

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

White paper

Contents

- Meeting the contract2
- The requirements management problem2
- A better approach4
 - Complete and verifiable requirements4
 - Traceability between requirements5
 - Traceability across the application lifecycle5
 - Applying risk factors9
 - A lifecycle quality management platform9
- The HP difference10
 - The right solution10
 - The right services10
 - A complete solution10
- Learn more11



More than 60 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 assures 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.

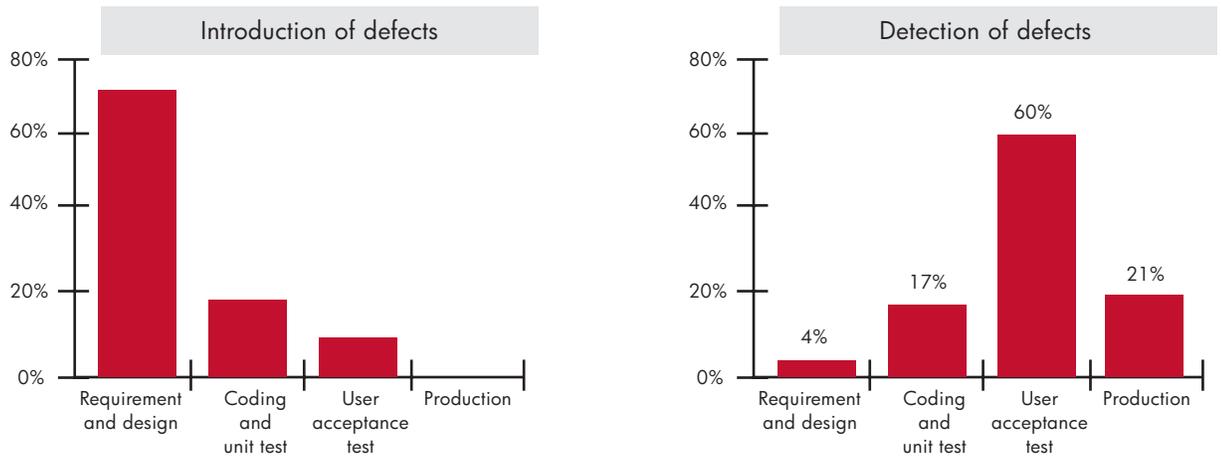


More than 60 percent of IT organizations that use an automated software quality system use HP Quality Center software. HP Quality Center software goes beyond traditional approaches to requirements management by allowing quality managers to reduce risk and optimize the business outcome of the project. 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.

Figure 1: NIST software quality study results



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.

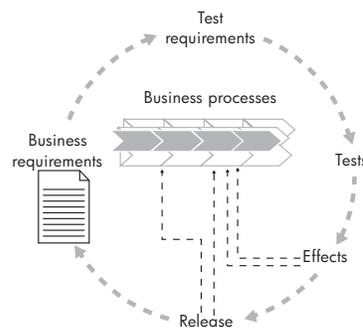
Software quality managers have critical questions to answer:

- 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 release?

Without answers to the questions above, trade-off decisions become a crapshoot. 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.



HP Quality Center software maintains traceability between requirements and provides other features to make traceability a useful tool for the analyst or quality manager.

An effective requirements management 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.

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 three factors that enable requirements and quality management:

