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Adopting a Lifecycle Approach to Software Quality Management

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Introduction

Hurwitz & Associates sees a major transition in the way organizations are approaching software quality management. These organizations are adopting new approaches such as Service Oriented Architecture (SOA) as a way to create agile reusable business services that are intended to help them respond to rapid changes and business opportunities. Managers of these organizations have come to the realization that their SOA strategy is only as good as the quality of their software. With this realization, forward thinking IT management is mandating a new approach to managing software quality. They are moving their development organizations away from narrowly-focused, traditional testing methods to a lifecycle approach to managing software quality.

In the past, quality management typically meant testing software code. This testing usually occurred at the end of the software development cycle, after many of the important decisions about requirements definition; reliability, usability, and cost were made without any input from the "testers." The software development process has also been hampered by conflicting goals and insufficient communication between software development and quality teams. Software developers are tasked with creating software assets on time and on budget. Managers responsible for software quality struggle for their voices to be heard and are seen as delaying the time-to-market for the resulting product. These conflicts can lead to missed opportunities to control quality at various stages - including requirements, architecture, code development, testing, and delivery - of the software development process. This lack of a consistent, predictable, and repeatable approach to software quality management throughout the software development lifecycle often results in projects that are destined to run over budget, miss deadlines, and fall short of customer expectations.

This paper will consider how companies are working to overcome these obstacles to achieving consistent quality in the software delivery process. Hurwitz & Associates reviewed the IBM Rational Quality Management solution and then interviewed nine IBM Rational customers to understand their challenges and priorities for following a lifecycle approach to software quality management. The majority of these companies cited the following factors as very important in their decision to implement the Rational Quality Management solution: improving software quality, improving collaboration, increasing efficiency, and decreasing downtime. Most of these companies realized a significant improvement in test efficiency and reuse and observed a moderate to significant improvement in time-to-market dates after implementing Rational Quality Management solutions. Further implications of a lifecycle approach to quality management and details of the customer survey will be presented.

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Creating a Culture of Quality in the Organization

Moving from a stovepiped approach to testing to a comprehensive strategy for a lifecycle approach to quality management is a journey for most companies. In many situations, the focus has been limited to correcting software development problems instead of a more comprehensive focus on overall business outcomes. Companies are now beginning to ask: What are the business imperatives supporting this software development project? Are we leveraging our software assets in the most effective and productive manner? Does our approach to software development make our business goals easier to achieve?

Consider, for example, the situation of a typical insurance company that wanted to improve customer intimacy by creating a new customer service portal. This high priority project was mandated by the CEO, and, given the competitive environment, the development timeframe was very tight. The CEO was a firm believer in quality management across the entire company, and understood that quality applied to IT projects as well as to the company's product offerings. In keeping with the corporate directive, the new Chief Quality Officer had recently established guidelines for a lifecycle approach to software quality management. While he specified a series of changes to the quality management process that would be phased in over time, he hoped that certain process improvements made in the first phase would allow the company to bring a very high quality product to market and still meet the deadline.

In previous development projects, the quality management team became involved only towards the end of the project. By including the Quality Management team in the requirements definition phase of this new project, they developed a better understanding of the business goals as well as the functional requirements that would need to be tested. The Quality Management team had previously worked on similar projects and understood the complications that can arise in the testing phase. The team suggested several changes to the architectural approach that helped to improve overall quality and shorten the time to completion. This insurance company found that by linking the various stages of software development and testing, the customer service portal was delivered on time and was more reflective of business objectives. The overall efficiency of the software development process was greatly improved.

Finding the Right Balance between Quality and Time to Market

As one quality manager we interviewed stated, "our company is always struggling to find the balance between getting the job done on time and getting it done with a certain level of quality." Lifecycle quality management is an approach that organizations are

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beginning to implement to help find and maintain this balance. Many companies find the old model of software development, characterized by separate development and testing teams, will not scale. This model often relied on ad hoc collaboration such as walking down the hall or calling a question to the developer in an adjacent "cube". This approach is untenable when companies leverage offshore development teams or have internal teams distributed by region or business units. Clearly, these casual interactions become impractical. Lifecycle quality management means establishing a standardized and repeatable process for managing software quality from requirements definition through to delivery.

