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Requirements engineering for mobile telecommunications technology development.

Improving development processes using IBM Rational DOORS software

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Requirements engineering and its role in mobile telecommunications technology development

Even the best screenplay can turn into a box office failure if the actors don't work well together. While each cast member must learn and deliver his or her own lines, he or she must also understand how the roles interact with one another. To tell the whole story well, actors must collaborate.

Likewise, successful product development depends greatly on collaboration between the many individuals and teams involved, including systems engineers, software engineers, electronic engineers and the engineering director. For example, because time to market is so critical in the telecommunications industry, technology developers—for radio communications networks or other components in complex mobile systems—must be on the same page. To stay on track, they can use the project's "script," or requirements, as the thread that connects all project teams and stakeholders—including customers and business partners—together with common objectives. Ultimately, requirements define the product that satisfies a customer need or marketplace demand, so they must always be synchronized with those needs and demands.

Requirements engineering is a vital process that helps companies manage complex requirements, improve team collaboration and ultimately produce high-quality products more cost-effectively. This white paper explores requirements engineering and how it affects product development and engineering in the industrial segment. It also discusses the best practices and benefits of requirements engineering, how they can be achieved through solutions from IBM, and how they can help technology manufacturers within the telecommunications industry overcome today's quality and cost challenges. Case studies illustrate how leading network technology manufacturers have improved communication and collaboration through the requirements engineering process using IBM Rational® DOORS® requirements management software, resulting in increased productivity, time and cost savings, and a higher-quality end product.

Highlights

Staying connected through mobile telecommunications devices is an expectation of both businesses and individuals around the globe.

Mobile technology developers must focus on new ways to create complex systems faster, more cost-effectively and at a higher level of quality than ever before.

Meeting challenges in the telecommunications industry

Staying connected through mobile telecommunications devices—from anywhere, anytime—is no longer a luxury. It is now an expectation of both businesses and individuals around the globe. Even the newly elected president of the United States fought to keep his personal BlackBerry phone, becoming the first "wired" president in the White House.

In addition to this demand for connectedness, global customers expect far more than just a cell phone when they shop for a mobile device. Today's phones double as MP3 players and offer e-mail capabilities, Web browsers and various productivity applications. Connectivity has converged with entertainment and productivity, and the companies with the most feature-rich telecommunications network and smart devices will stay ahead of the competition. But only if they are first to market and only if their devices are reliable and have the features customers want.

As a result, developers of mobile telecommunications products and the network technologies that support them must focus on new ways to develop these complex systems faster, more cost-effectively and at a higher level of quality than ever before. They must be able to reuse software and components across different phone models for multiple network customers. Most important, they must clearly understand what they are building throughout the development lifecycle; in other words, they must fulfill all stakeholder requirements. Therefore, network technology developers must take a requirements-driven approach to product development and engineering in order to be successful.

Requirements engineering can help overcome the following challenges in developing technology within the telecommunications industry.

Highlights

Developers can leverage requirements engineering to achieve cost-effective innovation, to improve collaboration with network technology providers and to meet increased demand for complex technology convergence.

Cost-effective innovation

Telecommunications networks need innovative products to win marketshare. But to improve profit margins, they need to differentiate their brands and enhance performance while at the same time accelerating lifecycles, reducing costs, assuring quality and delivering product excellence. As a result, network technology developers are challenged to be proactive in adopting emerging technologies while still developing enhancements for present-generation systems.

Better collaboration with telecommunications networks

Reducing development costs and managing complexity require close partnership and integration between network technology providers and the telecommunications enterprises they serve. That means making some fundamental changes in the way they do business. They need to align design and product development with rapidly changing customer requirements while increasing product quality and reducing time to market and cost. Most of all, they must capture the requirements of their network customers—quickly, reliably and in a collaborative environment.

Increased demand for complex convergence

Mobile device makers have taken the phone far beyond "hello." Today's devices place music collections, cameras, photos, games and the Internet in a user's pocket. And the demand for new functionality keeps growing, especially in the area of mobile Internet. Overall, the market for mobile Internet services is estimated to reach US$80 billion by 2011.*

Highlights

A requirements-driven approach to product development and engineering can help mobile device makers and network technologists develop models more cost-effectively, faster and at a higher quality.

