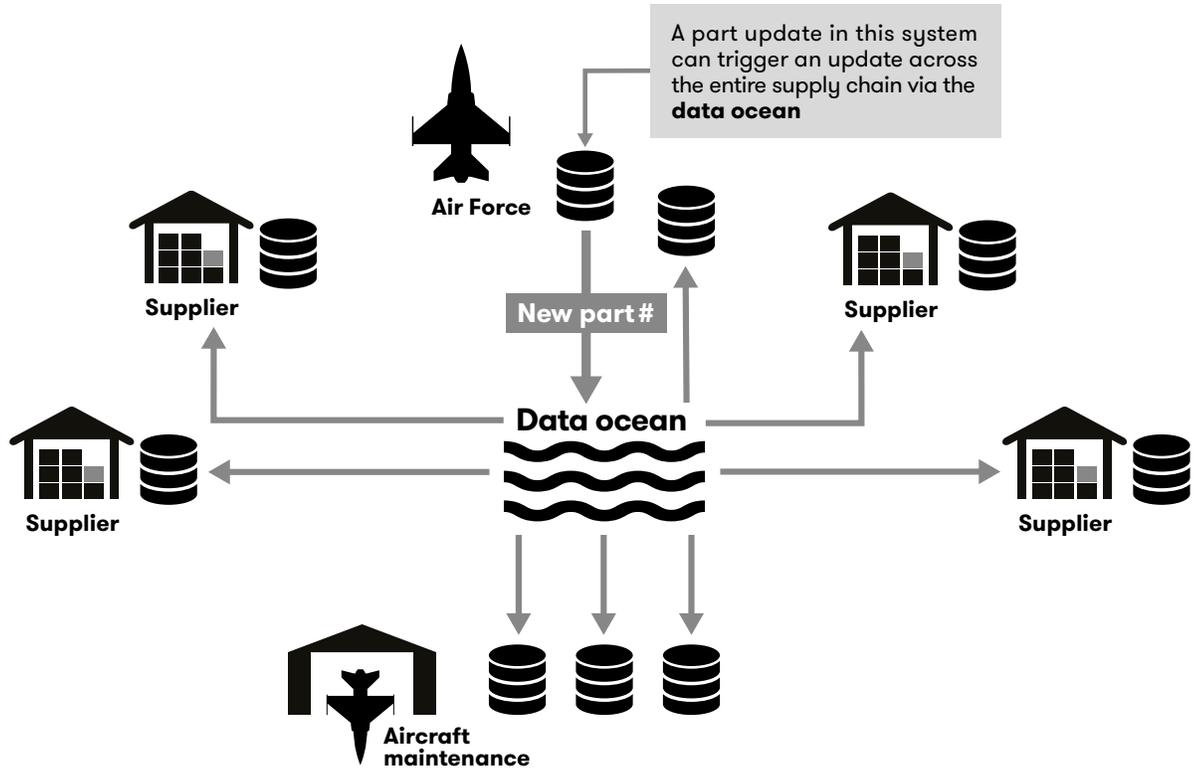
Let's look at an example: Without being prompted, your SCT identifies that your surface defense vehicle program is procuring a large quantity of stainless steel bolts that account for 7 percent of your current spend. The SCT traverses other supply chain networks — perhaps searching for officially approved aerospace manufacturing sources — and identifies that there are 12 other in-country manufacturers of bolts with the same size, form and fit.

The SCT then determines that three of those manufacturers sell the bolts for as much as 23 percent cheaper than what you are currently paying. It then actively researches those three manufacturers using a number of resources, including social media, information from industry bodies and search engines. The research identifies that one of those manufacturers has a bad safety record; however, the other two come up green. It sends you a report suggesting that if you use one of those two manufacturers as an alternative to your current supplier, you could save up to $3.4 million over the life of your vehicle program.

All this without your even realizing what the SCT was doing.

If your digital thread is integrated into your SCT, then the world is truly your oyster. The SCT can undertake intelligent learning and advise on valuable initiatives, such as co-op approaches to parts procurement, where a number of organizations procuring the same parts could save millions of dollars through bulk purchasing.

How a digital thread can benefit your business — and even save lives

The value of digital thread isn't just in the thread itself, although better application integration is always a plus. The main benefit is in the business value that can be extracted from the accessibility of information across an enterprise and its supply chain.

And this value isn't just measured by saving dollars. It is also measured by the quality of the end product and, in some circumstances, even the potential to save lives. A&D companies can consciously choose to introduce significantly more efficiency, effectiveness, quality and safety into the platforms they build and own. Today, there really is no reason to mobilize complex programs without addressing digital thread — and there is every reason to adopt the product data management technology to benefit your organization, your supply chain and the people who depend on your products.

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