In addition to offshore development, there are other IT trends impacting quality management at many companies. The move to Service Oriented Architecture (SOA) may provide a catalyst for change in the culture of Quality Management. One dimension of the services approach that helps businesses to become more flexible is the enhanced opportunity for the reuse of software components in different applications across multiple lines of business.

If these components are not well-tested and trusted, the potential for effective reuse is limited and the business is put at great risk. In fact, when companies begin to combine business services in new ways, there are often vulnerabilities created that could not have been anticipated. Since the software code tested by one team may be componentized and re-used across different business lines, at some point changes may be applied and then tested by a different quality management team. It becomes critical in this situation that the different teams follow a consistent process and leverage an integrated set of tools, consistent with the chosen quality processes, to effectively manage quality. In order to capitalize on opportunities for reuse in any significant way, organizations need a consistent, controlled, and measurable approach to testing.

There is no easy fix to many of the quality challenges that companies face. Creating a software development process that reflects a much stronger focus on the business outcomes requires a major cultural change for IT departments at many companies. Therefore, Hurwitz & Associates recommends that companies follow an incremental path to help them transition from their traditional software quality approach to the lifecycle quality management approach. Companies are likely to begin this transition from different places and with different priorities for quality management.

Companies Face Quality Management Challenges

In our research, Hurwitz & Associates has observed some consistent patterns in the types of business and technical challenges that impact company requirements for

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software quality management. The three examples below are intended to illustrate how these challenges are manifested in three very different business situations. Each of these companies identified the need to transition from a development environment hampered by poorly connected teams using a variety of homegrown and assorted vendors' testing tools to a faster and more effective process characterized by a comprehensive and collaborative approach to quality management. But, the transition to lifecycle quality management is a complex one and requires an incremental approach.

We divide the key priorities in achieving quality lifecycle management into three categories: dynamic collaboration, a corporate standardized approach to quality, and aggressive migration to automating the testing process.

- **Dynamic Collaboration.**   An insurance company recognized that industry dynamics, including an increasing number of mergers and acquisitions, had contributed to dramatic changes in the competitive environment. New features were being added to insurance products more frequently, and customers were expecting a higher level of customer service. In order to sustain its market position, the company needed to provide faster turnaround times and higher data quality to support the information requirements of individual financial advisors. The IT Quality Management team determined it would be better able to respond to these changing business requirements if changes were made to increase the automation of Quality Management workflows. It was expected that improvements in the speed and ease of collaboration between teams would help to increase the quality of future production releases.

  The Manager of the IT Quality Management team knew that there were often delays when different teams worked on the same project. For example, the workflows were slowed when spreadsheet recordings of outputs from one test were passed from one team to another doing follow on tests. By transforming the collaboration process between the performance and development teams with a new Quality Management portal, the company was able to dramatically improve the overall quality of the final product. They implemented testing tools that would help to automate the workflows required for the teams to collaborate and get the job done one time. This new approach also helped the team manager to monitor key Quality Management metrics so that problems in the workflows could be corrected quickly. With the teams collaborating in a more standardized and automatic way, the company had better insight into where the problems might be and where the process might have broken down. Different test versions are now managed in an automated way and distributed teams are able to see each others' test cases.

- **A Standardized Approach to Quality.** A global human resources management company had evolved to a more distributed software production environment.

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Cost pressures forced the company to begin using off-shore development teams for a majority of its internal IT applications. This approach, in combination with a move to a Service Oriented Architecture approach, was intended to control labor costs and increase quality. However, expectations for software quality were not being met. The newly appointed Chief Quality Officer wanted to move to a lifecycle approach to software Quality Management to help the company meet its goal of increasing software quality and SOA-based component reusability. His objective was to move from an environment where each development team had its own specialized and often homegrown testing tools to an environment where standardized tools could be leveraged using a repeatable, consistent, and governed approach. By instituting a project governance process that provided insight into project metrics at each stage from requirements definition through to completion, the Chief Quality Officer was able to keep projects on track and improve software quality.