Mobile device and network manufacturers must be prepared to leverage their strengths to attain a competitive advantage in this area. But without comprehensive requirements management throughout the lifecycle of complex software and systems development, these companies may struggle to achieve success.

How can telecommunications equipment manufacturers manage the above challenges? A first step is to eliminate poor requirements practices and adopt a requirements engineering process for product development.

Defining requirements engineering

Requirements engineering—in terms of systems and software engineering—defines, manages and systematically tests requirements for a system. It does so in three stages: needs analysis, requirements analysis and requirements specifications.

Requirements engineering occurs in two stages: requirements definition and requirements management.

Although this definition of requirements engineering is more than a decade old, a standard process has only recently evolved with the availability of integrated suites of automated lifecycle development tools featuring requirements management solutions. In basic terms, requirements engineering helps product development organizations understand what they intend to build in two stages. The first stage is to define requirements up front. The second stage is to manage them by having clear visibility throughout the product lifecycle.

Highlights

The first stage of requirements engineering—requirements definition—consists of four parts: discovery, analysis, specification and verification. The second stage, requirements management, simplifies and enhances communication and collaboration among all teams and stakeholders, resulting in better requirements management throughout the organization. This stage enables engineers to:

- *Evaluate the effect of proposed changes.*
- *Trace individual requirements to downstream work products.*
- *Track requirements status during development.*

As a result, they can monitor project status by knowing what percentage of the allocated requirements have been:

- *Implemented and verified.*
- *Just implemented.*
- *Not yet fully implemented.*

Requirements engineering creates a dynamic process that flows from ideas to implementation, testing and maintenance, providing a vital connection between developers and stakeholders.

The requirements definition and requirements management stages make up a dynamic process that flows from ideas, requirements and feature definitions to product and system specifications and models to mechanical, electric/electronic and embedded software implementations to testing and maintenance. All the while, requirements connect the global engineering teams—systems, software, electrical/electronic and mechanical—and keep them more keenly focused on common objectives. Furthermore, requirements provide a vital connection between the engineering teams and other peripheral stakeholders, including suppliers, customers and internal legal and quality assurance teams.

By using a requirements engineering framework and a supporting tool for requirements management and traceability, engineers can thoughtfully tailor development practices to suit the project type, constraints and organizational culture.

Highlights

Rational DOORS can help global mobile device makers keep track of the interlinked and dependent parts of their embedded software.

Because Rational DOORS automates the management and control of requirements, technology development organizations can increase engineer productivity and reduce time to market.

Requirements engineering for developers of telecommunications technology

The embedded software that powers the complex features in today's mobile devices has many interlinked and dependent parts. And developers must understand how all of the different parts work together. To do that, they must be able to *see* all of the connections, even those that may not be obvious. Otherwise, the end result could be a product failure. As the demand for convergence technologies in this industry increases, these systems and components will become even more complex. Therefore, engineering teams must work as a cohesive unit to capture customer requirements, manage changes and reuse components so that they can respond faster to customer demands. Rational DOORS can help with this and other challenges common to today's telecommunications industry.

Manage complexity for faster time to market

Requirements engineering for developing telecommunications technology using Rational DOORS can help you:

- *Deconstruct initial user requirements into detailed requirements.*
- *Link requirements and design to check whether requirements are satisfied by the design.*
- *Trace dependencies between requirements and changes.*
- *Analyze the impact of requirements changes.*

As a result, Rational DOORS can enable engineering teams to have greater control over management and analysis of the hundreds of thousands of requirements for telecommunications products. By using this automated requirements management tool as the cornerstone of the requirements engineering environment, you can reduce time to market and increase productivity through standardized processes.

Highlights

The Rational DOORS central repository allows geographically dispersed teams to share requirements information, helping to ensure that specifications are correct throughout the project.

Using the traceability functionality of Rational DOORS, engineers can trace a large volume of features back to the requirements and reuse them for common components across multiple product lines and models. The teams gain productivity while the company saves money and accelerates delivery of customer-driven features. Most important, management can stay within the scope and timeframes of increasingly complex projects through impact analysis and change management.

In addition, because requirements are shared in the Rational DOORS central repository, geographically dispersed teams can more easily share information, collaborate more effectively and spend less time tracking changes. As a result, teams can better ensure that specifications are correct at the beginning of the project because they are working and gathering information from the same—and the right—documents.

