

WHITE PAPER

Six Exercises to Strengthen Traceability

Introduction

Manufacturers and other organizations that develop products containing both hardware and software – such as medical devices, connected cars, and consumer electronics – are under increasing pressure both to prove compliance with tightening industry regulations, and to increase quality to effectively compete.

The answer to solving quality, time, and cost issues is often as simple as strengthening the traceability of the product development process. Strong traceability helps maintain a high level of product and process quality, and supports compliance efforts.

Sound like a ton of extra work? Surprisingly, strengthening traceability and using the right tools can actually save you hours of manually creating and updating trace reports and matrices – for real time auditability.

What's In This Guide

This white paper offers six exercises to help you strengthen traceability — without adding the burden of additional hours to your development process. Completing these exercises gets everyone involved in the development process on the same page regarding traceability.

These exercises also reveal holes in your processes, as well as the tools you use to manage them. Sometimes the biggest weakness in your traceability is the tool itself. If your product or process has grown in size and complexity over the years, you may have outgrown your traceability solution without realizing it.

Getting Started

Strong traceability involves knowing what information needs to be traced, capturing that information at different points in the process, and sharing it across teams, departments, and ultimately the entire organization — all in a timely manner.

To that end, you'll need to do some prep work before tackling these six exercises.

DEVELOP A STRATEGY

If you want stronger traceability, you need to have a strategy in place. To develop a traceability strategy, gather your key stakeholders and answer the following questions:

1. What are our current product development problems?
2. What compliance requirements must we meet now and in the near future?
3. Why is traceability important to our business?
4. How will each department benefit from traceability?

5. What is the current state of traceability at our business and in each department?

Answering these questions will give everyone a better understanding of traceability and how it affects your business.

MAKE TIME

The time it takes to complete all six exercises will vary by organization, but it could take as little as two hours if properly managed and structured. We have outlined an estimated time for each exercise to help you plan.

ASSEMBLE AN A-TEAM

Management knows best, right? Well, not always. The truth is, management often lacks knowledge about day-to-day activities and processes. To avoid blind spots that may impede traceability, consider inviting the following people to join your traceability A-team:

- Product experts from marketing, R&D, and product management
- Business analysts and project managers from design
- Developers and engineers from development
- Testers and QA managers
- Product documentation personnel
- Key regulatory and compliance personnel

Your business may have different titles for the people you invite, but this list should give you a good idea of the roles to consider.

THINK FRESH

People like doing things the way they've always been done, and this bias can impede your progress. To prevent this, find a neutral third party to offer a fresh perspective — someone from another department or an

external consultant. This “referee” can help direct the conversation, keep everyone on track, and ensure that everyone’s needs and concerns are addressed in a way that obtains the best results for the business.

GIVE HOMEWORK AND GATHER RESOURCES

Once the meeting is scheduled, share this toolkit with your team one week prior, so the wheels are already turning and they know what to expect.

Before you get started, make sure you have access to the following resources:

- Meeting room with a whiteboard (the larger, the better)
- Markers for whiteboard (black, blue, green, red, and yellow)
- Sticky notes (the larger, the better)
- Pens and paper for each person

You’re now ready to begin the traceability best practices exercises.

1. Identify Key Assets

A key asset is any development item that should be managed independently for better tracking and accountability. These can include requirements, test cases, development tasks, and issues.

Are these assets managed in documents and spreadsheets? Break them down to more manageable core elements. For example, instead of treating the entire requirements document as a single asset, focus on specific requirements. You can also collectively manage specific product artifacts, such as a traceability matrix or other reports.

Exercise (15 minutes)

Have each participant write down the key assets they manage, and the other items that are affected by changing each managed asset.

Collect the lists of assets and write them on a whiteboard with a black marker, organizing them into categories that make sense to everyone, such as:

- Risks
- Design/Requirements/Specifications
- Testing
- Issues/Deviations/Tasks/Feature Requests
- Source Control/Other Product or IP Assets
- Reports

IDENTIFY KEY ASSETS

Requirements	Testing
Business Requirements	Test Cases
User Stories	Test Records
Functional Requirements	Automated Tests
Design	Functional Tests
Physical Requirements	Regression Tests
Electrical Requirements	Performance Tests

Questions to Ask

- **What are you going to deliver?** (Explicit product requirements, electrical requirements, functional requirements, compliance requirements, user stories, etc.)
- **How are you going to consistently verify the product?** (Functional test, materials test, regression test, load test, verification test, test cases, etc.)

