

Industry:

Government/Public Sector

Organization:

Pennsylvania Department of Environmental Protection

Description:

The Pennsylvania Department of Environmental Protection (DEP) is the state agency largely responsible for administering Pennsylvania's environmental laws and regulations. Its mission is to protect Pennsylvania's air, land and water from pollution and to provide for the health and safety of its citizens through a cleaner environment.

Business Problem:

The Pennsylvania DEP was on a tight schedule to deliver a high-performance, mission-critical Web-based mapping application and needed a proven methodology supported by integrated development tools.

Rational Solution:

Rational Unified Process, Rational Purify, Rational Quantify, Rational RequisitePro, Rational Robot, Rational Rose, Rational Suite Enterprise

Key Benefits:

Developed an innovative, award-winning Web-based mapping application almost a month ahead of schedule and well within budget

Effectively managed requirements from a wide range of diverse stakeholders and tracked requirement throughout development and testing

Verified and enhanced system performance before deployment with extensive load testing

Applied a proven methodology and integrated development tools to increase team productivity and efficiency

Used visual modeling to track business flows and gain a clearer understanding of the entire system

Pennsylvania Department of Environmental Protection Delivers Innovative, High-Performance Software Ahead Of Schedule Using Rational® Suite Enterprise

The mission of the Pennsylvania Department of Environmental Protection (DEP) is to protect the state's air, land and water from pollution and to provide for the health and safety of its citizens through a cleaner environment. As part of that commitment to public health and safety, the development team at the DEP's Geospatial Data Center recently developed a vital, first-of-its-kind Web-based mapping application that allows spatial analysis of geographic data. The award-winning and innovative application, called eMapPA, combines extensive geographic and environmental information – such as the location of landslide areas, abandoned mines, conservancies, public water intake systems, and much more – into overlapping layers overlaid on a map of Pennsylvania. The eMapPA project involved integrating new code with existing databases and multiple third-party software components.

Creating such an application is a complex undertaking in and of itself. But the DEP team faced other constraints that compounded the difficulty of the challenge. First, a heightened national awareness of security and public safety focused public attention on the project and demanded an exceptionally aggressive schedule. Second, due to the widespread interest and broad user base for eMapPA, the application would have to perform under far higher user loads than any application that the team had developed before. Confronted with these challenges, it would have surprised few if the project missed its deadline, or ran over-budget. Instead, using Rational Suite® Enterprise, the DEP's dedicated and talented group of six developers, three testers, and four analysts exceeded all expectations and delivered eMapPA well within budget, and almost a month ahead of schedule. The application is so popular, and offers so much value to a wide range of users, that it regularly receives millions of visits per month – many orders of magnitude more than was expected.

The project has also garnered recognition and praise from the highest levels of state government, including an award for innovation from then Pennsylvania Governor Mark Schweiker.

Ebby Abraham, Chief of the Geospatial Data Center for the DEP, and project manager for eMapPA, reports that Rational Suite Enterprise's comprehensive support for the full development lifecycle was crucial to the project's success, and essential to his team's ability to deliver eMapPA ahead of schedule. He and his team used the Rational Unified Process® guidelines and Rational Suite Enterprise's tools for requirements management, visual modeling, automated documentation, unit testing, and load testing to complete the first version of the software in less than six months. "Rational tools enabled us to have a good handle on the complete lifecycle of the project. Without Rational Suite Enterprise, it would have taken at least 18 months, with limited success," notes Abraham.

The Mandate: Performance, Accuracy, And Ease of Use

As project leader, Abraham was given a clear-cut directive by the CIO of the Department of Environmental Protection, Karen Bassett. Abraham recalls, "Our mandate was very simple from our CIO. We had to deploy an application that was accurate and very user friendly. But just as important, it had to perform – especially when we are talking about emergency management and emergency response. For instance, if an oil tanker spills on a bridge and it falls into the river, we need to know immediately where the public water intake systems are and shut that off. As another example, we have nuclear plants that we regulate, and if there is a leak, we need to know what areas have to be evacuated. So this is a matter of



life and death. The magnitude and the importance of this application were so high that it was constantly in the public eye.”

Along with that mandate, Bassett offered her full backing to the team, which included empowering the team to select the best possible tools for the job. “We had total support from our CIO – and none of this would be possible without executive level support from her. She was straightforward when she told us, ‘These are the requirements, go out and find the best possible solution.’ First and foremost, we needed to ensure that eMapPA was reliable and scalable, but we also needed an effective way to manage requirements and model the system. We also wanted any tools we used to be integrated and well-respected in the industry. We felt that the best possible solution for us was using Rational Suite Enterprise,” Abraham explains. The DEP team consulted with a Rational technical representative, who spent a day answering questions and showing the team how Rational solutions would help. After that, the team was confident that Rational Suite Enterprise was exactly what they needed.

