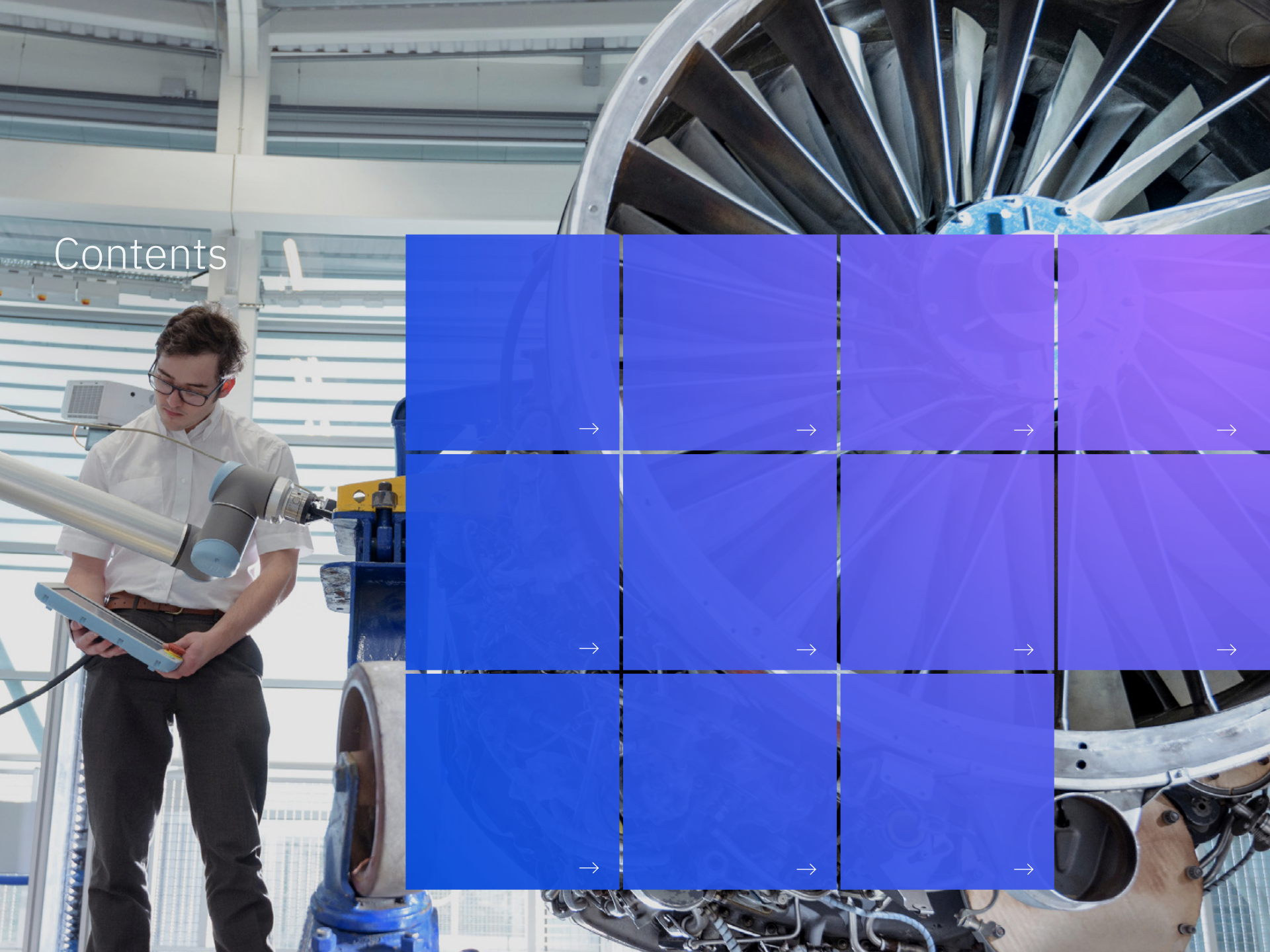




Moving to knowledge-driven requirements management

Using the power of AI to manage requirements efficiently, intelligently, and more accurately with IBM Engineering Requirements Management

