Through the DevOps Looking Glass: Learnings from HP's Own Transformation Initiative

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INTRODUCTION

In Frost & Sullivan surveys, *agility* tops business leaders' list of priorities, as they prepare for the fast-paced, hypercompetitive future. IT departments, in particular, find that in order to support escalating business technology needs, they must streamline processes, minimize resource consumption, and reduce time-to-market. To help them achieve that goal, many IT organizations are looking to implement DevOps, a software delivery methodology and framework that covers all steps in the application lifecycle.

But having a goal of streamlined application delivery is not enough to assure a successful DevOps implementation, especially when the business is a large corporation with hundreds of workloads and thousands of development and operations technicians responsible for deploying and maintaining them. Some organizations have found their DevOps implementations hindered by factors such as limited support, uncertain return, or simply lack of momentum. Others struggle with how to start or expand their DevOps initiative. Still others harbor misperceptions about DevOps; leading them to implement components (for example, Agile Development or continuous delivery) rather than a full-scope DevOps methodology. For such businesses, a glimpse behind-the-scenes at the "hows" of DevOps implementation is likely to prove helpful.

> "How do you start a [DevOps] fire? You start with a few sparks [passionate developers] and some dry tinder [well chosen projects]. Be careful not to add too much additional fuel to the fire too soon, or to leave it exposed to the elements of corporate governance before the flame catches and is strong enough to survive."
> - Ralph Loura, CIO, HP Enterprise Group

In this paper, we follow a large global enterprise (which happens to be HP itself) through the change and decision process, planning, and pilot programs that represent its journey towards DevOps; beginning with the important area of continuous integration and testing. As it moves along its journey, HP faces many of the same challenges as any large enterprise: breaking down silos and shifting organizational roles; convincing skeptics; choosing the right pilot projects; and identifying new ways to measure success. While the initiative is ongoing, HP's own IT department has determined that the transformation towards DevOps is already delivering positive results to the business and to IT.

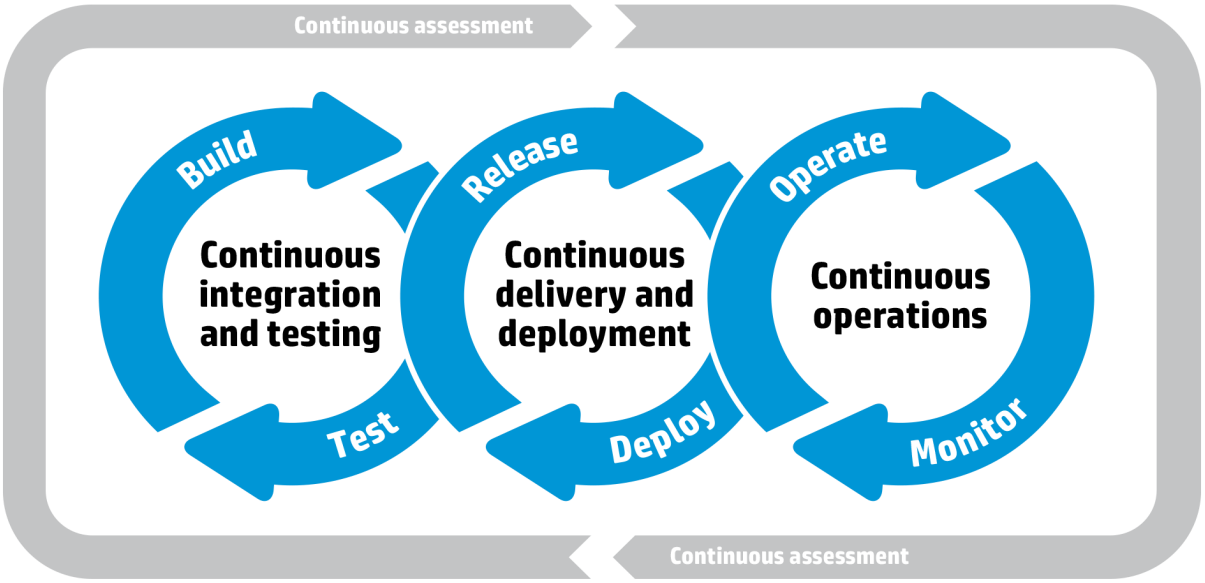
Finally, we present valuable best practices and "lessons learned" straight from the HP IT team, to help you start or progress along your own DevOps journey.