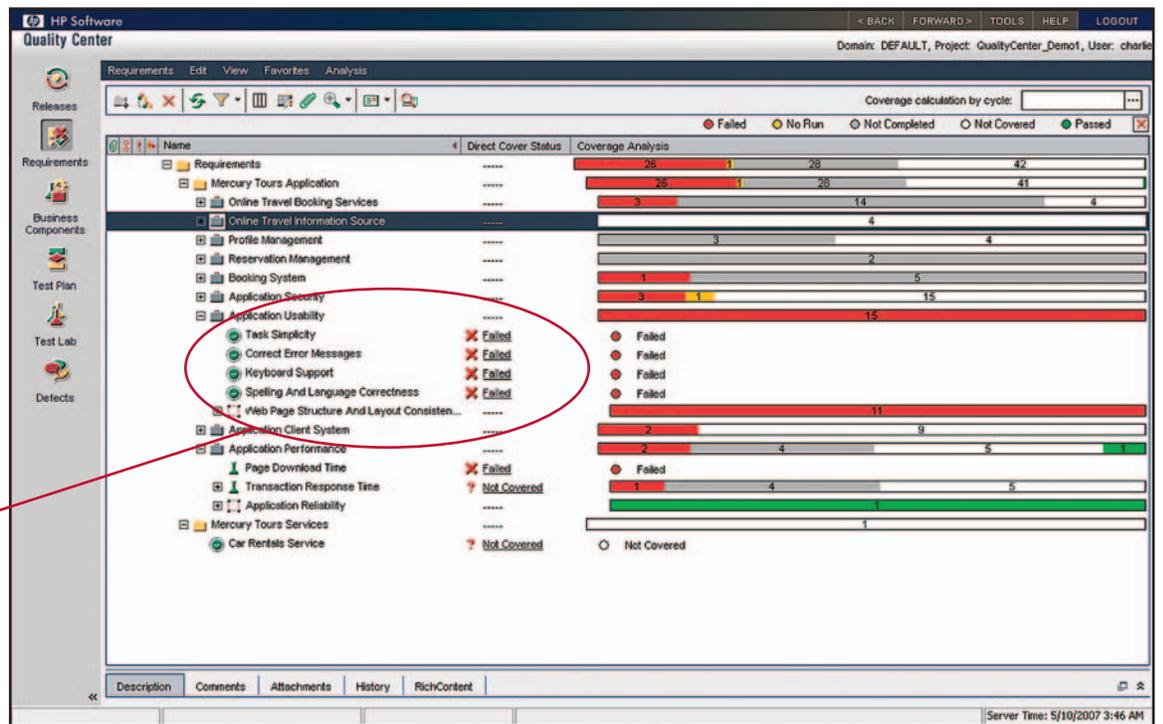
- Complete and verifiable requirements
- Traceability of requirements across the application lifecycle
- Evaluation of a requirement's business value and risk factors

We will look at how HP Quality Center uses these factors to manage requirements and how that fits into the larger quality management process.

Complete and verifiable requirements

The first challenge for business analysts and quality managers is to create requirements that are complete, clear and verifiable. HP Quality Center software lets IT determine what information must be included in any requirement. 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. Since users interact with the software through everyday interfaces like web browsers and Microsoft® Office Word, requirements can be routed to other analysts and even business users for review, verification or even updating.

Figure 2: Tracing requirements to test and defects



Test status by requirement

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—or test procedure—you must know what other requirements may be affected by the change. HP Quality Center software maintains traceability between requirements and provides other features to make traceability a useful tool for the analyst or quality manager. For example:

