Jama software®

Reduce Project Risk in the Product Development Process:

Bridge engineering silos with Living Requirements™ Management

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1 Introduction

Engineers are often allowed to choose their own tools with the intention of maximizing their productivity, but this often leads to a product development process that is fragmented into siloed activities and data across software, hardware, quality, systems, and risk teams.

In addition, this siloed process typically results in requirements (that specify necessary dependencies and outcomes) being trapped in static documents.

In this eBook, we'll address how implementing Living Requirements™ management forms a digital thread through siloed development, test, and risk activities — providing end-to-end compliance, risk mitigation, and process improvement that can help address the main causes of negative outcomes in the product development process.

2 The Causes (and Consequences) of Increased Negative Outcomes and Risk in the Product Development Process

According to an Engineering.com survey, **83% of companies surveyed experienced at least one negative product outcome** including: significant delays, cost overruns, product defects, compliance gaps, recalls, omitted requirements, and lengthy rework.

In many cases these negative outcomes were quite significant and led to changes in management and staff.

After our work with hundreds of companies building complex products, systems, and software, we've been able to identify the root causes of these negative outcomes.

Interestingly, they were quite similar across the organizations, and the overall statistics about fragmented and siloed product development tell us that many organizations feel lost.
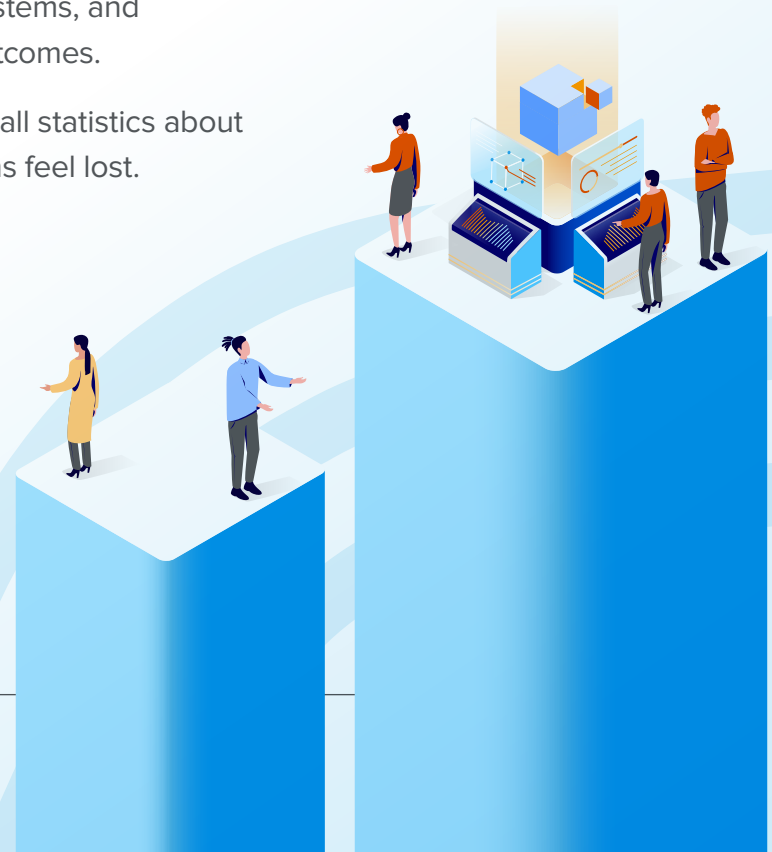
Engineering and design teams agree on these root causes of negative product outcomes in the development process:

- Not enough collaboration up front during design and requirements definition and review

- Errors, defects, and omissions not found until the end of the process causing costly delays and overruns

- Compliance done after the fact in a heavily manual process.

- No management visibility into key metrics for the end-to-end process

- No digital thread connecting these teams

Engineering and design teams agree on these root causes of risk in the product development process:

- Limited customer and cross-functional involvement in the review and approval of requirements

- Static requirement documents rarely viewed by key stakeholders, maintained in Microsoft Word/Excel or a standalone tool, and used only by a few as a repository

- Missing decomposed requirements

- No ability to track the life of a requirement through development, test, and release

- Release cycle misalignment across engineering disciplines

- Misinterpretation of requirements across engineering disciplines

- No process exception tracking to determine requirements that have been omitted or modified

- No identification of process risk patterns — delays in development, multiple test failures, rework cycles, etc.