- **How are you going to assess, manage, and mitigate risk?** (FMEA, FTA, Safety Assurance Case, Risk Management File, etc.)
- **What types of issues are you going to track?** (Change requests, product defects, program bugs, spelling mistakes, quality problems, etc.)
- **What types of customer requests are you going to track?** (Feature, cosmetic, functional, training, etc.)
- **What types of intellectual product capital require versioning?** (Software source code, firmware code, data sets, technical documentation, standard operating procedures, etc.)
- **What types of reports are essential for you and your team?** (Traceability matrices, detailed reports, trend reports, burn-up and burn-down charts, etc.)

Exploring and identifying development assets gives the group a better understanding of the related artifacts that are managed in the development lifecycle. After you have collected and organized your key assets on a whiteboard, you can move on to the next exercise.

2. Explore Terminology and Meaning

Before getting started on this exercise, remind everyone that this is a traceability exercise. They should think beyond just the artifact naming, because you may want to separate key items for specific reporting or tracking needs later.

Exercise (15 minutes)

Get everyone to agree on one naming convention per artifact, especially if there are legal or compliance reasons for consistent names.

There may be situations where they can't come to an agreement. For example, customers may call something a defect, QA may call it a deviation, development may call it an issue, and engineering may call it an anomaly, but each group is referring the same thing. In these situations, map the terms to each other and move on.

ISSUES



Issues

Deviation, Issue, Defects, Anomalies
Work Items, Concern, Question

Explore Terminology and Meaning

If your artifacts cannot be categorized under one name or have a different process, assign a name for each artifact.

Establish a simple meaning for each artifact, and write the meaning on a sticky note. You can even use some of the original words used by others, so everybody is on the same page.

Write a general definition of the different types of artifacts. Don't worry about defining every type, unless there is a specific reason for tracking and relating them differently. (Requirements will likely be the exception to this rule, because each requirement type or artifact will likely have a different meaning.)

TASKS



Feature
Requests



Development
Tasks

Explore Terminology and Meaning

Once you've agreed to each artifact's name and written all definitions on sticky notes, put the sticky notes at the head of the table or on another board to the side. You'll use these definitions in upcoming exercises.

Questions to Ask

- **Does each artifact name have a different process?** If not, try to get the team to agree on names for artifacts that are essentially the same. For example, maybe all types of tests (manual and automated) require a formal test case to document or verify completion of the test.
- **Which artifacts require consistent naming for auditing or compliance?** Identify these artifacts and agree on a name for each. If a government agency explicitly defines a specific artifact with a certain name, it is usually a best practice to call it by the same name to minimize auditing confusion.

Getting everyone on the same page with terminology and meaning helps reduce confusion and eliminates possible negative implications from a legal or compliance perspective.

3. Analyze the Impact of Change

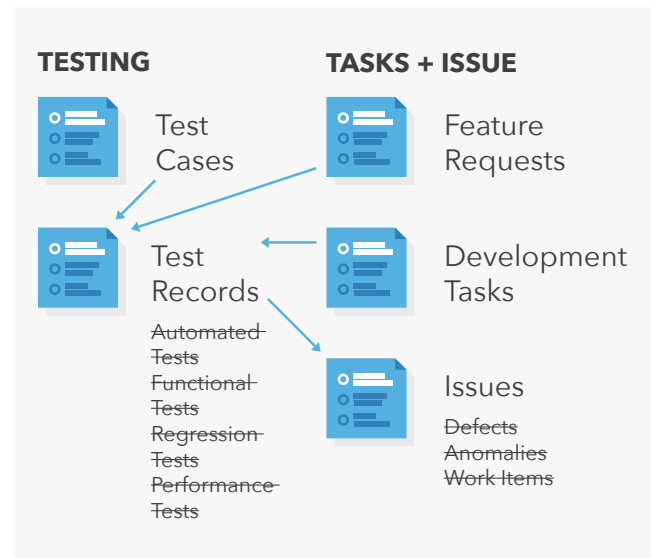
You now need to determine how change affects other related artifacts. For example, what is the impact on a test case when a requirement changes?