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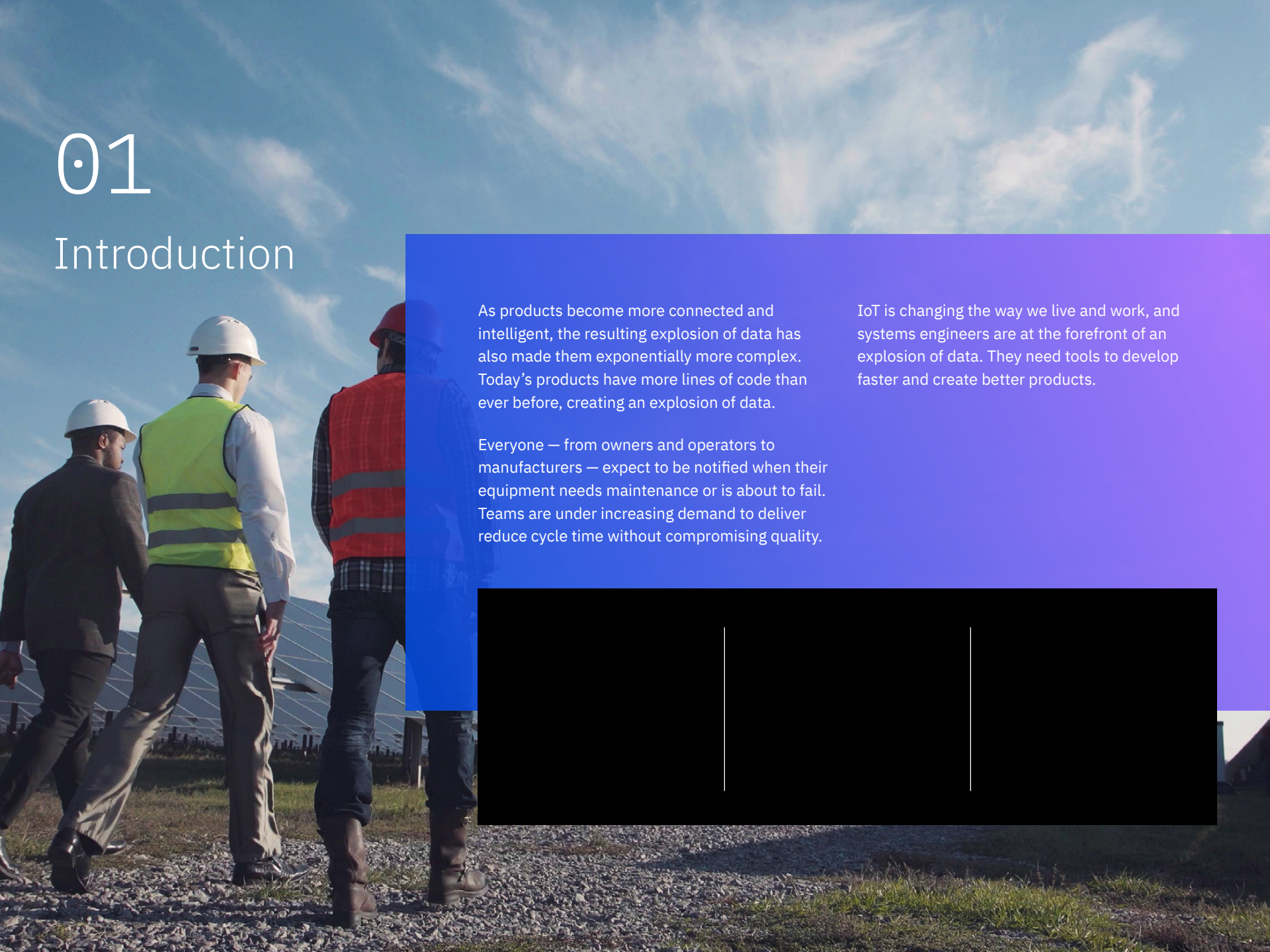
01

Introduction

As products become more connected and intelligent, the resulting explosion of data has also made them exponentially more complex. Today's products have more lines of code than ever before, creating an explosion of data.

Everyone — from owners and operators to manufacturers — expect to be notified when their equipment needs maintenance or is about to fail. Teams are under increasing demand to deliver reduce cycle time without compromising quality.

IoT is changing the way we live and work, and systems engineers are at the forefront of an explosion of data. They need tools to develop faster and create better products.



