

The Forrester Wave™: Configuration Management Software For Infrastructure Automation, Q4 2017

Tools And Technology: The Infrastructure Transformation Playbook

by Chris Gardner and Robert Stroud
October 11, 2017

Why Read This Report

In our 25-criteria evaluation of configuration management providers, we identified the 14 most significant solutions — Ansible, Ansible Tower, CFEngine Community Edition, CFEngine Enterprise, Chef, Chef Automate, Microsoft Azure Automation, Microsoft Powershell DSC, Normation Professional Services, Open Source Puppet, Puppet Enterprise, Rudder, Salt, and SaltStack Enterprise — and researched, analyzed, and scored them. We focused on core features, including deployment, configuration modeling, monitoring and governance, and community support as well as on the vendors' ability to match a strategy to these features. This report helps infrastructure and operations (I&O) professionals make the right choice when looking for configuration management solutions for their development and operations (DevOps) and infrastructure-as-code (IaC) automation.

Key Takeaways

Chef And Puppet Lead The Market

Forrester's research uncovered a market in which Puppet Enterprise, Chef Automate, Open Source Puppet, and Chef rank as Leaders. SaltStack Enterprise, Normation Professional Services, Rudder, Ansible Tower, and Ansible offer competitive options as Strong Performers. Salt, Microsoft Azure Automation, CFEngine Enterprise, Microsoft PowerShell DSC, and CFEngine Community Edition are Contenders.

These Tools Form Part Of A Configuration Management Whole

The greater landscape consists of service, software, and element domains. Within the element domain are provisioning and control subdomains. The tools in this Forrester Wave straddle these subdomains and are sometimes involved with release management as well.

Open Source/Free Solutions May Serve Your Needs

Forrester evaluated not only each vendor's enterprise product but also its open source/free version. While, in every case, the enterprise-class products offered more features, many vendors had competitive free solutions that customers could integrate into larger continuous delivery toolchains.

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Related Research Documents

- [The Forrester Wave™: Continuous Delivery And Release Automation, Q3 2017](#)
- [Refine Configuration Management And CMDB For The Modern Digital Organization](#)
- [Vendor Landscape: Configuration Management](#)



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Configuration Management Delivers On The Promise Of IaC

It's no longer possible to manage infrastructure manually. In a world of infrastructure-as-code, where systems can be spun up and decommissioned in minutes or seconds, robust automation is essential, and configuration drift and compliance become very real issues.¹ As infrastructure and application development converge, the rapid delivery of consistent, reliably configured infrastructure becomes critical to I&O success and foundational to successful DevOps.² To achieve the required speed of innovation, I&O professionals must adopt a structured approach to delivering software-defined models across the complete life cycle — an approach that requires automation.

The tools in this Forrester Wave have become known as configuration management tools. The term “configuration management” is ambiguous, and literal interpretations of frameworks such as ITIL and COBIT add further confusion. It's a poor choice of nomenclature, but it's a term that the industry has adopted — and there's great interest in the topic.³ Here are a few noteworthy points regarding these automated tools and the larger configuration and asset management space they belong to:

- › **Different domains shape this space.** Think of the overarching space as three separate but interweaving domains: service, software, and element (see Figure 1). The “service” domain is platform-independent, integrative, and overlaps with enterprise architecture at the upper end. The “software” domain consists of design, build, and deployment technologies. It's more platform-aware and can span multiple platforms, such as on-premises and cloud. The “element” domain is where operations typically occur. It's platform-bound, can be imperative- or declarative-focused, and is often supplied by a vendor or third party. The element domain is where the provisioning and control subdomains live (see Figure 2). Within these subdomains are the tools to discover, provision, and control configuration elements.⁴ These subdomain forms the basis for this Forrester Wave.⁵
- › **Automation escalates configuration management, from concept to reality.** This Forrester Wave focuses on a particular set of automated tools that apply configuration policies to applications, systems, and cloud resources or directly to hardware. These policies should be model-based and human-readable. They should be scalable and reusable across environments, avoiding the “snowflake” (i.e., unique) configurations typical among traditional infrastructure management.⁶ The tools must identify drift as quickly as possible and remediate it; this reduces the chance of human-enabled mistakes and lowers risk.⁷ There must be an audit trail for all changes, and it should be possible to review reports and correct compliance issues.
- › **Element configuration management tools will converge with CDRA.** Continuous delivery release automation (CDRA) tools model, package, and deploy apps. In particular, they have the choreography to manage releases across complex, clustered environments, addressing issues like draining queues and quiescing workloads prior to applying new software packages. CDRA is a critical component of software-powered businesses and a central capability of DevOps.⁸ Increasingly, organizations are using configuration management to normalize environments and ensure consistency. Some application release automation platforms leverage the configuration