Exercise (15 minutes)

On the whiteboard, draw blue arrows from each artifact to the dependents that would also change if the original artifact changes.

Do not perform this exercise for reports, because the whiteboard could become unmanageable.

Note: To complete all six exercises in two hours, you must stop this exercise when you reach 15 minutes. If the exercise cannot be completed in 15 minutes, you may want to finish it in a separate meeting. For now, map out a few key impacts of change per category.



Analyze the Impact of Change

Questions to Ask

- **Which artifacts are directly impacted by change?** Changing one artifact can have a ripple effect and result in other indirect changes, which is common in many product development lifecycles.

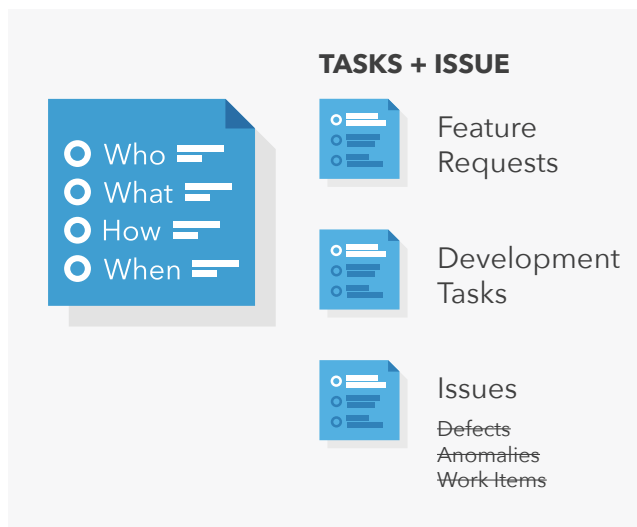
Managing change in an organization is not easy and can have many risk factors. Mapping these potential risks will give your team a bigger picture of how each change affects both upstream and downstream artifacts. This visual impact analysis can also be used to help determine if an artifact is worth changing, because it may cause delays.

4. Establish Trace Relationships and Handoffs

You can now start to define the types of relationships and handoffs that need to occur if change happens. Don't focus on how you do it today. Instead, consider what is the most effective or ideal way to communicate changes and handoffs.

Exercise: (30 minutes)

On a sticky note, define the type of relationships that exist for each blue arrow on the whiteboard. The facilitator should write the who, what, how, and when on the left side of each sticky note, then place it on the blue arrow. **Do not perform this exercise for reports.**



Establish Relationships and Handoffs

This exercise can take more time than you've allocated, so try to define one key relationship per group at a minimum. Ideally, tracing two to three relationships per group underscores the importance of key handoffs.

Using traceable relationships to connect artifacts helps map out the interdependencies and impact before change is considered. These relationships are critical

for achieving effective traceability and should be automated as much as possible.

Questions to Ask

- Who needs to be notified of the change? (A specific group, manager, assigned person, customer, etc.)
- What needs to be checked, approved, changed, or created if the related artifact changes or enters a final state? (A simple flag, quick review, formal review, creation of another item, etc.)
- What other systems need to be updated? (PLM, QMS, CRM, ERP, SCM, Help Desk, etc.)
- How should the changes be communicated? (Flagged, email, formal notification, etc.)
- When should the changes be communicated? (Immediately, time-based, escalate if no action taken within x days, etc.)

5. Make Sense of Data

Establishing performance guidelines and tracking metrics are critical for measuring productivity, identifying potential delays, and helping to reduce the risk of future issues. Many times, team members don't understand why a report is needed or don't have the time each day to record the necessary data. This exercise will clarify which reports and metrics are necessary.