- **Aggressive Migration to Automated Testing.** A provider of a software development technology platform was experiencing difficulties keeping up with the demands of its partners and customers. The company's solution leverages graphical models to implement flexible business processes based on a Service Oriented Architecture (SOA). While software quality was considered a top priority, the process was addressed through lengthy and costly manual testing cycles. This approach was putting the company at risk because of the changing requirements for software testing in SOA environments. In these environments, it becomes more important to subject the software to testing across a wide range of alternatives – or "what if" scenarios – to add more "negative" testing. By initiating a more comprehensive and automated approach to software testing, the Quality Management team put the company back on track, speeding up the development process and increasing the stability of future releases.

Making Lifecycle Quality Management a Top Priority

It is not uncommon for a development team to get caught up in short term requirements and lose sight of the strategic business objectives. Truly successful software development teams take a holistic business approach to the management of software development. This move to a more structured business process approach for software development will assist companies in making the transition to lifecycle quality management. For example, companies should look at quality management holistically by focusing on all stages of the process from requirements definition on through functional and performance testing, change and configuration management, and defect tracking. Since this is not a small step, management has to be shown that there

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is business value in moving to a quality management lifecycle approach. Three major business impacts of a strong Quality Management program are described below.

- **Speeding up the software delivery process and improving collaboration between distributed teams.** Globalization and increasing numbers of mergers and acquisitions have increased competitive pressures across all industries. Companies place a high priority on getting to market faster. By replacing time-consuming, manual testing processes with automated and standardized tools, overall testing productivity will be enhanced. These tools will often provide developers with standards-based solutions that include a common user interface, common APIs, and common languages. This makes the training process easier, thus team members can easily move from one project team to another without requiring additional training. By standardizing testing tools and the testing process, collaboration among software development and software quality management teams is enhanced. Requirements, test cases, and test results can be more easily shared among teams if they all follow a consistent approach and are part of a seamless and automated quality management infrastructure. For example, when specific test results are documented through use of an automated tool, teams that are distributed by geography or function are able to share information as if they were working in the same location, thus accelerating the software delivery process.

- **Improving the ability to reuse software components.** If developers can reliably and predictably test components, they can be safely used in a SOA environment. Without this effective testing, these components may cause unpredictable problems for the business, resulting in lost productivity and significant quality problems that directly impact customer satisfaction.

- **Improving software product quality while decreasing costs in the testing process.** When there is a consistent approach to software quality that takes the entire lifecycle of an application into account, the cost to test will actually decrease. When you focus more on how the application under development will meet customer needs and less on counting defects in the code, the software quality management team becomes a true partner in the software delivery process. By driving towards higher quality earlier in the lifecycle, the test cycles are shorter and there is less rework of previously developed software components. This holistic approach will help developers and testers to collectively improve time to market and decrease software development costs.

Getting Started with Lifecycle Quality Management

What are some of the ways that organizations are moving towards a lifecycle approach to quality management? The quality management team is typically focused on ensuring

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that their tools have the features needed to automate specific testing functions. A lifecycle approach has larger implications and potential benefits, putting greater focus on the ultimate value that the end product will deliver to the business. Even with a highly competent testing team, the organization will not be able to evolve towards lifecycle quality management if the team has limited understanding of the business goals. By identifying which applications have the highest business value, corrections to the highest priority applications can be given the most attention. In many companies a shift in business culture is required before the quality management team, developers, and line of business manager can begin to share a common language and work together to improve software quality. Some common approaches to getting started on this business culture shift are described below.

Appoint a Chief Quality Officer. The transition to a lifecycle approach requires discipline and structure. It also may require that some experienced testers and developers change some of their methods to be more in line with an approach that optimizes results for the business. Many companies find that the appointment of a Chief Quality Officer is a key factor in the successful implementation of a comprehensive quality of culture across the enterprise. The person in this role will want to identify the different places where quality may breakdown within the organization. It is essential to coordinate all the different teams that have the potential to impact the quality of software development. How should this be accomplished? The Chief Quality Officer can help to establish a lifecycle approach to quality management by creating a governance model that identifies key quality metrics and sets the strategy for software quality across the enterprise. This structured approach will help the organization to find ways to resolve potential quality issues by supporting collaboration across development teams, quality management teams, and line of business management.

