

Industry:

Aerospace & Defense

Organization:

Lockheed Martin Canada

Description:

Lockheed Martin Canada is a highly diversified global enterprise principally engaged in the research, design, manufacture, and integration of advanced-technology products. The company is Canada's premier supplier of electronic defense and surveillance systems.

Lockheed Martin Canada employs over 700 people across Canada and banks its reputation as a top company on the development and success of their employees, both as individuals and team players.

Business Problem:

Lockheed Martin Canada was contracted to provide a comprehensive, integrated software engineering environment, and needed effective tools to manage the project from requirements to deployment.

Rational Solution:

Rational ClearCase,
Rational ClearQuest,
Rational RequisitePro,
Rational SoDA,
Rational Suite Enterprise,
Rational Unified Process

Key Benefits:

Successfully managed a complex project with integrated, best-in-class tools

Effectively organized, prioritized and refined an extensive set of project requirements

Leveraged requirements to jumpstart use case analysis and process modeling

Improved team communication by providing controlled, convenient access to project requirements, models and other vital information

Rational software

Lockheed Martin Canada Finds that Rational Suite Enterprise Sells Itself

A Team that Leads by Example

The primary software development facility of any branch of a nation's armed forces shoulders considerable responsibility for developing and maintaining high-quality, mission-critical applications. When one such organization needed an integrated environment for software engineering and program management, as well as an upgrade to their network infrastructure, they turned to Lockheed Martin Canada for help. (Hereafter, this organization, which does not wish to be identified, will be referred to as "the Agency".) Rick Martelli, a program manager at Lockheed Martin Canada, spearheaded the effort to develop a solution that would meet the Agency's needs. Shortly after beginning the project, Martelli and his small team of specialists realized that the functional specification they had been given was not validated. Although it was a large document, it lacked essential details, and did not necessarily reflect the real requirements of the facility. Faced with this problem, Martelli decided to take a bold, lead-by-example approach.

Martelli was confident that Rational Suite® Enterprise could meet or surpass all of the Agency's requirements, based on his knowledge of Rational Software's wide range of best-in-class software development tools and professional services. Nevertheless, he needed to prove it to himself, as well as to the managers and decision makers at the Agency. Martelli describes the situation, "When we started the project, we had two issues that we needed to address. First, we needed to verify the set of requirements that we started with and determine whether or not Rational products would be able to support that kind of capability. Second, we needed an environment for ourselves from which to run the project. We were trying to address two different problem areas — one, serving the customer, the other serving ourselves. So as we were

validating the requirements for our client, we purchased Rational Suite Enterprise for ourselves and attended training courses through Rational University." Martelli planned to use Rational's tools to manage his project while at the same time proving to the Agency's managers that these same tools were just what they needed to succeed.

The Need for Speed (and Quality)

Martelli and his team are part of Lockheed Martin Canada's Information Systems and Services Group. Lockheed Martin Canada is a highly diversified global enterprise principally engaged in the research, design, manufacture, and integration of advanced-technology products. The company is a leader in systems integration, software development and large-scale program management and Canada's premier supplier of electronic defense and surveillance systems. Primary capabilities encompass the integration and management of complex computer-based electronic systems; the design, manufacture and supply of military-standard computers, electronic warfare, sonar and security systems; and the provision of lifecycle support for major platforms.

Lockheed Martin Canada employs over 700 people across Canada with its head office in Kanata and supporting operations in Montreal, Halifax, and Victoria. Its workforce includes skilled systems engineers, hardware engineers, and software engineers, as well as specialists in program management and integrated logistics support. Lockheed Martin Canada builds its success on the development and success of their employees, both as individuals and team players.

The Agency was counting on Lockheed Martin Canada's extensive experience with military and national defense projects. Like Rational Software and Lockheed Martin, the Agency believes that quality is everyone's responsibility.



“The Rational University training in conjunction with mentoring from the Rational Services team was a very good combination.”

ty. While they are a public sector organization they still have to compete with commercial organizations — which means speed is also very important to them. As Martelli explains, “They want to do rapid application development. They want the ability to produce applications faster and cheaper. That would mean their customers, who are other military agencies, would be more likely to come to them as opposed to another contractor. Rational products are what this agency is going to use to become a more cost effective organization.” Rational’s e-development approach — which combines tools, services and best practices for software development — is ideally suited to the Agency’s needs, because they cannot afford to sacrifice quality for speed, nor can they afford to proceed slowly in an effort to improve quality.

