Reducing risk through requirements-driven quality management: an end-to-end approach

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Sixty percent of IT organizations that use an automated software quality system use HP Quality Center software.¹

Meeting the contract

When IT undertakes a development project, it signs—figuratively or literally—a contract with the business. The contract spells out what requirements will be fulfilled and when they will be delivered. Further, IT commits to a level of quality in the product that facilitates its success when deployed. No attorney would permit a client to sign a legal contract unless all the risks were known, yet IT departments often lack the ability to quantify and respond to the risks that arise during development and test. Requirements management—as part of a comprehensive software quality management system—helps IT quantify the risks associated with each requirement and make informed decisions about resource allocation and release.

More than sixty percent of IT organizations that use an automated software quality system use HP Quality Center software. HP Quality Center software goes beyond traditional approaches to requirements management by allowing quality managers to reduce risk and optimize the business outcome of the project. This paper shows how it does this by tracing requirements from definition to release and by giving IT and business managers real data to support decisions about contract fulfillment.

The requirements management problem

The dynamics of software quality management are well understood. For example, most people know that the majority of software defects are introduced early in the application lifecycle but found much later. As shown in Figure 1, the National Institute of Standards and Technology (NIST) estimates about 70 percent of software defects are introduced in the requirements phase.² And the later they are found, the more expensive they are to fix. According to one study, the cost to fix a defect after delivery is more than 100 times the cost to fix it in the requirements and design phase. These facts highlight the need for close collaboration with business users, careful, unambiguous requirements definition and management of requirements throughout the application lifecycle.

²NIST 2002 RT Project 7007.011
Managing requirements through definition, development, test, and release is a joint effort between business analysts—who represent the customer’s needs—and software quality managers who shepherd them through the testing and release process. When their name is on the contract, business analysts must:

- Define concise and unambiguous requirements.
- Establish the business value of each requirement.
- Quantify the risk associated with each requirement.
- Understand the dependencies of each requirement.

Software quality managers have critical questions to answer:

- Are the requirements verifiable when implemented?
- Are the requirements realistic, and how will they be implemented and tested?
- Where do I assign testing resources for increased efficiency and reduced risk?
- Is the planned testing for the requirement a good trade-off between the requirement’s business value and its risk?

Even with careful planning, requirements change, and changes ripple through development, test, and release. Changes pose additional questions:

- How does the change affect other requirements?
- What tests are affected by the change?
- What new risks are introduced by the change?
- What is the effect on the release?

Without answers to the questions above, trade-off decisions become risky. Analysts may believe one requirement is more important than another, but they cannot show why. Test planners may decide to reduce the test effort on some requirements, but they cannot quantify the risk of doing so, and they cannot demonstrate that the risk is justified given the business value of the requirement. When functionality must be dropped from a release, no one can demonstrate to the business that the proposed change offers the best business value at the appropriate risk point compared to other alternatives.
An effective requirements management (RM) system must help both business analysts and quality managers meet their commitments with limited resources and in the face of inevitable change. They need a structured way to manage requirements, and they need real data to evaluate alternatives. Just as important, they need a way to engage business users in a meaningful conversation about business value and risk. HP Quality Center software helps them do that.

**Creating complete and verifiable requirements**

One of the most critical roles in requirements management process is the business analyst (BA). The BA acts as a liaison among project stakeholders to gather, analyze, communicate, and validate application requirements.

HP Quality Center helps BAs and other stakeholders achieve their objectives by providing multiple pre-configured requirement types—from technical specifications to use cases—to verify that all levels of requirements are captured and stored in the central repository. You can also configure custom requirements types depending on your organization’s needs and procedures. The information included in the requirement definition can include standard fields such as the requirement name and description, but may also contain custom fields, rich text, and attachments. The more relevant details are included in the requirements definition by the BA, the easier it will be for the rest of the team to align their deliverables with the business requirements.

In addition, custom workflows—triggered by requirement type or even the attributes of an individual requirement—facilitate the collection and inclusion of the needed data and invoke other actions needed to promote consistent and complete requirements definition.

For business analysts who prefer to work in the familiar interface of Microsoft® Word, HP Quality Center offers the rich text editor. Existing requirements can also be imported into HP Quality Center from Microsoft Word, Excel® or a third-party requirements management tool. Having all project requirements information in a central repository is the first step to a centralized, managed RM process.

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**A better approach**

Many software vendors offer requirements management as a silo in a quality management system, but risk-based requirements and quality management are inseparable from the larger process of managing the planning, test and release of a software system. There are four factors that enable requirements and quality management:

- Complete and verifiable requirements
- Traceability between requirements, tests, and defects across the application lifecycle
- Versioning and baselining of multiple requirement types
- Evaluation of a requirement’s business value and risk factors

We will look at how HP Quality Center uses these factors to manage requirements and how that fits into the larger quality management process.
Storing requirements in a central repository with native version control

By storing the requirements in a centralized location and leveraging the native versioning capabilities in HP Quality Center, business analysts, developers, and testers can collaborate and share data without overriding each other's work. Once requirement definitions have been finalized, project teams can create a baseline to capture all project assets and traceable relationships between them. Managing this information in a centralized location allows BAs and other project stakeholders to make informed decisions about when requirements are ready to be moved to the next stage of the lifecycle.