02

Requirements Management and the Internet of Things

Poor requirements management is arguably the most significant contributing factor in the failure of a project. It can lead to re-work and wasted time, traceability and quality issues, out-of-control costs, and an overall increase in risk.

Before the age of IoT, engineering and product design teams could use documents, spreadsheets, emails, wikis, and other tools for managing requirements. But, as engineering data increases, so does requirements complexity. Successful requirements management demands the ability to capture relationships and manage dependencies. It is also essential that teams can

collaborate in real time to handle the crucial tasks of versioning and change management.

Artificial intelligence (AI) is becoming increasingly valuable for managing this data in a way that improves quality and reduces cycle time.

IBM's engineering requirements management solutions offer knowledge-driven tools to efficiently handle today's complex projects. Using these tools, IBM clients can:

- Reduce the cost of defects by **60 percent**
- Reduce the cost of manual reviews by **25 percent**
- Reduce development costs by **57 percent**
- Accelerate time to market by **20 percent**
- Reduce cost of quality by **69 percent**

IBM's requirements management tools allow you to do what cannot be done with documents, emails and spreadsheets. Capabilities include requirements capture, elaboration, management, teamwide collaboration, and Requirements Management Quality Assistant—an embedded Watson capability that integrates the power of AI into the heart of requirements management.



03

Live collaboration

Keeping stakeholders informed and engaged is critical. With IBM's requirements management solution, users are automatically kept in the loop with email notifications and customizable dashboards that enable users to see the most important information upon login. Dashboards are customizable, and provide at-a-glance details regarding team members, project timelines, changes that have been made, and any ongoing reviews and comments. IBM's requirements management solution acts as a "single source of truth," and enables interested parties to access the latest information automatically.

Whether your team is housed within the same building or distributed across the globe, collaboration is challenging when using traditional requirements management tools. Information is scattered and difficult to find and verify. And, even when the data is finally located, the time spent gathering, reviewing, and combining it can result in requirements that are weeks out of date or missing vital changes.

Additionally, multi-user editing is almost impossible to manage with traditional tools. This often results in multiple versions of a document circulating throughout the team and wasted time as the document owner is forced to consolidate changes, maintain an updated copy, and inform everyone of the changes. Automated requirements allow several people to easily collaborate on the same data at the

same time regardless of where they are located. This ensures the team always has access to the latest, most accurate information when they need it.

"IBM's requirements management solution acts as a 'single source of truth.'"

When a document is ready for review, stakeholders can use IBM's requirements management solutions to make comments directly in the tool. This allows important decisions and discussions to occur easily across to the team, eliminating the time and effort needed to track down emails and consolidate comments. Comments can be ranked by importance and directed to specific team members so the critical issues can be handled first by the right person. As new comments are added, email notifications with hyperlinks point to exactly the information they need. These capabilities shorten review cycles and speed collaboration, even across multiple time zones.

04

Consistency

On complex projects, teams need their data organized logically and consistently.

Traditional requirements management tools cannot annotate requirements specifications without adversely affecting the original structure and context. Even when requirements have been annotated, it's impossible to sort and filter documents based on this information and determine which annotations are missing. Plus, someone is eventually forced to clean up the documents and remove the annotations. Word processing users often resort to copying requirements from their documents into spreadsheets, adding separate columns for annotations. Whenever the documents are updated, users must manually synchronize the changes for all documents and spreadsheets. These unscalable, manual processes are time consuming, and often introduce errors. This leads to untrustworthy data that puts the project at extreme risk.

IBM's engineering requirements management solutions allow teams to set up templates that outline the basic structure of the information. For example, a system requirements template can include boilerplate text for the introduction

and areas for functional and non-functional requirements. Additionally, each data type can be "templated" with the necessary annotations.

The team can access the latest information when they need it without losing the format of the original document. Annotations, like priority, risk, status, and category can be displayed in columns, and both content and annotations can be sorted and filtered. You can also save views, which enables you to change the perspective of your data quickly to display only the information you need. Analysis is quicker, and the information you use is more consistent and accurate.



05

Traceability



Traditionally, spreadsheets are often used to store the annotations needed for requirements documents, and additional spreadsheets are used to capture relationships between requirements and tests. Verification matrixes, compliance matrixes, and traceability matrixes must then be maintained separately. These manual processes do not scale and are prone to user errors.