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management tools in this Forrester Wave, while others attempt to perform configuration management tasks on their own. Regardless, these two worlds are colliding, and we expect to see further consolidation in the coming years.

FIGURE 1 Different Processes And Tools Live Within Three Domains Of Asset And Configuration Management

Asset and configuration domains

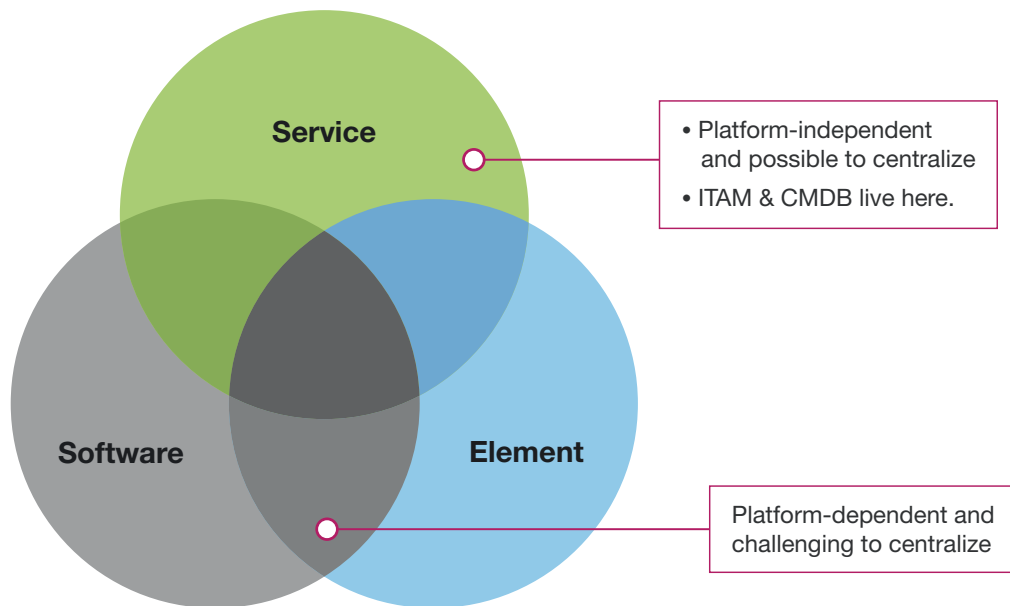
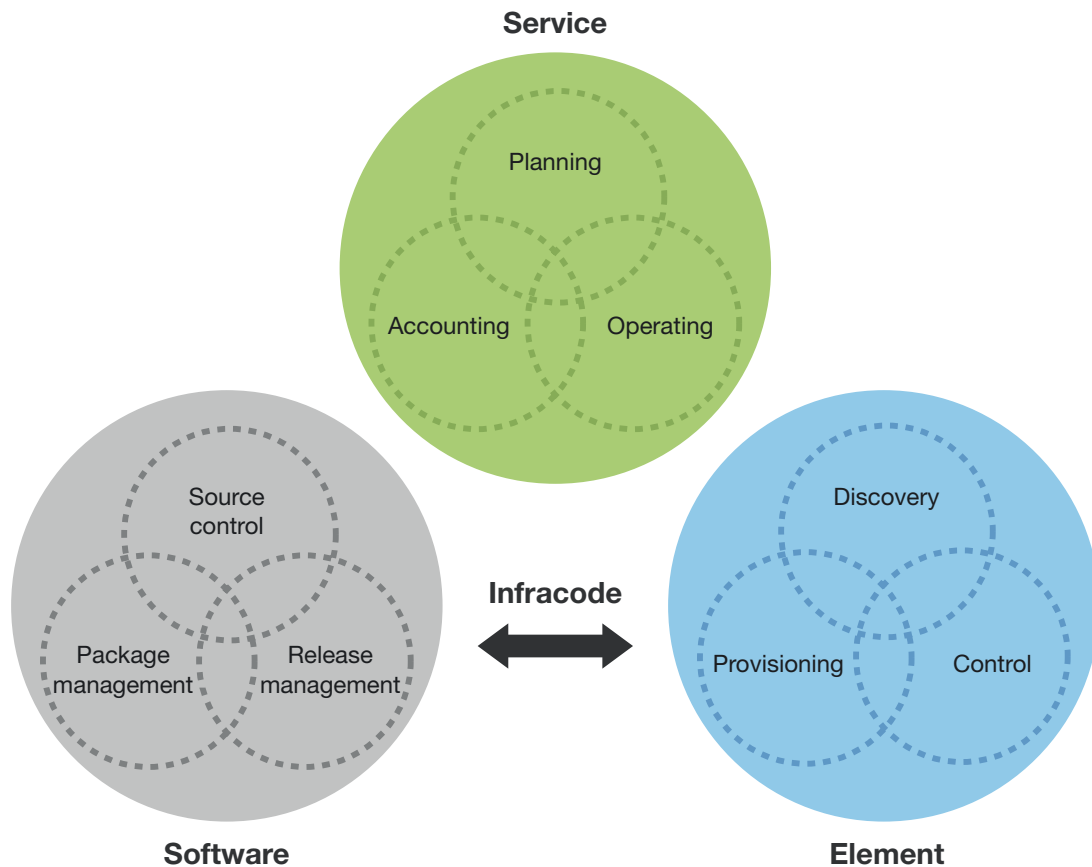


