

# The Seven Building Blocks of the **Digital Thread**

**JIM BROWN**

*President  
Tech-Clarity*



# Executive Overview

## The Digital Thread is Essential

Over three-quarters of manufacturers view the digital thread as either important or critical to achieving their business strategy<sup>1</sup>. These industrial companies view the digital thread as a fundamental way to improve performance and gain an advantage over their competitors. Our research<sup>1</sup>, however, shows that only about one-quarter of companies have implemented a digital thread initiative.

Having a comprehensive digital thread is moving from an advantage to a competitive necessity. But many companies struggle to define their needs and start an initiative. This guide introduces the top 7 fundamentals that manufacturers should consider to implement and support their digital thread, along with some key solution requirements to support them.



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# Introducing the Guide

## Intent of this Guide

This guide is intended to help companies evaluate their digital thread capabilities or start putting them in place. The goal is to provide a reference to define a manufacturer's needs and create a common set of requirements. It does not include a list of detailed requirements, but instead offers a series of high-level checklists to ensure that the most important success factors are in place. It is not intended to replace our more comprehensive Buyer's Guides.

## How to Use this Guide

Like the Buyer's Guides, the requirements extend beyond functionality to cover implementation, adoption, partner, and special considerations that companies should keep in mind when evaluating their capabilities and plans. More detailed requirements can be found in our Buyer's Guides, including:

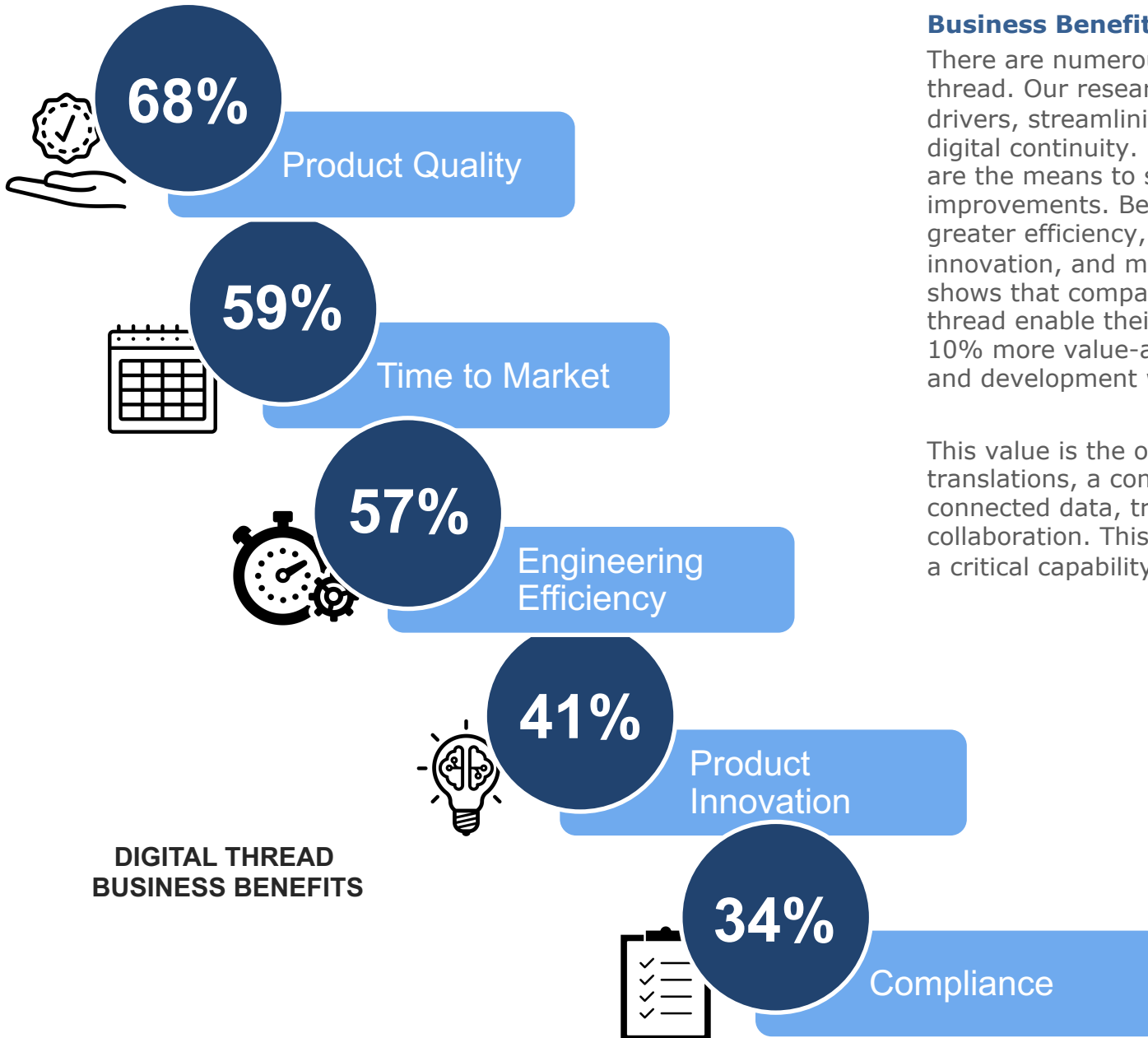
- Choosing the Right Enterprise PLM to Support the Digital Thread
- BOM Management Buyer's Guide
- Choosing the Right Cloud PLM
- Product Data Management Buyer's Guide
- Improving Service with IoT Remote Monitoring
- Managing Service Information
- Simulation Buyer's Guide for Design Engineers

In addition, our industry-specific guides provide more context for specialized industry needs, such as:

- Medical Device Manufacturers Software Selection Guide
- Choosing the Right PLM to Support the A&D Digital Thread



# Why Digital Thread?



DIGITAL THREAD  
BUSINESS BENEFITS

## Business Benefits of the Digital Thread

There are numerous definitions of the digital thread. Our research<sup>1</sup> highlights two primary value drivers, streamlining engineering and creating digital continuity. More importantly, these factors are the means to significant business improvements. Benefits include improved quality, greater efficiency, lead-time reduction, enhanced innovation, and more. Specifically, our study<sup>1</sup> shows that companies that have adopted a digital thread enable their technical resources to spend 10% more value-added time on innovation, design, and development work.

