

DynamicOps VRM: Scaling Virtualization Up to the Enterprise

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A few years ago, Credit Suisse needed an enterprise software solution to streamline the management and deployment of its virtual infrastructure. Credit Suisse had turned to server virtualization to increase operational flexibility and reduce costs in selected business units and geographies, and in support of its business growth, needed to scale and manage its virtual infrastructure across the enterprise without being hampered by virtual machine sprawl or other management inefficiencies. Following a thorough assessment of potential third party solutions, Credit Suisse decided to build its own Virtual Machine Provisioning System, or VMPS, to resolve these issues and meet its growth requirements.

VMPS, which is now known as the Virtual Resource Manager (VRM), streamlines and automates the deployment and management of virtualized infrastructures, providing users with a self-service environment in which virtual machines – including a packaged server or desktop environment, applications and tools – are provisioned and maintained throughout their lifecycles. Designed and developed in a live, operational environment, VRM has been used in large-scale production at Credit Suisse for the past two years, giving it a level of maturity and capability that few other virtual infrastructure management products can match. VRM's pre-packaged virtual machine templates and automated workflows enable users to be productive "out of the box". At the same time, the product's open architecture facilitates customization of user profiles, workflows and policies, allowing the product to be tailored to the specific needs of any end-user environment.

VRM has enabled Credit Suisse end users and IT administrators alike to dramatically increase productivity, while significantly reducing both CAPEX and OPEX costs. Most importantly, the product has increased the company's nimbleness, allowing it to be more agile and competitive in its primary markets. As the development and marketing responsibilities for VRM are now spun off to DynamicOps, a separate company, we look forward to seeing other large enterprises benefit from the product, both in its current form and through a continuing stream of innovative releases in the future.

How to Scale Virtual Infrastructure – Without the Headaches

In the second half of 2005, the Credit Suisse IT team faced some major challenges - and opportunities - associated with server virtualization deployments across various parts of the company. Credit Suisse had aggressively but purposefully virtualized several hundred servers

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in four of its data centers around the world. In the process, the company had significantly increased server utilization, while reducing server hardware and associated capital expenditure (CAPEX) costs. Credit Suisse business units were running everything from .NET and Java-based development and testing tools to selected, production-level, investment banking applications on Microsoft Virtual Server and VMware ESX Server virtualization platforms.

But with several hundred users and a few thousand virtual machines already supported, Credit Suisse operational teams needed to scale their virtual infrastructure management processes to support a rapidly growing number of users and VMs, while avoiding virtual machine sprawl and related inefficiencies. The rapid adoption of server virtualization across the company had created a series of challenges and opportunities for both IT and business leaders. First, the IT teams needed to accelerate the provisioning and deployment of new virtual servers, in order to meet a large and steadily rising demand for VMs without creating a provisioning backlog. Though the adoption of virtualization platforms such as Microsoft Virtual Server and VMware ESX Server had helped to reduce server provisioning times, the increasing demand called for a new, more automated approach to virtual server deployment.

Second, as they planned their virtual infrastructure, the IT teams realized that they could not rely on existing processes to track and manage the growing number of virtual server and desktop environments throughout their lifecycles. They realized that as new VMs were being created, not enough would be retired, due to the sheer number of VMs the operational teams needed to track.

Third, in order to scale the virtual infrastructure without compromising quality, Credit Suisse IT teams recognized the need for a more automated way of ensuring the quality and consistency of new VM builds, and for measuring, controlling and accounting for resource usage by end users of the VM-based applications. This would also enable Credit Suisse operations teams to achieve even greater operating expense (OPEX) reductions from their server virtualization deployments.

Finally, Credit Suisse IT and business leaders together saw how a more automated approach to virtual infrastructure management would allow the company to significantly expand its business, likely at the expense of less nimble competitors. In order to remain a leading player in the highly competitive investment banking and financial services markets, Credit Suisse must bring product and service innovations to market faster than its competitors. In fact, the company has long relied on its superior IT agility and nimbleness as a competitive weapon in both established and emerging segments. A highly automated and flexible approach to scaling and managing its virtual infrastructure would enable Credit Suisse to more consistently out-innovate and out-manuever its major rivals.

