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IBM Tivoli Rome Laboratory Increases Productivity and Improves Quality with IBM Rational Software Development Platform.

Overview

■ **The Challenge**
Seeking improved responsiveness to customer needs and greater market share, IBM Tivoli wanted to increase the productivity of its development and testing teams, while improving its ability to deliver products that meet customer expectations for superior quality.

■ **The Solution**
The Tivoli Rome Laboratory adopted the IBM Rational Software Development Platform, including IBM Rational Unified Process and the supporting development and testing solutions.

■ **The Benefit**
Developer productivity increased by more than 30 percent. Requirement and design defects were cut in half. Test productivity increased by 20 percent, while test coverage increased by 30 percent. Almost 20 percent of all functional testing is now automated. Overall, the lab achieved an ROI of almost 200 percent on its first release.

The IBM Tivoli® Rome Laboratory is the largest software development facility in IBM Italy, with a staff of about 550 employees including software developers, test engineers, project managers, architects, designers, system engineers and IT specialists. The primary mission of the Rome Lab is the development and maintenance for Tivoli products, such as IBM Tivoli Configuration Manager, IBM Tivoli Remote Control, IBM Tivoli Monitoring, IBM Tivoli License Compliance Manager, and IBM Tivoli Workload Scheduler.

The Rome Lab recently defined a set of focused initiatives to ensure its core products would continue to meet or exceed customer expectations for quality, new features, and timely updates. With these objectives in mind, the lab started an evaluation of its development process, looking for ways to increase productivity and improve software quality. While many development organizations look first to development tools to drive improvements, Rome Lab began by examining its development methodology. "We were not focused

on tools," says Claudio Marinelli, Senior Software Engineer at Tivoli Rome Laboratory. "Instead we focused on some specific disciplines that we thought we could improve. After identifying those disciplines we determined which activities within those disciplines we could improve by using software tools."

Following this analysis, Rome Lab adopted IBM Rational Unified Process®, or RUP®, with a primary emphasis on best practices including model-driven architecture and design. The group also adopted a use case-driven approach, including the use case-based testing best practice. In support of RUP, Rome Lab also leveraged the IBM Rational® Software Development Platform, including IBM Rational XDE™ Developer and IBM Rational Software Architect for visual modeling and model driven development; IBM Rational Functional Tester for automated testing; and IBM Rational Method Composer for delivering, managing, and documenting processes and best practices.

Customizing RUP

Prior to adopting the RUP methodology, the Rome Lab development team used the Tivoli Product Development Model (TPDM). Rome Lab was able to complement TPDM and accelerate its adoption of RUP by customizing RUP to focus on the disciplines that showed the most opportunity for improvement.

"Many development organizations are already using some kind of development process when they introduce RUP. That was our situation; we already had the TPDM process in place. We customized RUP to map RUP concepts with which we were already familiar. By keeping the framework of TPDM, it was very easy to introduce the new best practices. TPDM still drives our development process while RUP provides best practices on how to formally implement it. In essence, TPDM is very effective in defining who does what activity and when, while leaving freedom to define how the activity should be done. RUP enabled us to improve the 'how' aspect of TPDM with best practices and guidelines. This is a very appealing aspect of RUP for us—the ability to easily add new best practices into an environment with an existing development process," explains Marinelli. "With RUP, for the first time, we had a common set of best practices that everyone could use without reinventing the wheel every time."

For its initial customization of RUP, the Rome Lab used IBM Rational Process Workbench®, including RUP Organizer, RUP Modeler, and RUP Builder. Rome Lab also used process engineering guidance from the Process Engineering Process (PEP), to facilitate the adoption and deployment of RUP in their software development organization. Today, the team adds new disciplines and customizations with Rational Method Composer, a flexible process platform that enables the team to deliver and manage customized and consistent sets of processes, practices, and guidance across the organization.

"For the initial customization with Rational Process Workbench, we focused on requirements, analysis and design, and implementation. Later, we imported those customizations into Rational Method Composer, and we have since added the test discipline as well as best practices to address legacy project development. The transition to Rational Method Composer was straightforward; it didn't take long for us to learn and become productive with it," notes Marinelli.

Advantages Encourage Acceptance

Among the first groups to apply RUP at Rome Labs was the project team for Tivoli Workload Scheduler. The team of approximately 40 developers and 30 testers used the Rational Software Development Platform, including RUP, to deliver Release 8.3 of Tivoli Workload Scheduler (TWS), a workload management solution that automates and control cross-platform scheduling.