A BRIEF LOOK AT DEVOPS

DevOps, of course, is a methodology and framework for developing, delivering, operating, and managing software through its lifecycle. Through the interworking of technology, people (technical and non-technical employees), and processes, a DevOps implementation creates a "continuous delivery pipeline" for applications, utilizing automated processes where possible, and manual processes where appropriate.

Consistent with the concept of "continuous delivery," in describing the components of DevOps, we tend to avoid words like "phase" and "step" that imply sequential execution. Instead, we prefer the word "facet" as more accurately portraying the simultaneous and iterative execution of tasks. Thus, we define a comprehensive DevOps implementation as encompassing all facets of the application delivery lifecycle, including Plan, Define, Develop, Test, Release, and Monitor (see Exhibit 1).

Exhibit 1: HP DevOps Framework for the Application Lifecycle



Source: HP

"Without a DevOps mindset, the acceleration that is lost cannot be ignored anymore. It's like going ten miles an hour on a highway."
- Edward Raigosa, HP DevOps Team Leader

Continuous integration begins just after the change request (for new or existing code) is approved and funded to begin work. It is the process of merging all developers' working copies of software into a mainline build at regular, rapid intervals—often every day or several times a day. Continuous integration is designed to ensure that one developer's work in progress won't cause issues with other developers' code, and to find any such issues early and often. As such, continuous integration is often coupled with test automation as a way to create a state of on-going quality, rather than waiting to test after all the development is done.

This practice—the coupling of continuous testing and continuous integration—is a key starting point for DevOps, and remains essential throughout the lifecycle. Continuous testing means releasing updates in small batches, and applying automated test functionality that is integrated with the development tooling used for continuous integration; thus, allowing you to "test early and often." Automated testing is a must, and should be cost-effectively done throughout the lifecycle—e.g., at development, build, regression, Quality Assurance, integration, staging, even post-release, in production—with monitoring tools collecting and feeding back usage, availability, and performance data to all stakeholders.

DevOps process owners may tend to underestimate the importance of continuous testing to the development and delivery process if they are focused closely on developer practices. Traditionally, organizations have invested as little as 10 percent of the project timeline to highly manual testing processes. However, in a well-tuned DevOps environment, best practices can call for upwards of 25% of the process to be devoted to continuous testing for certain applications. An investment in continuous integration and continuous testing is proving to deliver tremendous value, with benefits to both the business and to IT.

> "For HP IT, DevOps is all about doing much more, with higher quality, and freeing resources to deliver even greater value."
> - Rafael Garcia, Director, HP IT

Business benefits include:

- Deliver fast with confidence – since errors and glitches have a higher probability of being identified and corrected early, before release.
- Assure application performance – since the application can be tested both in development and in the production environment.
- Respond quickly to market changes – since usage data is continuously available to drive development.
- Gain competitive advantage – since automation means more resources (technical and budget) are available to pursue innovative solutions.

IT benefits include:

- Decreased cycle time for software development/deployment – since testing occurs in lock-step with development.
- Decreased time to recover from downtime – since small batches, tested incrementally, can be pushed into production rapidly or immediately.

- More efficient resource utilization – since automated test functionality is integrated into the development platform and part of the build process.
- Increased collaboration and communication across dev, testing and operations teams, thus leading to innovation – since user and quality feedback is delivered in real-time to all team members (technical and non-technical).

The benefits indicate the value of investing in continuous integration and testing as an on-ramp to your DevOps initiatives. Both IT and the business will benefit from more efficient resource utilization, better application quality, and increased customer satisfaction. But how can you ensure your implementation will have the greatest chance for success? A case study will provide an effective example.