FIGURE 2 Service, Software, And Element Embody Specific Use Cases**Asset and configuration domain subgroupings****When It Comes To Managing These Tools, Everyone's A Developer**

To make these tools work effectively, everyone in I&O must transition to a developer role. This requires retraining professionals in development skills such as coding and learning one (or more) new programming languages.

- › **Sysadmins are now developers.** Forrester believes that I&O professionals increasingly need to draw on design thinking to maintain their value.⁹ This means becoming a developer: treating systems like blocks of code, checking this code into repositories, and following well-established continuous development and integration practices.¹⁰ As infrastructure becomes increasingly composable, I&O will design and codify reference infrastructure compositions alongside enterprise architects.

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- › **Declarative versus imperative doesn't matter . . . except when it might.** Many of the languages utilized by these tools are either declarative or imperative. A declarative language declares the state of the system as a policy the operator wishes to achieve; the tool itself decides how to get the system to that state. An imperative language is more like traditional programming, with the programmer giving a series of commands to execute with logical workflow. Choice of language doesn't typically improve stability or time-to-market. That said, you may want to consider a declarative approach if operations professionals drive your configuration management efforts. Likewise, if you have a mature development shop, you may want to consider an imperative language for the flexibility and level of control it provides. Ultimately, the choice of tool should augment other efforts and fit alongside other development initiatives, not become an exercise in language philosophy.¹¹
- › **There may be a case (or lack thereof) for agentless.** A small number of the tools in this Forrester Wave can run agentless. In other words, they don't require a piece of software installed on the target machine to update a configuration. While there are some use cases that require this, such as certain internet-of-things (IoT) devices with very small memory footprints, there's no inherent advantage to running agentless for the vast majority of situations. It's not a security improvement and, in fact, can be a significant security risk. To perform activities without an agent, the tools will often need SSH or similar access, requiring ports to be continually open. The bottom line: If you have a choice between agents and agentless, install agents.

Simple Functionality May Be Sufficient For Your Needs

All of the vendors in this Forrester Wave submitted two products: an open source version (typically the automation engine itself) that handles core functionality and an enterprise version that adds features around reporting, compliance, and auditing. While, in all cases, the enterprise versions scored higher, depending on your use case, you may find the open source versions sufficient for your needs.