The development team readily adopted the best practices of RUP as the benefits became quickly apparent. "The developers accepted RUP right away, because we could see the advantages in our day to day activities," explains Arcangelo Di Balsamo, chief programmer for the project at Rome Lab. "For example, by developing our product in iterations and setting checkpoints at least monthly for all the development activities, we were able to make necessary changes to the architecture and avoid the pain of discovering such problems in the later phases of the development cycle."

The modeling activities promoted by RUP and enabled by Rational XDE Developer and Rational Software Architect were also rapidly embraced by the team. Use cases, which define system functionality from the user's perspective, helped guide development and testing teams. "By cre-

ating a use case model view before starting development of the code, we were able to really think about all the possible scenarios that users of our product will encounter. The use case models also helped us analyze our testing and write test cases before we started coding activities. This led to good test coverage and helped us find defects in early testing phases. Also, in the architectural design, we could specify all the subsystems and their interfaces, that made it easier to partition the work. By assigning the responsibility of each subsystem to a developer, we established clear ownership of each of the subsystems that make up our product," Di Balsamo adds. "The developers recognized the numerous advantages and benefits of using RUP, so it was easy for them to accept it as a new methodology."

Marinelli adds, "One of the major results we achieved with the adoption of RUP was the implementation of an effective end-to-end process that spans multiple disciplines, including requirements, analysis and design, implementation and test. This includes the capability to formally link different artifacts, and use a common language, the Unified Modeling Language (UML), to define the specification of those artifacts at different level of abstraction. We use the Rational Software Development Platform to support this end-to-end process."

Increased Productivity

Gathering and tracking metrics have been standard activities on all Rome Lab development efforts for some time. Comparing metrics for projects completed prior to the introduction of RUP best practices and Rational solutions with those gathered during the Tivoli Workload Scheduler development effort, enabled the team to quantify productivity gains and quality improvements.

One gauge of productivity is the number of newly-written or changed lines of code by one person in a year, typically measured in thousands of new and changed source instructions per person-year (KCSI/PY). The development

team calculated this metric for Tivoli Workload Scheduler 8.3 and compared it against two baseline projects. The first was an earlier minor release of the same product; the second was a release of another product, similar in size and scope to the Tivoli Workload Scheduler 8.3 project. Neither of the baseline project teams used RUP; they used the labs traditional development methods, which relied on textual design.

"We saw a strong improvement in development productivity when using RUP," reports Agostino Colussi, test architect at Tivoli Rome Lab. "With RUP, we saw a productivity gain of 30 percent or more over both baseline projects."

Defect Distribution by Phase Baseline
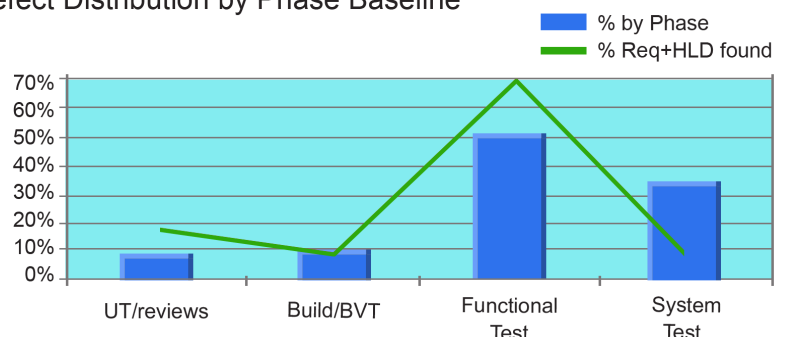
Defect Distribution by Phase TWS 8.3
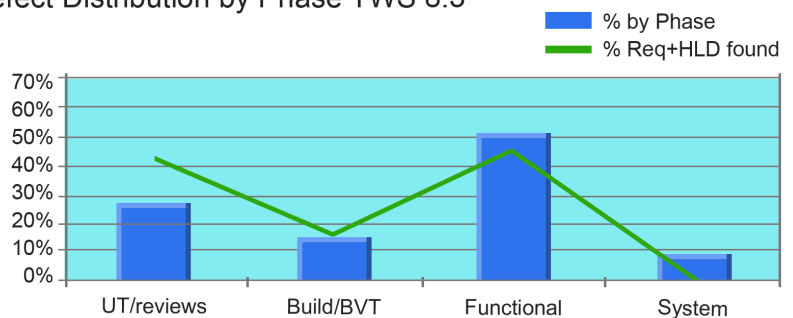
Using RUP best practices and the IBM Rational Software Development Platform, Rome Labs found and removed defects much earlier in the development process.