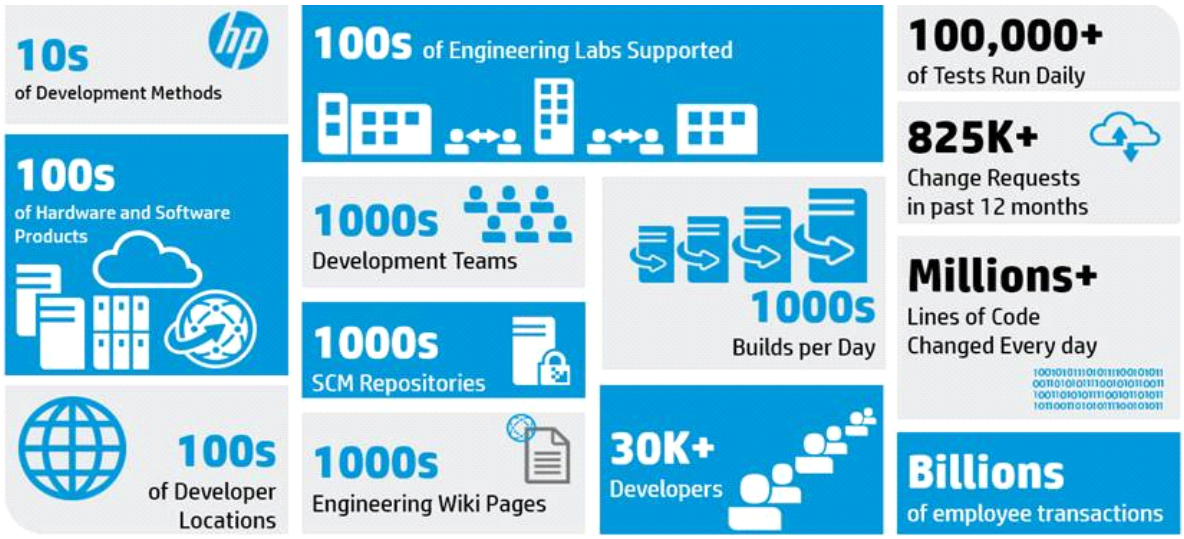
THE HP DEVOPS JOURNEY: HOW HP IT CAME TO ADOPT CONTINUOUS INTEGRATION AND TESTING

HP is a global leader in technology products, software, and services. With over 300,000 employees worldwide serving enterprise, government, and consumer customers, the company claims over $100B in annual sales. It is also recognized as one of the world's top brands—a distinction that confers great value but also brings great pressure in the disruptive and highly competitive global technology market.[1] Like businesses of all sizes, HP must not only respond to a rapidly changing economic and technology climate, but must also anticipate changes, and create new opportunities—all the while providing a positive return for shareholders. And, as with all businesses, but especially those in the technology industry, HP relies heavily on its IT organization to keep the company competitive.

About HP IT

The HP IT organization provides the technology resources that support both internal business needs (that is, support for HP employees and systems) as well as HP customers (via HP technology products and services). Among the many different departments within the IT organization is HP Research and Development IT (R&D IT). Staffed with hundreds of technical employees, this organization is responsible for the tools and services that support the products and software that HP brings to market. Exhibit 2 provides a glimpse of the wide range of products, components, and processes managed by this critical organization.

Exhibit 2: HP R&D IT by the Numbers



Source: HP

[1] Forbes "World's Most Valuable Brands, 2014" http://www.forbes.com/companies/hewlett-packard/

While the actual numbers may vary, the profile of the HP R&D IT organization is likely very similar to thousands of other enterprises that are faced with multiple, diverse teams of developers who are responsible for a broad range of applications; each of which comes with its own requirements for frequency of updates, speed of deployment, and performance tolerance. And where there are multiple development organizations, there are undoubtedly multiple approaches to development. This is the context under which HP began its effort to transform its development and delivery.

Trigger for Change

As with many businesses, HP leaders faced pivotal decision-points that shifted DevOps from a good idea to a necessity. First was HP's 2014 decision to split into two companies. From a tactical standpoint, this required the IT leadership team to decide how to split or duplicate IT functions across the two new companies. Also informing the decision was the steady market-driven evolution of technology from purpose-built hardware to flexible "software-defined everything" and cloud solutions. With software comprising a greater role for internal business functions as well as customer-facing products and services, the leadership team placed a high priority on ensuring that HP's processes for software development and delivery would be able to support the rapid pace of innovation coming from HP's R&D team.