This value is the outcome of reduced handoffs and translations, a complete and cohesive data model, connected data, traceability, reuse, and better collaboration. This is why the digital thread is such a critical capability for manufacturers.

# Supporting the Digital Thread

## PLM is the Backbone

An effective digital thread incorporates data from a variety of disciplines and systems. This information needs to be contextualized, associated, and integrated. Product Lifecycle Management (PLM) is the logical starting point because the digital thread starts in Engineering. PLM is the foundation. Our research confirms this, showing that Top Performing companies are 73% more likely to use PLM to support the digital thread<sup>1</sup>.

## PLM Drives Efficiency

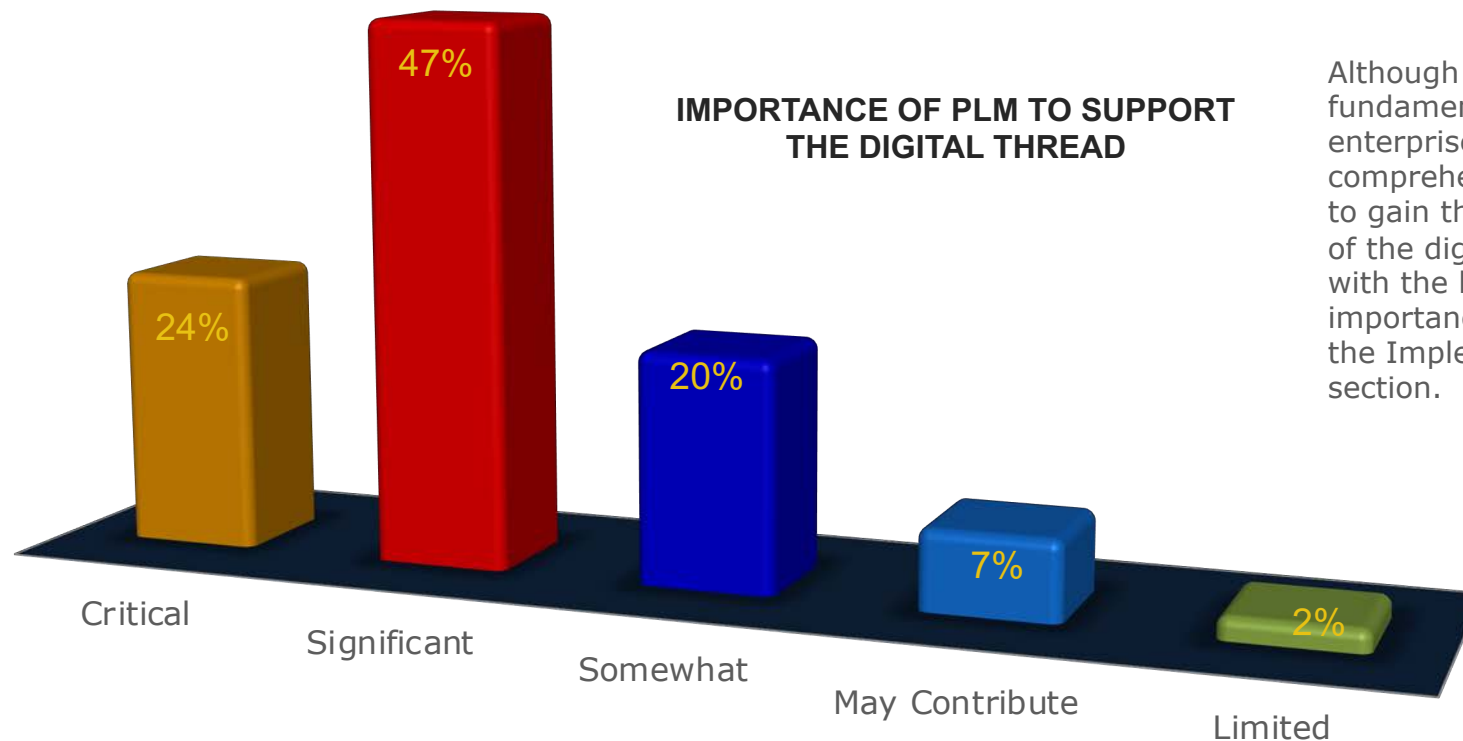
Another reason that PLM is at the core of the digital thread is because of the positive impact it makes on engineering efficiency. This is crucial because our data shows that the most common business impact of digital thread challenges is engineering inefficiency.<sup>1</sup> Efficiency increases as more data, organizations, and lifecycle phases are incorporated.

## The 7 Building Blocks

PLM helps companies streamline processes and bring information into a common data model and platform. PLM requirements to support the digital thread start with the basics:

- Managing Engineering Information
- BOMs, Configurations, and DMU
- Production Planning
- Part and Supplier Management
- Product Traceability and Closed-Loop Quality
- Enterprise Change
- Secure Collaboration

Although companies can start with the fundamentals to gain value, an enterprise PLM system is the most comprehensive solution and is required to gain the full potential business value of the digital thread. This guide starts with the basics, but shares the importance of leaving room to grow in the Implementation and Adoption section.