The First Step: Defining the True Requirements

As the project got underway, Martelli faced some significant challenges. First, the scope of the project was quite broad, and they needed a solution that would facilitate the sharing of information across a variety of functional areas. “The domains that we were specifically going after were requirements management, change management, process management, project management and also test automation,” notes Martelli. Plus, Martelli and his team had little direct experience with Rational products prior to this project, so they needed to come up to speed quickly. “Right away, we started configuring the Rational environment for our project to demonstrate some of the capabilities to the customer and also to learn by actually building the environment for ourselves,” Martelli remembers. At this stage, training at Rational University and on-site mentoring was particularly helpful, “The Rational University training in conjunction with mentoring from the Rational Services team was a very good combination. Many times we would get the instructor from the course to come in and do follow-up mentoring. This provided a lot of continuity, making it much more efficient to get up and running.”

But Martelli’s concern was with project requirements. As he explains, “One of the biggest challenges we had was that when we initially competed for this contract, we had a

functional specification that was provided by the customer. Unbeknownst to us, this functional specification had never been validated by the customer. They hadn’t consulted the people that would be actually using and implementing the process. When the document was initially prepared, it outlined the entire capability of an organization that was process-centric. That was a model that was based on a Level 5 organization on the SEI Capability Maturity Model (CMM). This specification was done in isolation to the actual managers and staff here at the organization facility. So they were also reviewing these requirements at the same time that we were trying to address them.”

An Integrated Product Team Development Approach

Martelli and his team immediately began organizing the existing requirements using Rational® RequisitePro®, the market-leading requirements management solution. Rational RequisitePro is a key component of the Rational® Team Unifying Platform — a powerful set of team-unifying tools and resources that provide the foundation for Rational Suite Enterprise, and every member of the Rational Suite family. The Rational Team Unifying Platform enables teams to easily share accurate, up-to-date project information like requirements, visual models, code and test scripts “We brought those requirements into a Rational RequisitePro database and created a structure whereby we could filter out the noise in the requirements. We were able to ignore those that had very little value, and also focus on the priorities that our client had. At the same time, we were demonstrating the capability that we would deploy as we used it.” Because Rational RequisitePro stores requirements in a database, the team was able to easily search, sort and prioritize them. And, because requirements in Rational RequisitePro can be viewed, created and edited using the familiar Microsoft Word environment, they are readily accessible in a format convenient to everyone that has a stake in the project.

To help determine which of the original requirements were truly important, and which were of lower priority, Martelli solicited feedback from all parties involved. He explains,

"We used an integrated product team development approach. This is a program management methodology, where product teams have full responsibility and authorization to produce a particular product. We created a team with stakeholders from each of the different organizations. They fit together at all stages of the development cycle to provide a solution; nobody is brought in at the final moment. They are part of the team from day one. We brought in representation from senior management, from middle management and from the actual end users, all of whom were stakeholders on the team. We went through the entire requirements database and each group assigned their priority. We made sure that if they thought that the level of support was insufficient, they would define that. Basically, we got them to prioritize the requirements and decide whether or not the requirements were valid."

Modeling the Process with Rational Rose

As the requirements were defined, Martelli started to create a requirements analysis model using Rational Rose®. Rational Rose is the world's leading visual modeling tool and is used to model everything from high level business processes, to complex component based software architectures, to database structures. Rational Rose models are based on the Unified Modeling Language (UML). Rational pioneered the UML, which has become the standard notation used to specify, visualize, and construct artifacts of software and systems. Martelli found that modeling use cases in Rose was particularly valuable, because both his team and the Agency's team were able to see how the proposed system would work from the user's perspective.

"We used the requirements in Rational RequisitePro as a starting point for use case analysis," Martelli explains. "We wanted to link the capability identified in the functional specification to the way they conducted their work at this particular facility, and we used Rational Rose to do that. We modeled our interpretation of that capability based on how they actually performed their work in the process. If a requirement was vague, we modeled what we intended to deliver as far as that capability. Then we used their feedback on our use case analysis as a means of gathering further

requirements. One of the features that really facilitated that was Rational Rose's ability to publish the model to the Web — that let everyone to view exactly what was happening with the use cases. Rational Rose worked very effectively in the sense that not only were we able to go to the customer and say, 'Here's how we can deploy Rational Suite Enterprise,' and get feedback; but it was also a tool for me as a program manager to see if my team members understood what the issue was and whether or not they really understood what the customer needed. So the Rose model worked both ways." Martelli took advantage of the integration between Rational Rose and Rational RequisitePro. "We traced our Rational Rose process models back to the Rational RequisitePro requirements from the functional specification. That way we could demonstrate complete traceability from their initial capability needs directly to the customization that we were going to support with Rational Suite Enterprise."

