DIGITAL SYSTEMS

White Paper - How to Build a Digital Thread that delivers for your business

From Shop Floor to Top Floor

How to Improve your Manufacturing Performance

Imagine this: A design engineer discovers that a housing mold is causing **problems in manufacturing** and immediately makes an adjustment. Quality assurance identifies a tendency for micro-cracks in a supplied component, even before a batch is assembled. Thanks to historical **performance data**, the service technician knows exactly which spare part is needed for a faulty machine before arriving on site. Procurement evaluates suppliers not only based on price, but also on their delivery reliability and sustainability performance.

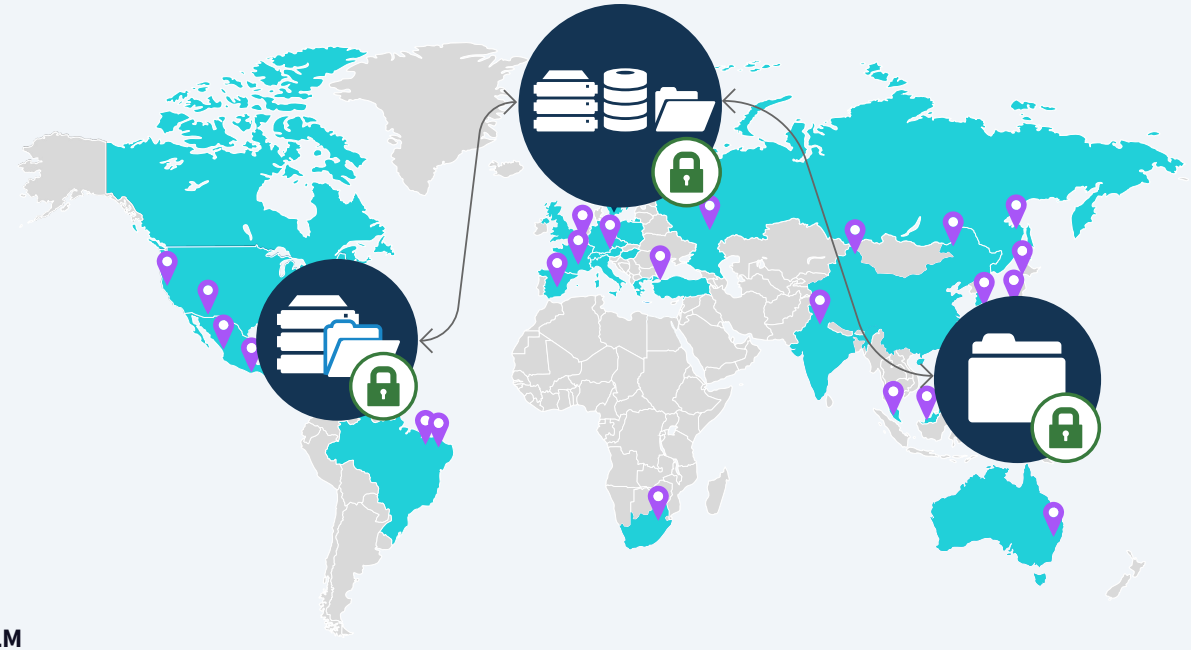
Continuous, **end-to-end connectivity** of data enables unprecedented agility and efficiency. It facilitates the development of **new business models** and makes production not only more cost-effective but also more sustainable. To achieve this, companies must be able to provide all product-related information – documents, drawings, specifications, quality reports, revisions, and more – across disciplines without system discontinuities. This is the business value of a **Digital Thread**.

What is a Digital Thread?

A Digital Thread is a continuous, **bidirectional flow** of information that contains all data, documents, and records related to a **product or process** throughout its entire **lifecycle**. This begins with the initial idea and design (CAD/PLM) and extends through production (MES/ERP), in-field use (IoT/ Service), maintenance, and service, all the way to end-of-life.

Implementing a **Digital Thread** improves interdisciplinary collaboration, delivers seamless traceability, and **enables data decisions** based on current, logically connected data. Those who explore the concept in depth will quickly encounter related topics such as **Single Source of Truth**, Master Data Management, and Manufacturing Operations Management (MoM).