Thus, as the HP executive team evolved HP's strategy and position in the market, IT needed to re-think its role and enhance its relevancy to the new HP Inc. and Hewlett-Packard Enterprise. And DevOps became a critical part of that path.

GETTING STARTED: RALLYING AROUND THE DEVOPS CONCEPT

Support for the DevOps initiative came from two powerful sources. First, a number of IT developers and operations engineers were already exploring DevOps solutions—and experiencing frustration when their efforts were stymied by entrenched organizational processes outside their control. Such teams provided valuable "bottoms-up" support for inter-organizational collaboration and change.

Adding steam was executive sponsorship from new IT leaders who brought with them positive experience with DevOps, as well as a clear-sighted view that the current model was not sustainable in light of HP's new direction. IT leaders and developers alike quoted industry guru Gene Kim: "DevOps adoption isn't mandatory, but neither is survival." [2]

"By implementing DevOps at HP IT, we are changing how we run HP, not only how we develop and test software."
- Olivier Jacques, Distinguished Technologist, HP IT

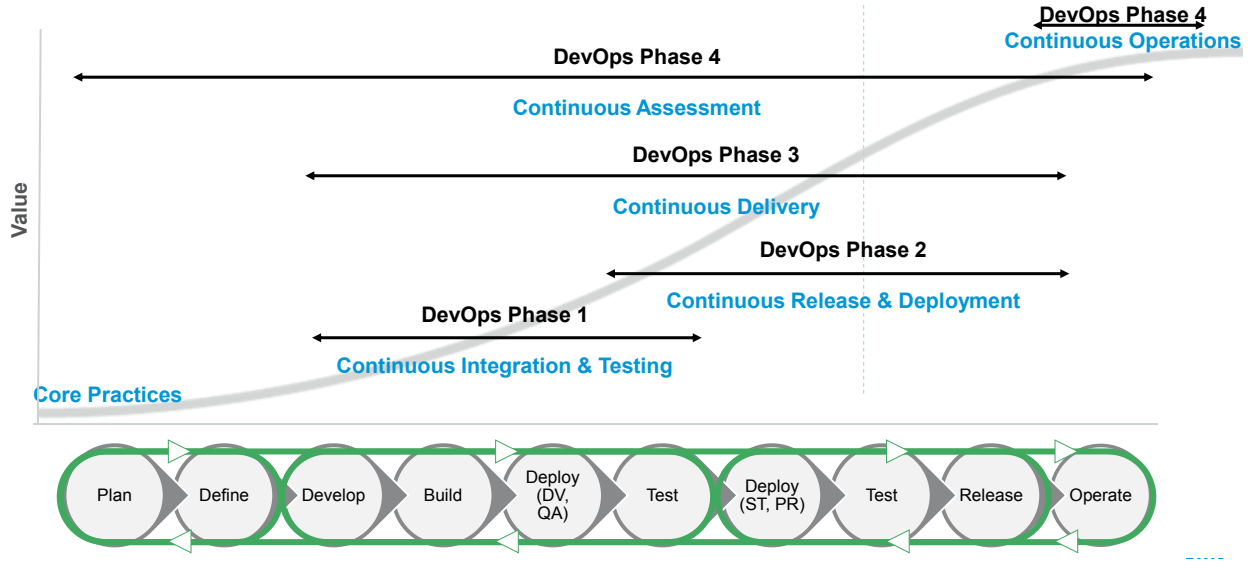
Despite the urgency, the DevOps initiative was not launched company-wide or through a disruptive, top-down mandate. Supporters understood that the project would have greater acceptance if they leveraged pre-existing interest and efforts, and shared early successes. A small team was launched with a few basic goals:

[2] Gene Kim, "Enterprise DevOps Adoption Isn't Mandatory, but Neither is Survival," *The Wall Street Journal* (May 22, 2014), http://blogs.wsj.com/cio/2014/05/22/enterprise-devops-adoption-isnt-mandatory-but-neither-is-survival/

- Share the concept of a DevOps pipeline for development and deployment among various workgroups.
- Provide a pipeline for those groups that were interested, but did not have a pipeline in place.
- Connect existing pipelines for those who were farther along.

