Requirements management for the Internet of Things

Using IBM Rational DOORS Next Generation on cloud for enhanced product development

Watson IoT™

IBM

Contents

Introduction

Products in the marketplace are becoming more instrumented, interconnected and intelligent. Consider this scenario:

As you exit your driveway, your car sends a signal to your home to arm the alarm system while your smartphone automatically synchronizes with your car's voice command system. Having analyzed your recent driving patterns, the vehicle's navigation system recommends a new route to cut fuel costs and avoid traffic delays. Finally, the car informs you that your antilock brakes need servicing and, after checking the schedule on your smartphone, presents you with available appointment times.

With the advent of the Internet of Things, all of the technologies required to make this scenario a reality exist today. The Internet of Things is not only changing the way people are living but is also changing the way people who build such things are doing their jobs. The Internet of Things products, such as the car in this example, have huge potential to make our lives better. However, developing these products can be challenging. They are complex and riddled with interdependencies that can cause costly incompatibility failures or delayed product launches. So how can you effectively develop and deliver the Internet of Things products? How can you make sure that the product you've developed meets its original requirements? The key is to ensure that requirements drive the entire product development process. Requirements management is the answer.

The IBM point of view on requirements management

Requirements management helps to increase predictability in product development by helping control and manage requirements changes. At the same time, it helps minimize cost and risk by allowing teams to assess the impact of changes before they are implemented. Requirements management is a set of methods and processes that helps you translate customer and market needs into the right products.

Requirements management is the cornerstone of successful projects and is very important right from a project's beginning when initial requirements are being gathered. You need some way of keeping track of all the often conflicting factors such as requests, their priorities or to whom they are important. And this attention has to continue throughout the project because:

– New requirements will be added
– Old needs will be removed
– Some needs will change
– It will prove infeasible to meet some requirements
– Items that seemed not to be in conflict with others will turn out to have conflicts after all

To deal with all these issues, organizations need to manage requirements through the lifecycle of a development project and, in most cases, even after the project has moved to deployment, use and maintenance. In many cases, the need to manage requirements may even extend to disposal.

So what do you get from applying requirements management? Consider these advantages:

– Improved understanding of requirements because of wider collaboration among business and development stakeholders
– Increased stakeholder satisfaction through the ability to more consistently meet their real needs
– The improved ability to deliver products, systems and applications on time and within budget
– Better integration of various pieces of products because of increased collaboration and consistency
– Improved change management due to improved assessment of the proposed change
– Better demonstration of compliance with regulations through traceability and protected audit trails