IBM's requirements management solutions allow users to "link as they think." Users can create relationships between new requirements and respond to higher level information using drag-and-drop functionality.

Additionally, IBM's tools support automation of the creation and maintenance of relationships throughout the development lifecycle, including relationships between requirements, work items, architecture, design, and test plans. These relationships can be displayed in columns, along with requirements and annotations, increasing the visibility of the project status. Views can be saved, enabling the team to quickly change the perspective of the data to fit stakeholder needs. These capabilities result in fewer errors, improved quality outcomes, and better project management.

The real value of traceability provided by IBM's requirements management solutions is evident when a project team must respond to an audit request or must understand the impact of a change request. When required, you can easily demonstrate required audit

information. Spreadsheet users struggle to maintain and interpret the connections between different levels of requirements across multiple documents. Translating the compliance of the project activities to user requirements and assessing the impact of changes is daunting.

The IBM solutions for requirements management eliminate these challenges. You can record relationships as you see them and use rich hover to view details about the related information without navigating away. The relationships are also traversable, enabling teams to quickly navigate from one document to another. By displaying related information in columns, gaps are highlighted to show where user requirements were dropped or are not related to lower level requirements or the final product. They also save time by identifying scope creep, where functionality that is not aligned with the project goals or business needs gets added to the project. The ability to view requirements and multiple levels of relationships graphically, lets you assess the impact of changes quickly and easily.

Dynamic traceability means that, as soon as a change is made, the requirements management tool automatically creates an update. If a downstream requirement changes, it is automatically reflected in traceability columns for the upstream requirements. Users can easily see the impact of changes via an up-to-date traceability matrix whenever required.

06

Understanding change



Even after the initial requirements have been agreed upon, change is inevitable. Perhaps a supplier is unable to meet an original target for cost or performance, or a test reveals that what was planned is not possible. Or, more simply, a requirement that has been acted upon needs to be either altered or corrected.

Effective change management is crucial. For every change, you must:

- Understand the impact of the change before it is made
- Ensure that all impacted areas are changed as necessary

Using traditional requirements management methods, you cannot easily understand the relationships between pieces of information. If a test fails or if a client issues an updated specification, documents and spreadsheets cannot analyze the impact. It can take weeks for the individual responsible for requirements management to understand the impact of the change.

IBM's requirements management tools help your whole team assess the impact of change before it happens, creating a strategy for change, and acting on a required change.

Teams can create a perspective or view of their data that shows where their requirements have relationships to other data spanning the entire development process. Users can graphically explore the complex mesh of information to understand the impact of change across multiple levels and domains. This information updates dynamically when any team member makes changes. If a downstream requirement changes, users can immediately see the potential impact of the change.

As changes occur, teams using traditional tools spend a lot of effort communicating the changes and ensuring that all impacted areas are addressed.

By using an on-premise or cloud based requirements management solution, engineering and design teams get a comprehensive history of every requirement change. Collaborative teams can easily see what changed, who changed it, and when it changed. IBM's tools also take advantage of the relationships between information. The system can alert users of a change so they can review and act on it accordingly. After they assess the change, the alert can be cleared. With a minimum level of effort, changes propagate down all levels of linked data in the project.

07

Requirements re-use

Products are becoming too complex to build in a one-off manner. Companies are building products as platforms with variations suited to different markets as a way to create higher levels of re-use. IBM's engineering solutions support requirements re-use by allowing the same requirement to be used across multiple projects. Each instance refers to the "master" copy, so changes to one version are propagated to all instances.

To help reduce the chance of errors during re-use, IBM offers a sophisticated configuration management mechanism that allows you to create versions and variants of products, systems, and subsystems while maintaining relationships between the original and its versions and variants.

This enables you to work in product lines (Product Line Engineering), taking into account the fact that such product lines are typically composed of multiple components (assets) in a hierarchy. The components can be managed like smaller products, each with their own baselines, development teams, and schedules. The hierarchy implies dependencies of the respective component baselines.

IBM's requirements management solutions allow engineering teams to work in parallel with each other across multiple versions or variants,

enabling them to associate versions in one discipline to versions in another in a "global configuration." Teams can easily understand the changes and apply the same changes to multiple versions or variants.