"

I find it really interesting that as the automotive industry becomes more complex, it's becoming much riskier to base a product development process on static requirements trapped in documents. You need a living requirements thread through the end-to-end process to minimize the risk of negative outcomes and maximize productivity.

Jama Connect is our single source of truth. If it's not in Jama Connect, it's not happening. If it's not in Jama Connect, it didn't happen. When I tell people in the automotive industry we use Jama Software, they all know what it is. If you're using anything other than Jama Software in the automotive industry, you're going to get more questions."

KURT SHULER
Vice President of Marketing, Arteris IP

The Unintended Consequences of a Fragmented Development Process

The unintended result of this fragmented process is that critical functions such as requirements traceability, verification, validation, risk mitigation, product integration, and compliance are often fraught with information gaps, defects, delays, rework, recalls, missed requirements, and significant manual effort. This includes all areas of the complex product, systems, and software delivery lifecycle that can experience negative outcomes and should be actively managed to reduce the likelihood of occurrence:

- **Performance**
  Product fails to perform specified functions

- **Quality**
  Product defects are discovered by customers post-launch

- **Delays**
  Product release deadlines are missed

- **Fit to Requirements**
  Product fails to meet the needs of customers

- **Compliance Gaps**
  Gaps identified late and require extreme cost to rework and fix

- **Regulatory Action**
  Product is not approved for launch or recalled post-launch

CENTRALIZE YOUR REQUIREMENTS

A modern requirements solution can help you define, manage, and validate complex systems requirements while eliminating the risks and inefficiencies associated with documents and legacy systems.

Learn more

3 What is a Digital Thread
and Why is it so Vital?

Digital Thread:

A data-driven architecture that links together information generated from across the product lifecycle and is envisioned to be the primary or authoritative data and communication platform for a company's products at any instance of time.

This is the best definition of Digital Thread we are aware of and is from an excellent 2018 paper by Singh and Willcox at MIT entitled Engineering Design with a Digital Thread. The term Digital Thread was first used in the 2006 with the publication of the Global Horizons report from USAF Global Science and Technology Vision task force. In this document, Digital Thread is defined as "the use of digital tools and representations for design, evaluation, and life cycle management."

As with many business terms, Digital Thread has now become over-used by consultants and software vendors. The definition of it — and how it differs from Digital Twin — have been interspersed with more general concepts of integration, simulation, data, and analytics and has lost the original, more precise meaning.

Digital Thread Components

Let's break down the definition of Digital Thread into its components to better understand the concept and share the most common approaches we see as companies move to make the Digital Thread a reality. Here is the definition breakdown:

01

a data-driven architecture

This recognizes that the use of a single common platform is impossible across all engineering disciplines (software, hardware, electrical, systems, risk, QA, etc.). Instead, a data-driven approach is required that determines the key information required from multiple tools. It's important to remember that data-driven does not mean "gather all your data" but rather that you should be using data to answer questions. In other words, do not fall into the trap of tool focus, but rather focus on the questions and collect data to provide the answer.

02

that links together information generated from across the product lifecycle

From initial requirement definition through to product release, significant information is generated across multiple tools. The challenge is to identify what information is most relevant and how to best link the information to make it actionable. The most common link we see is the definition of value to be delivered (user and system requirements). The most typical information captured across the product lifecycle are process statuses and exceptions (e.g., requirements that have not been approved, require rework, or are not fully addressed, gaps in testing or risk analyses). By linking these process statuses to requirements and tracking them through the product lifecycle it is possible to reduce the risk of negative product outcomes (e.g., delays, defects, cost overruns).

03 ————————————————

and is envisioned to be the primary or authoritative data and communication platform

Most companies refer to this as a "system of record" or a "single version of the truth." A Digital Thread is much more than simply integration or a data lake. By tying the definition of what is to be delivered (requirements) to the most critical downstream process metadata, a Digital Thread creates the ability to understand the state of the product development process, what risks are visible and what corrective actions should be considered. Without a Digital Thread, a company is flying blind in terms of the risks it faces in product development.

04 ————————————————

or a company's products at any instance of time

For a Digital Thread to be truly useful it must always reflect the current state of the product development process. The value is in seeing the product development process for the first time across fragmented teams and tools, to be able to identify process exceptions and early indicators of potential downstream risks. A static database of days- or weeks-old data will not be sufficient for a process that is changing rapidly across multiple, siloed teams.