To address these opportunities for increased operational efficiency and accelerated business growth, Credit Suisse IT and business managers took immediate action. The leadership team

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decided to invest in developing or licensing a software-based tool that would enable them to streamline the process of provisioning VMs and managing them throughout their lifecycles. The team first looked outside the company, and evaluated a set of virtual infrastructure management and automation products to determine whether any of them might fulfill the company's needs. The team assessed each of the candidate tools from the perspective of technical fit and cultural fit. At the time, management software packages supplied by the virtualization vendors only worked on top of each vendor's platform; required both training and experience to use effectively; and proved to be ineffective by themselves in automating management processes. In addition, none of the third party run book automation and orchestration products on the market came close to offering both the required suite of technical capabilities and the kind of service-delivery orientation that Credit Suisse would need to support and grow its business.

Following a rigorous assessment effort, the team concluded that no existing third-party products had the level of maturity, capability and cultural fit to satisfy its requirements. While selected third-party products possessed a number of mandatory features, in the end, none had the top-down design and architectural capabilities required to adapt the offering to each of Credit Suisse's service-oriented businesses. As a result, in late 2005, Credit Suisse decided that it would build its own virtual infrastructure management solution, which could be tailored to meet the company's specific business objectives and workflow needs.

Defining User Requirements

To address the dual opportunities for increased operational efficiency and accelerated business growth, Credit Suisse embarked on a project to define and develop an internal product called VMPS – the Virtual Machine Provisioning System. In anticipation of spinning out the development effort to a separate company that would offer the product to the broader market, the product was later re-named Virtual Resource Manager, or VRM (note: to avoid confusion, we will refer to the product as “VRM” in the balance of this paper).

To ensure that VRM fully satisfied Credit Suisse end users' business requirements, the company took an innovative approach: developers sat side-by-side with business users in designing and building the initial version of the product. This informal collaboration provided developers with day-to-day insights into the range of use cases and specific operational processes that the product would need to address. The approach also allowed for a more rapid, iterative development process, in which end users could try out new features as they were being built and provide developers with immediate feedback. This process, in turn, enabled product capabilities to be adjusted or refined on the fly to better meet end-user requirements.

From the beginning, the development team focused on building “mass customization” capabilities into VRM. What did this mean to Credit Suisse? To allow for efficient, “mass” deployments, VRM would need to scale effortlessly to accommodate the rapid growth of the

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business, in terms of numbers of users, machines and deployments, without compromising the quality, integrity or performance of the product. At the same time, VRM would need to be architected with a level of openness and flexibility that would enable the product to be customized for the diverse needs of Credit Suisse business units, including different processes, business and IT policies, and security profiles.

To achieve these dual design objectives, Credit Suisse incorporated three foundational design elements into the product - virtualization, automation and modularity:

- **Virtualization.** The management processes would need to enhance, not compromise, the strengths of the underlying virtualization platforms; and enable the organization to adapt culturally to a new, virtualized approach.
- **Automation.** Cumbersome and error-prone manual processes needed to be automated, which would have the additional benefit of freeing up IT and operational resources for other tasks.
- **Modularity.** A modular architecture would enable multiple benefits, including fewer dependencies in test & development; ease of packaging components for selective user access to particular data or capabilities; and clean, well-defined interfaces to support multiple underlying virtualization platforms as well as integration with existing management systems.

In addition to providing an open, scalable and modular architecture, the VRM product needed to meet the following requirements:

- **Powerful but flexible workflow.** The product would need to accurately model a large number of operational processes in Credit Suisse's various business units, and allow the workflows to be adapted over time in response to changing business needs.
- **Ability to more efficiently meet service level agreements (SLAs).** Credit Suisse wanted to streamline its ability to meet internal and external service level commitments, by speeding the execution of all the repetitive, operational tasks in its IT runbooks.
- **Prevention of virtual machine sprawl.** The product had to prevent the proliferation of VMs that were no longer active or useful.
- **Easy-to-use, self-service capability.** To effectively offload IT administrators, VRM would need to enable users to provision new virtual machines and manage existing ones, without the need for human intervention.

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- **“Out of the box” productivity.** Users needed to gain immediate value from the product, without the need for extensive training to “get up to speed”.
- **Secure access by authorized users.** Users would only have the ability to provision and manage those virtual machines and underlying system resources they had the rights to access.
- **Availability.** The architecture would need to support a high level of uptime for each of Credit Suisse’s businesses, minimizing both planned and unplanned downtime.
- **Accountability for resource usage.** To avoid the hoarding of physical resources, users would need to be held accountable for their usage of system resources, such as cpu cycles, memory and disk space.
- **Auditability.** The product needed built-in audit capabilities to ensure compliance with internal policies and external regulations.
- **Investment protection.** The product needed to preserve and exploit Credit Suisse’s investments in existing platforms and management tools, and be simple enough to be used effectively by the company’s current IT staff.