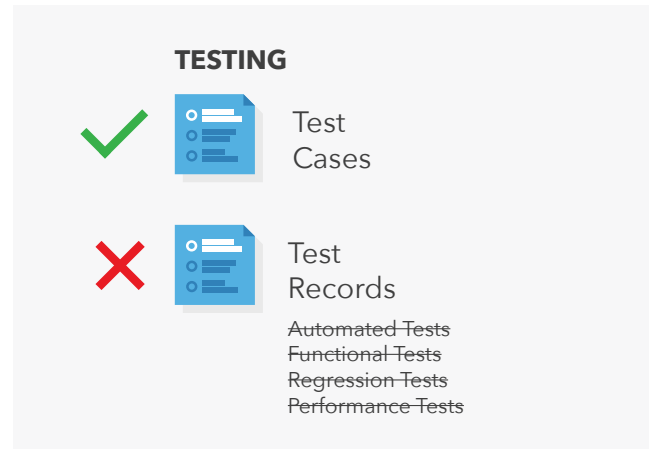
Exercises: (15 minutes)

Step 1: Review each report you defined earlier as an artifact and verify that nothing was overlooked. Re-read the definitions from the second exercise, and assess how easy it is to get the information required for each report. Mark each of the sticky notes with one of the following symbols:

- A red X to indicate there are problems getting data.
- A green check mark to indicate there are no problems getting data in a timely fashion.
- A yellow X to indicate there is not a unanimous decision.

Step 2: For each artifact, ask the teams who are most responsible for managing the data to rate how easy it is to pull data together for daily tasks and how easy it is to analyze data without generating reports. Mark each sticky note with one of the following:

- A red X to indicate they cannot easily get the data for daily tasks or they have to generate reports to analyze data.
- A green checkmark to indicate they can easily get the data to do their job.
- A yellow X to indicate there is not a unanimous decision.

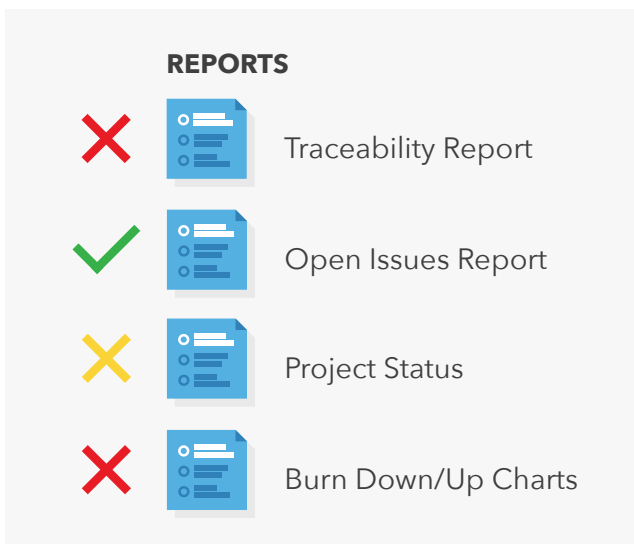


Make Sense of Data

Questions to Ask

- **What type of reports do you need to create?** Do you have all reports listed from an operational, management, and compliance perspective? Can you easily determine status and velocity of your projects? Can you easily pull the appropriate data to report against?
- **Can you easily get the data you need to do your job?** From a daily operational perspective, can you easily view the data you need to make well-informed decisions? Can you take action with this data?
- **Can you analyze key data quickly?** Can you organize data the way you work or do you have to create reports to analyze data?

These metrics drive your company's performance and establish targets and goals for each department. Using an application that gathers and presents metrics in a seamless operational task can ensure that good performance metrics are documented. It also provides quality metrics for management.



Make Sense of Data

6. Inventory Current Processes and Tools

How do you ensure that traceability between artifacts happens on a daily basis? That's the question this exercise aims to answer.

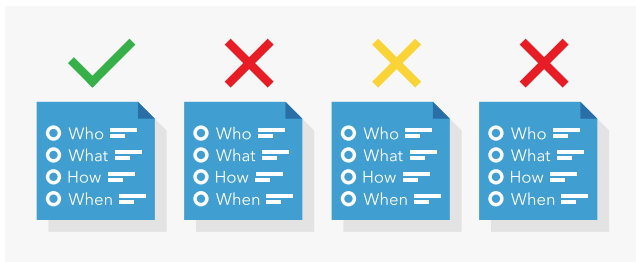
Exercises: (30 minutes)

Read the sticky notes with the who, what, how, and when for each trace relationship aloud. Then ask everyone to decide if they can do everything listed on the sticky notes using your current processes and tools. Mark each sticky note with one of the following:

A red X to indicate the process is broken or the tools don't support the process.