Convincing People with Convincing Numbers

With a set of valid requirements and approved use case models in hand, Martelli and his team took some time to assess Rational's ability to meet those requirements. Going into the project, he could not be sure that Rational products would be the right fit for the Agency, but after thorough analysis he was pleased with the results. Martelli remembers, "We went away and we compared the Rational products to the list of requirements and their priority. One team looked at change management — Rational® ClearQuest® and Rational® ClearCase® capabilities. The second team looked at requirements and automated test. They focused specifically on capabilities for Rational RequisitePro and Rational® Robot. At the end, what we found was that the Rational products addressed about 93% of the requirements, and the requirements that it did not address directly were considered low priority." In a few instances, a requirement that was partially met by a Rational product was completely addressed in a later release from Rational. "What we found is that each subsequent release of the product, we'd go back and we'd revisit those requirements that we said were only partially addressed and in

"Over 70 percent of our software system will be comprised of existing software components... And tools like Rational Rose and Rational SoDA enable us to assure that the reusable components meet the stringent quality and maintainability requirements of the Blue Team."

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many cases we find that it had gone from partial to full,” remarks Martelli.

Enforcing the Process with Rational ClearQuest and Rational ClearCase

Once they had prioritized the requirements, developed a model, and determined that Rational would meet all of their client's critical needs, Martelli's team began building a prototype environment based on Rational Suite Enterprise and Rational ClearCase, Rational's powerful software configuration management (SCM) system. Martelli reports that, at first, there was some resistance to the new system. The Rational tools, particularly Rational ClearQuest (Rational's highly flexible defect tracking and change management tool) and Rational ClearCase were much more capable of enforcing the Agency's established processes than their previous tools, and the end users had to adhere to their process more strictly than before. Ultimately, the Agency preferred it that way. As Rick illustrates, “We were not here to redesign their process. In fact, while we were doing this validation, they were trying to achieve ISO 9001. So we could not go in there and commandeer their process. Whatever we went with, it had to conform to their existing process. Once we actually took their process model and put into Rational ClearQuest, they had no choice. From then on, if there were any drawbacks, any problems in their process model, that was something that they had to resolve. Now we have a system in place that allows them to adapt very easily. And again, that is all based on Rational ClearQuest.”

Through tight integration between Rational ClearQuest and Rational ClearCase, Rational offers a unique, activity-based process for managing change throughout the development lifecycle. Unified Change Management (UCM) provides an out-of-the box process for linking enhancements and defects tracked in Rational ClearQuest to the specific releases and file versions managed in Rational ClearCase. In addition to artifacts managed in Rational ClearQuest and Rational ClearCase, UCM links requirements in Rational RequisitePro and test assets as well. This capability was introduced as the Agency's project was ongoing, and it was a pleasant surprise for Martelli and his team. “We had devised a similar change management system

which was based on change activities. With this system a developer is responsible for repairing, say five defects, and then authorized to check in those files under SCM control. What we found with Rational's UCM approach was that it mapped exactly to the solution that we had offered our customer. It lent credibility to our team, because this was a case where we had developed a capability, and Rational came out with an automation of that same capability.”

Documenting the Process with Rational SoDA

Rational Suite's ability to unify software teams stems from its Team Unifying Platform. Martelli and the team at the Agency have taken advantage of the capabilities of almost every tool in the Team Unifying Platform, including Rational RequisitePro, Rational ClearQuest, Rational® TestManager (for managing all testing activities), the Rational Unified Process® (a customizable knowledge base of best practices), and Rational® SoDA® (for Software Documentation Automation). The Team Unifying Platform also includes Rational ClearCase LT, a version of Rational ClearCase designed for project workgroups. Teams can use either Rational ClearCase LT or Rational ClearCase when implementing UCM to manage change and control workflow.

For Martelli, Rational SoDA's automated documentation and report generation proved especially useful. Rational SoDA unites information from a variety of Rational artifacts and assets — including visual models, requirements, change request and defect information, source code, test results and more — into cohesive, complete project documentation and reports. “One of the biggest areas that we had to address was metrics and reporting,” Martelli continues. “I would say that the most underrated product within Rational Suite is Rational SoDA. SoDA is key. With SoDA we addressed metrics and reporting within Rational ClearCase and ClearQuest, plus we could also draw in any other information from the data stores into one report. This report could be used to gauge progress or it can simply be used for communicating changes to particular team members. Rational SoDA was very effective in gathering the information from the different repositories that we had established. We can keep an up-to-date version

available for all the team members, so everybody is focused, everybody knows what needs to be done.”