If you do not manage your requirements, you are very likely to fail. Surveys consistently put requirements management issues ahead of managerial and technical issues as causes of project failures. This is true whether the failure is an overrun on schedule, a cost that is greater than originally budgeted, failure to meet needs, or even, as often happens, all three.
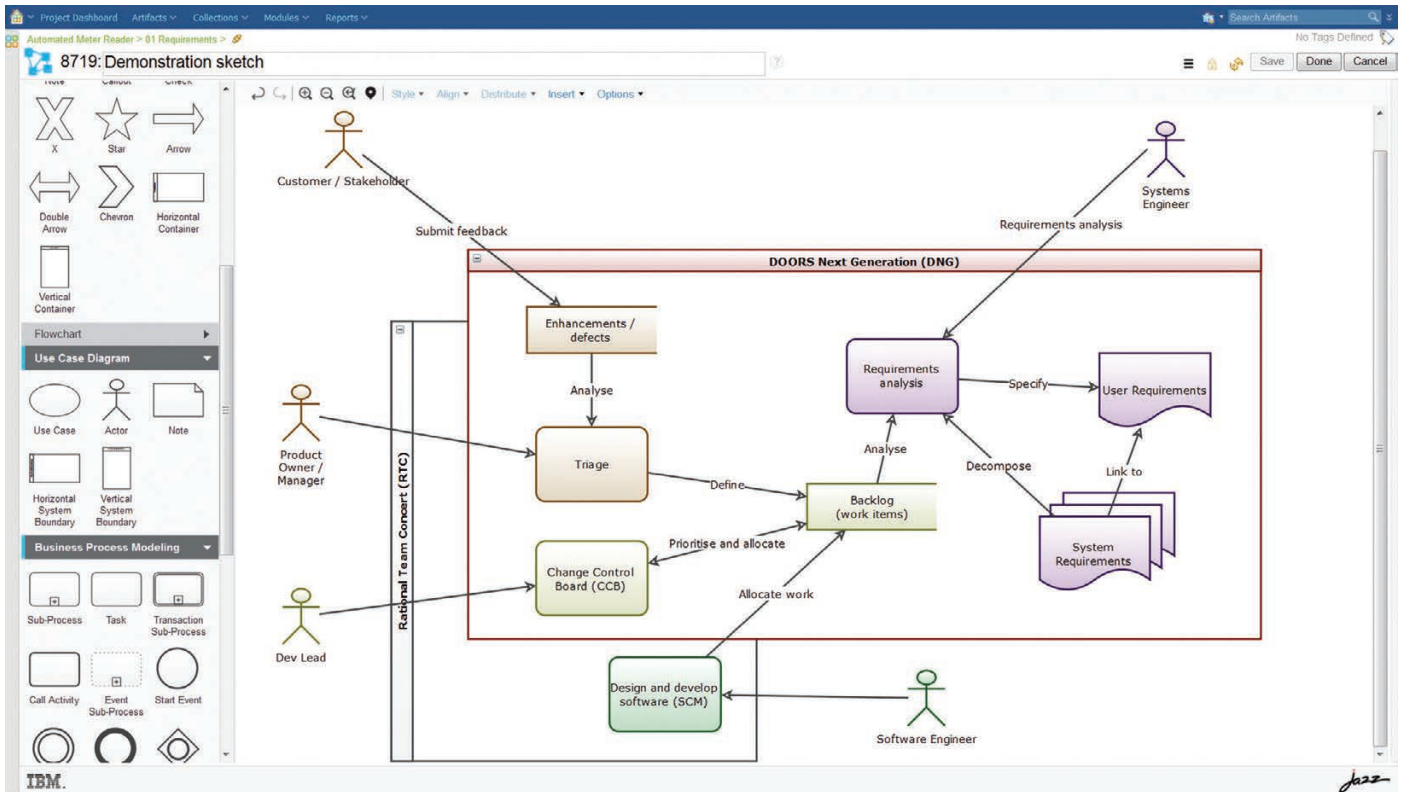
Why IBM is ideally positioned to help you with your requirements management

Requirements management tools from IBM help innovators, who design and produce the next set of devices, deal with increasing complexity and create products and solutions that meet the needs of the customers and marketplace.

IBM has a strong background in requirements management for complex systems engineering and regulated software development. This means IBM understands what you need from requirements management tools to develop the next generation of products for the Internet of Things.

IBM has a comprehensive portfolio of cloud-based as well as traditional offerings for requirements management. In addition to the classic IBM® Rational® DOORS®, a client-server installation that has evolved over more than 20 years, IBM now offers Rational DOORS Next Generation on cloud—the next-generation, web-based collaborative requirements management tool for the Internet of Things. With features such as a configuration management mechanism, Rational DOORS Next Generation on cloud is designed for collaboration and to provide a single platform for managing requirements to help project teams work more effectively across disciplines, time zones and supply chains. While it can be used as an on-premises solution, it is also available by subscription in a cloud configuration, which can lead to faster time to value.

Using these tools for effective requirements management may reduce your development cost by up to 57 percent, accelerate your time-to-market by up to 20 percent, and lower the cost of quality by up to 69 percent.[1]

Rational DOORS Next Generation: Modern web look and feel, and freeform diagram editor minimizes adoption cost and increases ease of usage.

"Our business fully embraces technology and is always willing to invest in the best. With IBM Rational DOORS, our clients know that we can support their quality and time-to-market objectives."