Establishing traceability between requirements

If John Donne had been a business analyst rather than a 17th century poet, he might have said, “No requirement is an island.” Requirements have a natural parent-child relationship because high-level business requirements can be decomposed into lower level functional requirements that, in turn, generate specific test requirements. For example, the business requirement “Generate e-mail confirmation to customer online order” would produce a number of distinct functional requirements (“Verify e-mail address,” “Transmit message,” “Receive returned e-mail message,” etc.), each of which needs to be implemented in a code module and requires testing.

Understanding these relationships is essential to planning and executing adequate test coverage. And when analyzing a proposed change to a requirement, you must know what other requirements may be affected by the change. HP Quality Center software maintains traceability between requirements and provides impact analysis reports that show which requirements—and associated testing assets—will be affected by the change. This helps project teams achieve greater visibility, create centralized change management processes and shorten the project development and testing cycles.

Tracing requirements across the application lifecycle

Traceability between requirements only solves part of the problem. It is also essential to follow individual requirements through the application lifecycle to test, defects, and release. That means testers and quality managers can see what and how much testing is planned for each requirement. They can analyze the status of the testing to see how much has been completed and how many defects have been found (Figure 2). And when defects are found, it lets them see which requirements are affected.
Applying defect history—Boehm and Basili find that historically 80 percent of the defects occur in 20 percent of the modules, and approximately 50 percent of the modules have no defects at all. The challenge for quality managers is to assign testing effort where it is most needed and to reduce effort where it is not. Tracing requirements to module defect history shows which requirements are most likely to experience problems and exactly which tests must be run to cover that critical 20 percent. When quality managers know where test effort is best applied to mitigate deployment risk, they can finally begin to plan for defects rather than just react to them.

Planning for release—No change draws more attention than a change in release date or in the requirements served by a release. HP Quality Center software allows quality managers to allocate entire requirements trees to a release and then to assign individual requirements to cycles within the planned release. Aligning all testing assets—requirements, tests, defects—to releases, cycles, and builds enables the quality assurance organization to monitor and report on progress. Quality managers can see at a glance how much test coverage has been planned for individual requirements, how much has been completed, and how many tests have passed. This is shown in Figure 3. Associating requirements and other test assets to tests, defects and release also lets IT examine the quality of release, cycles over time. Have all critical requirements been validated by testing? Is the defect-fix rate up? Has the defect-found rate shown the marked downturn we want? Release cycles can be compared to each other to see how much test coverage has been completed between cycles or to compare the efficiency of the test effort to internal goals. HP Quality Center software provides the data that IT executives look for in project updates and that quality assurance needs to make smart release decisions.

Reusing and sharing application requirements

Once requirements are created, it would be a waste to not reuse them for another project or application release that has similar objectives. In HP Quality Center, requirements can be stored in a shared library, allowing multiple business units to contribute to and reuse requirements. Once a requirement is created, it can be reused “as is” by another group, for another project or for the next application release, or it can be modified by creating a new version. This functionality not only reduces duplicate work, but also provides effective means for supporting compliance efforts. For example, an organization can mandate that all project teams use specific requirements to facilitate regulatory and process compliance. These requirements are then created by a centralized team, maintained in the shared library and distributed to all project teams.

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Figure 3. Release planning

Test coverage by release cycle.

HP Quality Center software provides the data that IT executives look for in project updates and that quality assurance needs to make smart release decisions.

Managing change—In addition to smart planning, analysts and quality managers must make the right decisions about change. HP Quality Center software helps quality managers see how requirements are affected by planned changes to testing and release. They make better decisions, and they can better justify decisions to business users and executive management.

Risk-based requirements and quality management
We have seen how HP Quality Center software’s end-to-end approach to managing requirements provides the planning data that IT needs. But even more critical is the need to apply that data to reduce risk at deployment. That’s what the contract demands. The need to evaluate and mitigate risk goes beyond traditional requirements management solutions, and it poses additional questions for business analysts and quality assurance managers:

• Is the planned test coverage adequate given the business criticality of the requirement?
• Where can we reduce effort with the least risk?

• What time/resource/risk trade-offs enable the best business outcome?
• How do we communicate risk to business users and set proper expectations?

In quality management terms: **Risk = business impact of failure * probability failure will occur.**

When requirements traceability is combined with the ability to assess and quantify a requirement’s business criticality, functional complexity, and failure probability, we have the basis for true risk-based requirements and quality management. And it is this ability to evaluate and mitigate risk that increases our chance for a successful business outcome to a development project.
Assessing business criticality

Users and business analysts usually have a sense of how important individual requirements are, but these judgments are subjective. They often lack the tools to quantify business criticality, to apply business criticality in trade-off decisions and to justify criticality trade-offs to their management. HP Quality Center software provides analysts a structured and objective approach to assess the business impact of requirements.

