IT CLOUD MANAGEMENT MARKET LANDSCAPE

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In this report, Taneja Group presents an evaluation of the current IT Cloud Management market landscape for enterprise customers. We look at this landscape as an evolution of IT operations management grown up into the cloud era. In addition to increasingly smart and capable operational monitoring and systems management, good cloud management also requires sophisticated capabilities in both automation and orchestration at scale to support end-user provisioning and agility, and detailed financial management services that reveal multi-cloud costs for analysis and chargeback or showback. Our objective is to evaluate cloud management offerings from leading vendors to enable senior business and technology leaders to decide which vendors offer the best overall solution.

In this study, we evaluated vendors with offerings in one or more of the three fundamental areas. Several well-known vendors (VMware, Microsoft, ServiceNow, HPE, IBM and BMC) have solutions in all three areas. Other vendors focus on only one or two areas, and because it's possible to compose a broader solution from parts, we've evaluated popular niche solutions within each area. All companies were required to have solutions that were generally available as of April 2016. To fairly assess the offerings, we looked at a set of differentiating factors in each of the categories that we believe enterprise customers should use to qualify cloud management solutions. As a final step, to facilitate optimal enterprise selection, we also evaluated the full solution vendors at a higher level where we looked at additional value derived from integrations across areas and other important enterprise vendor engagement factors.

Within each of the three areas that we will refer to as Cloud Orchestration, Operations Management, and Financial Management, and at the vendor level for full-suite vendors, we've applied categories of factors for scoring as determined by our team of experts, based on customer buying criteria, technical innovation, and market drivers. The overall results of the evaluation revealed that VMware has a strong lead in today's competitive cloud management landscape.

The Cloud Management Market: Ranking of Full Suite Solution Vendors
(4 = Highest Score; 0 = Lowest Score. Harvey Ball scores rounded down to nearest whole number.)

Evaluation Scores	VMW	MSFT	SVN	HPE	IBM	BMC
Cloud Orchestration	3.9	2.5	1.5	3.1	2.8	2.6
Operations Management	3.6	2.4	1.1	3.0	2.4	3.5
Financial Management	3.8	3.5	2.5	3.3	1.3	1.8
Vendor/Platform Criteria	3.3	2.5	2.8	2.3	2.3	2.8
Summary Score	**3.7**	**2.7**	**2.0**	**2.9**	**2.2**	**2.7**

Legend: VMW=VMware, MSFT=Microsoft, SVN=ServiceNow, HPE, IBM, BMC

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We show in Figure 1 a visual of our detailed evaluation results for full-suite vendors mapped onto an assessment of Platform Breadth versus Offering Strength. Platform Breadth accounts for well-implemented capabilities only – checkbox or complex third party integrations were discounted. Offering Strength is essentially our summary evaluation score (above) that includes both functional and vendor-level criteria. This holistic view of the market illustrates that competition is fierce, as these strategic players have delivered significant portfolios to offer complete IT cloud management solutions. Even though most solutions are in the top right quadrant and can deliver deep value in many areas, there is still obvious differentiation between offerings.

As IT cloud management matures into a well-defined set of enterprise capabilities, we find VMware is well-positioned with its enterprise grade platform, market-defining innovation, expertise and vision, and a capably deep and broad solution built expressly to simplify IT over an ever growing scope, scale, and level of sophistication. This did not happen in one step, rather it is the result of years of development and acquisition, yet unlike many of its other landscape competitors the VMware vRealize Suite is a coherently focused solution consisting of three integrated components addressing automation, operations and financial management. Architecturally, unlike many other vendor solutions, it doesn't look like spaghetti thrown up on the wall – and that directly translates into lowered OPEX. VMware has executed effectively towards a common architectural and management framework centered around the IT admin who, as the data center marches towards an inevitable hybrid cloud future, is required to mature from a silo focus to virtual data center administration and cloud management.

Many of the solutions evaluated in this report have grown organically over time, and are feeling their legacy weight in this new era of cloud scale automation, hybrid operations, and new economic models. Most of the larger vendors have embarked on a program to build newer, simplifying front-ends, but these are by and large a work in progress, often dragging much legacy wiring and componentry along to fill in all the required functionality. For customers long invested in a particular vendor's management solutions, these efforts may provide some hope of a "layer up" way to add cloud level functionality, but as this evaluation underscores, all complexity and friction at the cloud level of operations needs to be eliminated. This will continue to be a hard if not impossible task for management vendors not completely focused on cloud management.

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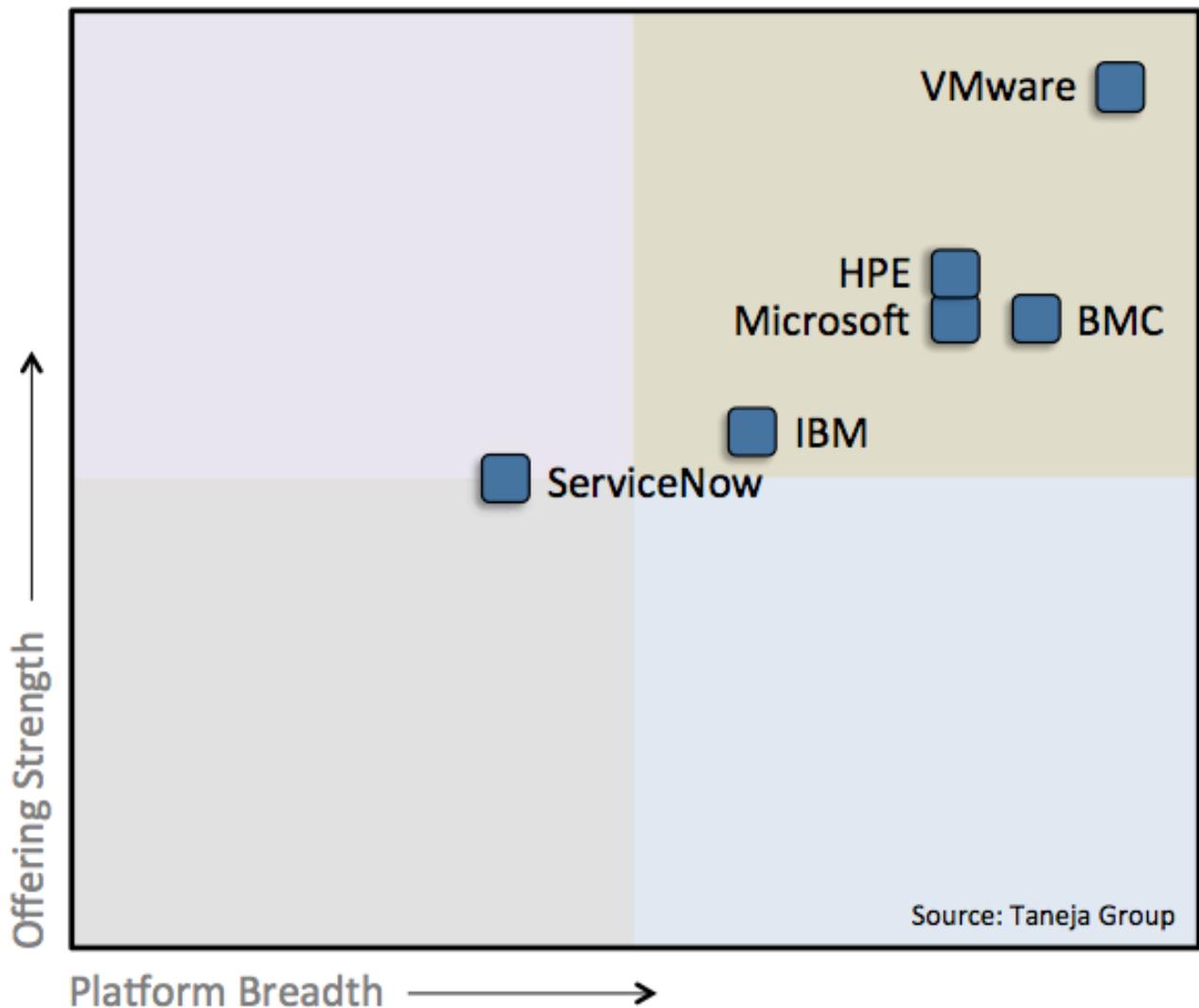## Evaluation of Cloud Management Suites for Enterprises

Figure 1: The Cloud Management Market Vendor Landscape: Platform Breadth vs. Offering Strength

Key Takeaways for IT and Business Leaders

While the detailed sections of this report go into significant depth evaluating the various cloud management offerings, here we present some key findings we've noted during our analysis. There are seven overall takeaways, plus three for each functional area of evaluation.

Overall Cloud Management Takeaways

- **Cloud service advancements continue to outpace cloud management.** The growth and sophistication level of both public and private cloud technologies and services has outrun the tools and capabilities available to manage them. Cloud management vendors and service providers are already playing catch-up, and given the continuing rate of innovation in IaaS

and PaaS capabilities, cloud management functionality will continue to lag user needs for the foreseeable future. Given this reality, look for vendors with a track record of cloud innovation, a strong product portfolio and an overall strategy that will allow them to deliver a cloud management framework capable of meeting the needs of your business over the long term.

