



Journey to the cloud

The creative CIO Agenda





Introduction

Since its inception ten years ago, cloud computing has expanded and evolved into one of the biggest paradigm shifts in the computer age. Instead of requiring millions of dollars of upfront capital investment and up to a year of time to provision a data center, it is now possible to do the equivalent with a credit card and a few mouse clicks in less than a minute. Once a steep barrier to entry, now any size organization from a single individual to a global, multi-billion dollar enterprise has virtually immediate access to all of the computing capacity it needs, on demand.

Almost all the digital disruption that is occurring today has some form of cloud computing at its core. The availability of very low-cost, on-demand, and easily provisioned Infrastructure as a Service (IaaS) has all but rendered obsolete the need for many organizations to build and operate their own data centers. The growing portfolio of application Software as a Service (SaaS) has enabled business organizations to directly procure solutions with little or no assistance from IT, eliminating the need for upfront capital and reducing the lag time from decision to value from months or years to weeks or days. The recent Harvey Nash / KPMG CIO Survey confirmed this journey to the cloud with the clear majority of respondents planning to make significant investments in cloud services, especially in Platform as a Service (PaaS) which has lagged the other two, primarily due to its higher degree of complexity and relative immaturity.

As the market for cloud services has matured, it is being deployed well beyond serving as a utility for storage and servers. Applying a cloud-first strategy has many compelling advantages not the least of which is freeing IT from the heavy burden of building and operating data centers. This significantly reduces IT's constant need for capital that can now be deployed elsewhere and eliminates the need for a large operations staff. Furthermore, with the appropriate governance processes in place, favoring SaaS solutions over internally developed ones helps the business become more self-sufficient, reducing demand and freeing up additional resources to work on more complex and high value initiatives.

For many organizations, implementing cloud computing and getting value from it are not necessarily synonymous. The diversity of legacy estates, technical debt, and growing number of available cloud services and delivery options (public, private, hybrid) creates a level of complexity in decision-making and implementation that is challenging at best and presents a barrier at worst. This KPMG PoV provides a view of the current cloud market, considers the potential benefits and barriers to cloud adoption, and provides recommendations for CIOs to help successfully navigate the current cloud environment and realize value from their cloud investments.

Key takeaways

- Cloud computing is now the preferred computing model for most technology enablement
- However, for most large enterprises, this implies a hybrid (public, private, on premise) environment for many years
- Orchestrating hybrid environments is difficult and complex, while the tools and processes are immature and evolving
- Keys to cloud value are having a holistic, enterprise-wide strategy, effective cloud governance integrated with IT governance, and an integrated consumption platform to provide easy access to cloud services and manage their operations

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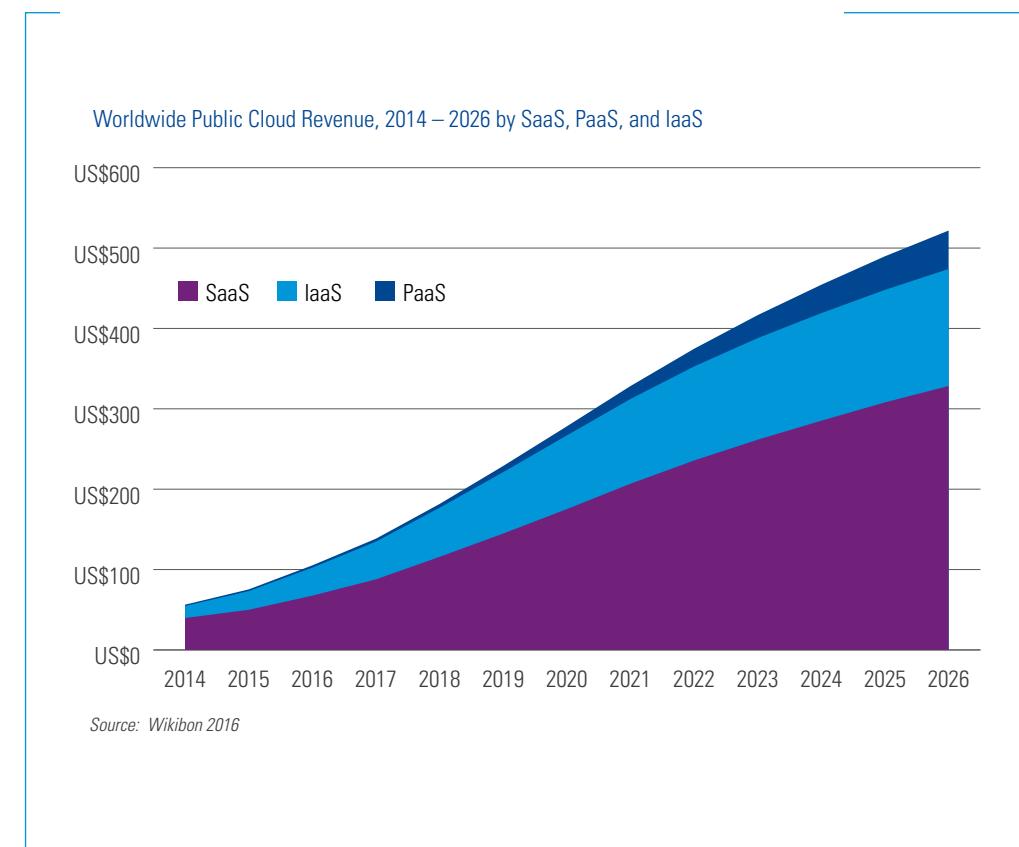
Cloud has come of age ...