- › **Coming from the same pedigree helps.** Open source versions of configuration management solutions typically have the same strong support as their enterprise brethren. They harness the power of the community to evolve the knowledge base of proven implementations, allowing I&O professionals to rapidly deploy automation. Some of these projects ran for years before releasing enterprise versions, and updates within the open source projects almost always make their way into the enterprise products.
- › **You can always upgrade.** Unsurprisingly, every vendor permits you to move from its open source products to its enterprise version. You might pursue such an upgrade if you need additional features or support agreements (community support is the standard for open source versions), or simply because you need to scale.

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- › **Tie these tools into CDRA toolchains.** Enterprise-class CDRA solutions such as those from CA Technologies, Electric Cloud, IBM, and XebiaLabs can leverage both the open source and enterprise versions of these tools in this Forrester Wave. Configuration jobs can kick off within the tools as part of a larger DevOps workflow, ensuring consistency across all environments.

Configuration Management Evaluation Overview

To assess the state of the configuration management market and compare how the solutions stack up against each other, Forrester evaluated the strengths and weaknesses of top configuration management vendors' tools. After examining past research, user needs assessments, and vendor and expert interviews, we developed a comprehensive set of evaluation criteria. We evaluated the solutions against 25 criteria, which we grouped into three high-level buckets:

- › **A current offering that delivers a minimum set of capabilities.** Evaluated solutions had to provide a minimum set of capabilities, including deployment, configuration modeling, monitoring and governance, and community support.
- › **A strategy that leads to better offerings in the future.** To assess strategy, we analyzed product strategy, market approach, consulting, training, and cost, and innovation in pricing.
- › **A market presence that demonstrates vendor stability.** To score market presence, we analyzed installed base and corporate profitability.

Evaluated Solutions And Inclusion Criteria

Forrester included 14 solutions in the assessment: Ansible, Ansible Tower, CFEngine Community Edition, CFEngine Enterprise, Chef, Chef Automate, Microsoft Azure Automation, Microsoft Powershell DSC, Normation Professional Services, Open Source Puppet, Puppet Enterprise, Rudder, Salt, and SaltStack Enterprise. The vendor of each solution (see Figure 3):

- › **Meets eligibility requirements.** Products evaluated were generally available on or before July 1, 2017.
- › **Has established itself as a configuration management vendor.** Each vendor has established itself as a key configuration management vendor, in accordance with a Forrester review of core features.
- › **Supplied publicly available documentation.** Each vendor supplied links to product feature documentation. This information is available regardless of business relationship.
- › **Has drawn established client interest.** Each vendor has sparked interest (in the form of regular, unprompted mentions and inquiries) from Forrester's client base over the past 12 months.
- › **Delivers a minimum set of configuration management capabilities.** Each vendor demonstrated its solutions' ability to support configuration management, such as deployment, configuration modeling, monitoring and governance, and community support.

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FIGURE 3 Evaluated Solutions: Product Information And Selection Criteria

| Solution | Version |
|---------------------------------|--------------------------|
| Ansible | 2.3.1 |
| Ansible Tower | 3.1 |
| CFEngine Community Engine | 3.10 LTS |
| CFEngine Enterprise | 3.10 LTS |
| Chef | 1.5.46 |
| Chef Automate | 1.5.46 |
| Microsoft Azure Automation | N/A |
| Microsoft Powershell DSC | 5.1 |
| Normation Professional Services | 4.2 |
| Open Source Puppet | Puppet 5 |
| Puppet Enterprise | Puppet Enterprise 2017.2 |
| Rudder | 4.2 |
| Salt | 2016.11.5 |
| SaltStack Enterprise | 5.1 |

Solution inclusion criteria

The solution automates configuration management of systems and addresses configuration drift.

The solution can model configurations in either a scripting language or through visual models or both.

Forrester clients reference the solution on inquiry calls.

The solution can automate on-premises and cloud environments.