- **Comprehensive cloud management platforms are rare.** Look for cloud management solutions that are integrated across operations, automation and business disciplines. This is a rare capability in the market today, but will be critical going forward in providing you with a holistic cloud management solution. Without robust built-in integration and a common look and feel, you will be dealing with a set of fragmented point tools that you'll have to stitch together or simply use independently. Ask vendors to demo their full cloud management suite – if a vendor can't show you how their various solution modules work together, then you probably won't find it easy to deploy and manage their full product suite due to overwhelming complexity.

- **Proprietary interests often dictate vendor priorities.** Despite what vendors may say, most cloud management toolsets are developed and optimized for particular platforms, versus designed for cross-cloud environments. For example, Microsoft cloud management is specifically designed for Azure clouds with Hyper-V and HPE cloud management for HPE's flavor of OpenStack clouds. Demand cross-cloud and cross-provider portability and management capabilities wherever possible, and ask prospective vendors how their cloud management suites will help you prevent lock-in.

- **Lack of standards makes cloud interoperability a challenge.** The lack of cloud portability and cross-cloud management standards makes it difficult for vendors (incl. cloud service brokers) to effectively manage resources across multiple flavors of clouds. (OpenStack is an attempt to standardize, but even some different OpenStack cloud implementations cannot effectively interoperate, as vendors add proprietary enterprise functionality to their own OpenStack-based clouds.) Query your vendor/provider on their workload portability and management capability across different clouds to ensure their offerings will meet your needs.

- **Hybrid cloud management is still a work in progress.** In general, hybrid cloud management—even on a single vendor's platform spanning on-premises and external clouds—is still a work in progress. Few offerings enable unfettered workload mobility, consistent resource management and costing, and compatible automation frameworks across public and private cloud boundaries. Focus on vendors that can deliver these capabilities today and into the future.

- **Prioritize offerings that enable you to manage highly distributed apps.** The shape of cloud management is largely driven by the applications that run in the cloud, and will be especially influenced by the new breed of cloud-architected microservices that are already dominant on the world's leading hyperscale clouds, such as Amazon, Facebook and Google. Given this, prioritize offerings that will enable you to effectively manage highly distributed apps in a hybrid cloud infrastructure. Ask vendors about their native cloud app development and DevOps capabilities to ensure that they can support the agility and mobility that will characterize cloud workloads going forward.

- **Cloud management is a relatively nascent market**. You should therefore expect a steady wave of consolidation of both vendors and technologies going forward. For example, just as IBM acquired Gravitant last year, other cloud platform vendors will be looking to buy independent players such as cloud service brokers to extend or fill gaps in their offerings. Evaluate prospective vendors with that possibility in mind, including the risk that acquired

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companies or technologies may not remain vendor-agnostic, and consider the impact that such consolidation might have on your supported cloud management frameworks and capabilities over the long haul.

Cloud Orchestration Takeaways

- **Demand flexible self-service and deployment options.** When it comes to selecting and provisioning cloud applications, there is no "one size fits all" approach that works best for every organizational need. Therefore, choose a vendor that offers a personalized self-service experience and hybrid cloud deployment options. Vendors should offer a self-service portal with an app store look and feel where business groups can quickly find, configure and request both vendor and third party services according to their needs. Vendors should also embrace hybrid cloud environments by providing out-of-the-box deployment to all major cloud services as well as assistance with workload placement decisions – look for cloud brokerage services that go beyond basic cloud cost comparisons to provide true "best fit" recommendations based on a full range of criteria.

- **Insist on application template functionality that goes wide and deep.** Given the numerous application types and build scenarios, you need application templates and a unified design canvas that provide orchestration for both simple and multi-tier application stacks. Template tools should enable integration with third party systems for end-to-end automation and access to an extensive library of out-of-the-box components and workflows to fast track the creation of standard services.

- **Orchestration and Operations Management solutions should work well together.** Many IT administration tasks require resource visibility and pinpointing issues before you can take action and automate remediation or recovery and optimization processes. For this reason, you need seamless integration between monitoring and orchestration tools; otherwise you are often left doing manual tasks that bridge the two worlds.

Operations Management Takeaways

- **At cloud scale and speed of IT operations, avoid stretching or deploying mix-and-match solutions.** Each disparate component, each integration required, each vendor included introduces complexity and friction, ultimately increasing OPEX. Beware of single panes of glass that are only lightweight dashboard fronts for multiple disparate toolsets. Open extensibility and validated plug-ins are great, but they also add complexity and variation. Too many third party plugins can sometimes overwhelm an otherwise simpler solution.

- **The facilitated analysis of unstructured data, machine data, and end-to-end log files is now a "must have" in IT operations**. Comprehensive logfile indexing and search solutions accelerate numerous IT investigative and reporting based tasks, provide immediate drill-down insight from the more structured event management components, and even directly can now generate sophisticated query-based proactive alerts/events. Look for search analytics solutions designed specifically to ease IT OPEX activities and that can be leveraged to generate predictive alerts.

- **Success with cloud operations depends on completely managing lifecycle workflows.** Look for solutions that are fully integrated and pass/share critical information back and forth in-band between activities. In cloud management, data from planning activities should inform operational alerting, and provisioning actions and operational service delivery metrics should

feed into costing. Automated policies should help drive and constrain each activity coherently as well. Old-school, manual hand-offs between capacity planning, operations centers, and admins will not cut it at the speed and scale of cloud activities.

Financial Management Takeaways

- **Look for vendors that embrace both cloud and traditional financial management.** Enterprises can benefit tremendously from cloud services but many IT resources and services are not cloud based. For example, facilities, consulting fees, service desks and physical infrastructure resources. As a result, vendors must deliver financial management that equally embraces both traditional IT resources and private/public cloud services to deliver a unified cost model and analytics that provide maximum transparency and full optimization of your entire computing landscape.

- **Cloud service brokers may not be optimized for your cloud environment.** Independent cloud service broker companies do some things very well, but their offerings are typically reliant on information from platform vendors' element managers (e.g. VMware vCenter), and they invariably can't be optimized for particular brands of virtualization or cloud platforms. If you consider these vendors, ask them to show you how well their features address your private and public cloud platforms of interest.

- **Cloud management vendors need better decision support.** Cloud management vendors with financial management solutions offer analytics that provide good cost and consumption visibility, but too often intelligent workload placement and financial planning functionality falls short of expectations. To deliver resource optimization in increasingly complex and ever expanding multi-cloud environments, vendors should take a look at cognitive computing and big data solutions that offer self-learning based on data mining and pattern recognition. These techniques can provide advancements in decision support by offering you insights you would find hard to recognize using customary dashboards and reports.

GUIDE TO THE CLOUD MANAGEMENT LANDSCAPE ASSESSMENT

Our comparative evaluation of the enterprise cloud management market landscape is divided into the following main sections:

- **Market Description and Vendor Landscape.** As a market overview, we describe the Cloud Management market, discuss primary market drivers, and then briefly describe the broader solution vendor landscape covered in our analysis.

- **Vendors and Solutions Evaluated.** In this section we outline each of the solution areas, our vendor selection criteria, and the vendors and solutions we have evaluated within each category.

- **Solution Area Evaluations.** In each solution market space we comparatively score the vendor offerings for each specific evaluation category, and then discuss our rationale for the scores we have given in each category, based on how each vendor's solutions stacked up against our detailed evaluation factors.

    o **Cloud Orchestration**
    o **Operations Management**
    o **Financial Management**

- **Full Suite Platform/Vendor Evaluation.** We then roll up scores and assess additional vendor-level criteria for those vendors offering end-to-end cloud management to get a platform level score.

MARKET DESCRIPTION AND VENDOR LANDSCAPE

IT Cloud Management

The IT Cloud Management market has matured well beyond its early days when it was simply considered an extension to existing traditional operational monitoring tools. In turn many of those tools were first developed to keep tabs on complex network implementations and then extended (some might say "bloated") over time to encompass silos of disparate infrastructure elements. But today's datacenter infrastructure has modernized through waves of infrastructure virtualization at every level, increasing convergence and lately, software-defined enabled journeys. Many of those old-school management solutions, although sometimes heavily invested in and grown over time with additional components with newer capabilities, are struggling to deliver effective operations in an increasingly agile, cloud-oriented IT market.

If the datacenter is evolving towards an inevitable hybrid cloud vision, today's IT staff are likewise well on their way to becoming "internal" service providers to their business "clients". These transformative cloud-based changes are helping IT become far more than a necessary administrative cost center. Enterprise IT today can become a true business partner and a revenue accelerator. However, managing IT as a service requires a change in how IT approaches management and in particular the kinds of management solutions required.

The classic operations team collected and processed all kinds of events, responded reactively to preset alarms, struggled to find root cause, and remediated as quickly as possible – often with labor-intensive approaches. Today's IT needs to be able to operate at a much higher speed and scale requiring tools that can optimally focus their attention and prioritize activities (e.g. within a single environment driven by intelligent KPI's). They need to leverage scarce time (and rare expertise)

through reliable automation and powerful orchestration support. To be agile they need to build reusable templates and composable blueprints rather than treat each new request as a unique project. If IT wants to be partners with their business clients, they need to offer service provider economics complete with self-service, QoS guarantees, predictable utility costing and a competitive cost.