Finally, the VRM product needed to further increase the nimbleness and agility of Credit Suisse business units, enabling them to continue to out-innovate and out-execute key competitors in investment banking, private banking, and other financial and investment services markets. To build and maintain a leadership position in its key markets, Credit Suisse business units required a way to rapidly prototype and test new product and service concepts, without making large investments of time, money or resources.

The VRM Solution

To satisfy this rigorous set of enterprise-level requirements for an automated, virtual infrastructure management solution, Credit Suisse designed and developed the Virtual Resource Manager (VRM). This enterprise software solution streamlines and automates the deployment and management of virtualized infrastructures, providing users with a self-service environment in which virtual machines are provisioned and maintained throughout their lifecycles. VRM automates and accelerates the execution of repetitive provisioning and management tasks based on a set of pre-defined policies, thereby increasing productivity and improving a company’s ability to meet internal and external service-level commitments.

Now in its third generation, VRM has been used in large-scale production at Credit Suisse for the past two years, including deployments at four different data centers across multiple lines of business and geographies. The product has undergone extensive testing and use in

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conjunction with a range of business applications and services, ensuring a high level of product quality and integrity. VRM's development roots – on the floor of a production-level, investment banking environment – combined with its multi-year hardening in a live, operational setting, give the product a level of seasoning and maturity that few other virtual infrastructure management offerings can match.

VRM's open and modular architecture, as shown in Figure 1, allows the product to manage multiple hypervisors, such as Citrix XenServer, Microsoft Hyper-V and VMware ESX Server, as well as hosted and OS-based virtualization platforms, including Microsoft Virtual Server and Solaris Containers, with a common set of functionality. This protects and enhances Credit Suisse's existing IT hardware and software infrastructure investments, and allows each line of business the freedom to choose the virtualization platform that best meets its needs. The open architectural design will also enable new virtualization platforms to be supported – and functional modules to be added or updated – without impacting other components of the product.

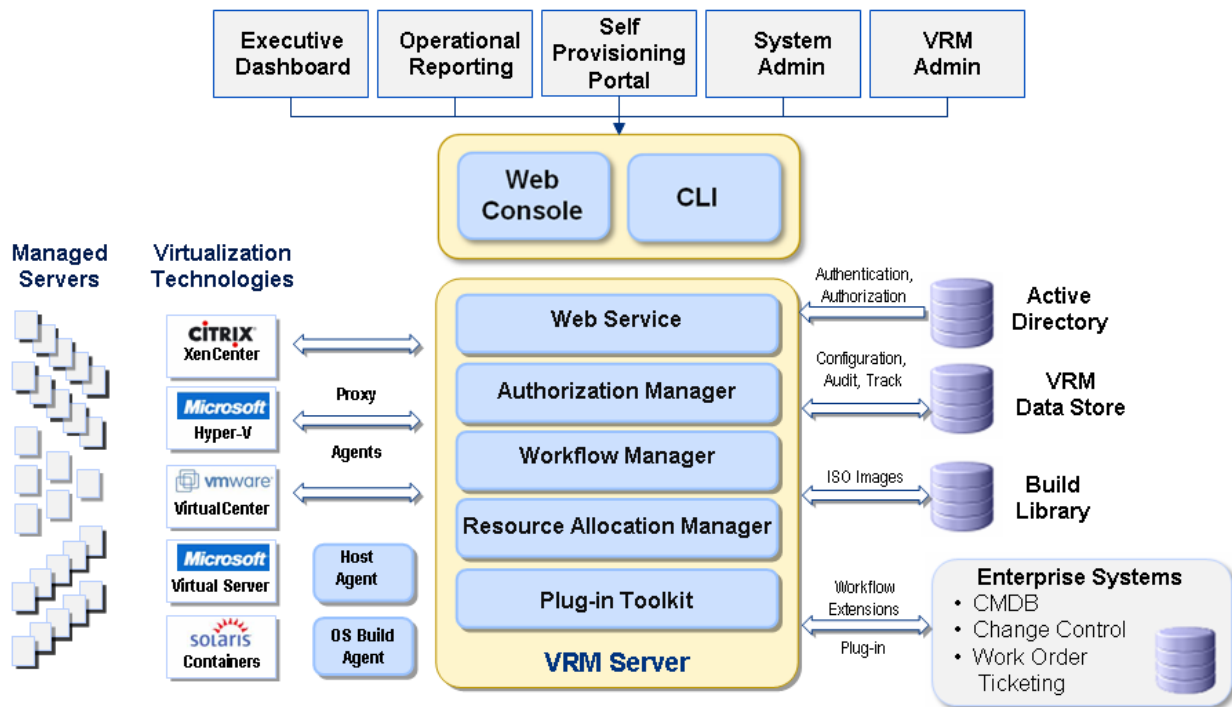


Figure 1: VRM Logical Architecture

VRM increases management scalability by federating across multiple virtualization managers, such as different VMware VirtualCenter instances. Thus, for example, in an environment running multiple installations of VirtualCenter, the product will automatically determine which VirtualCenter instance to use to provision a new virtual machine on a specific physical server. A