What we now refer to as public cloud computing came into existence ten years ago when Amazon announced a limited public beta of EC2 (Elastic Compute Cloud). At the time it was simply a virtualized CPU running Linux. Ten years later, the public cloud computing ecosystem has evolved and grown into a US\$100 billion-plus market while the private cloud market is estimated to be another US\$50 billion (see figure 1). Businesses now spend about ten percent of their technology budgets on cloud-related services according to Bernstein Research.

Much of the growth in cloud to date has come from a bifurcated approach. The bulk of the spending has either gone towards SaaS solutions driven primarily by business executives, often through direct procurement without IT's involvement; or has been directed by IT organizations on IaaS, primarily for new applications and in some cases, where practical, to replace aging infrastructure. In either case, it has often been the result of a tactical or opportunistic approach as opposed to an enterprise-wide cloud strategy - but this now appears to be changing.

Data from the 2016 Harvey Nash / KPMG CIO Survey confirms that cloud is poised for mainstream adoption and even more rapid growth (see figure 2). While investments in SaaS and IaaS will continue to grow, investment in PaaS will almost double its growth rate as CIOs adopt cloud computing as their strategic development and production platform for both new applications and services, and as they begin the process of paying down technical debt and migrating or modernizing their legacy IT estate.

Outside of pure SaaS solutions and new cloud-native development, more widespread adoption has been hindered by a number of issues ranging from a shortage of cloud skills, a lack of integrated cross-platform management and orchestration tools to simplify some of the complexity, and a moving target of regulations and data privacy laws that have varied from country to country. The good news is that many of these issues are being eliminated or at least significantly improved.