To ensure that the most effective DevOps approach would be consistently deployed, the team determined that each pipeline would be developed in a phased approach, beginning with **continuous integration and testing** (see Exhibit 3). Furthermore, processes should be **automated** wherever possible and appropriate. Finally, the implementations should facilitate **collaboration** among stakeholders at every step, from initial input to shared feedback, thus paving the way for continuous innovation.

Exhibit 3: HP Professional Services Approach to DevOps Implementation



Source: HP

"You need to be careful to start small with a 'land and expand' model, versus trying to drive a big center-led change initiative. There are too many good reasons not to start, or to revert once a toe or two is stubbed long the way."
- Ralph Loura, CIO, HP Enterprise Group

FROM PLANNING TO TRIAL EXECUTION

For initial trials, the DevOps team selected projects from workgroups that were already engaged in exploring continuous integration and testing. The team then initiated a series of steps, as follows:

Identify Stakeholders

For each trial, a diverse group of stakeholders—representing development, testing, operations, quality assurance, security, line of business, and other relevant functions—was identified and engaged.

Conduct a Workshop for Stakeholders

To launch each trial, HP was able to draw on its own resources—the same HP Professional Services organization that provides DevOps readiness and implementation services to HP customers. Using the same methodology as with customer engagements, HP Professional Services consultants conducted a Day 1 hands-on workshop for stakeholders, which focused on roles, processes, and technology for implementing and maintaining a continuous integration and test environment for the software project (see Exhibit 4). To demonstrate support for the project, HP's senior IT leaders, including the CIO, attended and actively participated in the entire workshop.

Exhibit 4: HP "Day 1" DevOps Transformation Workshop

Source: HP

The HP Professional Services DevOps Transformation Workshops provided a valuable starting point for the trials, ensuring that stakeholders understood their roles and were committed to the project. Furthermore, the Professional Services team applies its learnings from each engagement, thus creating a "continuous learning, continuous improvement" environment (not unlike that achieved in DevOps), which benefits both internal stakeholders and customers.

Collect and Assess Data

Following the workshop, individual workgroups implemented their DevOps pipelines, starting with continuous integration and testing. From the automated test platform, they collected relevant data, including cycle time for implementing changes, frequency of changes without downtime, and time to recover from downtime. Armed with early promising results, the team shared its findings with the CIO, who supported a move to a broader pilot.

PILOT: INTEGRATING PROCESSES AND ASSESSING CONSTRAINTS

The DevOps team understood that it is easier to achieve success with isolated or new workflows than with the complex, interconnected, legacy software systems that comprise the bulk of enterprise operations. Therefore, the next step in the implementation was to conduct a more comprehensive pilot to assess how the new pipelines would operate in a broader context.

The individual project pipelines were connected to a "hub," from which they could integrate with existing HP processes and components. These include HP Service Manager (IT service desk software that automates processes for service delivery and support) and HP Configuration Management System (a set of tools for collecting, storing, and managing data about IT service configurations).

Another goal of the pilot was to assess challenges. Team members considered security best practices, compliance requirements, and scalability of software. They also tested various development and management tools—from HP and other vendors—to determine which worked optimally. As a result, they were able to start to build a picture of which applications were best suited and which were least suited for DevOps.

ONGOING RESULTS AND LEARNINGS

For HP, the DevOps rollout continues. Pipelines continue to be built for selected applications, with early successes used to spur interest among other teams. HP's IT, product, and professional services teams continue to enhance their DevOps knowledge, folding the learnings from internal and customer deployments back into the products, services, and DevOps rollout plans.