Why the Digital Thread is So Important

As mentioned above, the product development process is often fragmented across siloed teams and tools which leads to significant risk of product delays, defects, cost overruns, failed verification and validation, recalls, etc.

End-to-end process visibility is required for better cross-team collaboration and the early detection of anomalies to reduce these risks. To solve for this, organizations often attempt to force everyone to use one common software platform, forgoing their choice best-of-breed tools. This solution is neither practical — nor particularly realistic — since engineers are (and should continue to be) allowed to choose discipline-specific tooling which optimize their activities.

What is required is a loosely coupled approach that ties together the necessary metadata across these disparate tools in a way that connects the desired outcome (user and system requirements) to downstream activities – the Digital Thread.

The Digital Thread is the best approach to reduce the risk of negative product outcomes while preserving engineering autonomy and productivity.

4 The Solution is Living Requirements™ Management in Jama Connect

At Jama Software, we are focused on solving the fundamental product development problem – the end-end process to deliver product is fragmented into siloed teams, activities, and tools. With this loss of connectivity, requirements remain static and separated from what comes out the other end leading to numerous negative outcomes.

Living Requirements™ management forms a digital thread through siloed development, test, and risk activities — providing end-to-end compliance, risk mitigation, and process improvement that can help address the main causes of negative outcomes in the product development process.

To align these functions, the solution is **not** to try and force all engineers onto a single platform, but **instead**, to convert *static requirements documents into living requirements management* that form the vital digital thread through engineering teams' tools and activities.

"

Collaboration in an online document is powerful; no more sending static documents through email."

Research and Development Systems Engineer Manager FEI (Thermo Fisher)

With Living Requirements management, real-time, cross-team collaboration and coordination is now highly productive ensuring process exceptions and design changes are identified early and addressed quickly across all groups, streamlining data and workflows across the entire development lifecycle to reduce risk, meet compliance standards, and minimize delays.

LIVING REQUIREMENTS ADDRESS THE ROOT CAUSES OF NEGATIVE OUTCOMES TO DELIVER INCREASED PRODUCTIVITY, FASTER SPEED OF DELIVERY, AND RISK REDUCTION.

Learn more about Living Requirements Management in Jama Connect.

Watch video

70% Implementing Jama Connect increases collaborative productivity up to 70%

50% Implementing Jama Connect reduces the risk of negative product outcomes, such as rework, by up to 50%.

Static vs. Living Requirements

	STATIC REQUIREMENTS	LIVING REQUIREMENTS
Item-level thread to all downstream process states	☐	☑
Impact of change easily determined	☐	☑
Exception reporting on missed requirements	☐	☑
Compliance is highly automated	☐	☑
Enables end-end process improvement	☐	☑
Enables benchmarking performance	☐	☑
Team productivity improvements	☐	☑
Overall product risk reduction	☐	☑

5 Assessing Your Requirements Management Maturity

At Jama Software, we are quite fortunate to be working with hundreds of organizations immersed in maturing their requirements management approach within a broader product development process.

Some are motivated to mature their requirements management process to reach compliance with relevant standards, others have experienced significant delays, cost overruns, or defects and are looking to improve process performance, while the most advanced are able to measure end-end process performance and benchmark themselves against others.

The table below shows the key dimensions of requirements management and the five maturity levels we observe within our customer base.

LEVEL	OBJECTIVE	CHANGE CONTROL	COMPLIANCE REPORTING	LIVING REQUIREMENTS	PROCESS IMPROVEMENT	BENCHMARK
5	Dev Process Improvement	✓	✓	✓	✓	✓
4	Product Risk Reduction	✓	✓	✓		
3	System-based Compliance	✓	✓			
2	Maintain Requirements	✓				
1	Document Requirements	⚠				
0	No formal requirements					

The key dimensions of requirements management maturity defined:

- **Change control**
  The process by which requirements are documented, versioned, reviewed, approved, tracked, centralized, access controlled, updated, and referenced post–decomposition into development.

- **Compliance reporting**
  The generation of the necessary proof-of-process compliance to standards, most commonly: requirement validation, verification, traceability, risk assessments and test results.

- **Living Requirements™**
  Visibility and traceability of the state of each requirement and its downstream decomposition, development, and testing at any time from requirement draft through to product release. Requirements that are not living are static and trapped in documents with no system linkage to the entire product development process. Living Requirements reduce common product development risks of delays, missed requirements, rework, compliance gaps, limited reuse, defects, and recalls.