In other words, IT operations in world-class organizations are rapidly evolving from "just keeping the lights on" to "how to best deliver IT as a service (in all respects)". In this evaluation we've therefore looked at IT Cloud Management as a cohesive, and increasingly converged, set of capabilities that includes automation and orchestration, operations management, and financial management.[1]

Solution Vendor Landscape

At a high level the IT Cloud Management market landscape divides into two main camps – vendors offering a full end-to-end suite (or platform with a matrix of portfolio products) that can be deployed as a single vendor solution, and niche vendors that offer solutions in only specific areas within cloud management.

Generally the full suite vendors are larger, more mature and have other IT solutions in their portfolios. Their solutions are battle-tested, and often are the result of years of development and best-in-class acquisitions, and have both extensive services support and established partner ecosystems. However, because these solutions have been developed over time there are legitimate concerns with legacy approaches being applied to new IT challenges, increased solution complexity to integrate, deploy, support and operate, and mounting licensing costs.

The description of "traditional data center systems management vendors" usually refers to the historical "Big 4" of IBM, HPE, CA, and BMC. Newer systems management vendors often smear these vendors with the "legacy" moniker, yet we note in this evaluation that several of these vendors are not selling the same solutions they sold even 10 years ago and are constantly updating and revising their portfolios (e.g. CA moving more towards agile development and service provider solutions and away from cloud management platforms).

We think it more useful here to consider the full suite vendors as sub-dividing into three main camps – IT systems management focused vendors, vendors of popular hypervisors and/or clouds, and full stack IT vendors that sell software, hardware, and everything in-between.

- **IT Systems Management Vendors** – These vendors are focused on systems management, betting that customers will prefer independent, infrastructure agnostic solutions (e.g. BMC, ServiceNow).
- **Vendors with Hypervisor/Cloud Offerings** – These vendors have virtualization or cloud solutions that provide them with intimate knowledge of what needs to be managed and how, as well as the opportunity to integrate management directly into the larger cloud stack (e.g. Microsoft, VMware, Red Hat).
- **Full Stack IT Vendors** – These large IT solution providers have catalogs of solutions covering the entire IT space giving them an advantage as a single vendor source, but also raising concerns about legacy approaches, vendor lock-in, and pace of innovation (e.g. IBM, HPE).

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[1] It is important to keep in mind that while out of scope of this evaluation, every IT management discipline (e.g. security, disaster recovery, data governance) must also take up the challenges of the new cloud-centric datacenter.

Compared with full suite vendors, niche vendors are smaller but largely seen as more entrepreneurial and innovative within their respective areas. Some enterprise IT organizations will seek out new disruptive technologies that can give their organizations an edge over their competition. However, the enterprise adoption of niche solutions literally increases the number of vendors IT must deal with causing greater costs for support and services, integration complexity, staff training and expertise. Moreover, enterprises are well aware that as startup niche vendors demonstrate success, they are often acquired and folded into the larger full suite vendors, and many will therefore wait for that event before then investing with the more established acquiring vendor.

Note that some vendors like Red Hat and Cisco fall between these descriptions. Red Hat is a vendor with its own Hypervisor/Cloud offerings and is quickly assembling a comprehensive management suite out of the multiplying open source tool space they live within. Cisco has designs on becoming known more as a Full Stack IT Vendor, with recent acquisitions and partnering extending their networking leadership and UCS servers with storage and hyperconverged solutions.

We also note another interesting division emerging in the market – that between on-premise deployment and SaaS based management (remote cloud hosted services). ServiceNow, for example, is SaaS based, which provides certain customer advantages in scalability, agility, pace of innovation, and lowered tool support and operations OPEX. Yet SaaS management has some challenges to prove out in terms of reliability, ultimate security, and even long-term cost.

We see many on-premise vendors now offering parts of their cloud management solutions as-a-service. Microsoft, for example, has OMS delivered as SaaS, but layering on on-premise SCOM implementations. BMC and HPE also both offer SaaS-based logfile analysis solutions, no doubt calculating that big data analytics are easier to deliver and consume as cloud-hosted services. In the broader IT management market, we see multiple startups offering different pieces of IT management as remote cloud services (e.g. asset management, help desk, storage management). We expect that many if not all on-premise solution vendors will come to offer cloud-hosted SaaS management options across most of their portfolios as a SaaS management model becomes more widely accepted by enterprise customers.

VENDORS AND SOLUTIONS EVALUATED

Vendor Comparative Categories

To organize our analysis and facilitate accurate comparisons with various offerings, we have grouped solutions into three main market segments:

- **Cloud Orchestration –** Multi-platform Support, IT-as-a-Service, Template Support, Template Networking Coverage, Policy-based Orchestration/Integration, Automation Resiliency, Discovery and Ease of Deployment and Automation Extensibility.

- **Operations Management –** Monitoring Coverage, Performance Management, Capacity Management, Infrastructure Optimization, Workload Hosting Optimization/Placement, Extensibility, Log Management, Integration with Third Party Ecosystem, Policy/QoS based Management, Platform Support, Single Point of Interaction.

- **Financial Management –** Cost and Consumption Transparency, Business Management, Data Center Optimization and Data Center Planning.

In addition, we have selected the top vendors with full solutions (a solution in each of the three segments) to evaluate at a "platform" and vendor level with additional criteria.

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Vendor Selection Criteria

As a baseline, all selected vendors were required to have at least some solutions in one or more categories that were generally available by April 2016. We primarily scored factors based on already available solutions in our head-to-head comparisons, though we did consider impending functionality in public beta/field deployment when judging innovation and roadmap related factors. In addition, we took into account significant upcoming offerings in our evaluation of vendor strategy and the key takeaways that we've offered as a result of assessing vendor solutions in each category. We have included popular niche vendors because they offer good feature competition in their respective areas as point solutions (although enterprise IT shops should be cautious about piecing together a heterogeneous cloud management layer).

Vendors and Solutions Evaluated

In this comparative study, we evaluated the cloud management offerings of 13 vendors. We have listed for each vendor the solutions evaluated across the relevant market segments in the table below.

Vendor	Solution(s) Evaluated		
	Cloud Orchestration	**Operations Management**	**Financial Management**
Full Suite Vendors			
BMC (BMC)	BMC Cloud Lifecycle Management	BMC TrueSight Operations Management (App Visibility Manager, Infrastructure Management, IT Data Analytics), Capacity Optimization, Intelligence	BMC TrueSight Capacity Optimization
HPE (HPE)	HP Cloud Service Automation	HPE Operations Manager (OMi) (with Operations Manager, Performance Manager), Cloud Optimizer, Operations Analytics	HPE Asset Manager Software, Asset Manager, CloudSystem Chargeback and Cloud Optimizer
IBM (IBM)	IBM Cloud Manager with OpenStack, IBM Cloud Orchestrator	Netcool Operations Insight (Netcool/OMNIbus, Message Bus Gateway, SmartCloud Analytics – Log Analysis)	Gravitant cloudMatrix
Microsoft (MSFT)	Microsoft System Center 2012 R2, Virtual Machine Manager (VMM), Azure Pack	MS Systems Center Operations Manager 2012 R2, Operations Management Suite	Microsoft System Center 2012 R2 and Cloud Cruiser for Azure Cloud and Cloud Cruiser 16
ServiceNow (SVN)	ServiceNow ServiceWatch Suite, Orchestration, Event Management, Discovery, Cloud Provisioning	IT Operations Management, ServiceWatch Insight	ServiceNow Financial Management
VMware (VMW)	VMware vRealize Enterprise Suite, vRealize Automation, vRealize Orchestrator	vRealize Operations vRealize Log Insight	vRealize Business for Cloud
Vendors with Multiple Solutions			
Cisco (CSCO)	Cisco UCS Director, Cisco Prime Service Catalog	UCS Director, Performance Manager	
Red Hat (RH)	Red Hat CloudForms	Red Hat CloudForms	

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Single Solution Vendors			
Apptio (APTO)			Apptio ATUM (Apptio TBM Unified Model), Apptio's suite of TBM (Technology Business Management) applications
Cloud Cruiser (CCR)			Cloud Cruiser for Azure Cloud and Cloud Cruiser 16
RightScale (RS)	RightScale Cloud Portfolio Management		
Splunk (SPL)		Splunk Enterprise, IT Service Intelligence	
VMTurbo (VMT)		VMTurbo Operations Manager, Cloud Control Module	

CLOUD ORCHESTRATION LANDSCAPE

In this section we present the category-level scores for cloud orchestration solutions, along with our rationale based on our assessment of the vendors' offerings against each of the evaluation factors. To arrive at overall marks, we computed a weighted average of the 8 category scores, and then adjusted the scores based on our own judgment of each vendor's market position, installed base, product strategy, and focus and expertise. The vendors included in this section are BMC, Cisco, HPE, IBM, Microsoft, Red Hat, RightScale, ServiceNow and VMware.