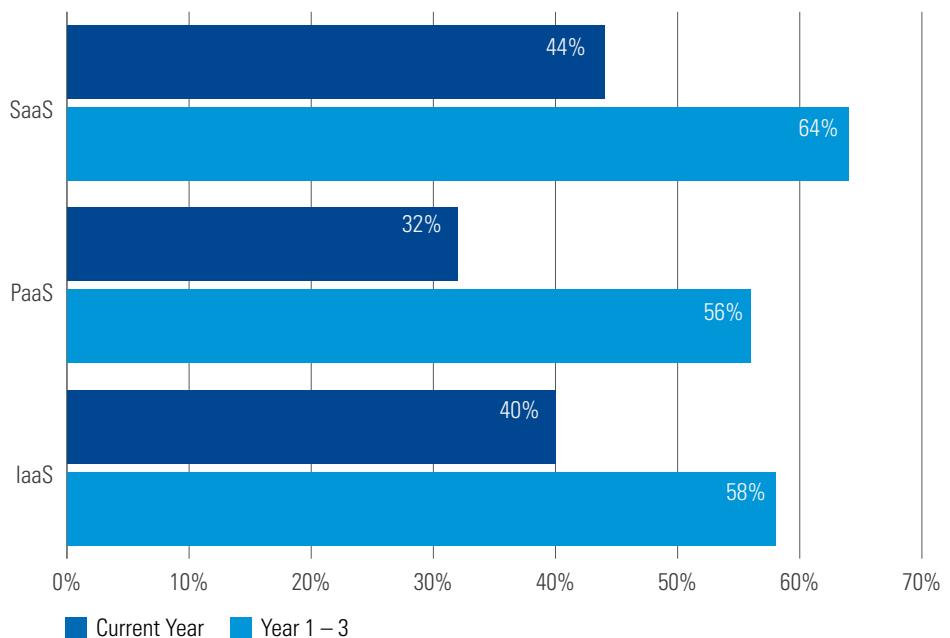


...and is now an essential enabler of a variety of strategic capabilities

Much of the initial investment in cloud has been driven by one-off tactical opportunities, economics or both. With most organizations under constant pressure to cut costs and improve operational efficiencies, moving workloads (where possible) and spinning up new applications on cloud infrastructure has been a quick fix. Meanwhile software vendors, with a few exceptions, have made a quick pivot to embracing SaaS models over the traditional licensing approach, forcing many businesses to go along for the ride.

While the requirements for cost reduction and efficiency will never go away, the demand for digital transformation and a response to digital disruption have propelled cloud from being a tactical reaction to being a strategic enabler. With the new value proposition for business built around speed and agility, cloud has to be part of the answer.

Figure 2: Cloud investment by type
(Significant IT budgets > US\$250m)



Source: Harvey Nash / KPMG 2016 CIO Survey



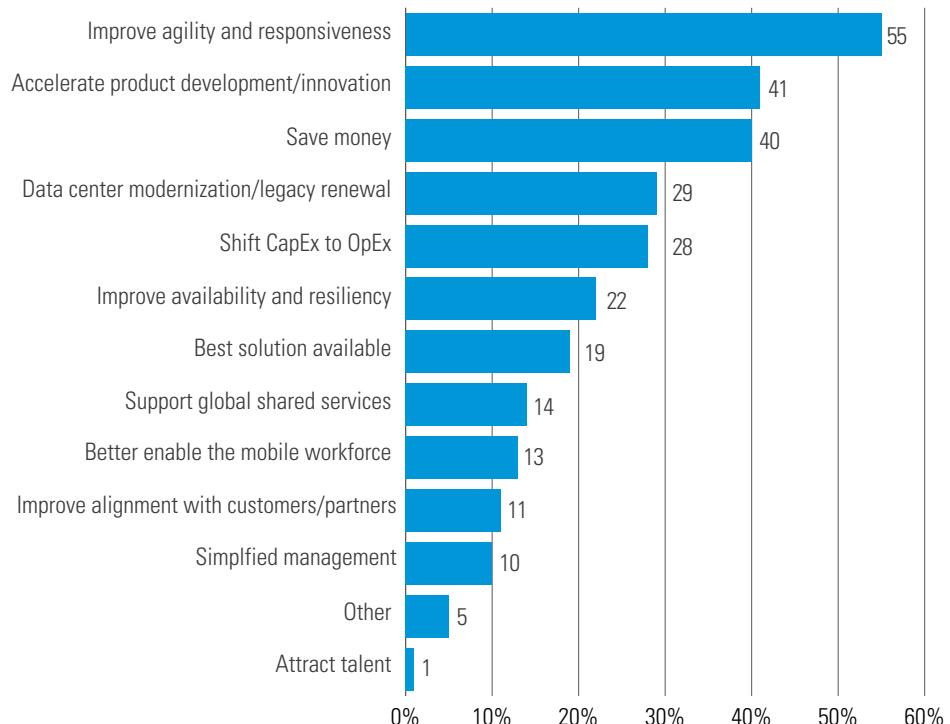
...and is now an essential enabler of a variety of strategic capabilities cont...

When CIOs were asked about their top reasons for adopting cloud computing in the 2016 Harvey Nash / KPMG survey, saving money only came in third. This indicates that rather than looking for immediate cost savings they are now taking a longer term and more strategic perspective. The top three reasons for adopting cloud include:

- **Improve agility and responsiveness.** To remain competitive, organizations need to be able to respond quickly to marketplace changes and customer demand. Using analytics to better understand customer experience, they need to be able to adapt products and services, marketing programs, and other elements based on what they learn. For example, an increasing number of online ads are customized for the user based on their past behaviours.
- **Accelerate product development / innovation.** Digital disruption has accelerated product lifecycles and significantly reduced barriers to entry in many industries. It is not uncommon for product lifecycles to be measured in months or even weeks, not years. As a result, time to market is the new value driver for business and with technology underpinning all core business processes, they expect the same from IT. For example, Amazon's Echo and Google Home are innovative products that would not be possible without the cloud and its big data sets and raw computing power.
- **Save money.** It may not be top on this occasion – but it is always important. Organizations not only need to be innovative and fast, they must minimize cost and optimize margin at the same time in order to sustain their ability to continue to invest.