- A green checkmark to indicate everything on the sticky note can be accomplished with the current process and tools.
- A yellow X to indicate there is not a unanimous decision.

Once you identify processes that are successful and ones that fail, ask the following questions.



Inventory Current Processes and Tools

Questions to Ask

For each green checkmark, ask:

- Why are these processes successful?
- Do they give proactive backward and forward traceability?
- Are key activities and notifications automated?

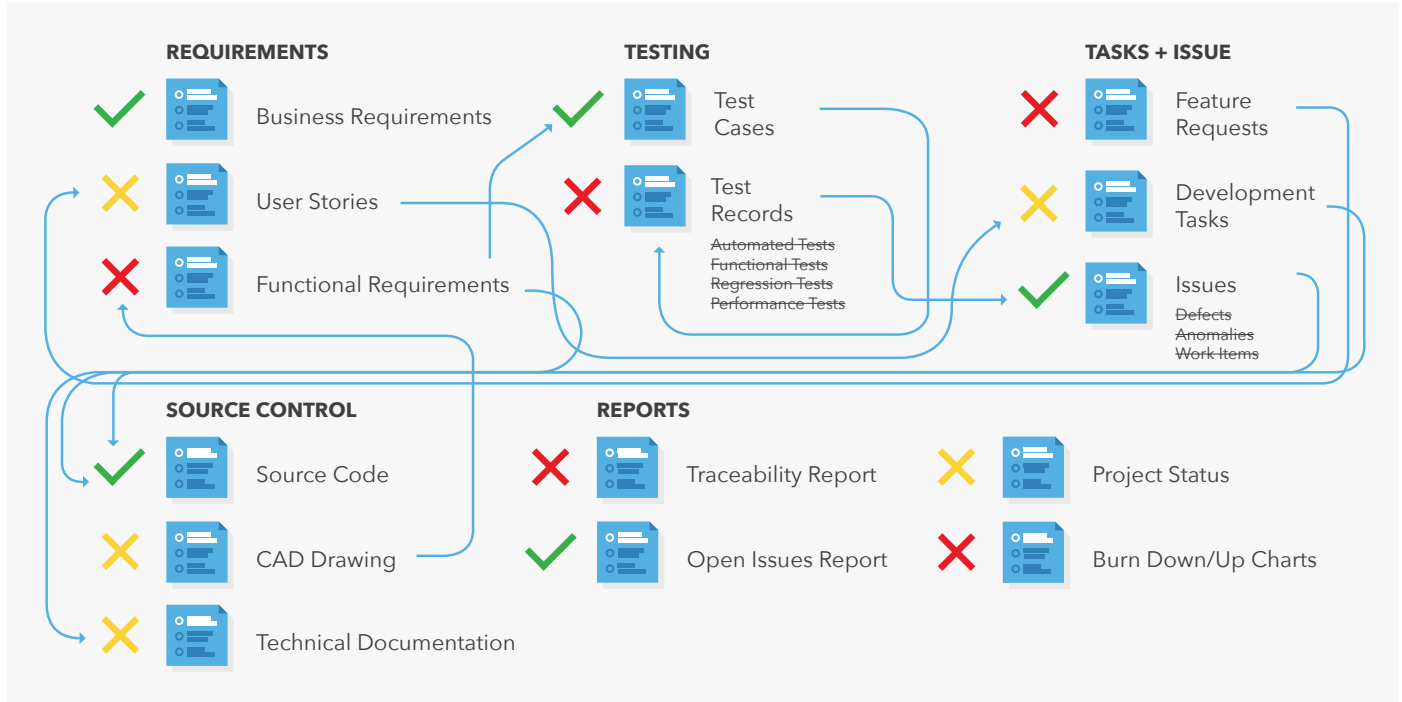
For each red or yellow X, ask:

- Why aren't they successful?
- Do people not understand the process?
- Is there a lack of communication?
- Do the tools support your preferred trace relationships?
- Is the process still valid or have there been changes in the organization that make the process obsolete?