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single VRM installation can support a reasonably large enterprise environment, scaling up to hundreds of physical servers, thousands of desktops, and dozens of virtualization manager instances. Through VRM's executive dashboard and reporting capabilities, the product can also provide a unified management view across multiple VRM instances.

Based on Windows Workflow Foundation, the VRM workflow engine has the scalability and performance to model a large number of proven operational processes in Credit Suisse's various business units, along with the flexibility to readily adapt the workflows in response to shifts in business conditions or market needs. The workflow engine can lay out and control any event-driven, operational or management process that is currently performed by a mix of IT staff and other software, subject to constraints that are enforced by specific policies. Examples of such processes include virtual machine provisioning, resource allocation and reclamation, and updating of system status.

The workflow engine includes an open interface for integrating with other software applications, which may already provide optimized workflows for managing particular aspects of a company's virtual infrastructure. Existing IT management systems and configuration management databases can effectively be integrated with VRM, by creating plug-ins, extending workflows, and exchanging data via the use of the VRM data store. VRM provides specialized interfaces for .NET programmers, who can rapidly develop custom plug-ins for .NET supported applications and services. This open structure enables new workflows, including best-in-class third party offerings, to be quickly added and tailored to a company's own virtual infrastructure and management environment.

Once key tasks and activities have been defined and implemented in VRM as workflows, the product can automate these workflows based on a set of pre-defined policies, as illustrated in *Figure 2*. With this capability, VRM can automate the execution of any set of manual, repetitive tasks required to provision and manage a virtualized infrastructure, according to whatever set of policies have been set up to govern them. For example, when an end user requests the creation of a new virtual machine, the system first identifies that user's provisioning group, which can be uniquely defined for each class of user and line of business. The provisioning group dictates things like the amount of physical server resources that can be set aside for the VM; the virtual machine template that will be used to build the VM, including workflow policies, security profile and build profile (i.e. VM configuration properties); and the set of users who are authorized to manage the resources of that group. With all of these policies pre-defined, the system can quickly create and provision VMs for users, reducing the wait time to a matter of minutes, versus hours or days without VRM. Automated policy enforcement ensures that all of this happens in a high-quality and consistent manner, within the constraints established by IT management. This eliminates the errors and associated re-work that inevitably occur under a purely manual approach.

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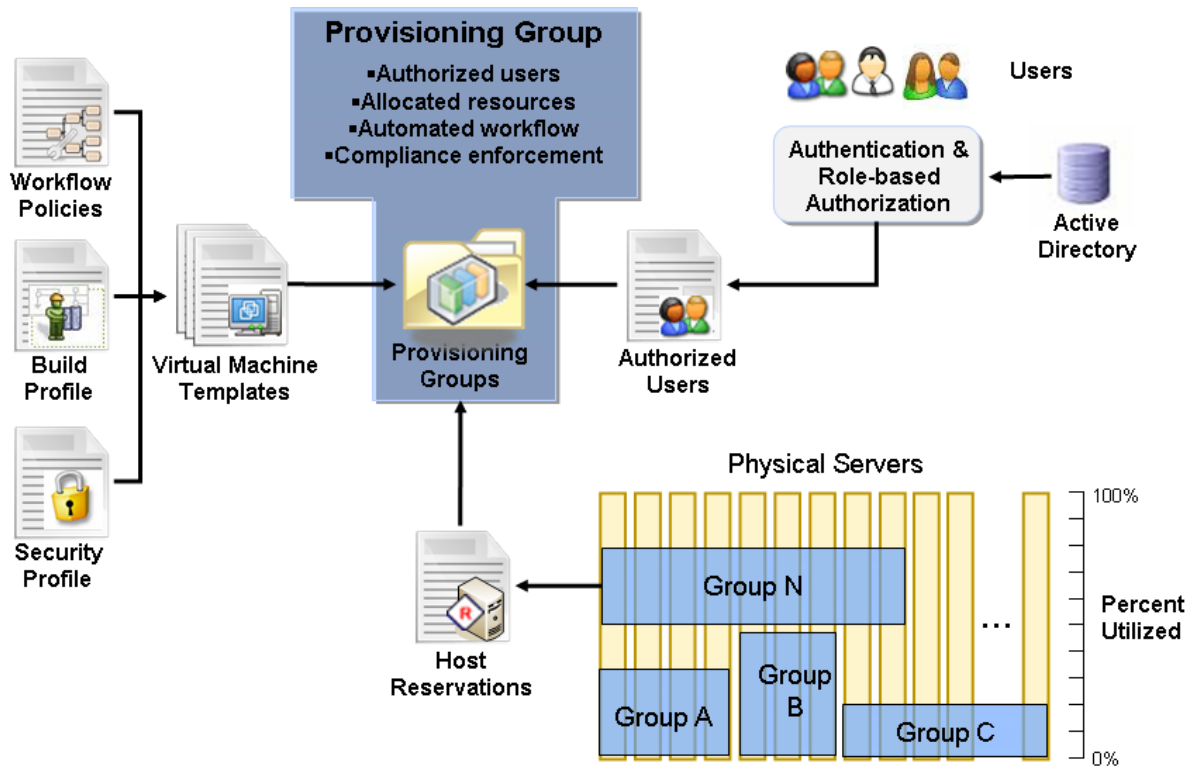