The categories covered in this section are Multi-platform Support, IT-as-a-Service, Template Support, Template Networking Coverage, Policy-based Orchestration/Integration, Automation Resiliency, Discovery and Ease of Deployment and Automation Extensibility. For each category we have provided a summary that discusses the key factors we used to evaluate vendor offerings, the importance of the factors and significant observations.

CLOUD ORCHESTRATION COMPETITIVE LANDSCAPE *(4 = HIGHEST SCORE)*

Cloud Orchestration Competitive Factors	VMW	MSFT	SVN	HPE	IBM	BMC	CSCO	RH	RS
Multi-Platform Support	●	◐	○	●	●	●	◕	●	◕
IT-as-a-Service	●	◐	◐	●	◐	◐	◕	◕	●
Template Support	●	◕	◐	●	●	◐	●	◐	●
Template Networking Coverage	●	◕	◔	◕	◐	◕	●	◕	◕
Policy-based Orchestration/Integration	●	◐	◕	◕	◕	●	◐	●	◐
Automation Resiliency	●	◕	◔	◕	◕	◕	◐	◐	◐
Discovery and Ease of Deployment	◕	◐	◔	◔	◐	◔	◐	◔	◐
Automation Extensibility	●	◕	◐	◕	◕	◐	◐	●	●
OVERALL SCORES:	◕ 3.9	◐ 2.5	◔ 1.5	◕ 3.1	◐ 2.8	◐ 2.6	◐ 2.8	◐ 2.9	◕ 3.0

Evaluation of Multi-Platform Support

It's a hybrid cloud world and the move to hybrid cloud environments is driving enterprises to seek cloud management vendors that provide support for multiple hypervisors and multiple public clouds. In the past, companies were happy if cloud management vendors supported one or two public clouds, but that has changed rapidly as companies now seek "best fit" workload placement.

Enterprises know that support for a broad range of hypervisors and public clouds improves application performance and compliance by allowing users to choose the host environments that are optimal for each application stack. The key is finding vendors that offer multiple options and tight integration to guard against increased support costs and the need for additional professional services. For this reason, we see a general trend toward out-of-the-box support for multiple public clouds and wizards that ease installation.

Most vendors offer multiple hypervisor options, with VMware ESXi, Microsoft Hyper-V and Red Hat KVM compatibility now standard for most cloud management platforms. Microsoft and ServiceNow both lag in this area, with Microsoft continuing to prioritize their own stack over other platforms and ServiceNow only providing support for VMware ESXi.

As we mentioned above, there is a growing trend to seek the "best fit" cloud options for each application, which is compelling vendors to offer support for multiple public cloud services. Amazon Web Services (AWS) Cloud makes every vendor's list (except for Microsoft's) and Azure is a close second, supported by VMware, HPE, IBM, BMC, Red Hat and RightScale.

We believe the strongest public cloud support comes from RightScale. They offer a broad range of cloud options, including AWS, Azure, Google Compute Engine, Rackspace, vCloud Air, Digital Ocean, CloudStack and OpenStack. VMware, HPE and IBM are also very competitive in this area, providing support for AWS, Microsoft Azure, and OpenStack, as well as their proprietary cloud offerings - VCloud Air, HP Helion and SoftLayer, respectively.

OpenStack has a strong market presence and offers broad community support, which has made it the open architecture of choice for major cloud management providers. Of the vendors we evaluated, only RightScale offers support for both OpenStack and CloudStack. OpenStack's modularity and composable architecture increases scaling capabilities and flexibility; however, some companies report that OpenStack deployments require high levels of technical know-how to deal with technical issues during the deployment phase. That said, IBM, Red Hat and HPE are all Platinum members of the OpenStack Foundation and EMC and Cisco are Gold members, so you should expect these companies and VMware to make significant investments in OpenStack, which will help drive the continued maturation of this open cloud architecture.

Evaluation of IT-as-a-Service

IT-as-a-Service (ITaaS) can be one of the most visible factors in transforming IT from a cost-center to a strategic partner with business lines by driving improvements in productivity and performance. The core components are a common self-service portal and a service catalog that provide developers and business users with a secure, self-directed experience for finding, requesting provisioning for, and managing the application stacks, cloud servers and cloud infrastructure they need.

All vendors provide basic self-service and service catalog capabilities, including branding, personalization, policy-based governance, approval workflows, dynamic provisioning, cost transparency, and integrated lifecycle controls. The differences show up in the unification and personalization of the self-service experience and a marketplace that provides an app store look and feel and easy access to third party applications and services.

In this light, VMware vRealize Suite provides an impressive ITaaS offering. The Unified Service Catalog offers personalized levels of governance to meet different business needs and a centralized self-service portal for ordering applications, custom services and cloud infrastructure. Showback and chargeback functionality is fully integrated, so users can track costs, and if authorized, users have easy access to lifecycle controls. Each tenant can have their own specific branding and user authentication is enabled via existing directory services (LDAP). VMware also offers a comprehensive marketplace, called the VMware Solution Exchange, where companies can discover and evaluate solutions from VMware and VMware partners.

HPE also offers strong ITaaS functions. The HP CSA Marketplace Portal provides a brandable, self-service interface for both new and existing cloud services. Users can order services tailored to their needs, based on offerings in service catalogs associated with their organization. Users can choose

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among different service configurations, including application stacks, custom services and cloud infrastructure. Each configuration option has associated costs, which the Portal displays. You can own subscriptions individually, or specify group ownership. You can select service terms and approval workflows are implemented as needed. Once the service is deployed you can request service modifications and perform lifecycle actions.

RightScale is the other vendor that scores very well in this category. The RightScale self-service portal enables users to deploy and manage their own cloud applications, track costs, and control lifecycle actions to optimize spend. IT defines the catalog of applications to enforce standards and govern cloud usage. RightScale's Multi-Cloud Marketplace provides an intuitive app store experience and offers applications from both RightScale and RightScale's partner community.

Microsoft's cloud management strategy is evolving, which increases complexity and can increase cost. In System Center 2012 Service Pack 1, the VMM Self-Service Portal was removed and has been replaced by self-service functionality in Azure Pack. It looks like Azure Stack, which is targeted for the end of 2016, may replace Azure Pack as Microsoft's cloud management solution.

Evaluation of Template Support

Application templates and design tools are considered the core components of cloud orchestration because they provide end-to-end service automation for both simple and multi-tier application stacks. The key benefits of service templates are built-in best practices, greater standardization, efficiency gains, faster updates and rapid customization.

All vendors we evaluated except Red Hat enable users to build servers, compose multi-tier application stacks and assemble multi-VM workflows using a graphical canvas and a drag-and-drop interface. Users select components from a palette, assemble the components on the canvas, define build/deployment dependencies and ultimately publish servers and application stacks to a service catalog. Designer components include infrastructure resources, networking, scripts and software components, such as operating systems, front-end load balancers, application servers and backend database services. According to a published Red Hat presentation, a "Service Designer" is a future capability and is planned for CloudForms 4.1.

VMware is a leader in this category in part because they recently took their visual canvas to the next level with the introduction of the Converged Blueprint (CBP) Designer, which is part of vRealize Suite. The significance of CBP is its single model for automation versus specialized models for infrastructure and applications. The unified model means CBP users can build virtual machines, software components and application stacks using a single canvas, which consolidates the role of the AppServices engine (a.k.a. Application Director or AppD) into vRealize Suite. Supported components include machine shells for all the supported out-of-the-box platforms, software components, networks and XaaS components, and CBP is backward compatible with blueprints that have already been published.

RightScale also scores well in this category with a visual ServerTemplates Designer, a ServerTemplate Library and RightScripts that are used to modify existing cloud servers. For example, you can change the input value of a RightScript and run the script to update a running server to avoid downtime. RightScripts can also modify ServerTemplates to create new ServerTemplates. For instance, you can clone a ServerTemplate and modify it by adding your own RightScripts or by editing, rearranging or deleting existing scripts.

Out-of-the-box workflows are another important part of a strong overall automation capability because pre-defined application templates fast-track the creation of standard services. We found that

the leading vendors, such as HPE, VMware, IBM, Microsoft, RightScale and Cisco, all offer extensive template libraries. For example, Microsoft offers templates for SQL Server, WordPress, Lync Server, Exchange Server, SugarCRM, and Apache, while HPE CSA has 5000+ workflows and 300+ application components across cloud and traditional workloads.

Workflow flexibility and extensibility also sets vendors apart from competition. This is another area where VMware shines above the competition by offering workflows and partner provided plug-ins that give users the ability to extend their visual canvas to include integrations with existing third party systems. Integration examples include generating a work order ticket, updating a CMDB, calling an IP management system, or new employee onboarding. HPE, IBM and Cisco also offer strong workflow flexibility and extensibility.

Evaluation of Template Networking Coverage

The goal of every cloud management vendor is to provide a unified template design environment that incorporates all resources and components needed to deploy enterprise-ready cloud applications. This streamlines the process of designing application workloads with the proper network connectivity, security, availability, scale, and performance.

To be more specific, it is vital that support for networking is integrated with template design, so that devices and policies can be easily configured and managed, thereby reducing the need for expensive customization work performed by senior architects and professional services teams.