Other questions to consider about current systems and processes:

- Will they continue to support current and future development and project methodologies?
- Will they continue to handle our current and future compliance needs?
- Do they help us or get in our way?

Establishing ideal processes will remove some of the burden of having emergency knee-jerk reactions, audit failures, and the need to improve efficiency and productivity. A good process will also reduce risk, and identify areas that should be controlled to ensure success.



Completed Exercises

What's Next?

How do you ensure that traceability between artifacts happens on a daily basis? That's the question this exercise aims to answer.

Now that you've completed the six traceability exercises, how does your current traceability strategy measure up? Does it effectively meet your needs?

Check out the whiteboard. How much red do you see? Any red X can hurt your business from a daily productivity or compliance perspective. Yellow marks could indicate that your teams are not on the same page, which may require a more thorough analysis of that particular area, or additional training.

One or two red Xs highlight trouble spots that can be corrected, but if you see more than a few red Xs, you've got bigger traceability issues. It's likely that the

tools you're using to maintain traceability aren't able to handle the complexity or size of your development process. The next section discusses what to look for in a strong traceability solution.

Finding the Ideal Traceability Solution

Now that you know what problems you face and how they affect your organization, how do you find the right solution to strengthen your traceability?

Providing strong traceability strategies and best practices involves adoption of a comprehensive, integrated, and configurable application development lifecycle (ALM) solution. The right ALM solution for you should match your business needs, development process, quality standards, and compliance initiatives. In other words, you shouldn't adapt your process to fit the tool; the tool should be flexible enough to adapt to your process.

ADAPTABLE AND CONFIGURABLE

Just like businesses, no two processes are ever the same. Most businesses need solutions that can be easily configured to fit with internal terminology, project requirements, business rules, compliance regulations, and user needs. As your business grows, so will your business processes. You will need a system that can adapt. When searching for such a system, keep these key attributes in mind:

Configurable Security

Strong, configurable security measures are required of most government and compliance agencies. Even if you aren't required to have security measures for compliance reasons, some level of security allows you to be certain that your intellectual property is protected when working with clients or contractors.

Configurable or Flexible Workflow

Configurable workflows ensure that your business and compliance rules are enforced and tracked, even if you require electronic signatures or approval processes. Many companies want to implement Agile or hybrid Agile development methods in order to reduce time to market, making configurable workflows even more important.

Configurable Naming and Labeling

Configurable naming and labeling helps encourage user adoption of a new solution by allowing you to change the names of development items, requirement types, specific fields, events, and reports that match your business and compliance initiatives. Trying to fit in to canned naming conventions only makes users more resistant to a new solution.

Configurable Automation

Rules and Notifications

Ensuring the right communication is happening in your organization sometimes requires proactive notifications, like emails or reminders based on escalation rules. Configurable automation rules ensure tasks or specific events are completed on time, based on your business rules.

STRONG RELATIONSHIP LINKING

Based on your business needs, creating and managing links between artifacts can be accomplished manually, suggestively, or automatically. Advanced parent-child linking, many-to-many linking, and relationship descriptions help identify the type of relationship that exists with a link. These linking capabilities ultimately enable the workings of good traceability practices: validation matrices, suspect notifications, process coverage, and forward and backward impact analysis.

Effective Content Reuse

Item mapping allows for effective content reuse in an organization, as artifacts transition or evolve from requirements to test cases to test executions to issues. Instituting content reuse and linking between artifacts helps prevent mistakes and establish a common language across the organization.

Suspect Relationships

When an artifact changes, it can impact other items. For example, a test case is impacted when a requirement changes. Flagging or marking artifacts as suspect can be automated by the system, or the user can be prompted to flag linked artifacts as suspect.