Figure 2: Policy-Driven Compliance

To further offload IT administrators, VRM includes an easy-to-use, self-service portal, which enables users to provision new virtual machines and manage existing ones, without the need for human intervention. The self-service portal empowers developers and users to instantly deploy the appropriate amount of virtualized infrastructure for as long as it is needed to design, test or run their applications. Together, VRM’s self-service portal and policy-driven automation improve Credit Suisse’s ability to more efficiently meet internal and external service-level commitments. This, in turn, increases the company’s agility and competitiveness, e.g. by reducing time-to-market for new or re-defined business/product concepts, and by enabling the company to more readily assess the risk associated with complex trading opportunities.

Once a VM has served its purpose and the allocated infrastructure resources are no longer needed, VRM decommissions the VM and reclaims the resources so they can be redeployed for other purposes. To prevent sprawl, each new virtual machine is given an expiration date, so that it can be retired once it is no longer needed for development or operations. Virtual machines that are abandoned, reach the end of their useful life, or otherwise outlive their usefulness are formally de-commissioned and eventually eliminated. This enables VRM to

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optimize resource usage and deliver an end-to-end virtual infrastructure management capability, as portrayed in *Figure 3*.

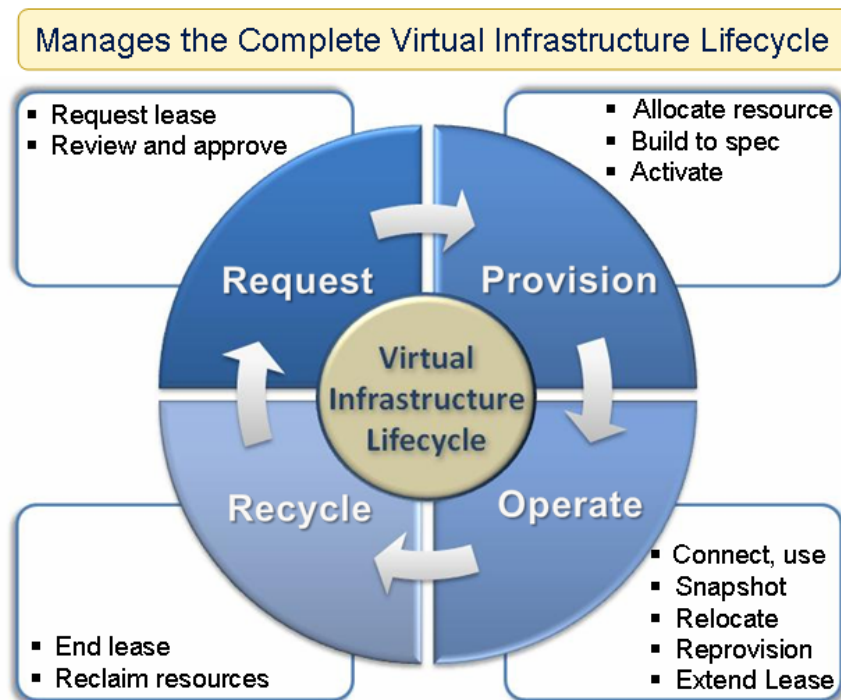


Figure 3: Virtual Resource Manager

In addition to these fundamental capabilities, the product comes with a set of features and capabilities that enable it to provide value from day one and to better complement or fit within companies' existing IT infrastructures:

- **“Out of the box” productivity.** Users are able to provision and manage virtual machines upon their very first experience with the product. The product comes with pre-defined virtual machine templates and task-specific workflows for a range of usage scenarios, such as the provisioning of servers and desktops, and the set-up and management of test environments. These pre-packaged VM templates and workflows can be cloned and customized for each line of business and user environment.
- **Secure, role-based access.** Strong authentication and role-based authorization ensure that only authorized staff members can access and manage resources in the product.