Because Rational Suite Enterprise offers a comprehensive set of tools for the full lifecycle supported by the proven Rational Unified Process methodology, it was an ideal choice for the DEP team. Rational Suite Enterprise provided DEP with tools for improving every phase of development – from gathering and defining requirements, to load testing on the finished product, and everything in between. The Rational Unified Process, or RUP®, is a configurable, time-tested set of software engineering best practices and served as a foundation for the team’s efforts. “RUP was a driving force of ours,” Abraham notes.

Building A Partnership With End-Users

Like many government projects, the eMapPA project had to satisfy requirements from a diverse set of stakeholders. “As a regulatory agency, our stakeholders come from all corners of the Commonwealth,” Abraham notes. “We had a public focus group which was involved very early on and actually drove a lot of the initial requirements. This public focus group is important because it includes people who are industry leaders, academia, local government officials, emergency management officials, and local consulting organizations

that use DEP on a day-to-day basis. On this project, government wasn’t driving the train so to speak. One of the most important user requirements, for example, was the ability to place a point on the map, draw a buffer around it, and identify all of the relevant public safety elements – such as landslide areas or floodplains – that are in that buffer.”

The team used Rational® RequisitePro to help gather and define the project requirements in the project’s early stages, and then manage them as the project progressed. “The public focus group helped us build our requirements, and that was a unique culture change in the DEP. We actually went out and built a partnership with our end-users in the public sector and recorded their requirements into Rational RequisitePro,” says Ron Hermany, GIS (Geographic Information Systems) Analyst at the DEP.

As the project moved forward, everyone on the DEP team accessed Rational RequisitePro to see what the up-to-date requirements were and what they needed to work on.

“RequisitePro was one of the most important tools that we used. At times we had requirements changes coming in almost on an hourly basis. All of our requirements were kept in Rational RequisitePro, so we could track changes throughout development. The Microsoft Word interface helped us document the user requirements and the database helped us analyze the impact of change. Because we were using RequisitePro, all team members knew what they were supposed to do,” adds Manish Saxena, GIS Project Lead for Tata Consulting Services (TCS), a consulting firm that DEP contracted to assist on the eMapPA project.

Developing and Documenting the System Architecture

After the project requirements had become relatively stable, the team began modeling use cases and developing the system architecture in Rational Rose® using the Unified Modeling Language. The team also used Rational Rose to model business processes and gain a clearer understanding of the overall system. Saxena recalls, “We started with business use case modeling and then moved on to the system use cases. The biggest benefit that we realized from business modeling was that we were able to track business flows through the application design. Using Rose,

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we did the business modeling first and then the system uses cases to break down the DEP business processes. The second important benefit was that we could envision the whole system on one diagram. The application was tightly integrated with many off the shelf products – including mapping components and the Jakarta Tomcat servlet engine — and we really needed a complete comprehensive view of the whole system at one shot.”

Managing requirements, modeling visually, using component architectures and following an iterative development approach are all best practices advocated in the Rational Unified Process. By applying these principles with the help of Rational RequisitePro and Rational Rose, the DEP team was able to facilitate parallel development and identify potential performance bottlenecks very early in the project. Saxena continues, “Because we were working against a tight deadline, we had to do the development and design almost in parallel. Once the use cases and activity diagrams were ready, the coding started immediately. And we used the design of the system to find out if there were any architectural bottlenecks.”

When the team needed up-to-date documentation of the system architecture, they used Rational® SoDA to generate it automatically. Rational SoDA pulls together current project information from various Rational tools – including Rational RequisitePro and Rational Rose – to produce consistent, complete projects documentation and reports. Saxena notes, “Rational SoDA saved us a tremendous amount of time. We used it to document the system architecture starting from use cases to activity reports to class diagrams and more. SoDA was one of our life savers.” Abraham adds, “As a government agency, it is essential that we have thorough system documentation. Rational SoDA saved 90% of the documentation effort. Without it we’d still be working on the documentation.”

System Performance Is Vital

Abraham and his team recognized that just creating a solid architecture and delivering an application that met all functional requirements would not be enough. The project would still not be considered a success if eMapPA could not continue to perform under high user loads. Ensuring system performance was a top priority throughout development because of the

public safety implications of a software failure, and because of the project's wide appeal and high visibility. “In the past we had deployed enterprise wide applications, without using any kind of load testing tools and we found out later that two or three users could crash the system,” Abraham notes.

Hermany adds, “One of the things that really helped us decide to use Rational tools was the promise of better performance. Some of our earlier applications just couldn't handle the growing number of users we were getting. The difference between past applications and present in terms of performance is monumental to say the least. It was really the difference between success and failure.” Abraham agrees, “Without a doubt. And that's what our CIO kept driving home to us. It is important that when we deploy a successful application, performance has to be the number one criteria.”