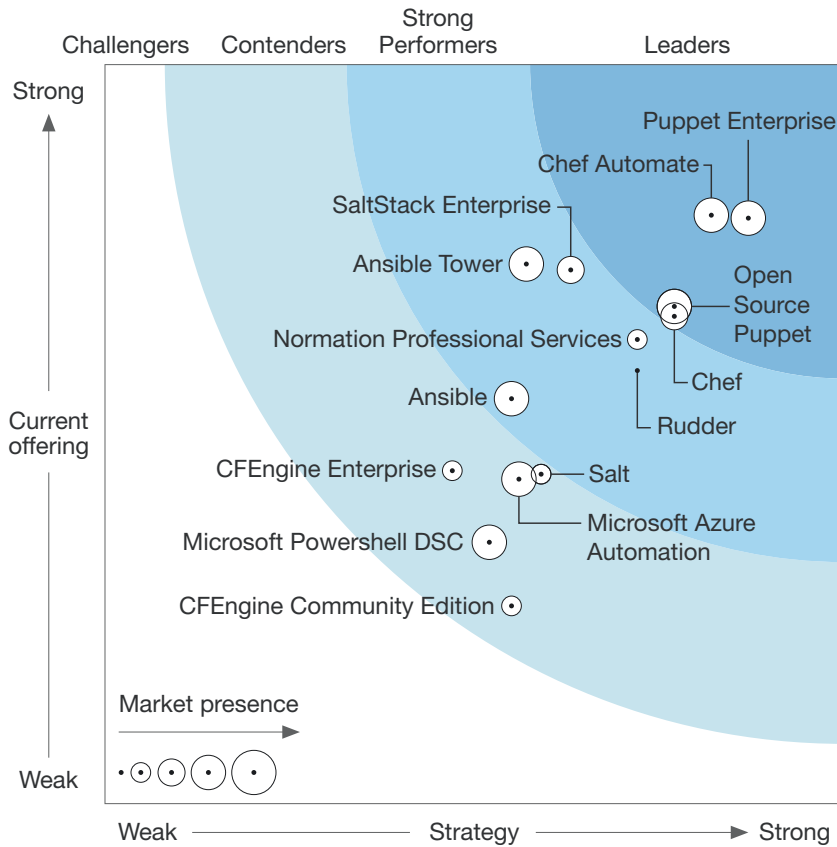
Vendor Profiles

We intend this evaluation of the configuration management market to be a starting point only and encourage clients to view detailed product evaluations and adapt criteria weightings to fit their individual needs through the Forrester Wave Excel-based vendor comparison tool (see Figure 4). Click the link at the beginning of this report on Forrester.com to download the tool.

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FIGURE 4 Forrester Wave™: Configuration Management Software For Infrastructure Automation, Q4 '17



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Go to Forrester.com to download the Forrester Wave tool for more detailed product evaluations, feature comparisons, and customizable rankings.

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FIGURE 4 Forrester Wave™: Configuration Management Software For Infrastructure Automation, Q4 '17 (Cont.)