1. Eliminating data silos & disconnected people



System discontinuities, data silos, and the inefficiencies they create can have a constant impact on operating costs. A **Digital Thread** addresses these challenges by creating an integrated ecosystem **People, Process** and **Technologies** that communicate seamlessly and exchange data in real-time. End-to-end processes with integrated applications and connected data sources enable a **continuous flow** of information from **design and development** through **manufacturing** and logistics.

At the heart of this data landscape are **Product Lifecycle Management** (PLM) platforms. A PLM system not only stores and organizes the original product definition like requirements, bills of material, and documentation. It also ensures the consistency and traceability of this data. By integrating information from both **upstream and downstream systems** and establishing a bidirectional data flow, your engineering, manufacturing, service and supply chain teams always have the latest and most accurate data.

What should your PLM solution provide?

It is essential that a PLM solution can interface with enterprise software such as ERP, QMS, BI tools, CRM, and IoT platforms, synchronizing processes across systems. This kind of integration not only shares information but also feeds findings from operations and service back into development, enabling continuous optimization.

Real-time data exchange between enterprise and shop floor systems

Centralized product database with version and configuration control

Change management processes that ensure traceability

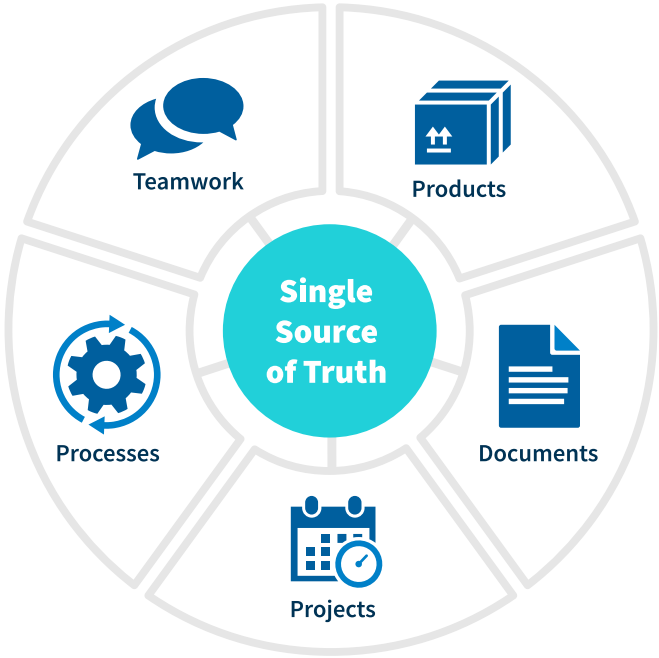
Tip:

A digital thread doesn‘t evolve overnight but develops step by step. The easiest way to implement it is through modular, scalable PLM platforms that your company can adopt at its own pace.

2. Create a Single Source of Truth

Fragmented data management is one of the most **significant challenges** you need to overcome for your Digital Thread. When departments, systems and people maintain divergent versions of the same product data, it quickly leads to errors in design and production, high scrap rates, and costly rework.

Fundamental to a Digital Thread is the concept of a **Single Source of Truth (SSoT)**. This refers to a consistent, reliable data foundation that supplies business processes and employees with trustworthy information. This approach improves an organization's **collaboration** and **responsiveness** by eliminating data silos and reliably disseminating **knowledge** throughout the company.



What do you need for a Single Source of Truth?

To establish a Single Source of Truth, you need a central, authoritative system that serves as the sole reference for critical data. Typically, companies rely on PLM software for this purpose. It must ensure the **consistency, accuracy**, and **completeness** of data throughout its lifecycle. Achieving this requires robust data governance rules that define who can enter and modify data and when. Equally important is Master Data Management, supported by clear processes for data capture, validation, release, and maintenance.

To unleash its full potential, an SSoT must include powerful integrations and standardized interfaces for systems such as ERP, MS 365, email, and CAD. Reliable change and release procedures, along with fast search functions across the entire dataset, also enhance collaboration.

Without a corporate culture that promotes data quality and standardization, the Single Source of Truth (SSoT) approach is destined to fail.

Fewer errors and production delays

Faster collaboration between teams

Reliable change and release procedures

Engineers in discrete manufacturing spend **27 %** of their time searching for components.

(Engineering.com)

3. Project management with product data

Many companies organize their engineering projects with software that lacks a clear focus on industrial requirements. Since these solutions have **no native connection** to the system landscape of the departments and partners involved, project and product data remain strictly separated. Under these circumstances, **coordinating and monitoring tasks** from numerous areas while taking customer requirements into account is almost **impossible**.