The eMapPA application now regularly handles millions of hits per month, but initially the performance requirements were more modest. At the start, the requirements specified that the application must be able to handle 100 concurrent sessions with a response time of no more than ten seconds. To ensure that this requirement and all other functional and performance requirements were fully tested, the eMapPA team created a test plan using project requirements in Rational RequisitePro as input. The integration between Rational RequisitePro, Rational Rose and Rational TestManager provides the DEP with traceability from requirements to use case modeling and testing.

Because performance was so crucial to the project's overall success, the DEP team brought in an experienced, full-time performance engineer – the first time any DEP project included such a position. Babu Mahadevan, Performance Engineer for TCS, used Rational TestManager and Rational Robot to create sophisticated load tests. Those tests helped Mahadevan verify performance, gather timing and resource consumption metrics, and identify bottlenecks and poorly-performing components that were slowing the system down. Rational TestManager is used to direct and monitor all aspects of the testing effort; and Rational Robot is used to record, script and run automated functional tests. Combined, TestManager and Robot enable teams to easi-

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ly create realistic load tests that can include thousands of virtual users performing a variety of tasks on a custom-made schedule.

Mahadevan is impressed with the tools’ ability to create multi-user test scripts, build complex schedules, and report results for analysis. “I had used other performance tools before; and Rational’s are a nice experience to work with. They provide a lot of features that other tools don’t provide — various ways to look at the results, different ways to create population combinations. Our tests have 100 different virtual users, doing ten different activities. We picked frequently used activities based on end-user input and narrowed down to ten activities which we scripted and ran.” Although 100 users may not seem like a heavy user load, Mahadevan created a schedule that performed all of the user activities in a short timeframe, enabling him to simulate much heavier usage and identify several performance issues.

Millions and Millions Served

Locating and isolating the cause of performance problems is not easy, particularly in an application as complex as eMapPA, which comprises a wide range of technologies, programming languages, and third-party components including Java, JavaScript, JSP, ASP and VB, as well as IIS, ArcIMS (an Internet mapping system), the Tomcat servlet engine, and an Oracle database backend. Using Rational Suite Enterprise’s testing tools, including Rational® Quantify®, Mahadevan was able to pinpoint bottlenecks, even when they occurred in off-the-shelf components. Rational Quantify’s advanced performance profiling capabilities took the guesswork out of performance tuning for DEP engineers.

Mahadevan recalls, “We identified application level issues. The tools produced enough load that we could identify the bottleneck and then narrow it down.” Abraham continues, “In fact we were able to detect a bottleneck in the architecture of one of our third-party components, and we shared it with the president of component’s vendor. He was very appreciative. If it weren’t for Rational, we wouldn’t have found that out.”

The team’s quality assurance efforts went far beyond load testing. Analysts on the eMapPA project used Rational Rose to identify potential architectural bottlenecks very early on. Developers used Rational Purify to locate memory leaks and memory access errors in their code. And Mahadevan’s load tests were followed by extensive real-world end user tests that validated his results. As a result, the team delivered an exceptionally scalable, high-quality application that regularly handles millions of hits per month. “We are up to five million hits per month. We did not expect this. We thought we’d see a maximum of twenty thousand, maybe forty thousand on the high end. We never expected this kind of response in terms of hit counts, and in terms of positive feedback,” Abraham says.

Rising To The Challenge

Considering all the challenges involved with the project, and its tremendous overall success, Abraham is convinced that eMapPA is one of his department’s greatest accomplishments. He is understandably proud of what his dedicated team, equipped with Rational Suite Enterprise, was able to achieve. “The project had an incredible amount of visibility. We had a limited budget and an extremely short amount of time. This was ideally – if we had the luxury – an 18 month project, and this was done in less than six months. The time-frame had to be very aggressive because of the environment that we are living in now. We had to produce a system that was accurate and reliable and that could be used by environmental management as well as our own policy- and decision-makers,” Abraham notes.

By applying the best practices of the Rational Unified Process and Rational Suite Enterprise’s integrated tools the DEP team was able to increase productivity, improve efficiency and deliver a highly-scalable, quality application in record time. Abraham continues, “The beautiful part is that the project was actually delivered three weeks ahead of schedule. With Rational Suite Enterprise, we were able to deliver this application not only ahead of schedule, but also well within the budget. Our previous Web-based applications get maybe three hits or four hits per month. In the first six weeks eMapPA had over two million hits. Never before had we seen that. And we’re getting amazing feed-

back – we had to set up a special email account just to get all the accolades and inquiries that people had about the site. In fact, shortly after we deployed the site we got a mention of honor from then Governor Schweiker. It was a very proud moment for us. Now, schools are using our application to teach — having school children interested in this area is very exciting thing for all of us.” Abraham concludes, “Rational has done great things for us, and we just want it to continue.”

About Rational

Rational provides a software development platform that improves the speed, quality, and predictability of software projects. This integrated, full life-cycle solution combines software engineering best practices, market-leading tools, and professional services. Ninety-six of the Fortune 100 rely on Rational tools and services to build better software, faster. This open platform is extended by partners who provide more than 500 complementary products and services.

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