- **Process improvement**
  Manage the product development process through data with the end-to-end visibility provided with Living Requirements. Cycle time targets at various stages, rework percentages, process exception reporting, etc.

- **Benchmark**
  Once the end-to-end product development process can be measured, it can then be compared to peer organizations to determine areas to focus on for further process performance gains.

Organizations are at different levels of requirements management maturity across these dimensions. Use this requirements management maturity system to identify where your organization stands:

LEVEL 0 | **No Formal Requirements**

No documentation exists for user or system requirements. Instead, development operates off user stories with no clear distinction between the functionality of the system being built and the expected user experience.

LEVEL 1 | **Document-Based Requirements**

Static requirements documents are created and most often maintained by each author on their desktop with various emails, Slack comments, etc. containing more information.

LEVEL 2 | **Siloed Requirements Tool**

A standalone tool is in place to draft, review, track comments, version, and store static requirements documents compliance gaps, limited reuse, defects, and recalls.

LEVEL 3 | **System-Based Compliance**

Compliance is the forcing function to shift from static to Living Requirements to meet standards for requirement validation, verification, and traceability in a single end-to-end system.

LEVEL 4 | **Product Risk Reduction**

A process-centric focus to reduce the likelihood of all forms of product risk via system–enabled Living Requirements. This requires detection and alerts for specification and functional changes, process exceptions, and test failures with the resulting impact analyses.

The risks mitigated include:

• Failure to meet the needs of customers

• Failure to perform specified functions

• Delays

• Cost overruns

• Defects

• Compliance and regulatory gaps, delays, fines

• Recalls

LEVEL 5 | **Development Process Improvement**

Moving past compliance and risk and into the spirit of the standards based on quality management and process control. This stage places focus on measuring, managing, and improving the product development process.

> " The ability to automatically trace requirements through the system development lifecycle is not a "nice to have" but paramount to our continued success and keeping our regulatory status."
>
> **Wendy Kennedy, CTO**
> **UltraLinq Healthcare Solution**

Current Level of Maturity

Now that the model has been described, which maturity level best describes your organization today? Before working with Jama Software, most companies we speak with are either using Microsoft Word/Excel and at level 1 or frustrated with their current tool and struggling to move much past level 2. Our top-performing customers are at level 4 and moving to level 5.

Desired Level of Maturity

Once you have made an honest assessment of what level your organization is currently at, the next step is to determine your desired maturity level and gain organizational support for the change. We generally do not recommend jumping more than 2 levels for the first stage of a process change.

Next Step

Once you have completed your self-assessment of current and desired maturity levels, we would encourage you to reach out to us to speak with one of our consultants.

We will listen to understand your organization's unique needs and provide some guidance on best practices based on years of helping clients succeed.

6 Jama Connect and The Living Requirements™ Dashboard

## Jama Software Overview

Jama Connect brings people and data together and provides visibility and actionable insights into the product development lifecycle.

Jama Connect, together with our industry-focused services, helps teams manage the complexities in the products and software they're building, see improved cycle times, increased quality, reduced rework, and minimized effort to prove compliance.

And now, with many of us around the world working remotely and on distributed teams, it's especially important to have the ability to communicate and collaborate effectively. Jama Connect is designed to help teams work together on their requirements, and review their work in real time, no matter where they are.

Jama Connect eliminates silos with a digital thread across people, processes, and ecosystems and is designed to support the end-to-end product development process with:

- A simple, single repository so it's easy for remote teams to gather, review and execute on requirements

- Structured reviews and collaboration - teams can elicit feedback, review product features in real time with stakeholders and track critical decisions across teams and locations