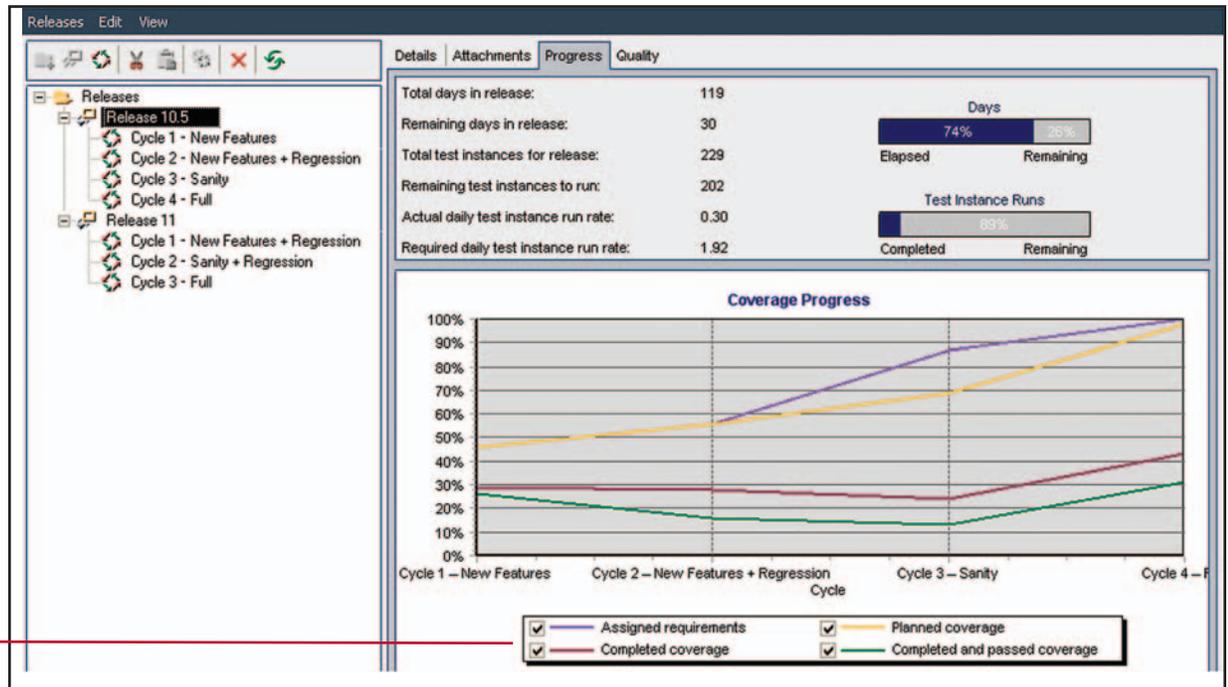
- Users can define multiple types of requirements and maintain relationships between them.

- Requirement types can be customized for each project.
- Trace-to and trace-from views display the parent/child relationship between requirements.
- Requirements can be organized into folders for easier navigation.
- Requirements can be imported from Microsoft® Word, or users can work directly in Microsoft Word within HP Quality Center software.
- Stakeholders are automatically informed via e-mail or requirements traceability alerts when a requirement changes.
- Audit trail tracks which values are changed and when.

Traceability 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.

Figure 3: Planning for release



Test coverage by release cycle

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.³ 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 that 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.

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Managing change—In addition to smart planning, analysts and quality managers must make 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:

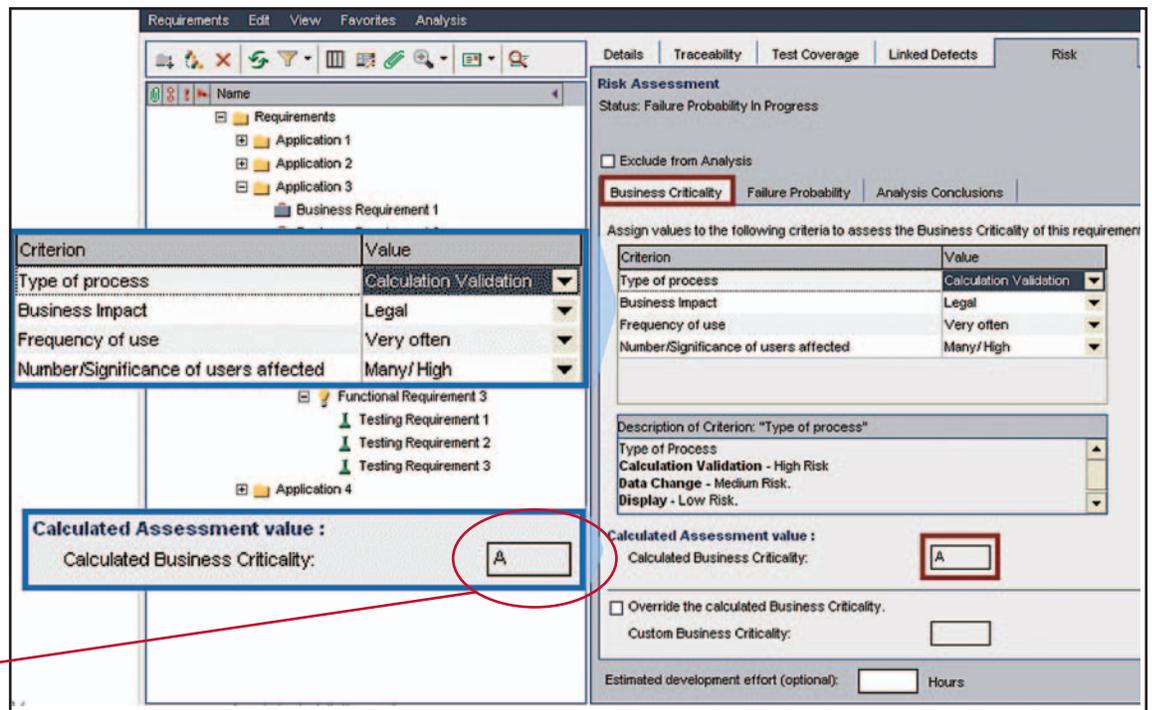
Risk = business impact of failure * probability failure will occur.