Safety Requirement	Verification TC	Test Run	Pass	Fail	Defects
 FSR-213 - The washer liquid spray shall not be enabled for >5s Approved, not assigned	 TC-2 - From REQ-FSR-213/217 - spray 7s Ready for Testing, not assigned	 TR-2 - From REQ-FSR-213/217 - spray 7s	✓		
		 TR-2 - From REQ-FSR-213/217 - spray 7s			
	 TC-6 - From REQ-FSR-213 - spray 3s Ready for Testing, not assigned	 TR-5 - From REQ-FSR-213 - spray 3s	✓		
		 TR-46 - From REQ-FSR-213 - spray 3s			
 TSR-220 - Counter 1 Reset Ready for Validation, assigned to Reviewer, Martin	 TC-13 - From REQ-TSR-220 - Counter 1 Reset Ready for Testing, assigned to Administrator, System	 TR-12 - From REQ-TSR-220 - Counter 1 Reset			
		 TR-15 - From REQ-TSR-220 - Counter 1 Reset			
		 TR-18 - From REQ-TSR-220 - Counter 1 Reset		✗	 TR-18 - From REQ-TSR-220 - Counter 1 Reset (Testrun failed)

Traceability Matrix

Actionable Traceability

Actionable traceability enables you to trace from requirements through test cases, test results, resolutions, and source code. It gives you complete forward and backward traceability — requirement to sub-requirements, requirements to test cases, test cases to test runs, test runs to issues, or any combination thereof.

Actionable traceability in your product development process ensures quality and helps manage the impact of change. And with the right combination of best practices and supporting tools, you can cost-effectively achieve integrated, actionable traceability.

Effective Analysis

Understanding the impact of a change is essential. Knowing dependencies before a change is considered or made provides a logical control over the process workflow. Complete product development lifecycle solutions can show both forward and backward impact analyses.

CONFIGURABLE TRACEABILITY MATRIX

The traceability matrix is one of the most important tools for tracking both internal and external goals to help ensure they are met. For regulated industries, it's often a mandated requirement for gaining approval, serving as evidence that all requirements have been implemented and tested, and all hazard mitigations have been implemented and validated for effectiveness.

Regulatory auditors don't always want to see the same information, so your traceability tool should not treat the trace matrix as a one-size-fits-all report. You should be able to configure your traceability matrix to meet your industry's specific needs.

TRANSPARENCY AND VISIBILITY

If all of the above features are configured to match your processes and language, then your solution should provide transparent traceability to the users. With an automated product development lifecycle solution, you no longer have to worry about duplications or trying to remember to email team members about changes. An automated solution will allow your users to do their daily jobs, analyze key data, and feel confident that specific business and compliance rules are being met.



Helix ALM is an application lifecycle management (ALM) solution that provides scalable artifact traceability for companies developing complex, high-quality products. Helix ALM builds development relationships by linking requirements together and connecting test cases, test results, even source code to provide upstream and downstream traceability of development artifacts. Our award-winning traceability solution supports all product development methodologies, enterprise organizations, and development within regulated industries. Helix ALM brings requirements clarity to your creation. See more on our website at www.perforce.com/products/helix-alm.

Need Help?

Many businesses find it difficult to dedicate the time or resources necessary to develop traceability strategies and best practices. Perforce has an experienced professional services team that can help with discovery sessions, installation, data migration, configuration, validation, and training. Contact Perforce at sales@perforce.com to discuss how we can help improve your traceability strategy.

About Perforce

Enterprises across the globe rely on Perforce to build and deliver complex digital products faster and with higher quality. Perforce is best known for its highly scalable version management and collaboration platform that securely manages change across all digital content - source code, art files, video files, images, libraries - while supporting the developer and build tools your teams need to be productive, such as Git, Visual Studio, Jenkins, Adobe, Maya and many others. Perforce also offers complete project lifecycle management tools to accelerate a project's delivery cycle by linking the requirements, test plans, source code, and helpdesk in an integrated platform. Perforce is trusted by the world's most innovative brands, including Pixar, NVIDIA, Scania, Ubisoft, and VMware. The company has offices in the US, the United Kingdom, Germany, Canada and Australia, and sales partners around the globe. For more information, please visit www.perforce.com