Coming in fourth place was data center modernization/legacy renewal, highlighting that while everything digital gets most of the visibility, there are years of technical debt that must be paid down in order to optimize investment in digital transformation. If systems of engagement and insight can't easily integrate with the core systems of record, overall value will be constrained and competitiveness impaired.

Figure 3: Top reasons for adopting cloud computing



Source: Harvey Nash / KPMG 2016 CIO Survey

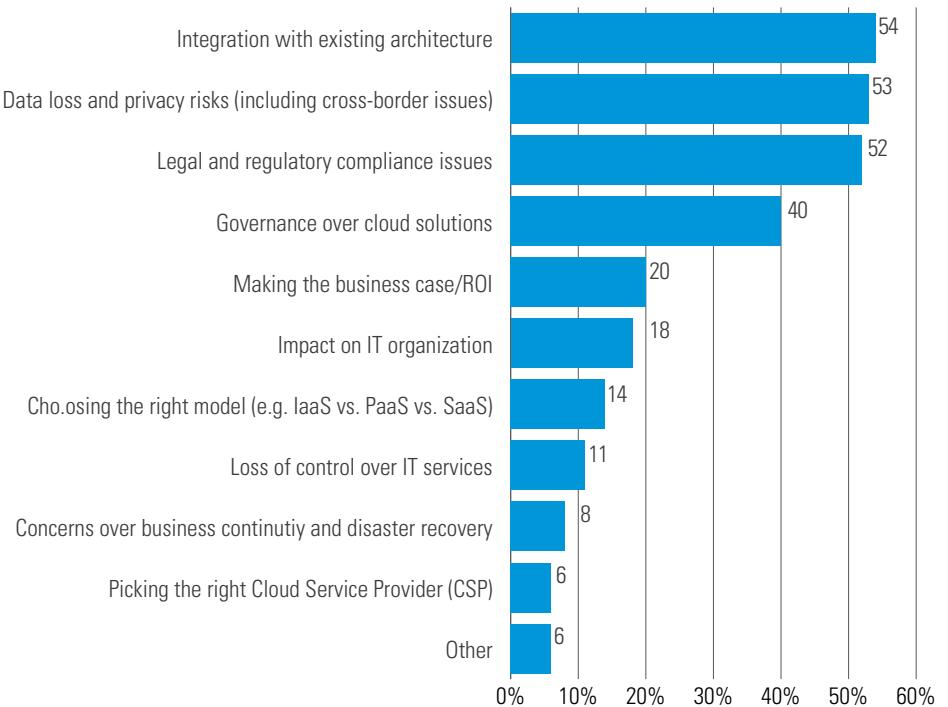


Cloud's complexity remains challenging

One of the challenges CIOs face when embracing cloud services is that cloud is often compared to a utility, suggesting that organizations can procure computing capabilities just like electricity or water, and only pay for what they use. But, except for most SaaS solutions, this grossly over-simplifies the current state of cloud computing, especially for large, global enterprises. Electricity consumers do not have to choose between different types of power (e.g. nuclear, coal, solar), electricity suppliers, where their electricity is generated (e.g. on their premises or remotely at the utility), or whether they are going to use AC or DC current. Furthermore, they don't have to create a new interface every time they want to plug something in.

Choosing cloud services means having to make decisions about service models (IaaS vs. PaaS vs. SaaS), delivery models (public vs. private vs. hybrid), location (on premise, off-premise dedicated, off-premise co-located) and then navigating an ecosystem with hundreds of vendors supplying the components that must be stitched together to provision a workable solution. Then you need to factor in the existing IT estate and its data centers and legacy applications, often representing a significant capital investment reflected in the organization's balance sheet. It's no wonder that CIOs encounter many barriers when adopting cloud, ranging from compatibility and integration issues with existing systems to legal and regulatory compliance (see figure 4).

Figure 4: Barriers to Cloud Adoption



Source: Harvey Nash / KPMG 2016 CIO Survey



Cloud's complexity remains challenging cont...