The result: planning and project reality diverge.

Project management is sometimes underestimated in the digitalization of industry. However, linking the **project and product worlds** is an **essential** element of an effective Digital Thread.

Integrate project management into industrial applications

In successful engineering projects, planning, control, and monitoring work hand in hand with operational value creation. Not every tool can meet this demand. Good project management software provides consistent product data to interdisciplinary teams. It is embedded in industrial applications like PLM or industry-specific solutions, coordinates tasks across numerous projects, and enables teams to self-organize within established guardrails – as agile as possible, as formal as necessary.

Given these prerequisites, software simplifies the work of all project stakeholders. It provides teams with all technical, scheduling, and organizational information. It improves collaboration and process quality in global project and program organizations, and promotes holistic project controlling, supporting management through a high degree of transparency.

Real-time project status updates

Transparent progress tracking for management

The ability for teams to self-organize within clear guardrails

4. Bridge the gap between Enterprise IT and the shop floor

By **consolidating data flows** from various sources, a Digital Thread provides a complete picture of processes, as well as business and product data. This **transparency** not only **facilitates collaboration** but also aims to standardize, accelerate, and automate business operations around industrial assets. However, this only works if you also **digitally map** your manufacturing, including all involved **assets** and **downstream processes**.

The added value of a Digital Thread becomes particularly clear when looking at manufacturing. The **shop floor** generates a **wealth of data** – process parameters, material consumption, manufacturing metrics, and more – that are of interest to many departments. The information can be integrated via the **Digital Thread** into a **closed-loop process** that feeds insights from manufacturing, operation, and service back to product development. This enables easier planning and development of current products as well as future product generations. **Quality** continuously improves through insights into a product's properties, behavior and can open up service based revenue models.

Digital Twins and Manufacturing Operations Management

Closed-loop engineering and end-to-end automation are only feasible under certain conditions. Crucial is the ability to precisely tailor digital twins to industrial requirements. These digital replicas not only enable **real-time monitoring** but also the control, optimization, and automation of processes throughout the lifecycle of industrial assets, from **manufacturing** and **commissioning** to after-sales service. You benefit from an audit-proof history of installed components and always retain an overview of the as-maintained state of your assets.

Companies typically rely on a Manufacturing Execution System (MES) to organize and execute manufacturing. However, the full potential of a Digital Thread cannot be realized with an MES alone. This can only be achieved with software for Manufacturing Operations Management (MOM).

Real-time asset monitoring

End-to-end process automation

Transparent integration between enterprise systems such as ERP and CRM and operational technology (OT)