Several vendors are packed at the top of this category; they are Microsoft, HPE, VMware, Cisco, Red Hat and RightScale. All of these vendors have recognized the importance of incorporating support for load balancing, virtual network devices and security policies into template design and application orchestration.

Leading vendors all support virtual networking, but their approaches for incorporating virtual networking support into template design can be quite different. For example, VMware blueprint authoring now includes NSX support. This enables users to configure existing virtual networks within VMware Blueprints. Cisco also enables the configuration of virtual networking within templates, but they have a proprietary approach that leverages Cisco Application Centric Infrastructure (Cisco ACI) and the Cisco Nexus switches portfolio.

As we expected, because security policies are an essential part of automated application delivery, all vendors we evaluated provide template parameters for security settings and authentication methods that can be imported from application settings. Also, some vendors, such as VMware, IBM and RightScale, can implement multiple security groups to provide the necessary protection.

It is worth mentioning that both VMware and Cisco are pioneering the ability to set up granular network security, prohibiting intruders that have compromised one node from directly accessing other nodes on the same VLAN. This capability is called micro-segmentation. HPE also supports micro-segmentation, but at the application layer through a partnership with vArmour.

Evaluation of Policy-based Orchestration/Integration

Policies play a major role in personalizing cloud services, which helps ensure user needs are met and organizational procedures and standards are observed. As a result, all the vendors we evaluated support policy-based governance, however policy-based eventing is still a gap in several vendor solutions. Lastly, automated resource reclamation is a capability that all vendors need to further develop to offer more systematic workflows that reduce administrative burden.

Looking across vendor capabilities in this category, we see different policy types, but in general policy governance plays an important role in the following areas: controlling which services a user can request, approval guidelines, service cost, service length, service level received, type of machine assigned (physical, virtual or cloud) and service placement. Other important policy governance features are the use of templates to standardize offering policies for different groups and the ability to easily configure policies without the need for coding or scripts.

Policy-based eventing enables automated workflows and facilitates integration with external systems. For example, a new service request might trigger an automated workflow for obtaining approval using external systems before a lifecycle action such as deploying a resource offering can occur. Other examples of integration with external systems include facilitating approval workflows, making CMDB updates and propagating changes in regulatory and operational compliance rules. Vendors that emphasize extensible event services are VMware, ServiceNow, HPE, IBM, BMC and Red Hat.

As mentioned above, resource reclamation is a capability we expect vendors will automate further as cloud management platforms continue to evolve. Today, no vendors truly automate resource reclamation. The best capability we found in this area was the use of analytics to identify underutilized resources that can subsequently be reclaimed. Service lease management is another common vendor capability that identifies when services will expire, which creates opportunities for resource reclamation.

Evaluation of Automation Resiliency

One of the most important benefits of cloud computing is elasticity, or the ability of the cloud to adapt to workload changes by provisioning and de-provisioning resources in an autonomic way. In the same manner, cloud orchestration should support auto-scaling as well as the ability to automate failover and recovery for overall reliability. The combination of auto-scaling and automated failover enables clouds to move beyond elasticity to being truly resilient in the face of unpredictable conditions and constantly changing usage and demand.

We contend that the most basic tenet of resiliency is data center recovery in the event of an outage or other unforeseen disaster. To this end, leading cloud management vendors are focused on simplifying High Availability (HA) and failover through various innovations and integrations. For instance, Cisco UCS has simplified setting up failover by inserting an "enable failover" checkbox when configuring a vNIC service profile template that when checked automatically enables the second fabric interconnect if the default one is unavailable. VMware has also simplified HA by reducing the number of appliances required for a HA configuration. We were pleased to see that all the vendors we evaluated support HA in their orchestration products, and as we expected, all the vendors also support auto-scaling.

The final factor we considered when evaluating vendors in this category was the ability to control snapshot sprawl. We found that the vendors with the strongest capability in this area were HPE and VMware although they address the need in different ways. BMC's solution requires their TrueSight Capacity Optimization tool to identify old snapshots and HPE Cloud Optimizer offers similar capability. VMware controls how many snapshots a machine can have and how long those snapshots exist through blueprint policies.

Evaluation of Discovery and Ease of Deployment

We believe there are a couple of important ways vendors can improve productivity and reduce costs and it starts with automating resource discovery. We were pleased to see that all vendors we

evaluated offer resource discovery and a couple of vendors stand out for their attention to incorporating discovery more tightly into other processes.

VMware is the first vendor we would like to highlight. vRealize Suite has the capability to discover pre-existing private resources and assign ownership so that those resources are immediately accessible to owners for self-service actions.

HPE is another vendor that we believe deserves a special mention. HPE has an embedded configuration management system to automate discovery and updates of cloud resources in a centralized repository. This tight integration helps ensure data accuracy and makes it easier to track and maintain an understanding of how deployed infrastructure maps to cloud services.

We believe ease of deployment is one of the most important criteria in this category and we were disappointed to see that most vendors fail to hit the mark in this area. For example, HPE has had challenges delivering a fully integrated suite with a common look and feel. This is a problem we often hear when companies offer a solution as part of a broad family of products. The other company having a challenge with ease of deployment is BMC. There issues appear to be related to the number of disparate products required for a complete ITaaS solution.

In contrast, there is one vendor, VMware, that has prioritized ease of deployment and their focus in this area was very apparent in vRealize Suite. Three improvements we would like to specifically highlight are the simplified deployment architecture for HA configurations, the use of elastic logical containers that simplify the delivery of infrastructure services needed to make workloads operational, and the addition of NSX support to VMware blueprint authoring, which helps users quickly configure existing virtual networks.

Another valuable cloud management capability that improves productivity is workload migration. Specifically, we believe the ability to migrate workloads seamlessly between private and public cloud is growing in importance as companies more broadly embrace hybrid cloud environments. Workload migration is not covered well by any vendor we evaluated as part of this report and appears to still be the realm of specialty vendors, such as Zerto and HotLink.

Evaluation of Automation Extensibility

There are many facets to automation extensibility, but the goal is to offer programmatic access to cloud management functionality through published APIs that enable custom workflows and automated processes through integration with data center solutions, such as with identity management, IT service management (ITSM), release management and configuration management systems (CMS).

We have found two different approaches to extensibility: companies that focus on broad third party integration by publishing SOAP/REST APIs; and companies that promote integration with their own proprietary suite of products. Vendors don't necessarily fall exclusively into one camp or the other, but our research has found a tendency to lean in one direction. Vendors that have an open integration focus include Red Hat, VMware, IBM, RightScale, Cisco, and HPE. Alternatively, vendors that encourage integration with their own tools and solutions are BMC and Microsoft. The one vendor that seems to offer both good API support and tight integration with their own products is ServiceNow.

DevOps and application release management integration is an important part of extensibility to fuse application development and deployment and facilitate a more continuous process that helps development teams build, deploy, run and manage applications in the cloud. One vendor offering a solution in this area is IBM, and their service is supported on IBM Bluemix, IBM's platform-as-a-

service; and on SoftLayer, an IBM company that provides cloud infrastructure-as-a-service. BMC also supports DevOps and their solution promotes the use of BMC Release Lifecycle Management.

Another way to provide release management and DevOps support is through integration with open-source configuration management software, such as Puppet, Chef and Salt. VMware, RightScale and HPE support this approach. For example, VMware's release automation solution, vRealize Code Stream, provides support for open-source configuration tools and models and automates each stage in the software delivery pipeline from development through production – driving consistency and therefore reliability of the software delivered.

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OPERATIONS MANAGEMENT LANDSCAPE

In this section we present the category-level scores for cloud operations management solutions, along with our rationale, based on our assessment of the vendors' offerings against each of the evaluation factors. To arrive at overall marks, we computed a weighted average of the 11 category scores, and then adjusted the scores based on our own judgment of each vendor's market position, installed base, product strategy, and focus and expertise.

The vendors included in this section are IBM, HPE, ServiceNow, Splunk, Red Hat, VMTurbo, BMC, Cisco, Microsoft and VMware. For each of the 11 categories we have provided a summary that discusses the key factors we used to evaluate vendor offerings, the importance of the factors and significant observations.

OPERATIONS MANAGEMENT COMPETITIVE LANDSCAPE *(4 = HIGH)*

Operations Management Factors	VMW	MSFT	SVN	HPE	IBM	BMC	CSCO	RH	SPL	VMT
Monitoring Coverage	●	●	◑	●	●	●	◑	◕	◑	○
Performance Management	●	◑	◑	●	●	●	◑	◕	◕	○
Capacity Management	●	◑	○	●	◕	●	◔	◔	◑	◑
Infrastructure Optimization	●	◕	○	●	◑	●	○	◕	◔	◕
Workload Hosting Optimization/Placement	◑	◔	○	◑	◔	◑	◔	◑	○	●
Extensibility	●	●	◑	●	●	●	◕	◕	●	◑
Logfile Management	◑	◑	○	◕	◑	●	○	○	●	○
Integration with Third Party Ecosystem	●	◕	◕	●	●	●	◔	◑	◑	◔
Policy/QoS Based Management	●	○	◔	○	○	◕	○	○	○	◑
Platform Support	◑	◕	◑	◑	◕	◕	◑	◑	●	◑
Single Point of Interaction	●	◕	◑	◕	◔	◑	◔	◔	◕	◕
OVERALL SCORES:	◕ 3.6	◑ 2.4	◔ 1.1	◕ 3.0	◑ 2.4	◕ 3.5	◔ 1.2	◔ 1.7	◑ 2.2	◔ 1.8

Evaluation of Monitoring Coverage

The cornerstone of IT operations begins with being able to see what is going on – one can't manage what one isn't measuring. In pre-virtualization days element management ruled with agents installed on every component to forward metrics and events to a centralized infrastructure manager console (or many consoles, at least one for each IT silo). With the evolution of more service-oriented management, IT began monitoring virtual machine performance, end-user experiences and transactions, application layer components, databases and middleware. As cloud and hybrid cloud architectures become the norm, IT needs to add multi-tenant, cross-cloud perspectives, too.