Evaluate existing Quality Management process. Before moving forward, a Chief Quality Officer needs to analyze the current quality management environment to identify strengths and weaknesses of the existing process. The quality management function has historically been a manual and time-consuming process. The software tools were often cumbersome, hard to use and hard to learn. Testers followed tried and true manual processes and developed a lot of their own code to move the process along. Because of this, many current IT Quality Management departments have an overabundance of testing tools from different vendors. These tools, along with a proliferation of homegrown tools, have not been designed to work well together. For this reason, many companies need to start by ensuring that they develop a consistent set of tools that work well together.

Educate Testers and Developers. In order to establish a consistent methodology and discipline for software development across the enterprise, the Chief Quality Officer

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needs to ensure that testers and developers are all educated in the new approach. For example, Agile testing methods and continuous integration may be taught to help testers and developers improve coding and incorporate testing earlier in the process. Companies want tools to be easy to use so new users can be efficiently trained and teams can swap responsibilities without significant re-training.

Many of the companies we interviewed were just getting started with a lifecycle quality management approach. All were customers of one or more products from IBM Rational software. The following summarizes the various IBM Quality Management applications deployed by the nine customers.

The IBM Rational Approach to Lifecycle Quality Management

The IBM approach to Quality Management starts with a vision of a continuous, comprehensive, and collaborative system of automated workflows across business processes that is repeatable and tracks quality and project metrics to facilitate immediate corrective action. Customers today have reached varying levels of success in embracing and implementing this vision. The initial focus for IBM Rational customers is automation, which can streamline and eliminate redundancies in Quality Management. When this automation is deployed to enable continuous workflows, the vision of a governed, repeatable process is within reach.

To this effect, the IBM Rational software delivery platform provides customers with an extensive set of tools that introduce quality management at the various stages of software development. The Rational Quality Management suite includes:
- IBM Rational RequisitePro is designed for requirements management.
- IBM Rational ClearCase is used for change and configuration management. It provides version control and parallel development support to improve productivity.
- IBM Rational ClearQuest is used for defect and enhancement tracking, as well as test management, helping customers to improve project visibility and control across different phases of the quality management lifecycle.
- IBM Rational Functional Tester is used for automated functional and regression testing.
- IBM Rational Purify and PurifyPlus are runtime analysis solutions for debugging to help developers to write more reliable and efficient code.
- IBM Rational Manual Tester is a test authoring and execution tool to improve speed, breadth, and reliability of manual testing.
- IBM Rational Performance Tester is used to verify response time and scalability under varying workloads, as well as to perform root-cause analysis of performance bottlenecks.
- IBM Rational Robot is a test automation tool for client-server applications.

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In addition to other tools in the suite, IBM provides process and portfolio management tools and methodologies to facilitate the implementation of a comprehensive, integrated approach to quality management. The IBM Rational Unified Process (RUP) is a framework that provides best practices for software development and project management. The IBM Rational Method Composer allows users to customize RUP to select and integrate the process components needed into each stage of the project.

IBM is continuing to add new capabilities to its Rational offerings with both the enhancement of existing tools and the addition of new products into the suite via acquisition. Recently, in July 2007, IBM acquired Watchfire which provides products that test for – and provide recommendations for guarding against – online security attacks and compliance breaches. IBM has also announced the intent to acquire Telelogic, which offers products that define, model, build, test, deliver, and govern the software used in complex embedded systems.

Results of Customer Benefit Study

In order to understand the current challenges and opportunities in software quality management, Hurwitz & Associates engaged in a detailed interview process with nine customers of the IBM Rational Quality Management product suite. They represented a broad range of industry sectors – including finance and insurance, technology, and federal and state government – in the U.S. and Europe. The purpose of the interviews was to better understand the business drivers that led these customers to seek improvements to their Quality Management process, the challenges they faced, and the benefits that were derived. The respondents were managers and directors in the testing and Quality Management organizations at their companies, and seven of the nine had been using Rational Quality Management tools for at least two years.

The majority of the customers surveyed were users of Functional Tester (RFT), Manual Tester (RMT), ClearCase, ClearQuest, and Requisite Pro. Several customers were users of Rational Robot (for client/server GUI testing) and Rational Performance Tester (RPT), while many of the other tools in the Rational Quality Management suite were being used by one or two of the customers surveyed.