Configuration management allows the project manager to monitor complex data changes and deliver those changes from one version to the next. The project administrator can deploy a configuration management strategy that is not limited to requirements data.

"...create versions and variants of products, systems, and subsystems while maintaining relationships between the original and its versions and variants."

08

Making your data work for you

Documents and spreadsheets limit how you look at your data. Customers might want their requirements structured as a document to simplify the review process, while the finance team wants annotations in a table layout so they can estimate requirement costs. This means creating and maintaining separate versions of documents or extracting and consolidating them from a variety of sources every time reports are required.

By implementing a more sophisticated requirements management platform, you can store information in a central location and present it in document format. Users can add attributes to individual statements without changing the original structure, and filter and sort information

based on the supporting characteristics. Cross references and relationships are maintained automatically, and users are alerted to any changes that they might need to act upon.

Best practices for writing clear, unambiguous requirements that can be verified can help alleviate project complexity. To avoid ambiguities, IBM's requirements management tools maintain a glossary that can be accessed, searched, and updated directly within the system.

Whether a stakeholder is interested in compliance, gap analysis, cost, test outcomes, or other information, a proper requirements management solution can create customized views to meet their needs. Views are dynamic and current, changing as the project changes, and can be viewed from the dashboard or printed. This eliminates the need to manually pull and consolidate information from multiple sources for different audiences.

IBM makes your data work for you, so you can spend time working on your project.



09

Requirements Quality Assistant (AI)

One of the most difficult aspects of today's complex engineering projects is the sheer amount of data that teams are required to manage. As product designs attempt to solve increasingly difficult problems, the result is an explosion of data. For example, in today's automobiles, the complexity of the software is outstripping the complexity of the vehicle itself. One car can have over a million lines of code.

The human capacity to learn and adapt simply can't keep up with this increase in data, which means that managing requirements using spreadsheets and documents—or even a traditional requirements management solution—is no longer feasible.

IBM Requirements Quality Assistant (RQA), a Watson capability embedded in the existing requirements management solution, applies AI to the requirements process. It improves the completeness, consistency, and accuracy of requirements as they are being written to remove ambiguity and avoid costly errors. Using Watson's Natural Language Processing capability, users can check for errors on the fly. RQA finds and pinpoints problems and provides expert guidance for correcting them.



RQA is pre-trained to detect a number of quality issues based on the INCOSE Guidelines for Writing Good Requirements. Machine learning allows the tool to learn nuance and context, so the more your teams use it, the smarter it becomes. Users can provide direct feedback to “teach” Watson and continually improve the model over time.

By applying AI to the requirements writing process through RQA, IBM has created a knowledge-driven requirements process that sorts through data to extract key insights, accelerating data management and improving requirements quality.

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Migrating from productivity tools

Moving from documents and spreadsheets is easier than you think.

IBM's requirements management solutions allow you to import your existing documents, maintaining their original structure, including headings, images, tables, and hierarchy. Sections are made to expand and collapse to ease navigation. Requirements are identified by keywords or delimited text and are associated with specific data types using a predetermined set of attributes.

When importing multiple documents, drag-and-drop linking allows you to relate your information and create consistent links. Turn on suspect profiles to monitor changes to linked information and automatically alert teams that related items have changed and that they should check the validity of their work.



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Conclusion

IBM's requirements management solutions enable you to control your project. Embedded AI functionality ensures your requirements are complete, consistent and accurate. You can focus on important tasks, such as building and designing, without having to worry about manually updating your data in multiple documents and spreadsheets. Your teams will work faster and respond more quickly with increased traceability and better impact analysis. Updates are automatic and immediate, and you can track everything via customized dashboards to show the right view to the right users at the right

time. Your whole team, regardless of location, can better collaborate and reduce risk from poor quality requirements.

Work smarter, not harder. IBM's requirements management solutions are the answer to smarter projects with knowledge-driven requirements. IBM clients have used these tools to enable effective requirements management that helped them reduce development time and costs while improving quality and time to market. You could be next.

For more information

To learn more about IBM's requirements management solutions, contact your IBM representative or IBM Business Partner, or visit the following website:

ibm.biz/doorsnextgen



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1. These percentages represent those derived by various IBM clients in specific operating conditions. Your actual results may vary.

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