Other criteria below detail how the best operations management solutions bring all this together and make it feasible, efficient, and affordable for IT to take on this ever broadening, end-to-end span of responsibility. In this category we evaluate the depth and breadth of fundamental monitoring coverage. Here the traditional platform management vendors might have a slight edge simply because over decades their legacy tools have grown their respective coverage matrices and they have developed best practices in physical IT silo management. But VMware and Microsoft have developed thorough partner ecosystem coverage due to their core data center platforms, and while not trying to be large NOC platforms, these vendors are delivering all that IT operations customers want, especially in virtualized and increasingly automated "cloudy" architectures.

Note that we have discounted the obvious fact that almost any management solution today can serve as an umbrella console configured to rake in events and data streams sourced from other layers of management (e.g. main claims for coverage with ServiceNow, Splunk). While seemingly convenient when silo solutions are already deployed, each layer and additional vendor only adds to the complexity of operations and ultimately degrades responsiveness and reliability.

In practice the big legacy vendors present spaghetti-like wiring diagrams of all kinds of moving parts that often require services to integrate and are confusing to operate. Significantly, we noted that many of these vendors are offering newer, more competitively converged and cloud-friendly front-end solutions that should ultimately replace their legacy portfolio-based approaches. Yet today's efforts seem not only incomplete and late to market, but still drag along legacy components of functionality.

Evaluation of Performance Management

Performance management involves reporting and alerting on the status and health of IT components. This involves tracking alerts, events, configurations and streams of metrics, with subsequent analysis and/or escalation capabilities that may range in capability from detailed element-level and reactive to aggregated business service level and predictive. A primary goal of newer generations of solutions is to effectively simplify and focus what is presented at the top level of interaction in favor of helping prioritize staff attention. The goal may not be to hide all complexity as much as to reduce noise (false alerts), provide context (e.g. models, maps, service groupings), improve interpretation (root cause) and accelerate response (reduce MTTR or even enable proactive automatic remediation). Ultimately IT customers want to reduce the OPEX involved in guaranteeing production-level IT health and performance, even as their world becomes increasingly complex.

While it was beyond this evaluation to lab test and validate the efficacy of each vendor's solutions in practice, we note that all these vendors have assembled several layers of capabilities in various components to apply sophisticated correlations and anomaly detection features. The best solutions add value by intelligently learning baselines of the dynamic and seasonal behavior of workloads, resources, and business cycles and then automatically setting "abnormal" alert thresholds. They also group (and reduce) events and alerts to the user, app or service, correlate with configuration changes, and provide contextual, knowledge-based recommendations. Finally, we like solutions that aggregate information to a service map or model, producing multivariate KPI's on health and status, and applying multiple kinds of correlations (e.g. time-based, transaction-based, topology-based).

Notably, VMware vRealize Suite shows sophisticated IT "health" scoring (KPI's) that the traditional vendors in this space (including Microsoft) might analogously produce and display only with multiple layers of components. Splunk can turn any defined search query into an alert that might count as smart alerting, but you have to write those searches and the alerting would not learn over time. We

should also note that VMTurbo avoids offering this capability in favor of focusing on dynamic optimization (leaving the health of IT to other solutions).

Evaluation of Capacity Management

If performance management is mostly about real-time alerting and events, capacity management is about proactively managing the ongoing state of resource utilization. The idea is that with solid capacity management you can avoid running out of resources, which inevitably results in throughput bottlenecks, latency issues, and provisioning shortages. The cloud era challenges traditional approaches, enabling potentially elastic supply balanced with additional concerns about utility costs over time.

Some solutions claim predictive capabilities by simply forecasting a linear trend line on resource utilization history while the best solutions account for both observed trends and committed future plans, and smartly alert on predicted capacity shortfalls. VMware vRealize Suite presents these separately from immediate health problems as "risk" factors in its single dashboard, while the big traditional solution vendors have a variety of legacy components to address capacity. Microsoft SCOM's cloud-based OMS has a plug-in for capacity management, but does not account for future plans in operational use.

Many smaller vendors simply do not attempt to predict future capacity shortfalls, perhaps because they are concerned only with the real-time optimization of what is available, assume other solutions are in play (like vRealize Suite), or are based on cloud provider assumptions of infinite elasticity (and unlimited budget).

Evaluation of Infrastructure Optimization

Where capacity management focuses on managing the remaining capacity of a system, infrastructure optimization looks for possible efficiency gains in the reclamation or re-alignment of resources. While we didn't include offline capacity planning solutions in this larger evaluation (e.g. those that involve long-running simulations, non-linear queuing modeling, or actual lab benchmarking), there are a number of capacity planning related optimizations that cloud management operations solutions can automatically produce.

For example, VMware vRealize Operations produces "efficiency" KPI's (again separate from performance "health" and capacity "risk" scores) that highlight where available infrastructure tuning opportunities exist. Microsoft's add-on OMS log analytics (evaluated separately below) can be used to find over-allocated or unused resources, although this isn't rolled up automatically to the top level interface. Likewise, IBM's logfile analysis, Splunk, and VMware vRealize Log Insight can also be leveraged. HPE's Cloud Optimizer and BMC TrueSight Capacity Optimization might tackle these tasks head-on, but come in separate layered components. ServiceNow checks this off with some orchestration processing to help reclaim provisioned assets, but it is a separate unguided task.

Part of our evaluation gave credit for integrated infrastructure utilization forecasting in which both future workload demands (planned growth and other "reservations") and planned infrastructure upgrades can be overlaid. Aligning workloads to infrastructure, both current and future reservations, is a core strength of VMTurbo's dynamic optimization approach. We note that HPE, BMC, and VMware also support the future analysis of planned changes. In particular, we note that VMware vRealize Operations automatically feeds committed future plans back into its other KPI's to inform even more intelligent predictive alerting.

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Evaluation of Workload Hosting Optimization

If the system is in good health and has sufficient future capacity, then the next task of operations is to best align the currently running workloads with the current infrastructure. While determining the "best alignment" can include functions of performance QoS, meeting committed SLAs, minimizing cost, or even considerations to maximize data protection and security, the evolution into cloud is bringing new opportunities to both maximize performance and broker lower costs.

VMTurbo deserves special mention here as a solution squarely aimed at the dynamics of moving virtual machines around to best fit them into available capacities (however we note modeling vm placement as a best-fit economics problem isn't sufficient to ensure actual application performance). We did note that VMware now not only provides automatic "within cluster" placement (with the native Distributed Resource Scheduler (DRS)), but can also make intelligent cross-cluster recommendations (with vRealize Operations in conjunction with DRS), although this is not yet automated to avoid issues with the many externalities in today's cross-cluster, cross-cloud scenarios.

Microsoft also has vm placement recommendation and re-balancing capability. Although most hint at ultimately aiming to provide active cloud brokerage, HPE, Red Hat, BMC, and even Cisco can currently make vm provisioning placement recommendations (or re-provisioning plans) but don't pretend to operate in real-time at the host, cluster, or cloud levels.

Evaluation of Extensibility

When providing an operations management solution, it's important to ensure extensibility through the exposure of API's and/or SDK's that allow the larger IT ecosystem to produce or provide appropriate plug-ins. We observed that in this case, the larger and more established the vendor, the richer and more complete the catalog of third party plug-ins. All of these vendors are large enough to have a multitude of technical partnerships, though any particular IT shop would be well served to identify any important gaps before investment. In all cases, custom services are also available to help extend or custom-build adapters to just about anything in IT that can produce metrics and/or events (from their own API's, command lines, or machine data logs).

Evaluation of Logfile Management

No current cloud-scale operations management solution is complete without some way to parse and mine value out of the plentitude of logfiles produced by almost every bit of IT infrastructure. This "machine data" may get processed and translated into event and metric streams input into the more structured activities evaluated above, but also deserves its own "unstructured" analysis solution to support just about every IT management activity including configuration and asset management, software license auditing, security management, and detailed feature usage analysis. Logfile analysis solutions collect, store, and index log files from across the IT stack. They must intelligently parse these files at variety and scale, and subsequently provide easy query/search access to IT users. Often logfile collections grow to "big data" sizes, so many solutions apply new big data analytics solutions and are cloud-hosted.