Some of the significant challenges to cloud adoption include:



Suitability for cloud

The fact is that many legacy systems have architectural limitations, are tightly coupled to their infrastructure, or have other constraints that prevent them from being easily migrated to the cloud. They will either need to be replaced or re-written at significant time and cost.

Data loss and privacy risks

Using public cloud means putting customer data outside the firewall and in a location that is not always obvious. Concerns arise over the ability of cloud providers to protect the data and keep it segregated from other co-located companies.

Legal and regulatory compliance

Different countries and different industries have varying approaches, which has an impact on where cloud computing resources are located, where data is stored, how it is transmitted, who has access to it, and who controls it. The large cloud providers are investing significantly to build out their geographic footprints to be able to meet these diverse requirements.

Cloud governance

Decision rights about when, where, and how to use cloud need to be identified and enforced. The availability of SaaS solutions has enabled business users to directly procure technology solutions without involving IT. This can be a benefit but it can also create serious risks and other problems if not controlled. Striking a balance to ensure the enterprise is protected without putting up barriers that slow decision-making and prevent the business from seizing opportunities is challenging but must be addressed.

Making the business case/ROI

Over the years, organizations have made considerable investments in data centers, filling them with servers, storage, and networking equipment to support their applications and services. These investments often represent a large asset on their balance sheet. Moving these workloads to the cloud would require one-off migration costs and a write-off of the remaining depreciation which could eliminate any cost benefit and invalidate the cloud business case.



Cloud's complexity remains challenging cont...

The rise of industry clouds

Adding to complexity is the recent emergence of industry cloud platforms. These are typically positioned as a specialized PaaS offering with API interfaces to a catalog of cloud-based services that developers can use to accelerate the creation of apps and deliver more value to their customers.

For example, GE has launched Predix, its platform for IoT and analytics. Using Predix, companies in industries like aviation, healthcare, and transportation can accelerate the development and delivery of IoT applications that monetize the vast amount of data being generated by sensors attached to all kinds of equipment.

Pitney Bowes is using Predix to power Clarity™, its industrial internet software solution aimed at customers of its inserting and mail finishing equipment to improve operations. It expects to drive up to 20 percent increases in machine yield over time, reduce call center activity by 20 percent, save up to 15 percent on parts replacement, and save 10 percent on tech support time.

Similarly, IBM has created an entire business unit around Watson, a technology platform that uses natural language processing and machine learning to reveal insights from large amounts of unstructured data. One of its product offerings is the Watson Developer Cloud, a set of APIs that can be used to invoke language, vision, speech, and data "smart" services.

For example, one company is harnessing cognitive analytics in the cloud to build a solution that helps doctors interrogate a vast corpus of medical research data and correctly diagnose patients faster than ever.

KPMG in the U.S. announced plans to apply IBM's Watson cognitive computing technology to KPMG's professional services offerings. The agreement, including a focus on auditing services, builds on several recent successful KPMG initiatives demonstrating the promise of cognitive technologies in transforming the firm's ability to deliver innovative and enhanced business services.

For a representative list of available services for Predix and Watson see the accompanying Sidebar.

Sidebar 1: Representative Predix and Watson Services

GE Predix Services (representative)

- **Connectivity** – plug-and-play, secure, and reliable connectivity service
- **Asset Data** – create and store machine asset models and instances
- **Analytics User Interface** – browser-based user interface to upload, validate, and run analytics
- **User Account & Authentication** – full featured OAuth 2.0 server
- **Mobile Service** – design, develop, and deploy industrial internet mobile apps that function independent of network connectivity
- **Event Audit Trail** – create, store, and update events for any user-defined events or states

IBM Watson Services (representative)

- **Alchemy Language** – text analysis through natural language processing to understand sentiment, keywords, entities, high-level concepts and more
- **Personality Insights** – extracts and analyses a spectrum of personality attributes to help discover actionable insights about people and entities
- **Text to Speech** – synthesizes speech audio from an input of plain text and supports multiple voices and multiple languages
- **Visual Recognition** – returns scores for relevant classifiers representing things such as objects, events, and settings from an image
- **Tradeoff Analytics** – helps people make decisions when balancing multiple objectives using a mathematical filtering technique called "Pareto Optimization"



Getting started: three keys to unlocking cloud value

Today's reality is that for the foreseeable future, most large enterprises will need to acquire and support multiple private and public cloud platforms, services, and solutions, and integrate them with existing infrastructure, applications, and data in a hybrid IT approach. Organizations migrating everything to the public cloud are rare today but that will change as public cloud offerings mature.