Rational SoDA is also integrated with Microsoft Project, which makes it even more useful to Martelli and the engineers at the Agency. “We have to merge program management with software engineering. We find that Microsoft Project is probably the best way to do that, as far as scheduling and tasking goes. As a project leader adds a task to Microsoft Project, it creates that activity record in Rational ClearQuest automatically or on request. Project leaders can then use Rational ClearQuest to gather their information and record the information associated with that particular activity. We can then use Rational SoDA to produce a report showing all the different activity and effort that’s been recorded, information that’s been recorded in Rational ClearQuest, and tie it directly to effort and schedule information from Microsoft Project. That’s a very powerful capability, and it is Rational SoDA that’s doing it for us,” Martelli observes.

The Exit Strategy: Lessons Learned, Rational Unified Process, Tutorials and Training

It was never a part of the project plan for Lockheed Martin Canada to maintain a presence at their customer’s location. So from the start, Martelli and his team designed a solution that included complete documentation of everything that they had done, as well as a support system for the Agency to use after they left.

Martelli describes the plan, “Whatever we produce, we make sure that there’s quite a bit of documentation to support it, so that it is maintainable by others. We also try to create an environment here that establishes a knowledge base within the facility so that we lower their dependence on us. We’ve been using the Rational tools to build an infrastructure for our users, something we call the Rational Support Repository. It’s a repository in Rational ClearQuest that contains lessons learned, action items for the Rational User Group, and a customization library. Basically, someone can submit any kind of script, whether it be for a Rational ClearQuest hook, a Rational ClearCase trigger, a Rational SoDA template,

or even a macro for Microsoft Project.” This resource has become a kind of re-use library, which other project leaders can go through to jumpstart their work. Martelli helped establish a Rational User Group within the Agency that keeps up with Rational developments, monitors other user groups, and watches for published articles on the Rational website.

At this stage, Martelli found yet another way to leverage the information stored in his Rational Rose models, by using the activity diagrams in Rational Rose to generate tutorials. He explains, “Once we feel that the customer has accepted the environment that we’ve demonstrated and that our activity diagrams follow that final configuration very closely, we can use those activity diagrams to derive tutorials. In that way, when we deliver the final product, there is not only the actual implementation of the environment, but there is also a tutorial that the end users can use for self-training.” Martelli then took it one step further, by leveraging the tutorials as test cases. He used Rational Robot, Rational’s award-winning functional testing tool, to record, modify and playback automated testing scripts that stepped through each of the tutorials. “We use Rational Robot for acceptance testing — so that way, if there are changes to any of the schemas, or updates to the Rational tools, we can re-run the tutorials using Rational Robot and verify that they are still valid.”

In addition to the tutorials and the user group’s resources, engineers at the Agency get training at Rational University and have easy access to the Rational Unified Process (RUP®). RUP is a web-enabled guide to industry-proven software engineering best practices. RUP can be easily tailored to reflect an organization’s own processes. As Martelli notes, RUP plays an important role at the Agency, “We have to have a way of being able to set up a project from this facility, set up the repository and then communicate to them exactly what we’ve done. That is what we use RUP for. If you’re on a particular project from this facility, we send you off on training, and when you come back, the client software is installed on your workstation. If you want to know exactly what to do and where to go, all you have to do is launch that particular software, go to the extended help, and look up your project. RUP will describe to you not

only where your repositories are and allow you to connect to them by just clicking on the link, but it will also define what the accounts are, what the privileges are, and so on. So, after they come back from Rational University Product Training, then they're basically ready to go. If they're not, they can access everything that we've done with explicit examples of what they need to do to get going." Currently, Martelli's team is working on integrating the lessons learned database with RUP. When completed, this will enable Agency users to view a lessons learned report directly when they access extended help from a Rational tool.

In addition to Rational's on-site training and mentoring, Martelli appreciates Rational University's ability to tailor course offerings. "We always go first ourselves, so that we can then better recommend what training is most suitable to the organization here. Once we've done that, Rational sits down and works with us, and together we develop a training program for the organization. We look at the roles, the types of courses, and also we see if we can introduce any specialized elements into the training packages that will better meet the needs of the customer."

The Bottom Line — A Win-Win Situation

It is clear that Martelli and his Lockheed Martin Canada team are very happy with the way Rational Suite Enterprise's integrated tools have helped them manage their side of the project. But what about their client? Are they equally pleased with their Rational solution? Absolutely, according to Martelli. "They went from, I would say, a somewhat undisciplined approach, to a very controlled and very disciplined approach. New team members can be brought up to speed quickly because everything is standardized and the infrastructure is in place." He continues, "As part of ISO, you've got to demonstrate that your process is improving. Prior to this project, they had a number of processes, but they couldn't verify that people were actually following them. Also, there weren't very many requests coming in to change the process. Once we went with Rational ClearQuest, we could see significant involvement from the end users. We could actually see that people were following

the processes and that improvements to the processes were coming through. When our customer was audited by the organization that handles the ISO certification, they were very impressed with how the quality system was being managed through Rational ClearQuest — our customer got a lot of praise there."