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- **High availability.** In the event of unplanned outages, the VRM architecture includes the redundancy and failover capabilities required to support a high level of uptime for each of Credit Suisse's businesses, with additional provisions to minimize planned downtime due to server maintenance and upgrades.
- **Accountability of resource usage.** Users can lease VMs for a specified time period, and once the lease expires, the VM is decommissioned and the lease is removed from the books of the user's entity. VRM tracks and logs the usage of system resources for each virtual machine, and enables users to in effect pay for their use of these resources through a built-in accounting capability. This feature will be further extended through integration with third-party chargeback systems.
- **Compliance with standards and auditability.** Automated, policy-based workflows ensure that all procedures are carried out in the same way across Credit Suisse business units and geographies, without the constant supervision of senior IT administrators. All events executed in a VRM workflow are logged in the VRM data store. This audit trail can be easily accessed by corporate reporting systems to ensure compliance with internal policies and/or external regulations, such as Sarbanes Oxley (SOX) or ITIL.

Sample Credit Suisse Usage Scenarios

Credit Suisse has deployed VMPS, now known as VRM, to overcome a number of IT and business related challenges. Among these usage scenarios are the following:

Server redeployment. Credit Suisse was planning to retire its physical MS Windows NT4 servers, by upgrading its NT4 production workloads to Windows Server 2003 based systems. IT managers responsible for this transition faced a common dilemma: how to test and stage the Windows NT4 application environments on new Windows Server 2003-based server hardware without disrupting production processing on the existing NT4 servers. In the pre-virtualization era, the company would have needed to purchase additional hardware for this purpose, which would have been quite expensive from a CAPEX standpoint. Even with server virtualization, a manual approach to testing and staging the upgrades, which would require building VMs by hand, could become a nightmare. With more than 10,000 NT4 servers in house, the building of VMs using custom scripts would be prone to administrative error, and would not scale to enable the upgrades to happen in a reasonable timeframe. Unfortunately, these options for retiring the NT4 servers were inflexible, labor intensive and costly.

With VRM running on top of a virtualized server infrastructure, the task of retiring the Windows NT4 servers became relatively routine. The IT team created and provisioned virtualized Windows Server 2003 test environments, using pre-defined templates with the same underlying configurations and mix of application workloads as the production systems.

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When test engineers discovered a problem, they would take the time to fix it, and then come back and start the process all over again. VRM's templates and automated provisioning assured that VMs were configured the same way for each iteration, providing IT teams with an identical, repeatable test environment without having to rely on scripts and manual processes. Once testing was successfully completed for each server, the team discarded the test VMs, and over the following weekend, rebuilt the physical machines to host the new Windows Server 2003 applications environment. This approach greatly reduced the risk of retiring the NT4 servers and accelerated the process by many months. VRM not only reduced hardware costs, but significantly reduced operational costs as well. In the end, this massive, corporate-wide retirement of NT4 based machines would not have been possible without the use of VRM.

Deploying and managing desktops in remote offices. As a leading, global financial services company, Credit Suisse has development and production operations in major financial and trading centers around the world. Credit Suisse's IT organization is responsible for ensuring that its bankers, traders and other professional staff at each location have access to the best possible infrastructure and set of applications to do their jobs effectively. Given the logistical issues of deploying, managing and maintaining remote infrastructure, this responsibility can be quite daunting.

IT managers identified two significant infrastructure-related challenges to running applications in remote offices that could not be addressed cost-effectively by using traditional approaches. In the first instance, Credit Suisse employees and contractors in the Singapore office needed to run a set of production-level, back-office settlement applications that were designed to run on local PCs. Unfortunately, the large datasets of these legacy applications made them quite chatty, which prevented them from running well on high-latency networks. At about that same time, Credit Suisse was planning to open a new "Center of Excellence" in India, which would house remote developers supporting some of its back-office applications. This center faced the prospect of doing its own builds on local machines for development and testing, a process that promised to be resource-intensive and produce inconsistent system images. In both situations, a lack of local infrastructure and IT resources threatened to undermine workers' productivity.