| | Forrester's weighting | CFEngine Community Edition | Ansible Tower | Ansible | CFEngine Enterprise | Microsoft Azure Automation | Microsoft PowerShell DSC | Open Source Puppet | Puppet Enterprise | Rudder | SaltStack Enterprise | Salt | Normation Professional DSC | Microsoft Azure Automation | Microsoft PowerShell DSC | Open Source Puppet | Puppet Enterprise | Rudder | SaltStack Enterprise | Salt | |
|-----------------------------------|-----------------------|----------------------------|---------------|---------|---------------------|----------------------------|--------------------------|--------------------|-------------------|--------|----------------------|------|----------------------------|----------------------------|--------------------------|--------------------|-------------------|--------|----------------------|------|--|
| Current offering | 50% | 2.74 | 3.65 | 1.34 | 2.25 | 3.31 | 3.98 | 2.20 | 1.77 | 3.14 | 3.35 | 3.96 | 2.93 | 2.23 | 3.61 | | | | | | |
| Deployment | 30% | 3.70 | 4.40 | 1.60 | 3.70 | 3.70 | 4.30 | 2.10 | 3.00 | 2.30 | 3.70 | 3.70 | 1.60 | 3.70 | 3.70 | | | | | | |
| Configuration modeling | 20% | 1.50 | 3.80 | 2.90 | 3.00 | 2.20 | 2.60 | 2.50 | 1.50 | 3.30 | 2.20 | 3.80 | 3.30 | 3.20 | 3.80 | | | | | | |
| Monitoring and governance | 20% | 1.40 | 2.60 | 1.40 | 2.70 | 1.30 | 4.10 | 3.10 | 0.60 | 3.70 | 1.50 | 3.70 | 3.70 | 0.50 | 4.20 | | | | | | |
| Community support | 30% | 3.50 | 3.50 | 0.00 | 0.00 | 5.00 | 4.50 | 1.50 | 1.50 | 3.50 | 5.00 | 4.50 | 3.50 | 1.25 | 3.00 | | | | | | |
| Strategy | 50% | 2.75 | 2.85 | 2.75 | 2.35 | 3.85 | 4.10 | 2.80 | 2.60 | 3.60 | 3.85 | 4.35 | 3.60 | 2.95 | 3.15 | | | | | | |
| Product strategy | 50% | 0.50 | 1.50 | 2.50 | 2.50 | 3.50 | 4.00 | 3.00 | 1.00 | 3.00 | 3.50 | 4.50 | 3.00 | 2.50 | 3.50 | | | | | | |
| Market approach | 10% | 5.00 | 5.00 | 3.00 | 3.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 1.00 | 2.00 | | | | | | |
| Consulting, training, and support | 20% | 5.00 | 5.00 | 1.00 | 1.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | | | | | | |
| Innovation in pricing | 20% | 5.00 | 3.00 | 5.00 | 3.00 | 5.00 | 5.00 | 1.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 3.00 | | | | | | |
| Market presence | 0% | 3.41 | 3.24 | 1.70 | 1.58 | 2.75 | 3.09 | 3.48 | 3.68 | 1.20 | 3.20 | 3.97 | 0.65 | 1.19 | 2.04 | | | | | | |
| Installed base | 60% | 4.75 | 4.00 | 1.50 | 1.50 | 4.25 | 3.75 | 5.00 | 5.00 | 1.00 | 5.00 | 4.75 | 0.75 | 1.25 | 2.00 | | | | | | |
| Corporate profitability | 40% | 1.40 | 2.10 | 2.00 | 1.70 | 0.50 | 2.10 | 1.20 | 1.70 | 1.50 | 0.50 | 2.80 | 0.50 | 1.10 | 2.10 | | | | | | |

All scores are based on a scale of 0 (weak) to 5 (strong).

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Leaders

- › **Puppet Enterprise.** Puppet Enterprise augments the open source Puppet offering with a web-based UI that provides visibility into configurations, dependencies, and events. Role-based permissions permit compliance professionals to easily access reports and audit event trails, while enhanced APIs provide richer orchestration capabilities and better integration with common enterprise systems such as virtual machines. Puppet Enterprise's strengths include drift correction, out-of-the-box third-party plug-ins, and monitoring and governance. Customers mentioned the strength of the tool while citing challenges with the installation process and managing the tool within complex enterprise environments.
- › **Chef Automate.** Chef Automate builds on the Chef open source automation engine, integrating the respective projects of Habitat and InSpec, and provides a web-based GUI and dashboard for compliance visibility. Users can deploy Automate on-premises, in the cloud, or through a software-as-a-service (SaaS)-based partnership with Amazon Web Services (AWS) known as OpsWorks. Automate excels at deployment support, monitoring and governance, and community support. Customers reported a strong partnership with Chef Automate but also a significant learning curve before achieving value with the product.
- › **Open Source Puppet.** The Puppet open source engine focuses on supporting configuration management on a variety of platforms, emphasizing that if a system is reachable by IP, it should be configurable. The Puppet Forge provides thousands of community-built modules (bundles of code and data) that users can download and customize as needed. The strengths of open source Puppet include breadth of system support and community engagement. Users appreciated the simplicity of the Puppet DSL and the ability to integrate Puppet with their existing processes.
- › **Chef.** The Chef open source engine primarily uses an imperative approach with broad support for various operating systems, containers, and cloud services. A code repository, called the Chef Supermarket, hosts thousands of Cookbooks (Chef code) that allow users to download common configurations. Chef partners support some Cookbooks, and users can "follow" Cookbooks in the Chef Supermarket to receive automatic notification of any updates. The strengths of open source Chef include the breadth of system support as well as community engagement. Users found Chef powerful but said it was difficult to master.

Strong Performers

- › **SaltStack Enterprise.** SaltStack Enterprise builds on the open source Salt offering, providing an enterprise GUI and API for integration. SaltStack Enterprise is primarily used by operations professionals, but users can be assigned reports on failures to identified teams for troubleshooting and remediation. Role-based security permits compliance professionals to log in and run reports based on CIS, CVE, and STIGS entries.¹² SaltStack Enterprise excels at analytics and reporting, vulnerability tracking, and compliance enforcement. Customers felt that SaltStack Enterprise's orchestration capabilities were powerful and sometimes better than its configuration management capabilities.