Prior Customer Experiences in Quality Management

One-half of the customers surveyed were using competitors' tools before moving to Rational Quality Management tools. The remainder was split evenly between those using homegrown tools and those without automated tools for software quality management. What factors served as impetus for these customers to seek improvements to their quality management process?

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The need for improved software quality, increased team collaboration, and greater efficiency in the quality process leading to faster time-to-market were cited as key factors. Competition is driving the business side to demand improvements in product performance and quality. "We need to deliver quality data to individual financial advisors faster" noted a banking customer. We "need to be ready for production faster" as several customers reinforced the time-to-market priority. Over 70% of the customers experienced a tangible or intangible business impact in the form of lost revenue and damaged reputation as a result of failing to meet scheduled dates for product go-live.

Improving software quality and team collaboration were the two highest ranked drivers cited by the customers in the survey.

Figure 1 shows the average ratings of the leading drivers for improvement in quality management. Improving software quality and increasing team collaboration were the two highest ranked drivers cited by the customers in the survey.
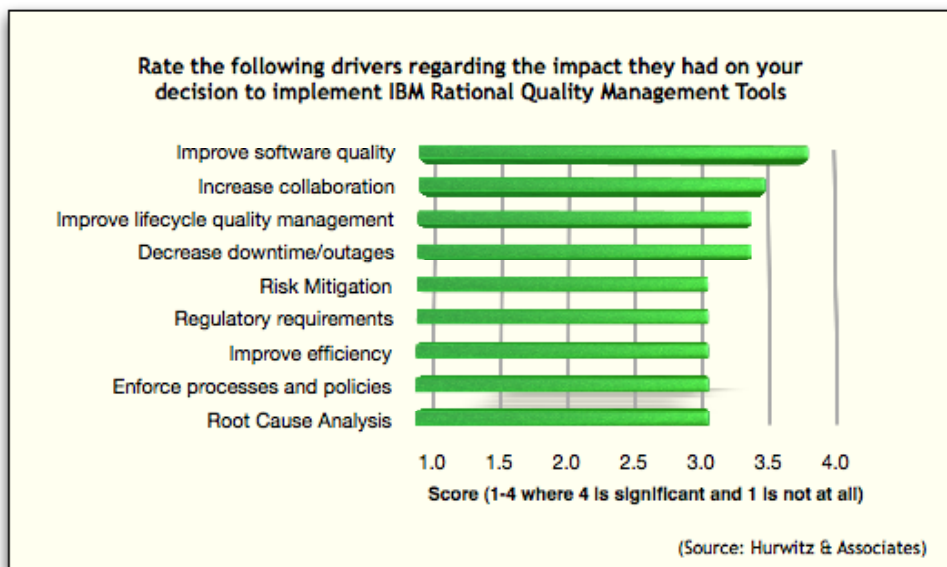

Figure 1: Business Drivers to Improve Quality Management

Organizational Resistance to Change: Gain Incurs Some Pain

The organizations represented in our interviews were dissatisfied with their entrenched approach to quality. The corporate culture clearly required some adjustments, but, despite the need, change rarely comes easily in a large, complex organization. As seems to be the case whenever new technology is introduced, be it improved finance

and accounting, manufacturing systems, or any automated workflow, there were organizational obstacles to changing the culture of quality management.

A large state government agency lacked a global approach to quality, but relied on "bits and pieces" of homegrown tools for version control and had no automated testing in place. After implementing the Rational suite in a phased rollout over a few years, they now have a formal, complete process – a platform for QM. But, along the way, users moved slowly as they clearly had pre-conceived notions, including the perception that the more they automate, they more they would lose control. A consultant with years of experience implementing Rational tools worked closely with the users to educate them. He observed that "they have a solid quality management process in place, but they have yet to realize the full potential of benefits from this process. The integrated, collaborative approach requires a change of perception of software development." This consultant understood the value of an iterative approach, but faced resistance from government users who were stuck in traditional testing methods.