Improved Test Effectiveness

Adopting RUP, Rational Functional Tester, and a use case-based approach to testing has also led to a quantifiable improvement in quality at Rome Labs. As they did with productivity, Colussi and his colleagues compared the Tivoli Workload Scheduler 8.3 project against a baseline project of similar scope. The results clearly showed that the team found and removed defects much earlier in the development process when following RUP best practices. "Model-driven development increased the effectiveness of reviews, allowing us to find critical problems in requirements and high-level designs much earlier. As a result, the high-level design and requirements defects found in formal test phases decreased by 50 percent" says Colussi."

The project's functional testing was also more effective, enabling the team to find 10 percent of all functional defects through automated tests. Colussi adds, "We saw a significant improvement in the effectiveness of our functional tests, due to use case-based testing practices and our focus on automation. As a result, we found less than 10 percent of our overall defects during system testing on our RUP project, compared to more than 30 percent on the earlier project."

Test Productivity Increased

Not only was the testing team able to find defects earlier in the development life cycle, they also experienced an improvement in overall testing productivity. "Use case-based testing can increase test productivity during test execution, and in our case, we increased test productivity by 20 percent. First of all, our test cases are more granular, enabling us to cover basic flows and then alternate flows. This, combined with the increased stability of our code in Tivoli Workload Scheduler 8.3, helped us avoid blocked test points. And the test case granularity made it simple to reproduce defects once we found them," says Colussi.

In addition to Rational Functional Tester, Rome Labs used JUnit and the open source Software Testing Automation Framework (STAF) to increase test automation. Colussi continues, "Using Rational Functional Tester and a use case-based testing approach, our coverage with test automation with Rational Functional Tester was very high—about 20 percent of our entire functional testing effort—that helped us increase our overall functional test coverage by 30 percent more. Going forward, these improvements will enable us to shorten testing timeframes, even as we continue to improve the quality of our products."

Calculating Return on Investment

To better assess the overall impact of RUP and the Rational Software Development Platform, Lucio Bortolotti, Technical Quality Champion at Rome Lab, conducted a return on investment (ROI) analysis for the Tivoli Workload Scheduler development effort by comparing it with the baseline project. He factored in additional costs such as training, mentoring, and skills ramp-up as well as product installation and configuration. The benefits analysis incorporated savings resulting from productivity improvements in development and testing, as well as savings due to earlier discovery of requirements and high-level design defects.

"On the Tivoli Workload Scheduler project, we achieved an ROI close to 200 percent. Basically, our investment paid off within a single release cycle. In addition, most of the costs are one time only, while the savings are likely to be repeated release after release," says Bortolotti. "If we extend the same exercise and assume that the project team will be involved in multiple releases, the cumulative ROI will increase to 373 percent, 491 percent, and 576 percent for the second, third, and fourth releases, respectively."

Looking Ahead

Rome Labs continues to introduce new best practices, including the business modeling discipline, into its development process and the team is expanding its use of the Rational Software Development Platform to enable these best practices. The group has started using IBM Rational RequisitePro® to manage requirements and link them directly to use cases in Rational Software Architect. Rome Lab developers also rely on IBM Rational Application Developer as their main integrated development environment. In addition, Rome Lab is planning to broaden its use of IBM Rational ClearCase®, which the team currently uses to reliably and securely manage, control, and access software assets.

Since adopting RUP and IBM Rational Software Development Platform solutions, the Rome Lab development team has delivered all of its projects on schedule. Over the same time, the team has met all of its quality targets, and incoming problem reports have decreased by more than 20 percent.

Following the successful results of its pilot projects, RUP is now being deployed on all Rome Lab projects.

"If the quality of our products does not meet customer expectations, we risk losing market share," notes Giovanni Lanfranchi, director of Tivoli Rome Laboratory. "With RUP and IBM Rational solutions we are ensuring our ability to deliver high quality products. We are able to identify and mitigate risks earlier, and communicate in a structured way among teams. We have already realized improvements in productivity and quality. With the expertise we have now built, we expect an increased return on investment as we move forward with the deployment of the best practices and methodologies across various projects in the lab."

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