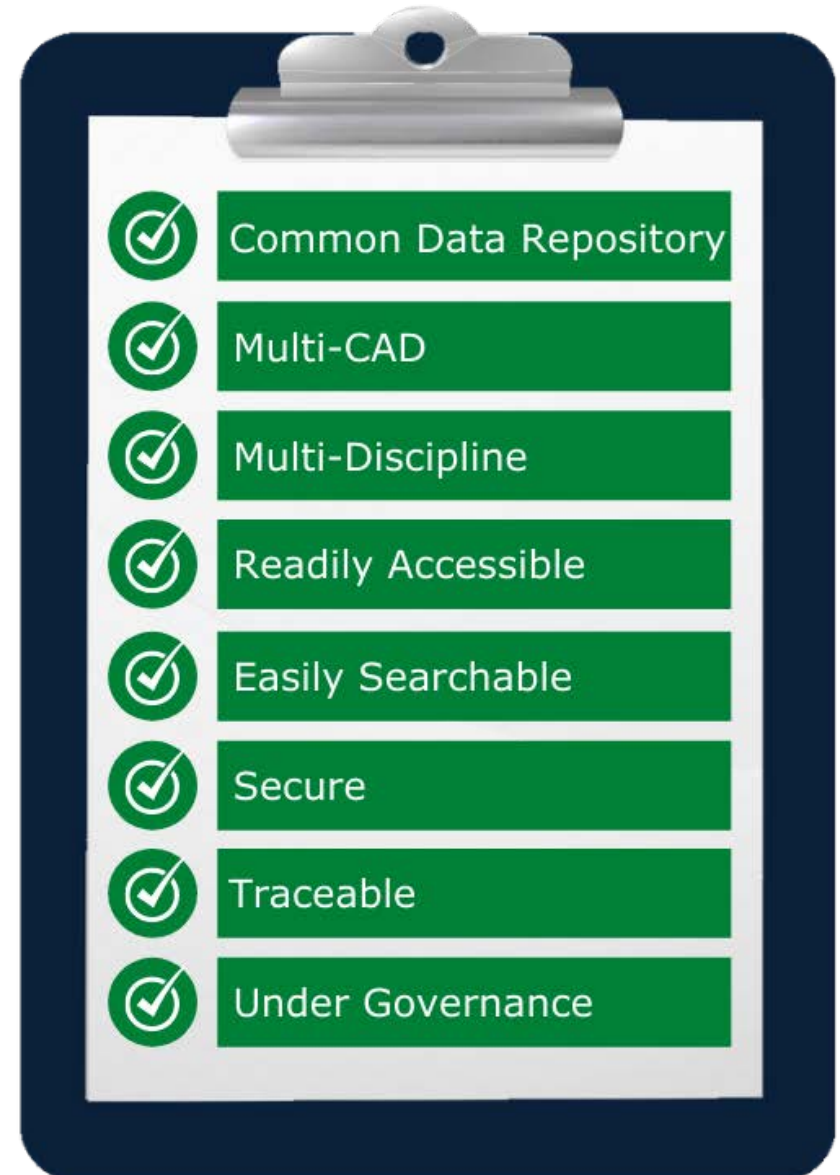
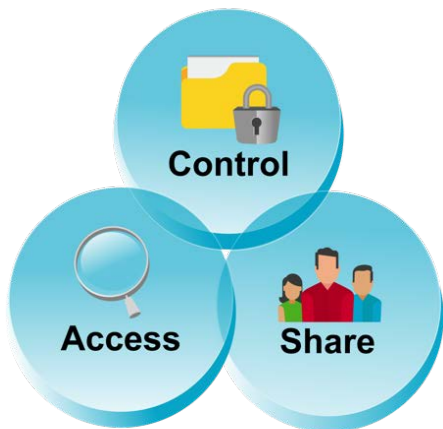
# 1: Managing Engineering Data

## Building Block 1: Managing Data

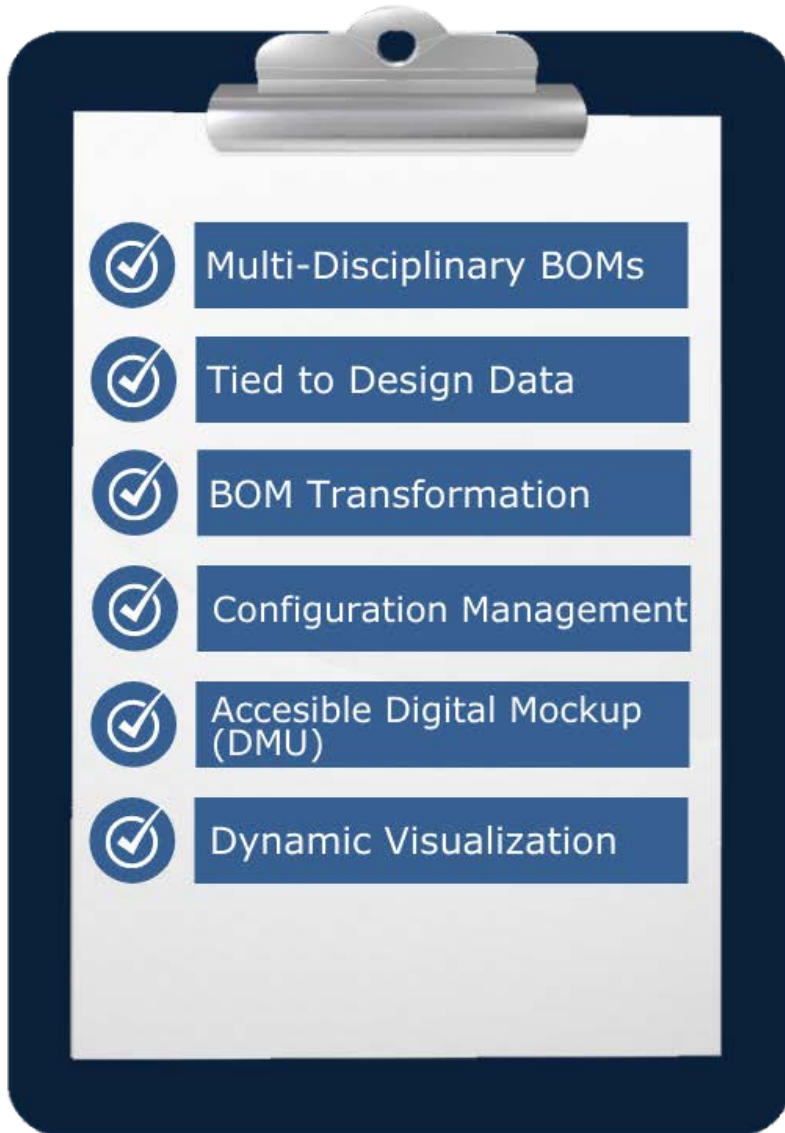
The first step in developing the digital thread, and possibly most obvious, is to ensure that data is accurate, current, and under control. Without having core product data managed there is no real hope of developing a successful digital thread. This data serves as an authoritative source of truth and creates the skeleton on which the rest of the digital thread rests, enabling cross-functional collaboration and concurrent engineering.