> "To implement DevOps at HP IT, we rely on a trust-based culture and a strong set of tools and processes."
> - Rafael Garcia, Director, HP IT

The process is not without its challenges. HP faced many of the same hurdles as any large enterprise, including:

- **Organizational resistance to change** – The DevOps approach is based on collaboration, which requires breaking down traditional organizational silos and refocusing the team's goals on what is optimal for the system, not any individual team or process. Even a well-run organization (for example, operations) is suddenly faced with a change in scope, new ways of measuring employees, and perhaps a

loss of absolute control over certain functions. While training workshops focus on the business value (and individual job satisfaction) associated with DevOps' shared ownership of the entire application delivery process, the disruptive message can be difficult for some staff and managers to digest and ultimately accept.

- **Constant pace of change** – Many IT organizations still think in terms of projects that have a start and an end-date. However, achieving the business goal of *agility* requires more than speedy delivery of such closed-ended projects; it means being constantly poised to shift direction on projects and products that never end. This is fundamental to why continuous integration and testing is so valuable; it addresses the on-going nature of high quality change and enhancement. But "change as a constant" is a new and potentially overwhelming concept to organizations and individuals.
- **Line of Business engagement** – DevOps success requires line-of-business stakeholders to be fully involved in the process—not just providing requirements at the start and feedback at rollout, but working alongside development, testing, QA, and operations colleagues to review key performance metrics at each step, recognize and prioritize potential issues, and help design solutions. LoB team members are often enthusiastic at their inclusion in the project team at the start of the initiative, but may underestimate the importance of their role and the time required to ensure success.

Results to Date

An enterprise-wide DevOps implementation involving thousands of workloads is a multi-year project; and, as noted, HP is still in the early days of its multi-prong rollout effort. While the company is still gathering data, short -term results and observations are positive.

"For us at HP IT, DevOps is an absolute must: it allows HP to compete efficiently with startups, while taking advantage of our scale."
- Edward Raigosa, HP DevOps Team Leader

For workloads that have implemented continuous integration and testing, business benefits are still being quantified; however, anecdotally, the team reports overall process improvements in:

- Decreased cycle time
- Increased frequency of changes that do not force downtime
- Faster recovery from downtime

Equally important is positive feedback from stakeholders and team participants. HP has received the following feedback:

- **Line-of-business stakeholders** report that Continuous Test and Integration gives them the ability to change directions quickly when the market demands—compared with previous processes that locked software requirements in place 12-18 months prior to deployment.

- **Developers** welcome relief from onerous change control processes, while still complying with audits and control processes via automation.
- **Team members** report greater satisfaction with their jobs, thanks to the greater visibility and control they have over the application lifecycle.

LESSONS LEARNED FROM HP: GETTING STARTED ON YOUR DEVOPS INITIATIVE

HP is, of course, a technology company with strong competence in application lifecycle management and testing software, as well as professional services expertise. And yet, when it comes to revolutionizing traditional software development and deployment processes, the company is like any other large enterprise, with multiple development organizations, multiple projects and products, multiple requirements, and multiple approaches. For that reason, HP's experience can provide valuable insight to any organization considering or expanding a DevOps implementation.

"Change is hard; cultural change is the hardest. Know you will get stuck on governance issues, personality issues, practicalities of enterprise life. It is important to have a champion with the ability to pick up the phone and clear obstacles, influence change, assume risks when needed, in order to keep the road clear for the team to work."
- Ralph Loura, CIO, HP Enterprise Group

Here are key learnings shared by HP R&D IT's DevOps project team:

- **Champion of the initiative should be a hands-on practitioner** – You need support from the senior leadership team as well as line of business stakeholders. But without someone at the helm who knows how to sequence code and deploy an application, you will struggle to earn credibility among the developers, testers and operations teams—and you risk overlooking critical elements.
- **Populate your pilot project team with those who are already exploring DevOps solutions** – You'll have the greatest and fastest success if you tap into the enthusiasm and mindset of developers, testers, and operations engineers who are looking for ways to make their jobs more efficient, while becoming the leaders in adoption of new best practices (and it is almost certain there are pockets of them in every large enterprise).
- **Understand that you are proposing a revolution** – IT teams are accustomed to implementing and using new technologies and systems. They are less comfortable with new ways of working—collaboration with new teams, shared accountability, and compromises for the overall benefit of the project. For this reason, it may make sense to pair your DevOps initiative with another disruptive event, whether company-wide (e.g., an acquisition or divestiture) or IT-based (e.g., implementation of a cloud or software-defined data center strategy). Keep in mind that such a major transformation may require the assistance of a third-party expert to take root.