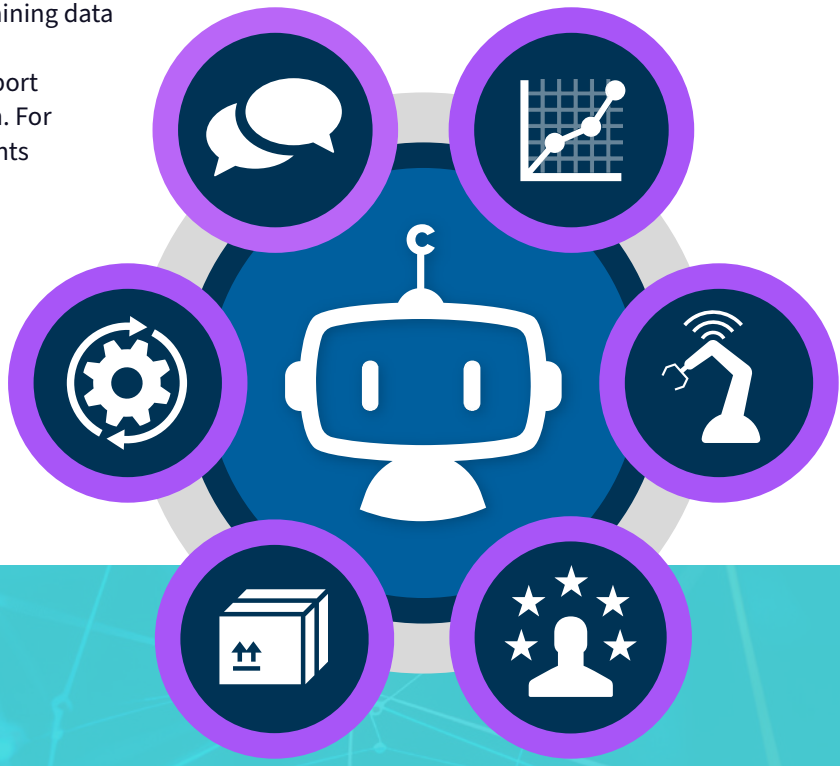
5. Integrate artificial intelligence

Data quality is a critical success factor in any AI initiative. Issues such as **inconsistencies**, **missing** or **unstructured** metadata, and inadequate validation mechanisms lead to an **unreliable data** foundation for AI algorithms. Under such circumstances, investments fizzle out without effect.

Building a **solid foundation** for AI applications takes time. Therefore, you should establish it as early as possible in your digital transformation. Here too, the interplay between a **Digital Thread** and product data management in a **Single Source of Truth** (SSoT) is crucial. Your company creates a central data repository with contextual information that not only supports operational decisions but also forms the foundation for analysis and enforcement of data governance. Building on this, you can integrate AI mechanisms into your processes as needed.

PLM and artificial intelligence

When it comes to AI, companies benefit from powerful, scalable PLM solutions. The software centralizes and versions large amounts of product data such as CAD models, specifications, and change documentation. This data is structured, processed, and enriched with metadata, creating the necessary quality of training data for AI models.
Given these prerequisites, AI applications support engineering across all phases of value creation. For example, you can use AI to create design variants from existing CAD data, optimize the energy consumption of production, or anticipate machine malfunctions through predictive maintenance. Your company automates processes across departments and enterprises, while management makes decisions based on data-driven insights.



Suggest new design options

Optimize production energy use

Predict equipment failures before they can happen

6. Protect data and compliance

A Digital Thread links a multitude of sensitive data. Therefore, you need **robust IT & OT security** to protect your intellectual property and operational data from **cyberattacks**. The effectiveness of this protection depends, not least, on the functions and architecture of the systems used.

Unauthorized access, theft, manipulation, or data loss can be effectively prevented with systems based on highly available architectures following the Zero-Trust principle. You need state-of-the-art functions for:

- **Access control and authorization (roles and rights)**
- **Robust encryption**
- **Multi-factor authentication**
- **Risk management**
- **Version control and change management**
- **Implementation of backup and recovery strategies, for example, in the event of a cyberattack**
- **Audit trails and histories of data access and changes (ensuring traceability in case of security incidents)**

Verify Compliance

A strong Digital Thread creates **transparency, consistency,** and **data integrity**. These are central criteria for implementing compliance, quality, and industry standards. To meet disclosure requirements and process specifications, companies should place high value on compliance conformity when selecting IT tools. Ideally, software should fulfill all industry-specific regulations, standards, and requirements. This way, you avoid legal risk and reputational damage.

Protect sensitive data and ensure compliance

Meet industry standards and regulatory requirements

Defend against cyber-attacks with robust security measures

Step into the future on your Digital Thread Journey

Connecting data, systems, and processes is one of the most important goals of digital transformation. A Digital Thread enables your company to meet this challenge. Seven key areas are particularly relevant:

1. **Eliminate system discontinuities and data silos**
2. **Maintain a Single Source of Truth with consistent data**
3. **Link project organization and product data**
4. **Connect Enterprise IT and Operational Technology**
5. **Integrate sustainability tools for tasks such as PCF calculation or energy management**
6. **Ensure IT security and compliance**

Building a Digital Thread involves **numerous tasks** that **cannot be tackled all at once**. The easiest approach is to use modular, scalable platforms that can be tailored to your company's requirements and industry at your own pace. This allows you to increase your digital maturity without placing excessive strain on processes and departments.

When designing manufacturing system landscape, **small** and **medium-sized companies** often find themselves in a dilemma. Because enterprise **PLM and Manufacturing solutions** seem too **expensive** and extensive to them, they opt for tools like CAD add-ons. While these are quick and easy to use, they do not solve their actual problems. pre-configured Software-as-a-Service (SaaS) solutions that can be implemented with little effort and cost. opening up the PLM world to smaller companies as well.

Interested in how TJ Digital can deliver a digital thread and improve your manufacturing performance?

Get in touch - 07986658355

Tim Shelley
Founder & Director

tim.shelley@tjdigitalsystems.com

www.tjdigitalsystems.com