When requirements traceability is combined with the ability to assess and quantify a requirement's business criticality 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.

Figure 4: Evaluating a requirement's business criticality



Calculated business criticality

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.

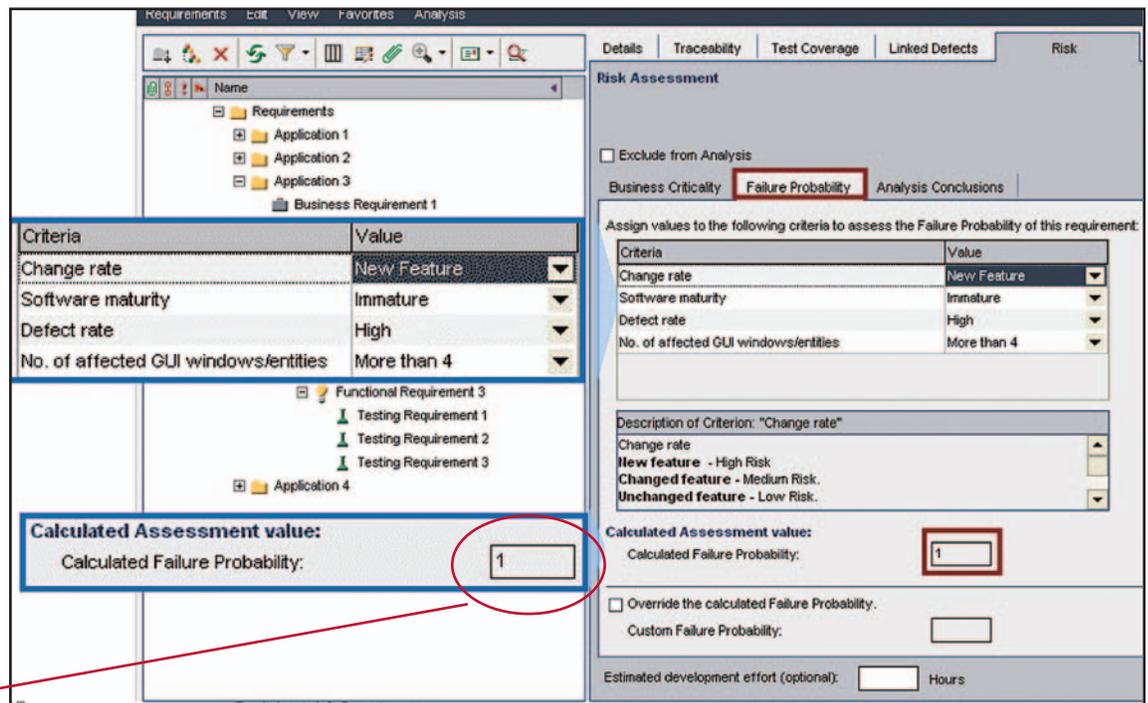
Characterizing each criterion according to its impact, HP Quality Center software calculates a business criticality assessment value which can be used to compare one requirement to another (Figure 4).