Tech-Clarity's recommended basics of controlling, accessing, and sharing product data are the right first step to start on the digital thread path. Data should be kept in a common repository and cover as much product data as possible, including mechanical CAD, electrical designs, and software designs. It should also extend to include requirements, systems models, and simulation data. Not only should this data be governed, but it should also be accessible. PLM can provide easy search capabilities and the ability to access the information from anywhere and any device.

This checklist provides some important reminders for manufacturers to consider when selecting a PLM system to support the digital thread.



## 2: BOMs, Configurations, and DMU



### Building Block 2: Manage Configurations

The digital thread must reflect products, their bills of materials (BOMs), and their configurations. These BOMs should be multi-disciplinary, reflecting not only physical parts but also electronics and software. The BOM should not be a static extract or an export, it should be a live representation of the product configuration and tied to the underlying design data. Creating accurate, up-to-date BOMs ensures downstream operations are aligned with design intent.

BOM capabilities should support variants and efficient product customization. Configurations should be defined independently and used to dynamically create a unique design BOM and subsequently tailored design deliverables including a unique BOM for the individual, customized, produced unit. In addition, the BOM should not stop in Engineering but be transformed and associated with the manufacturing BOM (MBOM) and service BOM (SBOM). Again, these should be specific to each individual configuration.

These BOMs and configurations should be easily visualized, including a dynamic, complete, three-dimensional digital mockup (DMU) of each unique configuration. Finally, they should be available for consumption by downstream departments and the supply chain. See our *BOM Management Buyer's Guide* for more.