A requirement’s business impact usually depends upon several factors. For example:

- How many customers might be affected by a defect?
- Does the module change data or only display it?
- Could a resulting error mean legal liability for the company?
- How often is the feature used?

And there may be other criteria that analysts establish for a particular enterprise or application.

Characterizing each criterion according to its impact, HP Quality Center software calculates a business criticality assessment value, which can be used to compare one requirement to another (Figure 4).

Assessing business criticality is a joint effort between IT and the business. The process of evaluating how failure might impact the business establishes a common vocabulary with business users and creates shared understanding. When business managers ask “Why?”, IT and business users stand shoulder-to-shoulder to answer.
Figure 5. Evaluating the functional complexity of requirements

### Failure probability

When the question is, “What’s the chance it will fail?” however, all eyes are on IT. Probability of failure depends upon the overall maturity of the software system, the extent to which the software is being changed and the defect rate experience with the specific software module. HP Quality Center software provides quality assurance managers a similar quantitative way to evaluate failure probability (Figure 4).

And remember, because requirements are traceable to other requirements, tests, and defects, we have real data to apply to failure probability.

### Functional complexity

Each requirement is unique and in order to achieve total quality we need to verify that the unique dimensions of each requirement is accounted for in every stage of the development lifecycle including testing. This requirement DNA, so to speak, is often referred to as the functional complexity of a requirement and can be assessed according to various factors including: number of process steps, number of windows affected, number of entities involved among others. HP Quality Center software provides business analysts with the ability to define what contributes to the functional complexity of a requirement and allows quality assurance managers to assess the impact this has on the level of testing which needs to occur in order to reduce business risk (Figure 5).
Applying risk factors

We have seen that each requirement is assigned a business criticality factor—A, B, or C—a probability of failure—1, 2 or 3 and a functional complexity score of 1, 2, or 3. Combining these calculations allows us to map the business risk against a ranking of high, medium, and low. This helps in two ways:

Risk comparison—Requirements can be compared based on risk. This is crucial when trade-off decisions must be made—and when they must be explained. When business users are engaged with IT business analysts in calculating business criticality and when IT has a structured, understandable way to analyze probability of failure, then recommendations are based on real data, and trade-off decisions become a team effort.

Test effort optimization—Test plans should allocate the most effort where there is the most risk. Since HP Quality Center software traces requirements to test plans, it can easily analyze the test effort by risk category.

Figure 6 shows this. This data shows quality managers if they are applying test effort in the right places. And it indicates at a glance how possible changes in the test plan impact risk.

A lifecycle quality management platform

Risk-based quality management is possible only when requirements management is an integral part of a lifecycle quality management platform. The ability to analyze the risk and business benefit of each requirement and then trace that requirement right through test, defects, and release gives quality managers the data needed to make smart decisions. HP Quality Center software does just that, and it does it right out of the box. No special integration is required, and because there is a single repository, no data synchronization is ever needed. The results are quicker time to value and lower total cost of ownership.
The HP difference

You have choices when it comes to automated software quality management solutions. When you must meet the contract, why choose HP?

The right solution

• HP Quality Center software offers a lifecycle approach to quality management. You have seen how our lifecycle approach helps optimize the business outcome of development projects. Non-integrated approaches don’t provide the data needed when you are asked the hard questions.

• HP Quality Center software provides the platform and application coverage you need.

• HP Quality Center software supports a quality methodology model in your organization. Using it, you can implement best practices and repeatable processes designed to save time and cost compared to traditional approaches.

• HP Quality Center software is an industry leader. IDC says 60 percent of IT shops using an automated software quality solution use HP Quality Center software. And some of the biggest development shops in the world—including SAP—use it.

• HP Quality Center software accelerates time to value. When a solution provides the functionality we have described—and does it right out of the box—you get going quicker and with less implementation cost.

The right services

HP provides quality software services that address your needs across the application lifecycle. Global service and support—from online self-solve support to proactive mission-critical services—enable you to choose the services that best match your business needs.

A complete solution

Training—HP provides a comprehensive curriculum of HP Software and IT Service Management training courses. These offerings provide the training you need to realize the full potential of your HP solutions.

Managed services—if you want help operating your HP solutions, HP offers managed services to bring the value you want quickly.

Finance services—HP Financial Services provides innovative financing and financial asset management programs to help you cost-effectively acquire, manage and ultimately retire your HP solutions.
Learn more.

If your business wants your signature on a quality contract, find out more about HP Quality Center software today.

To learn more about software quality management, order our book.

Optimize Quality for Business Outcomes by Andreas Golze, Mark Sarbiewski and Alain Zaim, paperback: 271 pages, language: English


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To access technical interactive support, visit Software Support Online at [www.hp.com/managementsoftware/services](http://www.hp.com/managementsoftware/services).

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