In the midst of the project, an independent reviewer appointed by a Canadian government agency audited the project office. "It was a kind of program management review," Martelli says. "It is a new policy for how projects are managed, so that they can track value against actual expenditures. In other words, they can say, 'We see you spent \$2 million, but did you get \$2 million worth of value from this project?' They have a checklist. Is there an issue's log maintained for the program? Is there a defect log being maintained for the program? Is there a change control log being maintained? Is there a risk management log? We met every requirement, and that was because of the Rational tool set. But what was more impressive to the reviewer was the fact that these logs weren't hard copies sitting on a shelf someplace. I would generate them on-line, and they would be up to date with that current day's activity."

Martelli's team also impressed the Agency's senior management by demonstrating a risk management system based on Rational RequisitePro and Rational ClearQuest. In this system, developers can flag technical requirements as high-risk or low-risk during their analysis. A project leader can then use Rational RequisitePro to filter out the low risk requirements and examine only those requirements rated as high risk or very high risk. Martelli notes, "You can then use RequisitePro to determine what your priorities should be. Once you've established that priority, then you can create a risk issue in Rational ClearQuest and create risk control actions and assign owners to those risk control actions. This really allows you to manage programmatic risk, and also get technical feedback from your development team on the technical risks. With Rational RequisitePro you can centralize that information, make it accessible, incorporate it into a plan and then tie that to Rational ClearQuest which controls your workflow."

The Agency had been using some Rational

tools in some departments, including Rational Rose, and Rational Apex[®] Ada, for Ada development. But, they were not necessarily employing them as an integrated part of their process. "The process that they wanted to have was there, but they didn't have the tools integrated into it to support it and enforce it." Martelli continues, "Here we've seen the value of process that's tightly integrated with the environment. It's a big conceptual leap for some people to make, in the sense that typically people see process being independent of tooling. To me, you cannot really leverage the benefits of the process unless you have the tools to support it. Nor can you improve on that process, unless you have tools to facilitate that as well. Once the process becomes something much more tangible, and you have the tools that enforce it, then change happens very quickly. With Rational, it's always going to be change for the better."

Bringing Home a Rational Solution

Considering the success that Lockheed Martin Canada has had with Rational on this project, Martelli and his integration specialist, Claude Mercier, are excited about the prospect of duplicating their success throughout Lockheed Martin Canada itself. "Lockheed Martin Canada has undertaken a similar exercise, where our Software Engineering Process group is reviewing our processes and looking to create an environment with a lot of capabilities. We're hoping that we can take what we've learned here and deploy a similar environment there," says Martelli. And Mercier adds, "Lockheed Martin Canada is driven by the fact that they want to get to CMM level three. Our belief is that with Rational's tools, it is much easier to achieve CMM level three. For example, Rational Rose allows you to model your processes easily, while being able to publish your model to a Web site accessible by your team and other stakeholders throughout the company. Rational SoDA allows you to easily generate documents from your Rational Rose model that can be used to capture and track requirements in Rational RequisitePro. With Rational ClearQuest you can implement a workflow associated with a process model and also implement a process

improvement capability. The Rational Unified Process provides the process management capability. And Rational ClearCase provides the needed version control for your models, requirement artifacts, and released products such as the customized Rational Unified Process."

The Big Picture

Over the years, Rational tools have contributed to the success of thousands of development teams. But rarely have such a wide range of Rational tools been deployed for such a unique purpose. Martelli and his team leveraged Rational Suite Enterprise's integrated tools and resources not to develop software, but to manage a project that would help another organization use those same tools to develop high-quality, mission-critical software, in less time.

Martelli, whose background is in software development sums it up best, "We looked at the Rational solution, not only to set up an environment where our customer could develop software to address their needs, we looked at the Rational solution for ourselves as a means of managing our program. We could capture requirements, identify risks, and place our work products under configuration control. And we could also do acceptance testing by verifying the particular process that utilized the Rational tool set. So we looked at the Rational products not strictly for software development. We looked at them for program management. Rational tools can address key areas for any development expert or development project. Whether the project is hardware, or systems integration, or strictly software, Rational products provide a capability that is available nowhere else."

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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