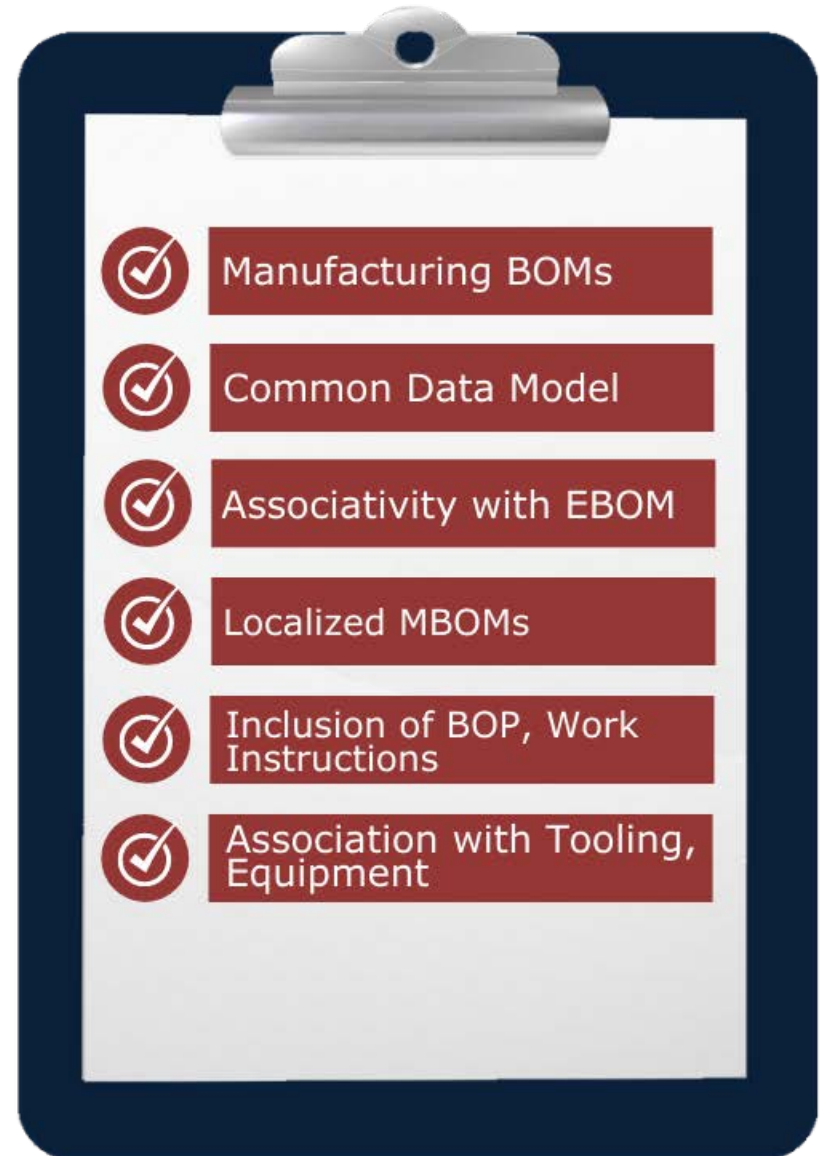


# 3: Production Planning

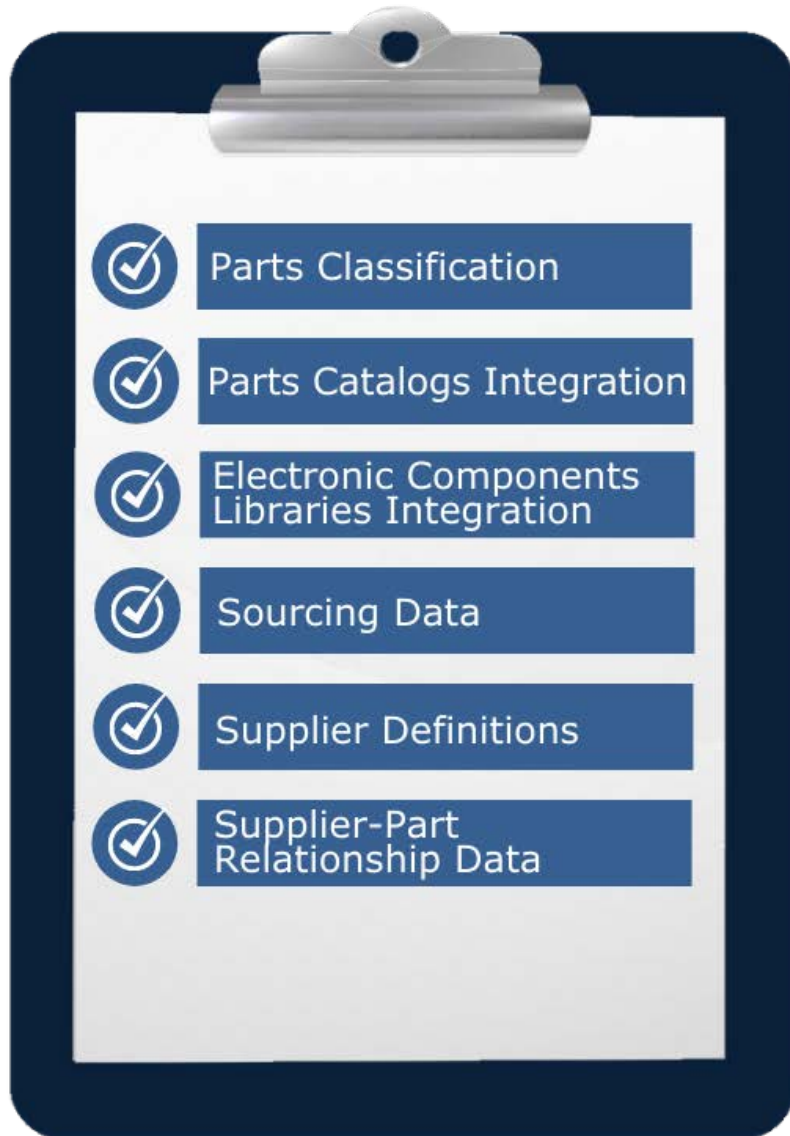
## Building Block 3: Prepare for Production

The digital thread doesn't stop with the product design, it continues to the design and execution of manufacturing processes. Manufacturing engineers should be able to work in parallel with design engineers to design manufacturing processes, tooling, and equipment. This concurrent engineering practice helps improve quality, cost, and time to market as manufacturability is more readily designed in. It also reduces cycle times because work is done in parallel. Keeping digital thread information in a common data model encourages concurrent design and collaboration.

MBOMs should be tailored to individual product configurations. In addition, the systems should have the ability to tailor MBOMs, bills of process (BOPs), and related manufacturing data to individual manufacturing plants to accommodate local supply chain and equipment differences.



# 4: Part and Supplier Management



## Building Block 4: Manage Parts, Suppliers, Reuse

The digital thread should be based on a standard parts catalog and encourage part rationalization and increased reuse. Engineers should be able to easily find internal and sourced part data to incorporate into their design. PLM should help engineers rapidly find the right parts and confirm they are fit for purpose. Designers should have access to detailed part data including cost details and approved suppliers. Accurate part data helps prevent the high enterprise-wide cost of part proliferation and reduces supply risk.

For many companies, the priority of effective part and supplier management is growing. Manufacturers are increasingly working collaboratively with their supply chains in order to efficiently design and deliver innovative products. Many have transitioned from primarily vertically-oriented approaches and no longer design and produce everything inhouse, instead choosing a supply chain-centric approach. This increases the challenge and value of maintaining the digital thread, which must maintain data quality and timeliness across the supply network.