—Alfredo Perez, Head of Project Management, Nagares

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Descriptions of the top six benefits of using Rational DOORS Next Generation on cloud for people who develop products for the Internet of Things follow:

Benefit 1: Live collaboration
As soon as you have more than one person working on a project, those people need ways to collaborate. This means they need to be able to share information, and they need to be aware of when information changes. To support this, Rational DOORS Next Generation on cloud offers sharing within and

between documents. Several people can work on the same information at the same time and collaborate, wherever they are located. The latest information is always available for the team to access when they need it. Fine-grained locking mechanisms mean that people can even work on the same document at the same time.

In addition to collaborating through sharing a common source of information, stakeholders can use Rational DOORS Next Generation on cloud to discuss and collaborate by commenting directly in the document. This makes important decisions and discussions available to the team in context. With Rational DOORS Next Generation, comments can be directed to team members and classified as major or minor, so the important things can be handled first by the right person. As people make comments, Rational DOORS Next Generation on cloud can send email notifications, including a hyperlink that gives users access only to the information they need. As a result, review cycles can be shortened and collaboration can be improved even when working across different time zones.

Keeping stakeholders informed and engaged is critical, and with Rational DOORS Next Generation, the team is automatically in the loop. Along with email notifications, Rational DOORS Next Generation on cloud provides dashboards that enable users to see the most important information as soon as they log in to this web-based application. Dashboards are customizable and can show views of information, team members, project timelines, changes that have been made, and any ongoing reviews and comments. Rational DOORS Next Generation on cloud acts as a "single source of truth" and enables interested parties to access the latest information automatically.

"Crane uses IBM Rational tools worldwide and that allows us to have a centralized location where the users can connect and collaborate on their work day-to-day."

—Bernadette Saysette, Supervisor of Engineering Tools, Crane Aerospace & Electronics

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Benefit 2: Consistency

When dealing with the Internet of Things, project data can easily become very complex. As a result, teams need relevant information to be organized logically and consistently. Information is traditionally presented in the form of documents because people are familiar with this form and find it easy to use. However, development teams generally need to handle not only the requirements but also the information about individual requirements. This includes information such as priority, risk, status and category. This additional information is held in what are called "attributes."

With Rational DOORS Next Generation, your team can access the latest information when they need it. The format of the original document is preserved and, if required, attributes can be displayed in columns alongside the requirements. The contents of the document can be sorted and filtered by any attribute. Even more useful, you can also save the displayed information in views, which enables you to change the way you look at your data quickly and display just the information you need, in the way you need to see it. As a result, analysis is quicker and the information you use is more consistent and accurate. Views can be created that fit the need of the stakeholder, whether he or she is interested in compliance, gap analysis, cost, test outcomes or something else. Views are dynamic and current, and they change as your project changes. Manually finding and consolidating information from multiple sources and purposing documents for different audiences are eliminated. The views of Rational DOORS Next Generation on cloud do that for you.

"It's integrating different stakeholders and getting everyone on a common platform that ultimately provides traceability, and bridges the gaps between Infosys teams, its customers and partners."