To address these challenges, the company considered several alternatives for meeting the application needs of the local teams. First, to address the issue in Singapore, the company could modify the applications to make them run better on a network of PCs, but this would be technically difficult and time-consuming. Second, the company could set up physical PCs to host the needed applications in its London data center, and have workers in Singapore and India log in and work remotely on the appropriate machines. However, this would require large amounts of space, and would also violate the IT team's rule of not housing PCs in its data center.

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So Credit Suisse IT architects came up with a third alternative: adapting the applications to run on virtualized servers, which would be managed by VRM in the London data center. The company provided employees and contractors in these two locations with remote access to applications hosted on virtual infrastructure in London, using protocols such as RDP and ICA, and deployed VRM to build, provision and manage these virtual desktops. Once VRM was set up, control could be delegated locally, where workers could use the self-service portal to request, provision and operate their virtual desktops based on pre-determined policies. This approach ensured strong application performance as well as high-quality, consistent builds, which could be provided to users within minutes of their request. By accelerating IT service delivery, this solution also made remote workers more productive, while reducing overall administrative costs.

Adopting a new development process. Credit Suisse was planning to move its 3,500 Windows developers to an agile development process, to accelerate time-to-market and improve overall efficiency. But the existing infrastructure and operational management processes were not flexible enough to easily support this transition. In an agile development approach, new builds are created, compiled, tested and integrated on a frequent, iterative basis, requiring rapid provisioning and flexible management of virtual machines.

To support this initiative, Credit Suisse deployed VRM to enable developers to provision and manage their own virtual machines through a self-service portal. VRM's automated workflow, in combination with the self-service capability, dramatically streamlined the provisioning and management of development and test builds, thereby enabling a smooth transition to an agile development approach. The use of VRM in conjunction with the company's Source Code Management (SCM) system ensures that developers get clean and consistent images every time. As a result, Credit Suisse has reduced the time-to-market for its Windows-based products and services, while boosting developer and IT productivity.

Accelerating risk analysis of new business opportunities. Credit Suisse wanted to expedite the risk analysis of new trading opportunities in one of its investment banking groups, to increase its agility and competitiveness. In order to beat out potential competitors, the company needed to perform the risk analysis quickly, but did not have the compute infrastructure immediately available to support this effort. In particular, the risk analysis team would not have the use of workstations in the data center, which would have gone against Credit Suisse IT policies.

To address this issue, the team turned to VRM to help it set up and expand a virtual compute grid that would serve as the platform for the analysis effort. The risk analysis of a set of complex trading opportunities was run on Excel/XP across multiple virtual machines, which were set up, provisioned and managed by VRM as needed, and then de-commissioned at the end of the exercise so that the resources could be re-deployed for other purposes. With this automated approach, the Credit Suisse team set up the compute grid in a matter of hours,

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versus the weeks it would have taken to set up manually on physical machines. The risk assessment calculations themselves took just 2-3 hours on the virtual compute grid, versus the 8-12 hours they had taken in the past. By accelerating the analysis into an intra-day window, Credit Suisse was able to take on more aggressive trades and increase its competitiveness. Ultimately, this innovation contributed millions of dollars of incremental revenue to Credit Suisse's business. This successful outcome would not have been possible without VRM to selectively deploy and manage the virtual infrastructure needed for the risk analysis activity.

Servicing unanticipated peaks in demand. Credit Suisse has had the opportunity to take on new business that has come its way due to the troubles or failures of some of its large, investment banking competitors. But in order to take on these new deals and new accounts, the company has had to ramp up its IT infrastructure to service the business, sometimes with only a few days' notice. In one instance, Credit Suisse needed to immediately expand its back-office systems to support a three-fold increase in trades per hour. In another example, a single customer brought trading volume that required a business unit to increase its systems capacity by ten-fold in just one week. Clearly, Credit Suisse could not have responded to these opportunities by manually re-deploying physical assets. Instead, the company needed an automated approach to set up, provision and manage the required level of incremental infrastructure within these very short lead times.

So, Credit Suisse again turned to VRM to get the job done. Using VRM, the IT team quickly identified spare capacity, shut down unneeded development machines, and redeployed unused and unneeded machines for production use. The increased agility and versatility of VRM has helped Credit Suisse to rapidly and dynamically service unplanned peaks in demand, allowing it to take on lucrative new business opportunities without compromising quality of service or impacting its other business.

Though these are just samples of Credit Suisse's internal deployments of VRM, they demonstrate the power and versatility of the product in overcoming a variety of IT and business related barriers, thereby improving both the company's competitiveness and bottom line.