Another customer, a large insurance company, was extremely satisfied with the results of its Rational deployment, but they commented that "it was a challenge implementing the RUP methodology while implementing the tools at the same time." RUP, the Rational Unified Process, is a methodology that includes a set of best practices for software development and project management. The challenges of implementing new business processes within an organization, while new technologies are being learned as well, requires commitment throughout the organization and support from senior management. The company experienced significant benefits from RUP, but noted that "the changed approach required a change in mindset."

A consultant emphasized that, with appropriate training, users adopting new tools and methods can reap great rewards. The Rational tools had "far greater value and broader functionality" than competitors' tools. While the organizational challenges vary from customer to customer, our research indicates that prior experience with the Rational product can be very helpful. Getting past human resistance to change is an important step that can't be ignored.

Automated Testing Leads to Improved Quality

Customers who had used manual testing approaches found an immediate benefit from automated testing. The manager of a software development organization stated that the move to Rational's automated testing tools led to increased quality, shortened test cycles, and lower costs. The tools allowed them to be more responsive to their customers with a faster, more efficient release process. Because the product quality

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improved substantially, the organization was able to reduce the number of maintenance releases from four to two a year. The automation improved test reusability and, perhaps most significantly, allowed testing earlier in the development process, a key theme echoed by many of the customers surveyed.

An insurance company Quality Manager commented that "earlier testing gives you a better chance of catching defects earlier, improving the process going from test to production, and shortening overall project time." They saved 25% of the Quality Management budget "by reducing the number of contractors required prior to go-live." The Manager of Quality and Methods for a business services company recognized that "over the course of one year we are saving three to four weeks of development time and we are also catching more errors." Another customer in financial services believed they had saved "a million dollars per year with Functional Tester (RFT)" over a purely manual testing approach.

The impact of automated tools and a culture of testing "early and often" have a dramatic effect on quality as shown in Figure 2. All four of the impacts averaged 3.0 or higher, led by an increased confidence that problems had been effectively addressed. It is interesting to observe that not one of the customers surveyed chose "not at all" for any of the impact dimensions.

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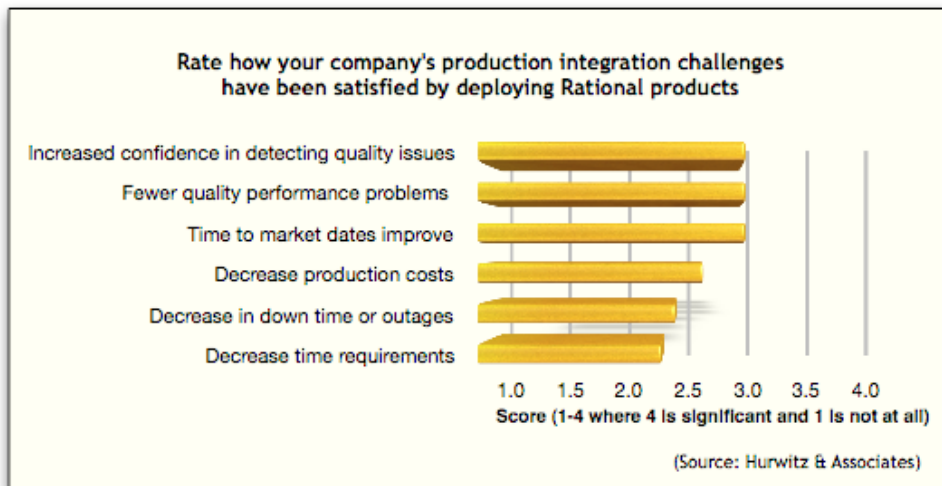