—Naresh Choudhary, Associate Vice President, Infosys Ltd.
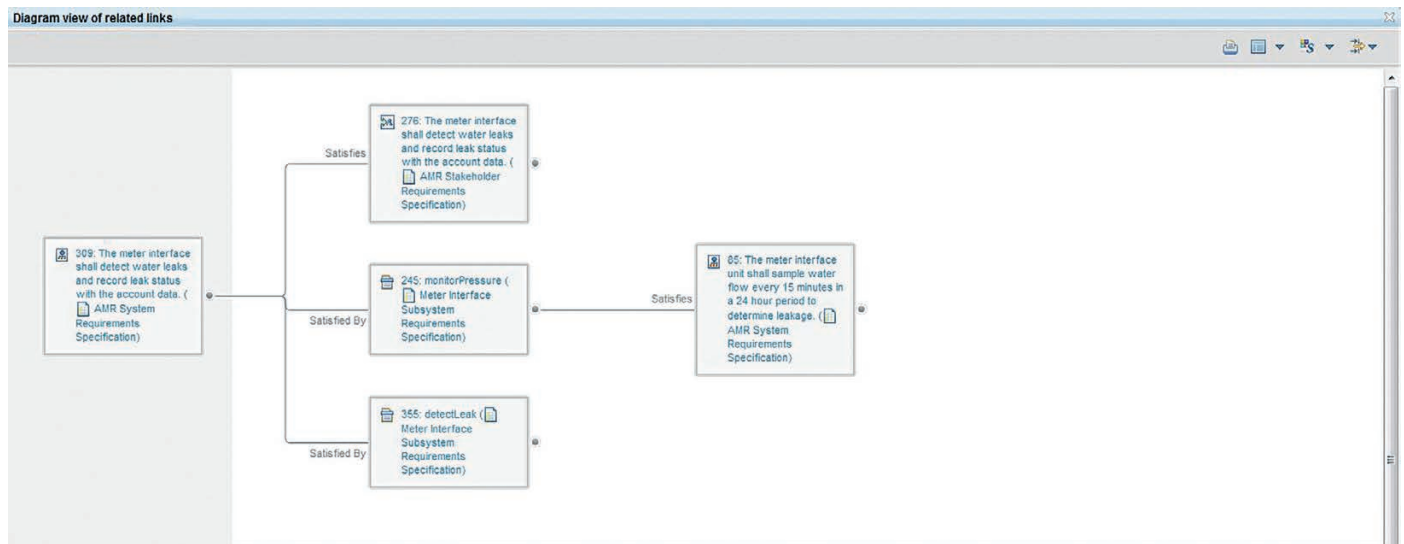
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Another useful capability provided by Rational DOORS Next Generation on cloud is the ability to set up templates that outline the basic structure of the information. For example, a system requirements template can include boilerplate text for the introduction and areas for different types of requirements. In addition, each type of information can be "templated" with needed information held in attributes. For example, system requirements can be kept in a system requirements specification that includes all the appropriate attributes, such as cost, risk or priority, along with any additional information deemed useful.

Benefit 3: Traceability

In addition to the information with which they work, teams also need to understand relationships between that information, such as linked requirements and links between requirements and tests. Rational DOORS Next Generation on cloud supports the easy creation and maintenance of the relationships, known as "links," throughout the development lifecycle. Because this includes relationships between requirements, work items, architecture, design and test plans, it removes the "air gaps" between "information islands" that are the result of using different tools. Removing these air gaps helps reduce user errors. In Rational DOORS Next Generation, users can "link as they think," creating relationships between new requirements and responding to higher level information simply by using drag-and-drop.

These relationships can be displayed in columns alongside requirements and attributes, which increases the visibility of the project status. The result is improved quality outcomes and better project management. The displays can be saved as views, which enable the team to quickly change the perspective of the data to fit the needs of stakeholders.

Rational DOORS Next Generation on cloud supports end-to-end upstream and downstream traceability.

The real value of traceability provided by Rational DOORS Next Generation on cloud is evident when a project team must respond to an audit request or must understand the impact of a change request. Without easy traceability, users struggle to maintain and later interpret the connections between different levels of requirements. With Rational DOORS Next Generation, these challenges are avoided. You can record relationships as you see them and use rich "hover" capabilities to view details about the related information from your current document without having the need to navigate away.

The relationships are traversable, which enables teams to quickly navigate from one document to another. Views that display related information in columns can highlight gaps whereby user requirements were dropped or are not related to lower level requirements or final product. They can help identify scope creep, whereby functionality that does not align with the project goals or business needs is added to the work, using up valuable time. Because you can see the requirements and multiple levels of relationships graphically, you can more easily and quickly assess the impact of change. And, when required, you can demonstrate what is needed during an audit without having to search for multiple documents and team members.

Traceability in Rational DOORS Next Generation on cloud is dynamic. As soon as someone makes a change, the update is visible wherever the information is used. For example, if a downstream requirement changes, it automatically shows up in traceability columns for the upstream requirements. Users have access to an up-to-date traceability matrix whenever it is needed and can also see what impact the change has.

Benefit 4: Understanding change

The period in a project after the initial requirements have been written and agreed on is always difficult. Though all parties start out happy as they begin work on the initial set of requirements, inevitably, changes occur. Customers change their minds. A supplier is unable to meet an original target for cost or performance. An engineer finds that what was planned is not possible. Or, more simply, a requirement already acted on is changed.