# 5: Product Traceability and Closed-Loop Quality

## Building Block 5: Design in Quality and Traceability

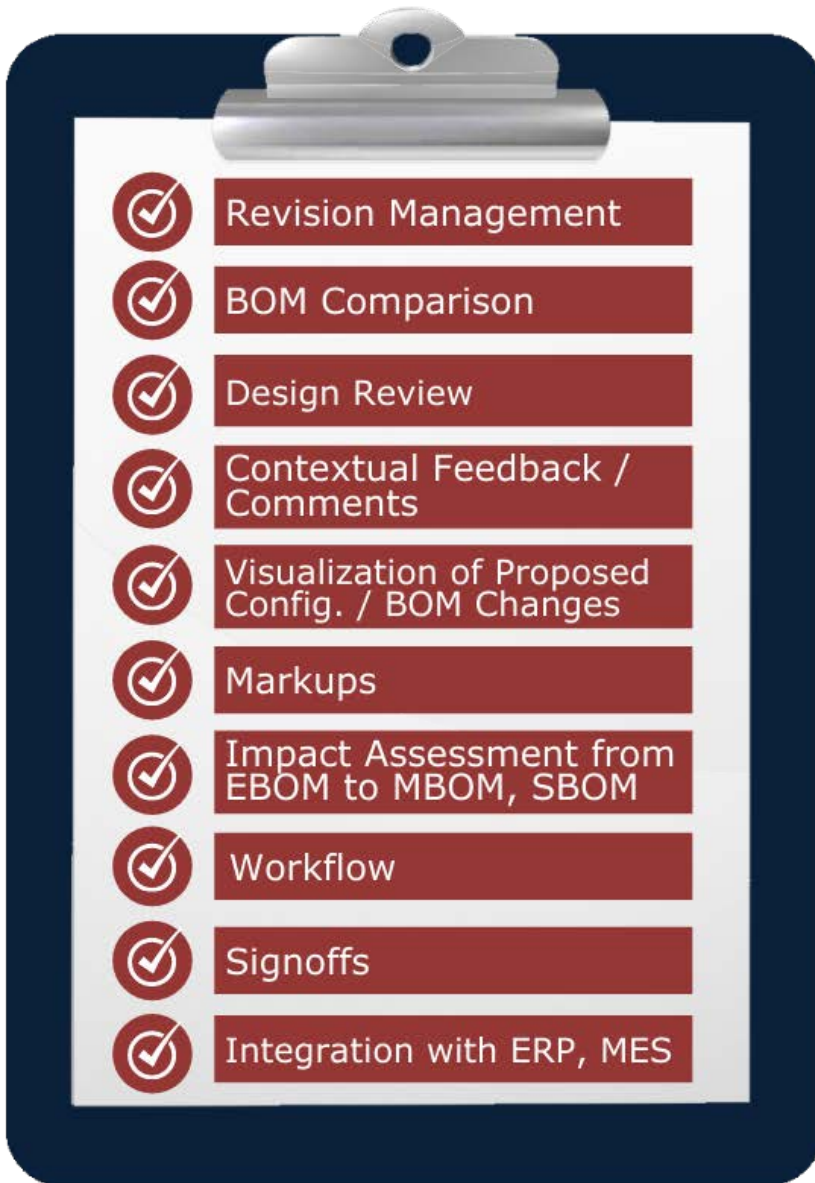
Quality information should be developed and included in the digital thread in a similar way as manufacturing data. Quality processes and information such as FMEA, PPAP, and more should be incorporated and associated in context with design data. This helps ensure that engineers are designing for quality and that quality is baked into the digital thread.

In addition, all product data starting from requirements should be captured and linked to provide digital design continuity and product traceability. This ensures that requirements are met, designs are auditable, and that appropriate quality control plans are in place to ensure products meet intended needs.

Quality information in the digital thread should extend beyond the design phase. The digital thread should include non-conformance reports, root cause analysis, and resolutions such as engineering change orders. Incorporating this information in the digital thread supports continuous improvement and ensures a closed-loop quality process. This information should also be easy to extract and format to meet regulatory requirements.



# 6: Enterprise Change



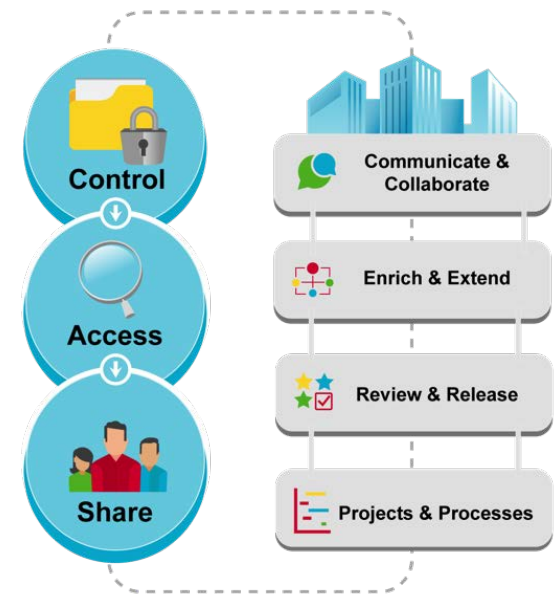
## Building Block 6: Manage Change

It's important to consider digital thread processes in addition to data. Collecting the right information is important, but it must be complemented by supporting business processes that create and maintain data integrity. One of the most pressing processes to support the digital thread is a functional change management process.

Tech-Clarity's Extended PDM model shows that one of the most primary extensions to PDM is process management. More information can be found in our *Expanding Beyond Your Outgrown PDM System Buyer's Guide*.

Change management best practices are well-defined and available. One of the key values of supporting the change process in PLM is the direct connection between the intended change and the supporting data. This helps support change reviews by providing the right contextual

information to understand the implication of the change. Our research identifies impact analysis as one of the most challenging parts of change control, with 41% of companies saying that understanding the impact of change is challenging.<sup>1</sup> Beyond defining the change, PLM should help communicate and implement the change across the business and the supply chain.