Key VRM Differentiators

Taken together, the following set of attributes and capabilities set DynamicOps Virtual Resource Manager apart from other virtual infrastructure management offerings on the market:

Open architecture. VRM's open and modular architecture enables support for all the major virtualization platforms and associated management products, allowing the product to serve as the overarching management application for heterogeneous virtualized environments. This is important, since most medium to large data centers are expected to support a mix of at least

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two different hypervisors or OS-based virtualization platforms in the years ahead. VRM's open architecture also facilitates integration with other leading enterprise management systems, such as configuration management databases (CMDBs), change control, chargeback, and work order ticketing products. This allows end users to readily integrate VRM with existing applications and to leverage the capabilities of other "best in class" systems that are focused in particular areas.

Powerful, customizable workflow. Early in the development of VRM, Credit Suisse decided to standardize on Microsoft Windows Workflow Foundation, rather than develop its own workflow engine. Over the years, Credit Suisse has provided Microsoft with specific feedback and enhancement requests, which have resulted in improvements to scalability, performance and transaction handling in the product. This collaboration has enabled Credit Suisse to benefit from Microsoft's ongoing investments in enhancing and supporting the workflow product, which is now among the most competitive on the market, and has freed up Credit Suisse developers to focus their energies in other areas. The VRM workflow engine enables existing workflows to be extended and new workflows to be added via plug-ins, so that workflows can be better tailored to a company's existing business and operational processes. While some other virtual infrastructure management suppliers must invest in developing their own workflow modules, Credit Suisse and its VRM software spin-off, DynamicOps, will enjoy the fruits of Microsoft's innovations in workflow technology.

Operational roots and production hardening. VRM's genesis and early development – on the floor of a production-oriented investment banking environment – provides it with strong operational roots that few other virtual infrastructure management products can match. VRM's multi-year use in Credit Suisse production settings give it a level of reliability and maturity that would usually only be found in the third or fourth generation of an enterprise-class software product.

Ease of use and administration. Though other virtual infrastructure management offerings also come with a self-service portal to empower users and a visual dashboard to ease administrative tasks, few come with the range of pre-packaged virtual machine templates and workflows that are included in VRM. These pre-defined, out-of-the-box templates and workflows, which have been proven in production use at Credit Suisse, allow users to be productive with VRM from day one. The simplicity of VRM administrative interfaces have another benefit: the product can be administered by a company's existing IT staff, precluding the need to bring in personnel with a more advanced skill set.

Taneja Group Opinion

The Virtual Resource Manager (VRM) has brought significant value to Credit Suisse along multiple dimensions. VRM has helped the company to avoid the sprawl that typically results from the rapid adoption of server virtualization, and has fully automated the provisioning and

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management of virtual desktops and servers. The self-service portal empowers developers and users to immediately deploy the appropriate amount of virtualized infrastructure for as long as it is needed to design, test or run their applications, after which time the resources are reclaimed and redeployed for other purposes. This liquidity and fluidity of resources – including the ability for “right-sized” chunks of infrastructure to be instantly deployed and re-purposed on demand – is at the heart of the vision of the dynamic datacenter.

In the two years that Credit Suisse has used VRM, the company has realized enormous benefits. By providing infrastructure resources on demand, VRM has significantly increased the productivity of Credit Suisse developers and end users alike. The product’s automated workflow, driven by pre-defined policies, has offloaded IT staff, while ensuring that resources are allocated correctly and where they are needed most. Credit Suisse has reduced both capital expenditures (CAPEX), by using virtualized machines in place of physical hardware; and operating expenses (OPEX), by saving on the space, power and cooling costs that physical hardware would have required. One striking example: by deploying virtualization and VRM, the company has succeeded in retiring hundreds of machines that previously sat under workers’ desks throughout its major offices. But VRM’s most compelling benefit is the increased level of agility and competitiveness the product has enabled, which in one instance has translated to a revenue windfall for the company.

VRM’s open architecture, operational roots, and proven use in production environments help to set it apart from other virtual infrastructure management products on the market. Looking ahead, VRM has the pedigree and technical foundation to allow it to participate in the next-generation, dynamic data center, in which all IT resources – cpu, memory, storage and networks - are virtualized, managed and orchestrated as part of a single, unified fabric, and available to users on demand. In the meantime, we believe that VRM, under the auspices of DynamicOps, has the potential to provide many other large enterprises with the kind of value it has already delivered to Credit Suisse. We look forward to seeing VRM grow in both technical capability and customer adoption over the months and years ahead.

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