Managing changes as effectively as possible is imperative. A change has two main steps:
- Understanding the impact of the change before it is made
- Ensuring that all impacted areas have been changed as necessary

With Rational DOORS Next Generation on cloud, the ability to create, maintain and show traceability helps make impact analysis relatively easy. Users can graphically explore the complex mesh of information they can use to understand the impact of change that spans multiple levels and even domains. This information is not static. It is updated as soon as it is changed. So, if a downstream requirement changes, it automatically shows up so users can see what impact the change might have.

With Rational DOORS Next Generation, a full history is maintained every time a requirement changes. The team can access the history and determine what changed, who changed it and when it changed. Rational DOORS Next Generation on cloud also takes advantage of the relationships between information.

Suspicion profiles alert users of a change, so they can review and act accordingly. After they assess the change, they clear the suspicion. If they make another change, a new suspicion is raised. With a minimum of effort, changes propagate down the levels of linked information in the project.

Rational DOORS Next Generation on cloud helps your whole team assess the impact of change before it happens, create a strategy for change and act on a required change.
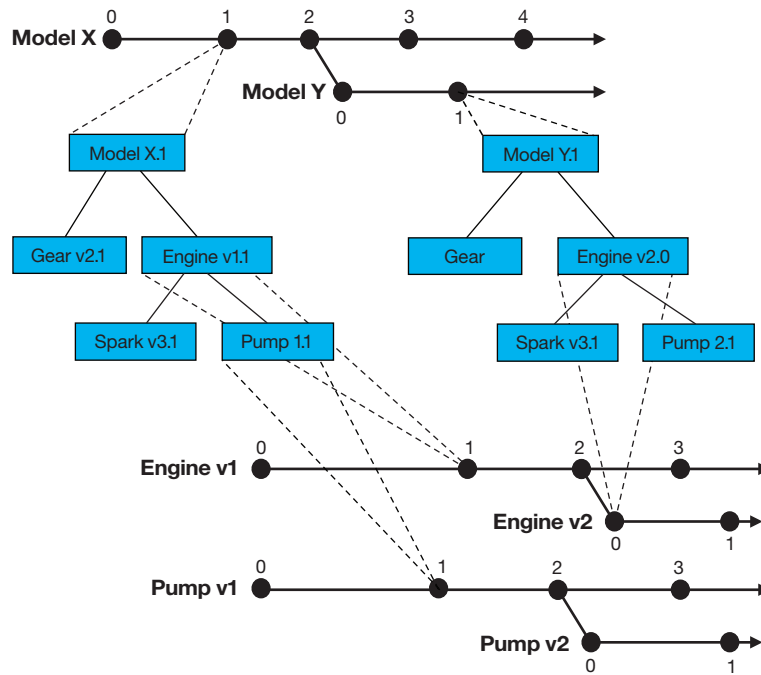
Benefit 5: Requirements re-use

Due to the complex and challenging nature of the Internet of Things, companies that are building and engineering things are also thinking about how to create higher levels of re-use. Products are becoming too complex to build in a one-off manner for every market. Hence companies are building products as platforms with variations better suited for each market. For some time, Rational DOORS Next Generation on cloud has supported requirements re-use by enabling the same requirement to be used in multiple places. Effectively, each instance refers to the "master" copy, so changes to one are propagated to all instances.

To help reduce the chance of error during re-use, Rational DOORS Next Generation v6 also introduces a sophisticated configuration management mechanism that supports a number of necessary functions, including the ability to:

– Create a group of things at particular versions (a configuration)
– Create baselines to identify the state at some point in time
– Control whether the things in the configuration can be modified or not (stream/workspace and baseline/snapshot)
– Branch from stream or baseline to make isolated changes

Re-use through a component version hierarchy

Applying configuration management allows you to create versions and variants of a product (or a system or subsystem) while maintaining relationships between the original and its versions and variants.

You can also use change and configuration management for speculative work. If you hear of an idea, don't disregard it because of where you are in a project. Rather than ignore change, embrace it and use configuration management practices to record the idea in the context of its state in a way that does not distract from current work. Then use change management to consider the idea at the appropriate time.