Splunk is perhaps the most recognized solution in this space, focusing on this capability almost exclusively as their core technology. Splunk can be fed many other sources of data including business application output, web clickstreams, and marketing analytics to power research that more broadly addresses IT-business questions. However, we do not find a standalone machine data/search query solution sufficient to meet broader IT cloud management needs.

Most of the full suite operations management vendors now offer logfile analytics explicitly for IT operations support, including VMware, Microsoft through OMS, HPE (Arcsight/Haven), IBM, and BMC. VMware vRealize Log Insight is tailored for the IT challenges at hand, while HPE Arcsight/Haven requires an over-the-top, full-scale, big data environment implementation. IBM's solution for Operations Insight is capable but only licensed for events, while Microsoft OMS and BMC's Intelligence service are effectively disparate SaaS offerings that require a hybrid approach to IT operations management.

Evaluation of Integration with Third Party Ecosystem

The flipside of the extensibility category above is outbound (aka northbound) integration with third party ecosystem solutions. A hallmark of truly well thought-out management solutions is that they can become data sources in turn to the broader IT ecosystem by feeding intelligent information into solutions like trouble ticketing, help desk, CMDB's, asset managers, financial management and application business health dashboards. Integrations can take several forms including event forwarding, triggered scripting, exposed reporting API's or CLI's, SDK/libraries, or even stored procedures.

While professional services are universally available from each vendor or its partners to accommodate custom integrations, the best solutions come with built-in adapters or ready plug-in modules for the most common out-of-the-box integrations (e.g. sending workflow/lifecycle events to BMC Remedy).

The operations management solution first has to be able to generate workflow/lifecycle events. vRealize Operations is notable in that it can initiate cascading actions based in its intelligent KPI's, and some of those KPI's (e.g. certain "risk" factors) in turn account for existing future plans (upgrades and/or reservations), helping close a full cycle loop of IT infrastructure "assurance".

Larger platform vendors offer many points of integration, but that also presents some challenges in maintaining customization expertise in multiple areas, not to mention introducing some complexity and risk into operational processes.

Evaluation of Policy-based/QoS Management

In an increasingly agile and cloud-like IT environment, it's becoming increasingly important to be able to exert proper IT management and governance via policies that can be dynamically implemented by provisioning systems and automatically monitored by operational components. For operational excellence, it's key for IT clients to both demand and be assured of receiving specified QoS levels. At the scale of cloud operations, only policy-driven solutions can deliver on QoS promises.

More solutions across the spectrum today have some element of policy establishment, often to limit or constrain the provisioning of a certain kind of resource to certain groups of users or kinds of applications. The key differences show up in how such policies might be operationally monitored, enforced or reported on downstream. We note that VMware vRealize Suite enables a coherent policy-based approach throughout the lifecycle, whereas the larger platform vendors have, at best, different solution components with various policy implementations.

For example, the monitoring-heavy vendors can apply custom thresholding based on information passed from orchestration tasks as a matter of "policy". This will often be different, again, from what might be reported (e.g. in financial management). ServiceNow, when it comes to QoS assurance, offers only a service level "visualization" (similarly BMC might propose Service Impact Reporting).

Evaluation of Platform Support

We look for today's management solutions to be able to run on-premise and as a cloud or hybrid service, supporting cross-cloud approaches. With multiple data centers, converging resources, shrinking staff, and hybrid cloud deployments, many enterprises are looking to subscribe to cloud-hosted management services (SaaS) to augment or even replace on-premise management tools.

We note that some solutions like Microsoft SCOM with OMS are both on premise and cloud-based, but bifurcated – half of the solution runs on-premise and the other half only as SaaS – which while taking advantage of cloud empowerment for some scalable activities is a fine architectural choice, it is not yet the fully agile solution we ultimately expect this market to evolve to.

Evaluation of Single Point of Interaction

The "single pane of glass" has long been the promise of IT systems management vendors. IT wants to increase admin efficiency and productivity by unifying and integrating multiple interfaces into one coherent point, or UI, of interaction. Furthermore, the intelligent use of rollup, or aggregating KPI's, should extend these efficiencies by distilling much detail down into obvious admin "calls to action". Ultimately the idea is to reduce the number of different tools, unique UI's, complex raw metrics and even disparate workflows into a simpler, and hopefully simplifying point of primary interaction.

Microsoft SCOM was the result of an early attempt at creating a unifying pane of glass, but despite a myriad of plugins and wide support, ended up imposing a monitoring UI format under which expert users performing non-monitoring tasks still needed to launch into unique UI's. HPE's OMi and IBM's DASH are good examples from legacy vendors taking up the challenge and starting to re-engineer improved solutions, but both are works in progress (and dependent on many moving parts). The VMware vRealize Suite approach is to first reduce a wide variety of data and large scope of operation into a dashboard of relevant KPI's, backed by drill-down and contextually relevant actions.

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FINANCIAL MANAGEMENT LANDSCAPE

In this section we present the category-level scores for Financial Management solutions, along with our rationale, based on our assessment of the vendors' offerings against each of the evaluation factors. To arrive at overall marks, we computed an average of the 4 category scores, and then adjusted the scores based on our own judgment of each vendor's market position, installed base, product strategy, and focus and expertise.

The vendors included in this section are Apptio, BMC, Cloud Cruiser, Cisco, HPE, IBM, Microsoft and VMware. Note that Microsoft's score in this section includes Microsoft's alliance partner Cloud Cruiser.

The categories covered in this section are Cost and Consumption Transparency, Business Management, Data Center Optimization and Data Center Planning.

For each category we have provided a summary that discusses the key factors we used to evaluate vendor offerings, the importance of the factors and significant observations.

FINANCIAL MANAGEMENT COMPETITIVE LANDSCAPE *(4 = HIGH)*

Financial Management Competitive Factors	VMW	MSFT*	SVN	IBM	HPE	BMC	CCR	APTO
Cost and Consumption Transparency	●	●	●	◑	●	◑	●	●
Business Management	●	●	◑	○	●	◑	◑	●
Data Center Optimization	●	◑	◑	○	◑	◑	◑	●
Data Center Planning	◑	◑	◔	◑	◑	◔	◑	●
OVERALL SCORES:	◑ 3.8	◑ 3.5	◑ 2.5	◔ 1.3	◑ 3.3	◔ 1.8	◑ 3.3	● 4.0

* Microsoft's score in this section includes Microsoft's alliance partner Cloud Cruiser.

Evaluation of Cost and Consumption Transparency

A comprehensive cost model is the heart of financial management and cost transparency. It shows the interdependencies and distribution of costs across the entire IT landscape including infrastructure, cloud environments, technical services, applications, and consumers (business lines). That said, the cost model is only as good as the data, therefore programmatic access to cost and capacity information is required to ensure rapid and efficient data collection. The final aspect of cost transparency is analytics, which allows users to explore cost drivers, trends and KPIs from different viewpoints using customized reports and role-based dashboards.

Multiple vendors, including Apptio, Cloud Cruiser, HPE, ServiceNow, Microsoft and VMware are packed at the top of this category. They all provide programmatic access to cost data from multiple sources, including financial systems, clouds environments, service desk software, and asset databases (CMDB). The common clouds supported are VMware, AWS, Azure and OpenStack.

These same six vendors also received top marks for comprehensive cost models since they all perform data normalization, model interdependencies, and automate cost allocation. Analytics is another strength for the top five vendors, since they all offer flexible, role-based dashboards and

custom reporting. Apptio deserves a special mention for going the extra mile to provide "data pivots" that help users view information from multiple dimensions.

IBM and BMC did not score as well in this category because IBM's Gravitant cloudMatrix lacks a unified cost model and BMC TrueSight Capacity Optimization provides mainly capacity analytics. BMC also doesn't offer out-of-the-box cloud data collection and they have a more limited cost model.

Evaluation of Business Management

Many companies would like to see more responsible IT consumption, but they don't know how to change organizational behavior. We believe a great place to start is better communication and better alignment, more specifically IT communicating costs and value and business units having a better understanding of how their spend/consumption matches their budget.

Towards these goals, showback/chargeback is IT's most powerful weapon when it comes to cost recovery and providing understanding of what IT services actually cost. The beauty of showback/chargeback tools is that the business unit reporting is automated with business rules and allocation templates, so IT administrators can throw out their spreadsheets and focus on more strategic activities. Apptio, BMC, Cloud Cruiser, HPE, Microsoft, ServiceNow and VMware all have strong showback/chargeback functionality.

Automatic budgeting tracking (planned vs. actual) and knowing when you are under or over spending is a very important component of Business Management. The leading vendors in this area are Apptio, Cloud Cruiser, HPE, Microsoft, ServiceNow and VMware. VMware, as part of their budgeting capability, assists managers with budget forecasting and provides flexibility to adjust planned usage.

Another important dimension to running IT more like a business is service quality management functionality that enables a better understanding of the trade-offs between cost and quality. This is an area where VMware really shines by providing alerts when SLAs and other commitments are in danger of being missed and publishing monthly service reports covering performance, along with root cause and business impact reports to identify remedial action. Apptio can also measure services against SLAs and Microsoft Systems Center 2012 R2 strives to help IT deliver predictable performance for business-critical applications by offering application health metrics that help trigger remediation actions.

IBM's Gravitant cloudMatrix does not have functionality in this category.