Figure 2: Impact on Software Quality

Customers also cited a series of benefits, specifically tied to the production integration process of preparing software products for release to market. These benefits are shown in Figure 3. The top production integration benefits cited were improved time to market, fewer problems, and increased confidence.
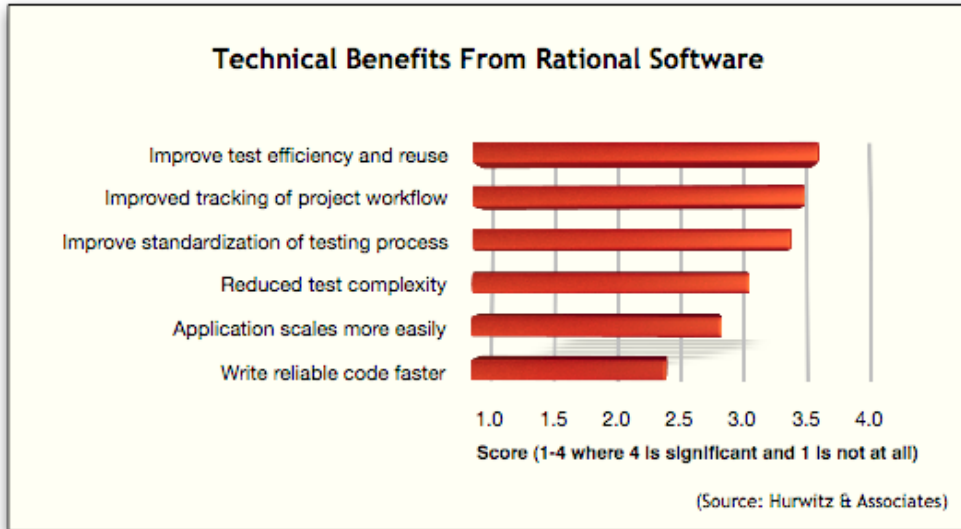
Technical Benefits From Rational Software

Figure 3: Production Integration Improvements

Another dimension of quality management that benefited from the use of the Rational tools were technical aspects of the testing process. These benefits relate to specific efficiencies that were introduced by the tools and cited by customers as shown in Figure 4. Improved test efficiency and reuse, improved tracking of workflow, and improved standardization of testing were the top technical benefits cited.
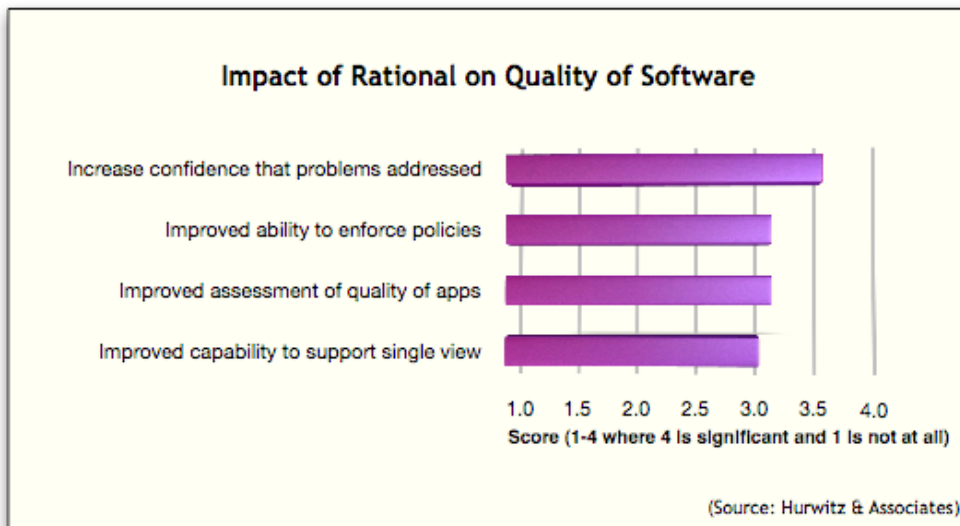

Impact of Rational on Quality of Software

Figure 4: Technical Benefits for Quality Management

Another key theme that emerged from our research concerned the benefits of a more comprehensive approach to Quality Management or as one customer noted "the Rational suite provides an enterprise Quality Management solution." A global insurance company had previously used a "waterfall" approach, doing all its testing at one stage of the process. Now, after implementing RUP, there is earlier collaboration, better communication, and improved test reusability, which lead to organizational efficiency and decreased risk. Another customer, a federal government agency, felt that "RUP's roles and activities are a good fit for our requirements. We can customize a workflow in Rational to enforce process." This customer follows a very formal process, which they need to document, enforce, and validate to control the workflow issues inherent when managing an organization with significant subcontractor churn. RUP allowed the agency to enforce this formal process, providing the required information governance.