We propose three keys to managing the complexity and risk in order to unlock value in this complex environment, including (1) taking a holistic enterprise-wide approach to cloud strategy; (2) integrating effective cloud governance into the existing technology governance framework; and (3) deploying an integrated consumption platform that provides easy access to underlying cloud services and capabilities, holistically manages their operation, and embeds some of the governance policies through automation.

First, adopt an enterprise-wide cloud strategy

As mentioned earlier, many organizations are now taking a cloud-first approach when implementing new solutions but unless you are a startup with a zero IT footprint, becoming a cloud-first company is a long journey.

Given that cloud solutions, especially SaaS, are often sold directly to the business, and can be procured quickly and with little upfront costs, it doesn't take long for organizations to accumulate significant pockets of shadow IT from multiple cloud providers. This creates even more complexity, leads to escalating costs from duplication, and makes it difficult if not impossible to ensure compliance with internal policies and external regulations.

An enterprise-wide cloud strategy explicitly strikes a balance between observing organizational priorities and policies with individual business stakeholder requirements. At a minimum the strategy should address: when it is appropriate to use public versus private cloud; when it is appropriate to use off premise versus on premise; where different types of data can be physically stored and accessed; which cloud providers, services, and solutions are pre-approved; and the process for procuring cloud-based solutions.

A significant driver of the cloud strategy is a detailed workload assessment for all existing and currently planned applications. The assessment will identify which applications can be immediately migrated to the cloud, which applications will require re-work to move to the cloud, and which applications are not suitable for a cloud environment. The strategic guidance developed will inform cloud governance.

Second, integrate effective cloud governance

With hundreds or even thousands of existing workloads to consider and new demand for capabilities to drive digital transformation on top of that, cloud governance must strike a balance between protecting the enterprise and optimizing cloud value across the entire organization - while not creating barriers that slow down or prevent the business from obtaining the technology enablement it needs to remain competitive, or, worse, leading to a multitude of "shadow" clouds.

A detailed cloud governance framework is beyond the scope of this report but conceptually cloud governance needs to be integrated with existing technology governance and cover the entire cloud lifecycle from planning through to off-boarding from a cloud provider.



Getting started: three keys to unlocking cloud value cont...

Cloud governance should address the following:

- **Strategic guidance** – leads to a formal strategy and roadmap
- **Enterprise architecture & technology** – adapts existing architecture and technology policies for cloud
- **Procurement, contracts, and legal** – sets out policies for how cloud services will be acquired and managed
- **Security, privacy, and compliance** – establishes policies around security, data privacy and location, and regulatory compliance
- **Operational policies** – establishes who has access, how cloud is consumed, managed and monitored.

Several cloud governance bodies will be required to develop, monitor and evolve cloud governance over time. These can either be new entities that become sub-groups to existing governance structures, or the responsibilities can be added to existing groups and at a minimum include:

- **Cloud governance steering committee** – this group will formulate initial cloud governance policies, monitor compliance, and review exceptions, and proposed changes
- **Cloud operations committee** – this group will focus on the day-to-day operations, management, provisioning, and other issues related to the overall consumption of cloud services.

Additional components of cloud governance are tools to expose cloud services, simplify cloud access, monitor and manage cloud services and providers, create accounting and billing modules, regulate applications design and development, and more. An effective way to automate parts of cloud governance is to utilize an integrated consumption platform.

Third, deploy an integrated consumption platform

As we previously discussed, hybrid IT environments are enormously complex and extremely challenging to manage. Since the market for orchestration solutions is immature and no single orchestration product is a silver bullet we recommend developing a consumption platform instead. A consumption platform is a holistic set of capabilities for multi-modal service consumption (independent of deployment model).

The current market is filled with traditional heavy orchestration providers (high touch, custom coding / scripting, lock-in) with proprietary solutions that fail to deliver the end-to-end automation of all the hybrid components while “light” orchestration products born out of the open source market are evolving rapidly.

Light orchestration with embedded in-line and out-of-band policy governance is required to securely manage future demand for cloud services and agile workloads. In-line governance means that compliance is embedded within orchestrated provisioning processes while out-of-band governance means that compliance is assessed continuously post deployment.