This enables you to work in product lines via (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 having their own baselines, development teams and schedules. Each component is a collection of artifacts that are configured and baselined separately. The hierarchy implies dependencies of the respective component baselines.

Practitioners need to use configuration management without being distracted by it. They need to do their job with existing tools, without a lengthy learning curve to understand new systems and without the need for an entirely new tool to apply configuration management practices to existing programs. Rational DOORS Next Generation on cloud provides capabilities to guide engineers in working in parallel with each other, either for multiple versions or variants. It enables them to associate versions in one discipline to versions in another in a "global configuration." Engineers can then understand the changes being made and apply the same changes to multiple versions or variants.

With the configuration management feature of Rational DOORS Next Generation, the practitioner's use of the solution remains the same, helping avoid complexity as much as possible. The project manager has the ability to monitor change over what could be complex data and deliver changes from one version to the next. The project administrator can configure a configuration management strategy that is not limited to just requirements data.

Benefit 6: Making your data work for you

With Rational DOORS Next Generation on cloud, you spend time working on your project, while the tool makes data work for you.

You can add attributes to individual statements without changing the original structure. You can filter and sort information based on the supporting characteristics. And because Rational DOORS Next Generation on cloud automatically maintains cross references and relationships between information, you don't have to. The tool also tracks change and alerts your team members of change that they might need to act on.

The tool's ease of use and flexibility are significant benefits because different users need to look at data in different ways. For example, your customer might want requirements structured as a document to simplify the review process. However, the finance team might want attributes in a table layout so they can estimate how much each requirement might cost.

Best practices for writing clear, unambiguous requirements that can be verified can help alleviate project complexity. To avoid ambiguities caused by misused and overused terms, many projects now include glossaries. With Rational DOORS Next Generation, the glossary is available from within all documents. You can search or update terms and even update the glossary from documents.

The IBM solution is highly integrated, facilitating greater collaboration. "Because we chose IBM, we gained an end-to-end solution on one integrated platform that meets all of our needs. IBM's experts made special adaptations to the products, which was a big differentiator for us."

—Haldun Aydogdu, Deputy General Manager and Project Officer, Anadolu Hayat Emeklilik

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Case study: Major health insurer cuts defects rate by 10 percent using DOORS NG on cloud

Overview

As the largest health insurer in its state, the insurer provides coverage for approximately 3.5 million people. To serve this large customer base effectively while complying with government regulations, the company employs hundreds of business analysts, project managers and IS specialists.

Business need

Requirements formulation is a key step in ensuring the satisfactory and timely completion of projects. The insurer needed to improve the consistency, quality, and management of those requirements.

Solution

The company implemented IBM Rational DOORS Next Generation to create a consistent way for all business analysts and stakeholders to formulate and access clearly understandable project requirements.

Benefits

In addition to cutting its project defect rate by more than 10 percent and reducing time to market, the insurer can demonstrate to senior management the value of its entire project portfolio.

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Conclusion

The Internet of Things represents an immense opportunity for businesses, but it also increases the challenge for development of products due to increased complexity, interdependencies and the need to work quickly. Requirements management serves as an essential practice and framework for product lifecycle management. With effective requirements management you can save time and money by controlling your project scope and staying on track to meet dynamic market and business needs, driving better insights for product development with traceability across the product lifecycle and improved collaboration among teams to achieve shorter development cycles and higher-quality products. Requirements management enables you to better manage the product development lifecycle to develop the instrumented, interconnected and intelligent products that the Internet of Things demands.

Others in your industry aren't waiting. IBM is delivering the requirements management capabilities for the Internet of Things today, helping customers reduce development costs, accelerate time to market, reduce the cost of quality and meet revenue objectives. Working with IBM, you can improve your requirements management processes with targeted solutions that are right for your business.

For more information

To learn more about the leading requirements management tool, IBM Rational DOORS Next Generation on cloud, and to take a free 60-day web-based trial, please contact your IBM representative or IBM Business Partner, or visit: ibm.co/doorsng

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