Evaluation of Data Center Optimization

Decision support is a key aspect of data center optimization and financial management overall. In order to improve data center operations, companies need to understand trends and forecasts and they need tools that assist them with resource planning as well as understanding how well their services stack up against their peers.

At the top of the list for valuable decision support tools is resource cost and capacity planning. VMware, Apptio, HPE, BMC, Microsoft and Cloud Cruiser all have capabilities in this area. Resource planning solutions help companies plan for future resource requirements based on historical usage and help teams understand who is using what resources and for what purpose. These solutions also help groups estimate the impact and cost of adding new workloads to remaining capacity as well as quantify the potential savings of resource reclamation opportunities. Other important capabilities include helping business units stay within budgets and enabling teams to see the cost of over-allocating IT resources.

Benchmarking is another powerful capability for optimization and helps companies understand how their services compare to other companies in their industry. For example, Apptio offers a standard cost and KPI model to make comparisons of your monthly actual costs against a database of benchmarks collected from peer organizations. VMware is the only other vendor we evaluated that provides benchmarking functionality.

Evaluation of Data Center Planning

Data center planning is all about helping enterprises plan for new workloads and enabling companies to model the impact of changes in resource consumption. It is also about helping companies compare cloud costs and more importantly evaluate cloud services in-depth to determine the overall "best fit" for workload placements.

Using what-if scenarios can be one of the most effective ways to determine how changes in consumption can affect charges for application licenses and infrastructure resources. What-if modeling can also help companies forecast and optimize service costs, for example comparing cloud services for best-cost workload placements. Apptio, VMware, HPE, Cloud Cruiser and Microsoft all offer strong what-if planning capabilities as part of their financial planning products.

When it comes to comparing cloud services, enterprises want to compare cloud services on more than just cost. To truly understand how cloud services compare, businesses need to have knowledge in three different areas to determine overall "best fit". These areas are a granular cost break down; an ability to understand how well cloud services match workload and application stack requirements; and a quality score that shows cloud service performance based on third party data. IBM's Gravitant cloudMatrix and Apptio address all three aspects of cloud comparison, so they score the best when it comes to comparing hybrid cloud services. VMware also provides a good cloud comparison capability, but they are not as strong as IBM's Gravitant cloudMatrix and Apptio when it comes to helping companies understand how well cloud services match overall workload and application stack requirements.

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FULL SUITE CLOUD MANAGEMENT VENDOR LANDSCAPE

In this section we now further evaluate those vendors offering a full suite of Cloud Management Solutions (orchestration, operations, financial). We recognize that most enterprises prefer to obtain a proven, scalable integrated suite solution from a single vendor rather than struggle to piece together niche solutions from smaller vendors. For these full suite vendors, we looked at additional enterprise criteria at the vendor and platform integration level, and—even though this report isn't intended to serve as a detailed evaluation of the vendors themselves—factors to evaluate the relative quality of vendor solutions and services.

The vendors included in this section are VMware, Microsoft, ServiceNow, HPE, IBM and BMC. The categories covered in this section are Integration across Solution Areas, Single Vendor Source, Ease of Admin, Pricing/Packaging, Release Currency, and Innovation/Roadmap.

For each category we have provided a summary that discusses the key factors we used to evaluate vendor offerings, the importance of the factors and significant observations.

FULL SUITE CLOUD MANAGEMENT VENDOR COMPETITIVE LANDSCAPE *(4 = HIGH)*

Full Cloud Management Vendor Competitive Factors	VMW	MSFT	SVN	HPE	IBM	BMC
Integration Across Solution Areas (Orchestration, Automation, Operations, Financial)	●	◑	◑	◕	◕	●
Single Vendor Source	●	●	◑	●	●	●
Ease of Admin	◕	◑	◕	◔	◔	◔
Pricing/Packaging	◕	◑	●	◑	◑	◑
Release Currency	◕	◕	●	◑	◑	◕
Innovation Vision/Roadmap	◕	◑	◑	◑	◑	◕
VENDOR/PLATFORM SCORE:	◕ 3.3	◑ 2.5	◑ 2.8	◑ 2.3	◑ 2.3	◑ 2.8

Evaluation of Integration Across Solution Areas

In this area we looked at the ways that information, data, policies, and workflows were integrated and linked across activities in orchestration, operations, and financial management. This is generally a recognized strength of full suite management vendors.

In this case, we found that HPE and IBM both had significant information flow and exchange between components of their full, larger suites (even if all the products weren't included in this evaluation). BMC though demonstrated better integration across their numerous product lines (e.g. Remedy, etc.). VMware was perhaps unique in embedding deep "natural" integration and closed loop information flow between the vRealize Suite components (and also the hypervisor itself). For example, future upgrades could be laid in as committed plans during an offline planning activity, but then that plan would be passed to operational monitoring to automatically adjust the relevant KPI alerting appropriately to account for that plan.

Evaluation of Single Vendor Source

Here we roughly evaluated the ability of these large vendors to offer comprehensive services, deliver best practices, manage a large partner ecosystem to the benefit of end customers, and provide a single source of support across the solutions. It's no surprise that all the big vendors claim these capabilities, but we note that ServiceNow is not as large an enterprise as the others when it comes to the scope and depth of these leveraged activities.

Evaluation of Ease of Admin

In this category we briefly examined the complexity, effort, risk and cost involved in deploying, maintaining, patching, and upgrading the suite of solutions. This has long been an area of criticism of the legacy platform management vendors – too long to deploy, too hard to patch, too many hours spent supporting the tools instead of using them productively. Unfortunately in too many cases, even their newer cloud management solutions still seem to depend on underlying legacy components.

ServiceNow as a SaaS service should have a leg up here for their inherent functionality, although they still depend quite a bit on third party capabilities.

Evaluation of Pricing/Packaging

Here we look at the high-level aspects of pricing models and software packaging/licensing. This is a continual work in progress for most, although we note that again, ServiceNow with a SaaS model has an advantage based on their native functionality.

Microsoft has historically provided quite a challenge to enterprises when it comes to figuring out licensing, but we expect this to simplify as Microsoft moves to becoming more of a service provider with Azure. VMware has simplified and rationalized both their packaging and pricing in the last year. The other legacy vendors, however, seem stuck with decades of aging enterprise contracts, multiple complex license schemes, and continually confused customers.

Evaluation of Release Currency

In this category we quickly looked at the ability and experience of a vendor to roll out frequent updates and the resulting reputation for quality of their past deliveries. Again, the SaaS-based ServiceNow has a natural advantage here. We note though that practically all of the suite vendors have a good timeline and delivery schedule, with enough QA/field testing that updates are reasonably stable.

Evaluation of Innovation/Roadmap

Finally, we assessed the vendors' history of innovation, their ongoing vision/long-term roadmap, and their demonstrated execution to vision. Arguably this area is not as quantifiable as many of the others, but in our analyst experience we find that VMware is among the leading vendors in terms of creating market-disrupting vision (through internal development or timely acquisition), and then delivering on that vision to the market, time and again. In other vendors we've noted what amounts to a history of failed acquisitions, delays on promised integrations, or a tendency to follow or play catch-up rather than provide market leadership (esp. in this cloud management space).

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CLOUD MANAGEMENT MARKET SUMMARY EVALUATION

In this final rollup, we've brought together the scores for each of the functional areas, and the full-vendor/platform evaluation score. While there are numerous options to weight these scores here we've simply averaged the four scores to arrive at a final, top-level cloud management landscape score, reflecting our original choice of criteria across the evaluation as the set of important and necessary items for complete cloud management (each IT organization may want to individually consider the importance of each area/category according to their own needs and requirements).

Evaluation Scores	VMW	MSFT	SVN	HPE	IBM	BMC
Cloud Orchestration	3.9	2.5	1.5	3.1	2.8	2.6
Operations Management	3.6	2.4	1.1	3.0	2.4	3.5
Financial Management	3.8	3.5	2.5	3.3	1.3	1.8
Vendor/Platform Criteria	3.3	2.5	2.8	2.3	2.3	2.8
Summary Score	**3.7**	**2.7**	**2.0**	**2.9**	**2.2**	**2.7**

Legend: VMW=VMware, MSFT=Microsoft, SVN=ServiceNow, HPE, IBM, BMC

VMware and Microsoft post leading scores, likely because they are both inherently also hypervisor/cloud platform vendors and therefore intimately familiar with and focused on the practices and capabilities that IT organizations need in their respective cloud transition efforts. HPE also has a top score with a strong showing in all three functional areas and BMC takes an upper spot led by their strong offering in Operations Management. VMware vRealize Suite tops the chart, indicating that VMware should be an early consideration by any IT organization looking to mature their cloud management capabilities.

ABOUT TANEJA GROUP

Taneja Group's mission is to deliver best-in-class technology analysis and consulting for the storage, server, virtualization, cloud and big data markets to enable our clients to convert technology into business. We are a boutique firm of operational experts with both broad and deep expertise in storage systems and technologies, server and desktop hardware and software, virtualization platforms and appliances, cloud software and services, big data technologies, and physical and virtual infrastructure management solutions. For more information, please visit www.tanejagroup.com*.*

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