The Value of Software Quality Metrics

Even those project managers who have embraced a lifecycle approach to quality may struggle to measure project progress and identify and correct problems early in the development cycle. Measurements gathered from a well-defined and repeatable process can assist project managers to make effective decisions based on objective information. The Rational QM suite of tools provide a range of management measures regarding overall status, change requests, defects, requirements and use cases, test coverage and financial measures.

The delivery and use of metrics is facilitated by a process methodology, the Rational Unified Process (RUP), which serves as a foundation for lifecycle quality management. A centralized project Web portal, the Rational ProjectConsole, provides a single, integrated view of metrics – collected from Rational tools and, optionally, from third-party tools, such as Microsoft Project, as well – in an information structure customizable to the needs of the organization. An effective measurement system allows decision makers to govern software delivery projects by managing critical issues based on those measures and indicators that address key stakeholder needs. Every project will be managed differently. Best practices within RUP incorporate the guidelines, workflows, templates, and examples to support the necessary customizations.

Lessons Learned and Conclusion

The importance of Quality Management is underscored by the more than 70% of customers surveyed who cited negative business impacts from quality failures. The

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software market is trying to move toward a lifecycle approach in order to maintain competitive positioning, though organizational change must be managed effectively to achieve a successful migration. Experienced quality management practitioners understand the complex nature of testing and the implications of change. For example, moving from manual testing to automated testing requires new skills and takes time. Training requirements must not be underestimated. And the training can be further complicated when organizations are both implementing and learning new tools while, at the same time, they are implementing new methodologies, such as RUP.

Other "lessons learned" by customers include the following:

- Senior management support and commitment throughout the organization is required to move from a culture of code testing at the end of a development cycle to a Quality Management approach that incorporates quality into all stages of the process.
- The appointment of a quality "guru" or "czar" – effectively a Chief Quality Officer with prior experience implementing lifecycle quality management – can be invaluable. Significant changes require a champion who can represent the organization's goals within the different teams that have a bearing on software quality.
- Lifecycle quality management is not a "big bang" event and must be rolled out in a controlled and iterative manner. Not every group can move to new tools at the same time. A strategy that can integrate a heterogeneous set of tools and processes will be less likely to encounter resistance.

Many customers we interviewed are in their initial phase of moving to a lifecycle approach to quality management. These Rational customers reported improved quality and cost savings from the initial phases of the transition. Many of these customers anticipate that the benefits will improve dramatically as they progress in their journey to a lifecycle approach. The reality is that not all customers today are in a position to reap the benefits of an integrated, full lifecycle approach because they still utilize a "mixed bag" of Rational Quality Management products, tools from other vendors, and homegrown tools.

Customers that have achieved initial success with this approach anticipate that the benefits of lifecycle quality management tools and the methodologies will increase as they are implemented throughout the organization. For example, one Quality Manager stated that, since his company implemented the Rational tools, "the quality process has improved by an order of magnitude. After only one year we have a quality program that people can rely on. I have gone from managing quality for two projects at a time to managing 10 or 12 projects at one time."

These Rational customers reported improved quality and cost savings from the initial phases of the transition. Many of these customers anticipate that the benefits will improve dramatically as they progress in their journey to a lifecycle approach.

To be successful with a lifecycle quality management approach, Hurwitz & Associates recommends that organizations begin with firm upper management support. In addition, management needs to ensure that everyone in the development organization is trained on the methodology and tools to adopt a lifecycle quality management approach. Companies need to embrace lifecycle quality management now as they seek to leverage innovative software approaches such as SOA, and become innovators in their markets. IBM Rational is investing significantly to provide innovative Quality Management solutions for its customers. The IBM Rational vision and products are worthy of serious attention from enterprises attempting to make the transition to a lifecycle approach.

Companies need to embrace lifecycle quality management now as they seek to leverage innovative software approaches such as SOA, and become innovators in their markets.

About Hurwitz & Associates

Hurwitz & Associates is a consulting, research and analyst firm that focuses on the customer benefits derived when advanced and emerging software technologies are used to solve business problems. The firm's research concentrates on understanding the business value of software technologies, such as Service Oriented Architecture and Web services, and how they are successfully implemented within highly distributed computing environments. Additional information on Hurwitz & Associates can be found at www.hurwitz.com.