- **Enable a parallel world first** – and convert over time. Attempting to evolve your old processes to the dramatically different DevOps methodology would be painfully costly, time-consuming, disruptive, and perhaps impossible. You are better off implementing DevOps separately from your old processes, converting as appropriate.
- **Choose the right projects** – DevOps isn't an all-or-nothing approach. Not every application is an equally good candidate for DevOps; for example, you may decide to continue to use your existing processes for certain complex legacy apps or highly compliant systems of record. That's why it's important, as you get started, to select software projects and products that will yield a quick, visible, and measurable success. The successes will yield valuable data about benefits, fueling interest and further investment in extending the DevOps initiative.
- **Don't cut corners** – As noted, the importance of continuous integration and testing cannot be overstated. Some of the team will argue that you can add efficiency by cutting back on the frequency of testing or just test in production. Others will suggest that continuous test means that you can skip the QA step (on the assumption that the unit testing in development will uncover any glitches). Wrong on both counts. Don't jeopardize your DevOps initiative by cutting corners before you get off the ground.
- **Engage Line of Business** – Line-of-business colleagues need to be fully invested in the DevOps process to make it work. Be sure to include these important stakeholders, not just during the planning and requirements stage, but throughout the process.
- **Ensure you have the right technology platforms to support your projects** – The HP team used some of HP's own software platforms—such as HP software for Application Development Management (HP ALM, HP testing tools), HP Business Service Management, and HP Helion Cloud—but also implemented third-party development tools and cloud deployment tools. The HP team offers the following tips related to technology platforms:
    - Poor tools won't jeopardize your implementation, but getting the best tools will help you achieve success.
    - Be sure you choose software platforms that work together and provide the greatest degree of flexibility and support. In particular, platforms must support ways to programmatically include them in the continuous delivery pipeline.
    - Implementing a proven commercial tool means you don't have to invest your own constrained internal resources on integration and on-going maintenance.
- **Engage a third-party DevOps expert** – As enterprise IT departments tackle the onslaught of disruptive technology changes (from new deployment environments like cloud, new consumption platforms like mobile, and productivity-enhancing technologies like collaboration and social media), they are increasingly turning to professionals to help them plan, design, and execute strategies to support business agility into the future. In a 2014 survey conducted by Frost & Sullivan, 90% of IT decision-makers say they have or will engage third-party experts to help them transform. Just as the HP IT team was able to tap into the expertise of the HP's Professional Services DevOps Solutions organization, you may find that professional services engagement may be what your business needs to get started.

THE LAST WORD

In a rapidly changing, competitive global marketplace, businesses' success will increasingly depend on *agility* and *innovation*. For IT organizations charged with developing, deploying, and maintaining the software that runs the business, achieving agility and innovation means turning away from cumbersome traditional processes and siloed technologies. Instead, many are exploring DevOps, the application delivery methodology and streamlined framework that replaces waterfall tasks, siloed organizations, and manual processes with a highly integrated, collaborative, and automated approach that includes continuous integration and testing of software components.

But resource-constrained IT organizations may struggle to introduce a DevOps framework, or to expand beyond a limited trial. For these organizations, a look at HP's own internal journey to DevOps is instructive. HP harnessed support from developers and leaders alike to build and share pipelines for continuous integration and testing of applications. For each pipeline it brings on board, the DevOps team measures and assesses performance, folding its learnings back into the overall DevOps initiative, for the benefit of other internal projects as well as HP DevOps customers.

Although the initiative faced its share of setbacks and hurdles, the ongoing project continues to gain momentum, with measurably positive results.

HP IT's DevOps effort is aligned with the company's own transformation as a business. Other enterprises, regardless of industry, would do well to learn from HP's journey.

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