- Change management throughout product development — end-to-end traceability and real-time collaboration improve visibility and make it easier to adapt to changes and track their impact
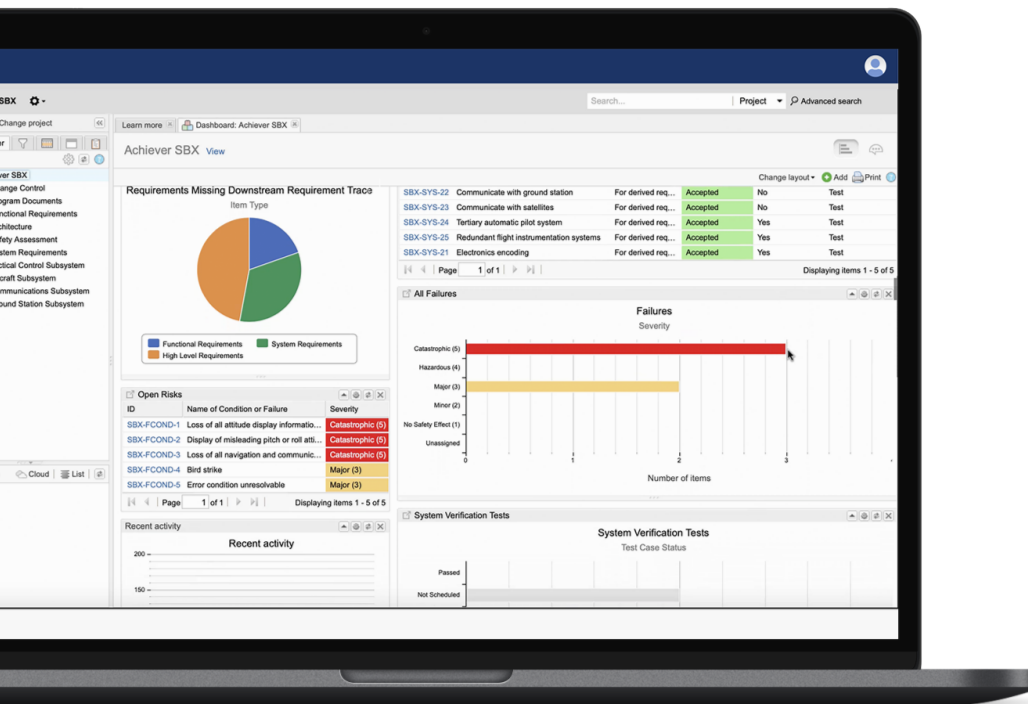
The Living Requirements Dashboard

Our Living Requirements™ dashboard now enables you to see what previously was hidden until too late. By identifying process exceptions, risks can be identified early and mitigated at the lowest cost. In this dashboard, you can see numerous process exceptions identified:

- Missing validation and verification

- Requirements never reviewed

- Stores missing tests

- Development artifacts missing downstream work items

- Requirements missing downstream requirement trace

- Orphaned requirements

- Unallocated system requirements

- Open risks

> We love the fact that it's very easy to compare prior versions of requirements. It's easy to track, review, sign off and know how and why we did certain things."

**Glen Hutto, VP of Wealth Solutions**
Alight Solutions

7 Are you ready for
Living Requirements?

Without Living Requirements management: requirements are **NOT** specified, approved, addressed, prioritized, delivered, tested, or risk assessed. This culminates in static requirements and compounding product risk.

With Jama Connect's easy-to-use and quick-to-adopt platform, requirements are the contextual thread that become the instrument of process compliance. Risk is minimized, silos are eliminated, and product development becomes transparent.

Making the case for Jama Connect®
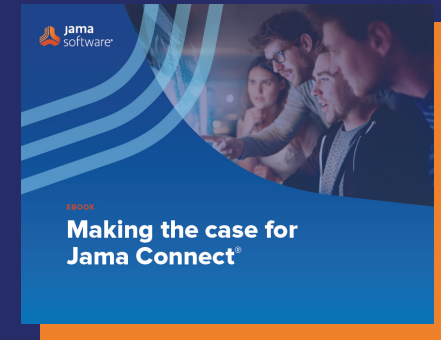
EBOOK

If you've decided to explore a new solution for managing requirements throughout your complex product or systems development process, you'll have to build consensus across your organization.

In our ebook, **Making the Case for Jama Connect**, you'll learn:

- What each internal team cares about most when selecting a new tool

- What sets Jama Software apart

- How to demonstrate ROI

Download ebook

Jama software®

ABOUT JAMA SOFTWARE

Jama Software is focused on maximizing innovation success. Numerous firsts for humanity in fields such as fuel cells, electrification, space, autonomous vehicles, surgical robotics, and more all rely on Jama Connect® to minimize the risk of product failure, delays, cost overruns, compliance gaps, defects, and rework. Jama Connect uniquely creates Living Requirements™ that form the digital thread through siloed development, test and risk activities to provide end-to-end compliance, risk mitigation, and process improvement. Our rapidly growing customer base of more than 12.5 million users across 30 countries spans the automotive, medical device, life sciences, semiconductor, aerospace & defense, industrial manufacturing, financial services, and insurance industries.

To learn more, please visit us at jamasoftware.com.