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- › **Normation Professional Services.** Normation Professional Services, the parent company of Rudder, provides additional services for the open source tool, selling plug-ins for Windows/AIX support, auditing, and HTTP data sourcing integration (e.g., connecting to traditional CMDB platforms). Services are available for implementation and operations training as well as end user support. Customers expressed concerns over the size of the company and its ability to scale for enterprises.
- › **Rudder.** Rudder is an open source automation platform focused on continuous reliability. Pivotal to Rudder's offering is the technique editor — low-code visual “building blocks” that piece together to form automation workflows. These generate declarative code available to users for further manipulation as needed. Under the hood, Rudder leverages CFEngine and PowerShell DSC for execution. Rudder excels at ease of model manipulation, analytics and reporting, and compliance. Users appreciated the product's ease of use, particularly when it came to configuration modelling.
- › **Ansible Tower.** The enterprise solution for Ansible focuses on improving the open source project's analytics and compliance capabilities. Role-based access control permits individuals to access tasks with their security passed onto processes. Ansible Tower integrates with other products in the Ansible suite, including Cloudforms (centralized governance and orchestration), Insights (machine learning), and Satellite (monitoring patch levels). Tower's strengths include version control and vulnerability/defect tracking. Customers appreciated the ease of getting up and running with Ansible Tower but expressed concern with its speed.
- › **Ansible.** The Ansible open source project focuses on minimalism and ease of use. The tool requires no agents, relying on SSH and WinRM to remotely control member nodes, which limits resource usage and potential network traffic. Modules (units of code) can be written in a variety of scripting languages, such as python, Ruby, and others. Ansible excels at system support and vulnerability/defect tracking. Users appreciated Ansible's learning curve and overall flexibility.

Contenders

- › **Salt.** The Salt open source project emphasizes choice, with the option to run the modular software with or without agents and using push or pull methodologies. Salt takes an operations-first focus. Unique to Salt is Reactor, an events-driven engine to trigger automated tasks based on jobs, authentication, and cloud-based events. Salt's strengths include support for various systems, version control, and drift correction. Salt's users appreciated the software's ease of use but expressed concerns over the project's long-term longevity.
- › **Microsoft Azure Automation.** Microsoft Azure Automation is a SaaS-based suite for process automation, configuration management (through PowerShell DSC), change tracking, inventory, and update management. The solution is SaaS-only; it's not possible to run Azure Automation on-premises or in another public cloud. Azure Automation's strengths include support for third-party plug-ins, analytics and reporting, and vulnerability/defect tracking. Microsoft did not provide customer references for Azure Automation.

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- › **CFEngine Enterprise.** The Enterprise version of CFEngine adds professional services and support to CFE Community Edition. It provides a GUI/dashboard to administer and monitor node health; user-based and role-based management; richer reporting (including third-party compliance and security reports); asset management capabilities; and modules to better support operating systems such as AIX and Windows. CFEngine Enterprise excels at system support and drift correction, and users appreciated the speed of the tool.
- › **Microsoft PowerShell DSC (Desired State Configuration).** Microsoft PowerShell DSC is a configuration management execution engine built primarily for Windows, with recent support added for Linux and MacOS. Users write code using PowerShell scripts or Python by using a Microsoft-supplied provider. PowerShell DSC's strengths include ease of use and extensive community engagement. Users liked PowerShell DSC's strong support of Windows.
- › **CFEngine Community Edition.** The father of modern-day configuration management, CFEngine Community Edition is an open source automation engine focused on performance. Configuration changes, written in a declarative abstraction language, can execute on thousands of nodes in seconds using C-based software agents. Enterprises often use CFEngine in large, high-performance environments where addressing configuration drift quickly is essential. Users liked CFEngine's lightweight nature but felt that integrating it with other software could be a challenge.

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Supplemental Material

Online Resource

The online version of Figure 4 is an Excel-based vendor and solution comparison tool that provides detailed product evaluations and customizable rankings. Click the link at the beginning of this report on Forrester.com to download the tool.