Rather than just purely focusing on orchestration as a “silver bullet” the consumption platform is a composite of commercial off-the-shelf (COTS) and engineered/open source components. It typically comprises three to four core tools with eight to twelve key integration points. There is no single mature end-to-end solution currently available in the market.

The consumption platform contains tools and processes in four main categories including:

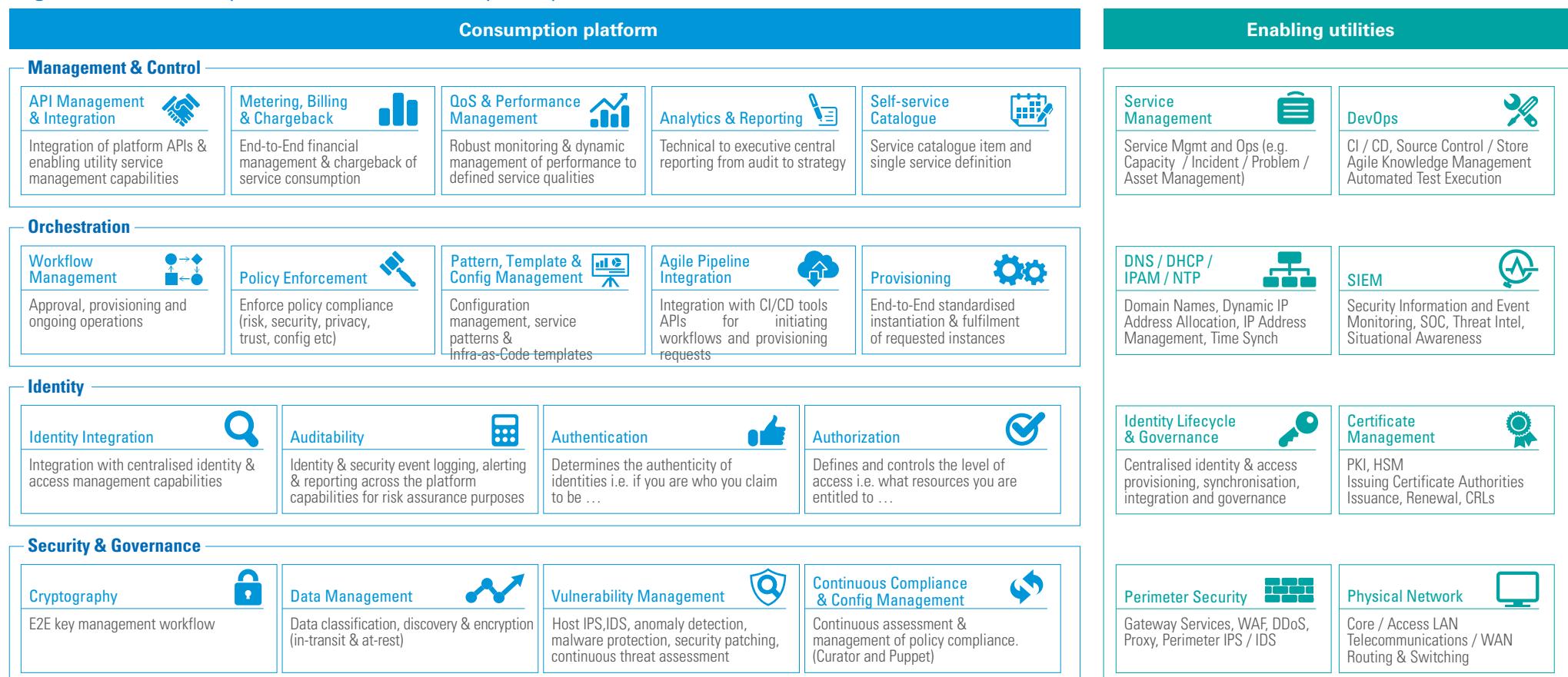
- **Management & control** – a set of tools for API management and integration, metering & chargeback, performance management, analytics and reporting, and a self-service catalog
- **Orchestration** – a set of tools for workflow management, policy enforcement, template & configuration management, agile pipeline integration, and provisioning
- **Identity** – tools for identity integration, auditability, authentication, and authorization
- **Security & Governance** – tools and processes for cryptography, data management, vulnerability management, and continuous compliance & configuration management.



Getting started: three keys to unlocking cloud value cont...

For an example of a representative consumption platform see Figure 5 below.