To help ensure the quality of your software, Rational DOORS allows you to test each requirement to validate its performance.

Build high-quality systems

Software quality is vital to the performance of mobile devices. Using Rational DOORS as the foundation of your requirements engineering approach, you can test each requirement to validate its performance. Teams can also integrate requirements and validate them against models created with IBM or third-party modeling tools to make it easier to find gaps between requirements and the models. By doing so, systems engineers can provide high-quality, innovative products that truly meet customers' needs.

Rational DOORS: success stories in the telecommunications industry

Many global telecommunications companies and their business partners have adopted requirements engineering, supported by IBM solutions, to successfully and cost-effectively increase team productivity and accelerate the delivery of higher-quality products.

Highlights

A global communications network provider is realizing a faster time to market by using Rational DOORS to manage requirements in a single repository and reuse requirements across projects.

Rational DOORS helps a telecommunications provider in Asia collect, link, trace, analyze and manage requirements, helping to improve product quality through enhanced oversight.

Telecommunications manufacturer improves development cycle time

One of the first benefits of requirements engineering that many Rational DOORS clients achieve is the ability to deliver products to market faster. The mobility business unit of a global communications network provider improved its development cycle time by formalizing its requirements definition process during the systems engineering process.

The business unit needs to support its manufacturing business partners around the globe 24x7. Rational DOORS helps the unit's management gather requirements from disparate geographic marketplaces and make them available to all of the manufacturing groups through a single repository. By streamlining processes and reusing requirements, the development team can facilitate high-quality products and reduce delivery time, resulting in a competitive advantage.

Telecommunications provider in Asia improved competitive advantage

Requirements engineering also supports corporate initiatives and goals for gaining a competitive advantage as a result of producing higher-quality, requirements-driven products on time and on budget. A flagship, end-to-end telecommunications provider in Asia uses Rational DOORS as its enterprise-wide requirements management and analysis solution. As a result, divisions throughout the corporation can collaborate more effectively because Rational DOORS helps them collect, link, trace, analyze and manage requirements better. Moreover, the telecommunications company reduces development costs by catching defects earlier in the lifecycle when they are less expensive to fix.

Highlights

Using Rational DOORS, these companies and many others manage and trace thousands of requirements within complex projects designed to build the convergence-driven connectivity devices that customers demand. The requirements management software helps them improve visibility of requirements throughout the engineering lifecycle. And the traceability capabilities of Rational DOORS help teams ensure that critical features are not missed.

The standardized requirements engineering processes in Rational DOORS help development organizations communicate and collaborate more easily.

Conclusion

Efficient and cost-effective product development is key to success in today's global development environments. A requirements engineering approach can help product development organizations work in harmony as they communicate and collaborate through standardized processes for requirements management.

Today's best-in-class companies will engineer requirements from the beginning of the product and system lifecycle, through every phase of development, and across all disciplines. Better management of requirements complexity is the foundation of requirements engineering. Ensuring traceability across all levels of requirements is probably the only way that engineering teams can effectively and confidently reuse requirements across multiple lines and models.

When requirements are traced and managed across teams and the development lifecycle, enormous amounts of rework can be avoided.

When integrated with testing and validation activities, requirements traceability can drive cost savings and faster time to market because engineering teams can discover discrepancies and missed requirements earlier in the development lifecycle. As a result, rework and its attendant costs can be avoided, and it's more likely that the end products will meet customer needs, which can boost profitability.

Highlights

Requirements engineering helps ensure that the product you produce is the product you intended.

Finally, requirements engineering helps organizations enhance collaboration among globally distributed teams and suppliers. This means that virtually all stakeholders can be involved in the requirements management process and be confident that everything they do is aimed at fulfilling customer requirements.

The requirements engineering best practices of complexity management, requirements traceability and collaboration can help you reduce time to market, cut costs, deliver higher-quality products, improve customer satisfaction, simplify regulatory compliance and achieve a greater competitive advantage.

For more information

To learn more about IBM Rational DOORS software, contact your IBM representative or IBM Business Partner, or visit:

ibm.com/software/rational

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* *Go mobile, grow…Should mobile Internet services be the next big growth gamble for mobile device makers?* IBM Institute of Business Value, http://www-935.ibm.com/services/us/index.wss/ibvstudy/gbs/a1029693?cntxt=a1000050, May 2008.

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