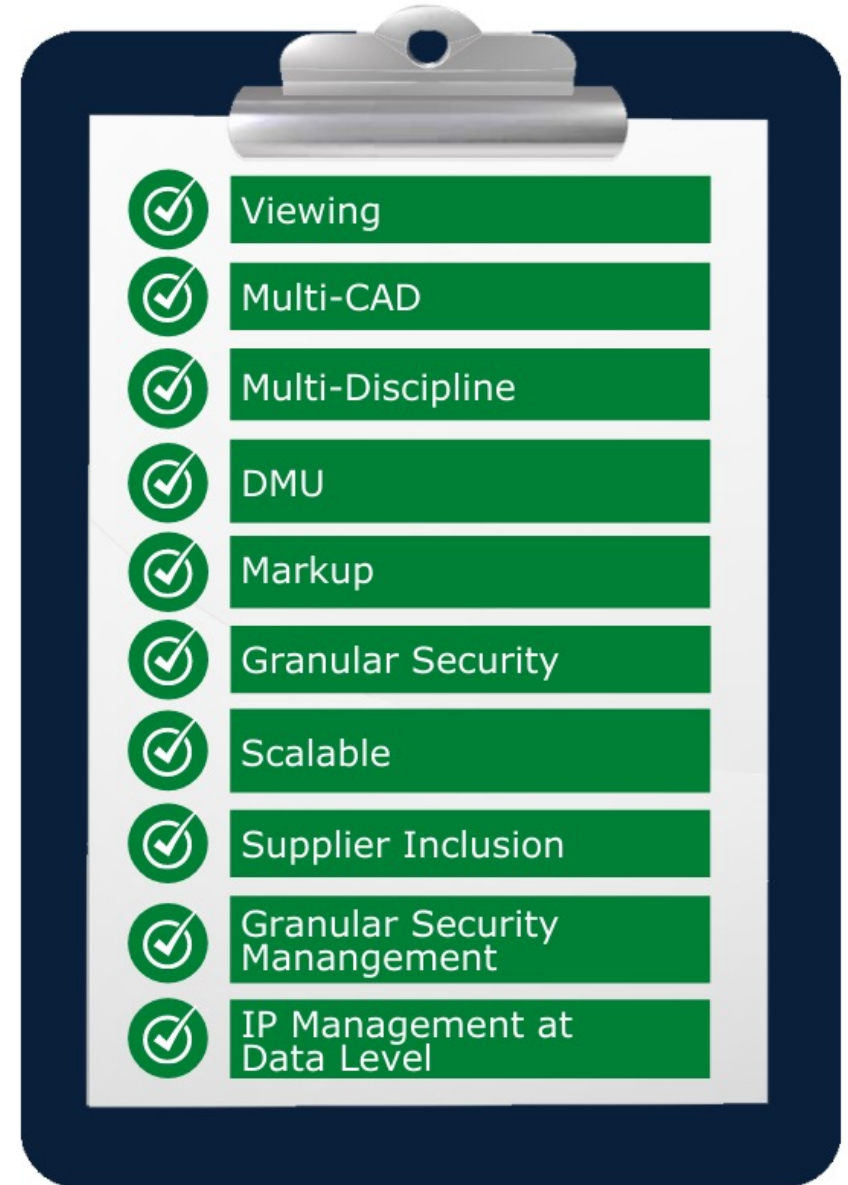
# 7: Secure Collaboration

## Building Block 7: Support Secure Collaboration and IP Protection

Beyond data and processes it's important to consider people. People are at the core of the innovation and execution supported by the digital thread. It's crucial for people to be able to collaborate on digital thread data in order to develop, maintain, and gain value from the digital thread. Collaboration is another key element supported by PLM, and you can learn more in our *Upgrading to PLM when PDM Falls Short Buyer's Guide*.

A PLM system that supports the digital thread should provide all of the basics of CAD collaboration, including viewing, markups, and more. It should extend these capabilities beyond the company to support secure, selective collaboration with the global supply chain. The system must support granular intellectual property (IP) policies to manage risk and ensure regulatory compliance. This security must be implemented at a foundation level in order to ensure all methods of data access are controlled.

The PLM solution supporting the digital thread should scale to support remote collaboration on even the largest assemblies, even in areas of the world with limited Internet bandwidth. Most importantly it should facilitate real-time collaboration and connection between all of the people and disciplines requires to develop a profitable product, extending beyond technical users to include management and business-oriented people. Secure collaboration is even more important as more people are working remotely.



# Implementation and Adoption

## Consider the Cloud / SaaS

Companies need to consider their implementation needs in addition to functional capabilities when they select a software solution. It's important is to make sure that the solution has a cloud / SaaS offering, or at least a strategy to deliver one. Even if a company doesn't have current plans to adopt PLM in the cloud, we believe that a cloud offering will be a market requirement. Choosing a solution without a path for the cloud may put a company at risk of adopting a solution at the end of its life. On the other hand, adopting the cloud offers a variety of benefits (see graphic).

In addition, companies should look for cloud solutions that leverage the cloud to their advantage. For example, look for ease of access, ability to scale, and tailored applications that help people perform specific tasks without excess overhead and complexity. For both cloud and traditional applications, look for the ability to configure and extend the solution. For more information, please see our *Choosing the Right Cloud PLM Buyer's Guide*.

## Support Integration

No single system contains the digital thread. Any system that will serve as the backbone for the digital thread must be able to readily integrate with other systems. This isn't always easy, for example 44% of companies indicate that integrating downstream data (e.g. manufacturing, quality, service) with design data is a challenge<sup>1</sup>, making it the second most common digital thread challenge.

The digital thread must integrate with enterprise systems such as ERP, Quality Management (QMS), and Customer Relationship Management (CRM) as well as execution systems including Manufacturing Execution Systems (MES) and the Internet of Things (IoT). Look for a high degree of openness, APIs, pre-built integration, and an integration toolkit that helps address unforeseen needs.