Figure 5: An example of a cloud consumption platform



Source KPMG

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Looking Ahead

Cloud computing will continue to evolve at a rapid pace as new tools and services are introduced, existing tools and services are enhanced, and organizations mature their capabilities based on their previous experiences. There are also several promising technologies that could simplify hybrid cloud implementation, three of which we will mention here.

01



Containers

Without getting overly technical, containers are similar to virtual machines (VM) with several important differences. A virtual machine uses a hypervisor to abstract the underlying hardware. Each VM has its own operating system, middleware, and applications enabling multiple VMs with different operating systems to run concurrently on the same hardware. Containers are operating system-specific and they share the operating system's libraries and kernel. The result is a lightweight package that uses less memory space and has very fast launch times. Whereas using virtualization can lift server utilization levels to 50 percent, containers can push well beyond that. Containers are highly portable in that they can be moved to any environment running their operating system. Containers also facilitate modularity and scalability which is why they are often used in conjunction with microservices (see point 2). You can easily break out an application's functionality into individual containers. The result is the ability to write once, and run anywhere with hyperscalability.

02



Microservices

In a nutshell, microservices are small independent processes that communicate with each other to form complex applications and utilize language-agnostic APIs. Microservices are built around business capabilities and are independently deployable by fully automated deployment technologies. Hence, a microservices architecture lets you build and deploy applications faster that are more scalable and resilient than traditional monolithic applications. Microservices and containers are highly complementary as you can drop a microservice into a container. By using a microservices architecture and containers, you can remove some of the challenges to being able to move applications between private and public cloud infrastructure.

03



Private and public cloud stack coherence

One of the challenges in integrating private and public cloud services is that private virtual machine infrastructure and the public cloud are based on different technology stacks. This makes it difficult for organizations to easily shift workloads from private to public cloud infrastructure and take advantage of the inherent flexibility this provides. Microsoft was the first to recognize the opportunity in being able to provide a set of software that enables enterprises and service providers to create a private cloud that looks, feels, and operates just like the public Azure cloud that Microsoft operates. However, scaling down hyperscale public cloud environments is difficult and Microsoft delayed the release of Azure Stack from the end of 2016 to mid-2017 and changed its distribution strategy from selling the software directly to enterprise IT shops to providing Azure Stack through integrated systems provided by hardware partners.



Contributors

With thanks to the following subject matter experts for providing their input and guidance in this paper.

David Conroy
**Managing Director, CIO Advisory,
KPMG in the USA**
T: +1 713 319 2011
E: dconroy@kpmg.com

James Williams
Director, CIO Advisory, KPMG in the USA
T: +1 214 840 4822
E: jameswilliams@kpmg.com

Saurabh Chauhan
Director, Advisory, KPMG in Australia
T: +61 2 9335 7012
E: schauhan2@kpmg.com.au

Gary Harmson
**Senior Manager, CIO Advisory
KPMG in the UK**
T: +44 20 73116383
E: Gary.Harmson@KPMG.co.uk

Marc Snyder
**Managing Director,
Head CIO Advisory Global Centre of
Excellence**
T: +1 978 807 0522
E: msnyder@kpmg.com

Craig Symons
**Director, CIO Advisory Global Centre of
Excellence**
T: +1 732 892 4799
E: csymons@kpmg.com

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KPMG recognizes that today's CIOs face increasingly complex demands and challenges in becoming the strategic technology partner their businesses require.

KPMG's CIO Advisory professionals can help CIOs, technology leaders, and business executives harness technology disruption, manage technology resources more effectively to drive agile and improved business performance, enhance strategic position, and improve the strategic value of their technology investments.

If your IT organization is seeking ways to leverage technology as a source of innovation and competitive growth, KPMG member firms can help. For more information on CIO Advisory's services and capabilities, please visit www.kpmg.com/us/IT.



Contacts

Denis Berry
CIO Advisory North America

T: +1 312 919 4302
E: dberry@kpmg.com

Lisa Heneghan
CIO Advisory EMEA

T: +44 7718 582 368
E: lisa.heneghan@kpmg.co.uk

Guy Holland
Technology Strategy & Performance, KPMG Australia

T: +61 410 530 410
E: guyholland@kpmg.com.au

Marc E. Snyder
CIO Advisory – Global Centre of Excellence

T: +1 978 807 0522
E: msnyder@kpmg.com

Claudio Soutto
CIO Advisory Latin America

T: +55 11 3940 3285
E: claudiosoutto@kpmg.com.br