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.

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

Figure 5: Assessing a requirement's failure probability



Calculated failure probability

Applying risk factors

We have seen that each requirement is assigned a business criticality factor—A, B or C—and a probability of failure—1, 2 or 3. Thus, each requirement maps into a risk category such as A1, A3 or B2. 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.

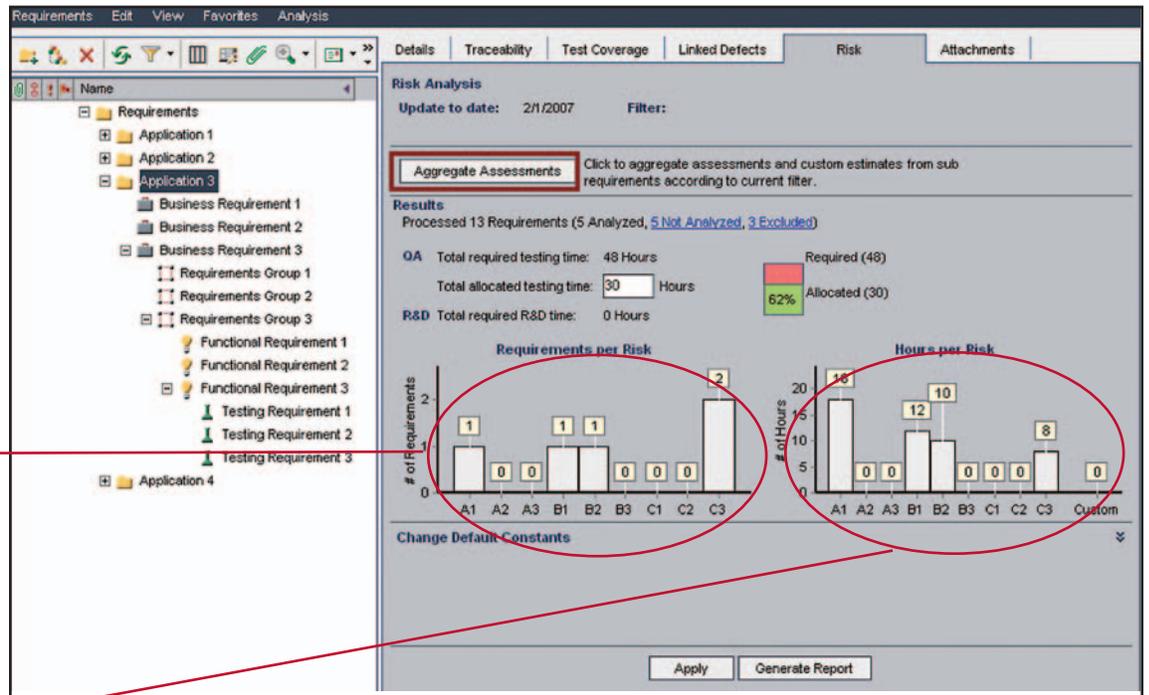
Test effort optimization—Test plans should allocate the most effort where there is the most risk. Since HP Quality Center software traces requirements to test plans, it can easily analyze the test effort by risk category.

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.

Figure 6: Planning test effort by requirement risk category



Requirements per risk category

Test hours per risk category

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. Piecemeal 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 the industry leader. IDC says 61 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-serve 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

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

Optimize Quality for Business Outcomes by Andreas Golze, Charlie Li and Shel Prince, paperback: 210 pages, language: English

Order: www.merc-training.com/main/us

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¹IDC, Worldwide Distributed Automated Software Quality Tools 2006–2010 Forecast

²NIST 2002 RTI Project 7007.011

³B. Boehm and V. Basili, "Software Defect Reduction Top 10 List," IEEE Computer, IEEE Computer Society, Vol. 34, No. 1, January 2001, pp. 135–137.

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