Data Sources Used In This Forrester Wave

Forrester used a combination of two data sources to assess the strengths and weaknesses of each solution. We evaluated the solutions of the vendors participating in this Forrester Wave, in part, using materials provided to Forrester on or before July 1, 2017.

- › **Vendor surveys.** Forrester surveyed vendors on their capabilities as they relate to the evaluation criteria. Once we analyzed the completed vendor surveys, we conducted vendor calls where necessary to gather details of vendor qualifications.

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- › **Customer reference calls.** To validate product and vendor qualifications, Forrester also conducted reference calls with three of each vendor's current customers.
- › **Vendor demonstrations.** Vendors demonstrated their technologies against a common set of use cases identified by Forrester from client inquiries.

The Forrester Wave Methodology

We conduct primary research to develop a list of vendors that meet our criteria to for evaluation in this market. From that initial pool of vendors, we then narrow our final list. We choose these vendors based on: 1) product fit; 2) customer success; and 3) Forrester client demand. We eliminate vendors that have limited customer references and products that don't fit the scope of our evaluation.

After examining past research, user need assessments, and vendor and expert interviews, we develop the initial evaluation criteria. To evaluate the vendors and their products against our set of criteria, we gather details of product qualifications through a combination of lab evaluations, questionnaires, demos, and/or discussions with client references. We send evaluations to the vendors for their review, and we adjust the evaluations to provide the most accurate view of vendor offerings and strategies.

We set default weightings to reflect our analysis of the needs of large user companies — and/or other scenarios as outlined in the Forrester Wave evaluation — and then score the vendors based on a clearly defined scale. We intend these default weightings to serve only as a starting point and encourage readers to adapt the weightings to fit their individual needs through the Excel-based tool. The final scores generate the graphical depiction of the market based on current offering, strategy, and market presence. Forrester intends to update vendor evaluations regularly as product capabilities and vendor strategies evolve. For more information on the methodology that every Forrester Wave follows, please visit [The Forrester Wave™ Methodology Guide](#) on our website.

Integrity Policy

We conduct all our research, including Forrester Wave evaluations, in accordance with the [Integrity Policy](#) posted on our website.

Endnotes

- ¹ For the current infrastructure-as-code landscape, see the Forrester report "[Lead The I&O Software Revolution With Infrastructure-As-Code.](#)"
- ² For more information on the strategic advantage of DevOps, see the Forrester report "[DevOps: The CIO's Guide To Velocity.](#)"
- ³ Configuration management, infrastructure automation, and the various vendors involved are frequently requested topics of Forrester client inquiries.
- ⁴ For an in-depth review of these domains and subdomains, see the Forrester report "[Refine Configuration Management And CMDB For The Modern Digital Organization.](#)"

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- ⁵ There is an additional class of discovery tools (e.g., Firescope and IBM TADDM), associated with hardware and software asset management and IT service management, that is out of scope for this report.
- ⁶ To see the importance of configuration automation for the software-defined data center, see the Forrester report “[Lead The I&O Software Revolution With Infrastructure-As-Code.](#)”
- ⁷ To understand the criticality of automation in regards to security and compliance, see the Forrester report “[Reduce Risk And Improve Security Through Infrastructure Automation.](#)”
- ⁸ For a detailed review of the players in this space, see the Forrester report “[The Forrester Wave™: Continuous Delivery And Release Automation, Q3 2017.](#)”
- ⁹ To understand the role of design thinking in the modern I&O organization, see the Forrester report “[Reshape Your Application Support For Digital Operations.](#)”
- ¹⁰ For a detailed dive into the skill sets needed by sysadmins in the future, see the Forrester report “[How A Sysadmin Becomes A Developer.](#)”
- ¹¹ To understand the interaction between requirements and language choices when it comes to governance, see the Forrester report “[Use DevOps And Supply Chain Principles To Automate Application Delivery Governance.](#)”
- ¹² CIS, CVE, and STIGS are security management frameworks. Source: Center for Internet Security (<https://www.cisecurity.org/>), Common Vulnerabilities and Exposures (<https://cve.mitre.org/>), and Security Technical Implementation Guides (STIGs) (<https://iase.disa.mil/stigs/Pages/index.aspx>).

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