## CLOUD SOFTWARE BENEFITS<sup>2</sup>



# Special Considerations

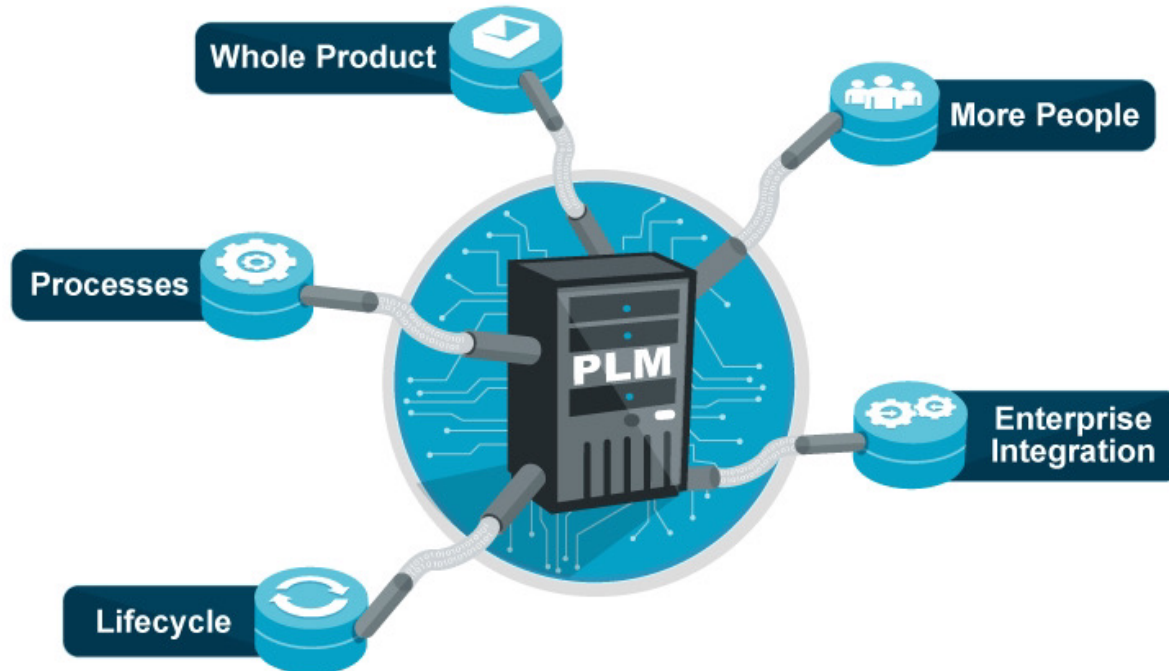
## Look for Enterprise Capabilities

Supporting the digital thread starts with the basics of PLM, but achieving full digital thread value requires much more of what PLM has to offer. It's important for manufacturers to prepare for the future when they embark on their digital thread journey. They should look beyond basic and even extended PDM capabilities to adopt more advanced, enterprise PLM capabilities. PLM solutions continue to expand in scope and should be able to offer capabilities for systems engineering, product architectures, model-based engineering (MBE), service management, and more. For more information, please see the *Upgrading to PLM when PDM Falls Short Buyer's Guide*.

## Prepare for Advanced Technologies

Manufacturers should also look for a PLM system that leverages more advanced technologies. A complete digital thread should include access to IoT information to extend the digital thread further into the product lifecycle. In addition, companies should look for analytics including Artificial Intelligence (AI) and Machine Learning (ML) that can extract significant insights and value from the data in the digital thread. Additional technology advances like Augmented Reality (AR) can further improve digital thread value through enhanced collaboration and by putting digital thread data in context with real-world scenarios.

### DIMENSIONS OF PLM EXPANSION



# Vendor Considerations



## Choose the Right Digital Thread Partner

A successful digital thread requires more than the right technology, it requires the right partner to help guide and support the journey. Companies should look for more than just a software solution from their vendor. They should expect training and adoption aids that help them identify and fulfill their digital thread requirements.

In addition, they should work with a vendor that understands the business aspects of the digital thread. Look for a partner that can provide template business processes and offer guidance to future digital thread needs to ensure that they continue receiving value over the long term. Finally, a partner should have experience implementing digital thread initiatives in companies like theirs. For example, they should understand special industry requirements like regulatory mandates.

Please see further considerations in our *Choosing the Right Enterprise PLM to Support the Digital Thread Buyer's Guide*.



# Conclusions and Next Steps

## Achieve the Business Value of the Digital Thread

The digital thread is crucial to business performance and competition for today's manufacturer. We believe that those companies that adopt the efficiencies and traceability available from the digital thread have an opportunity to outperform their competitors. In fact, our research shows that Top Performers, those that outperform their competitors across key product development metrics, are more than twice as likely to have already implemented a digital thread initiative.<sup>1</sup>

## Secure the Foundation of the Digital Thread with PLM

The digital thread starts in Engineering and PLM is the foundation. Our survey finds that Top Performing companies are 2.4 times as likely to view PLM as critical to supporting the digital thread.<sup>1</sup> PLM supports the basics of data management, processes, and collaboration that make up the seven foundational necessities of the digital thread. But PLM provides much more than that, supporting more advanced capabilities, integration, and technologies that will allow manufacturers to extend the value of their digital thread over time and continue to create competitive advantages. But they can start with the fundamental and grow their capabilities – and value – over time.

## Get the Right PLM and Get Started

As with any technology, it's important to recognize the importance of not only software capabilities but also factors like implementation, adoption, vendor considerations, industry needs, and specific company needs. Most importantly, manufacturers should get started because the window where the digital thread provides an advantage is closing as basic digital thread maturity becomes the industry norm.

Top Performers are almost **two and one-half times** as likely to have already implemented a digital thread initiative.

# Acknowledgments



**Jim Brown**  
President  
**Tech-Clarity, Inc.**

## About the Author

Jim Brown founded Tech-Clarity in 2002 and has over 30 years of experience in the manufacturing and software industries. Jim is an experienced researcher, author, and speaker and enjoys engaging with people with a passion to improve business performance through digital enterprise strategies and supporting software technology.

Jim is actively researching the impact of digital transformation and technology convergence in the manufacturing industries.



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**Tech-Clarity** is an independent research firm dedicated to making the business value of technology clear. We analyze how companies improve innovation, product development, design, engineering, manufacturing, and service performance through the use of digital transformation, best practices, software technology, industrial automation, and IT services.

## References

- 1) Jim Brown, "Choosing the Right Enterprise PLM to Support the Digital Thread," Tech-Clarity, 2020.
- 2) Jim Brown, "Choosing the Right Cloud PLM Buyer's Guide", Tech-Clarity, 2020.

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