CompTIA

TRENDS IN CLOUD COMPUTING

FULL REPORT

RESEARCH

FOURTH ANNUAL • AUGUST 2013

www.comptia.org

About this Research

CompTIA's *4th Annual Trends in Cloud Computing* study builds on previous CompTIA research in the cloud computing space, further exploring trends, challenges, and opportunities. The objectives of this study include:

- Collect information on end-user purchase drivers and/or inhibitors
- Assess depth of cloud usage and ways in which it is changing IT behavior
- Track the experience of channel partners offering cloud solutions, building cloud practices
- Gauge channel perceptions of end-user purchase drivers and or inhibitors
- Measure impact of cloud computing on channel roles/vendor relationships
- Assess the need for training and/or standards

This study consists of six sections, which can be viewed independently or together as sections of a comprehensive report. The individual sections and full report can be viewed at the cloud computing research page on the CompTIA website.

Section 1: Market Overview

Section 2: Channel Business Model Analysis

Section 3: Channel Relationships: Vendors, Customers, and Distributors

Section 4: End User Business Model Analysis

Section 5: End User Cloud Migration Issues

Section 6: Cloud Challenges and Opportunities

This study was conducted in two parts.

Part I: quantitative online survey of 501 IT and business professionals in the United States involved in IT decision-making (aka end users). Data collection occurred during June 2013. The margin of sampling error at the 95% confidence level for the U.S. results is +/- 4.5 percentage points. Sampling error is larger for subgroups of the data.

Part II: quantitative online survey of 400 IT firms in the United States (aka channel). Data collection occurred during June 2013. The margin of sampling error at the 95% confidence level for the U.S. results is +/- 5.0 percentage points. Sampling error is larger for subgroups of the data.

For both surveys, CompTIA worked with the research firm Research Now to facilitate data collection using an independent panel. As with any survey, sampling error is only one source of possible error. While non-sampling error cannot be accurately calculated, precautionary steps were taken in all phases of the survey design, collection and processing of the data to minimize its influence.

CompTIA is responsible for all content contained in this series. Any questions regarding the study should be directed to CompTIA Market Research staff at research@comptia.org.

CompTIA is a member of the Marketing Research Association (MRA) and adheres to the MRA's Code of Market Research Standards.

CompTIA

TRENDS IN CLOUD COMPUTING

SECTION 1: MARKET OVERVIEW

RESEARCH

FOURTH ANNUAL • AUGUST 2013

www.comptia.org

Key Points

- As cloud components are becoming more prevalent in IT architectures, more companies are relying on cloud computing for business processes such as storage (59%), business continuity/disaster recovery (48%), and security (44%). This strong usage and strong market indicators show that cloud computing is becoming a default part of the IT landscape.

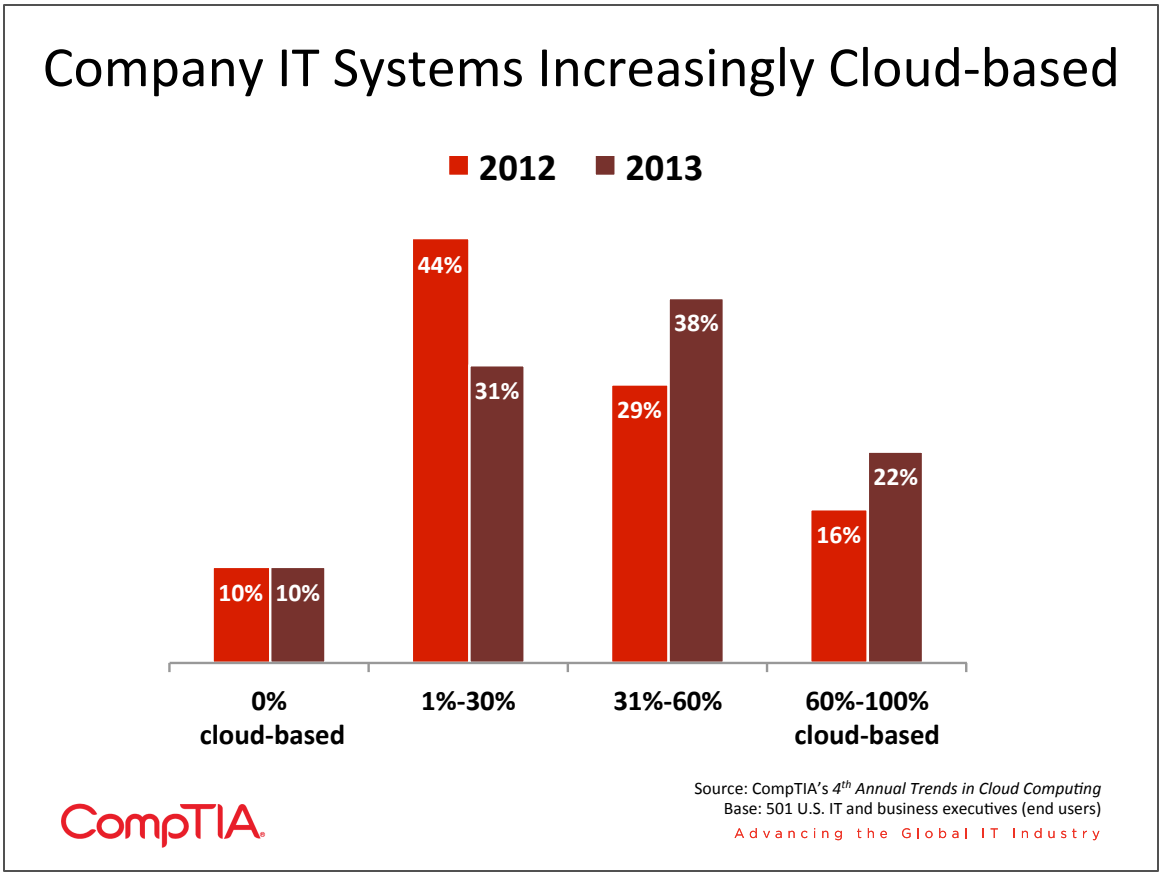
- Although adoption rates are high and market numbers are positive, there is still confusion related to cloud computing. This confusion will hinder end users and channel firms from fully transforming their IT practices and offerings. Only 46% of channel firms with cloud offerings described their cloud business as completely mature—an established, strategic part of business plans.

- The impact of cloud computing will continue to drive companies to clarify issues around usage and move towards greater maturity with the model. End users still report a wide range of benefits, led by the ability to cut costs. Approximately half of channel firms see faster revenue growth and larger profits from cloud offerings than from traditional offerings.

Cloud Technology Moving Into the Mainstream

In CompTIA's *IT Industry Outlook 2013* report, the trend for cloud computing was that companies would begin taking the technology for granted. This projection meant that companies would begin moving away from cloud transitions as standalone projects and begin viewing cloud components as pieces within their overall IT architecture.

Data from the *4th Annual Trends in Cloud Computing* study seem to confirm this behavior. While 80% of end user companies in last year's survey claimed to use some form of cloud computing, that number climbed to 90% this year. Furthermore, companies are estimating larger percentages of their infrastructure and applications being comprised by cloud systems.



As cloud components are becoming more prevalent in IT architectures, more companies are relying on cloud computing for business processes such as storage (59%), business continuity/disaster recovery (48%), and security (44%). This is being accomplished through use of all three models for cloud systems—Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Year over year, adoption rates for all three models has increased, especially among medium-sized businesses (see Appendix for details).

While future outlooks on the use of IaaS/PaaS indicate that momentum is slowing, this is indicative that the market is reaching a saturation plateau, not a sign that cloud computing is falling out of favor. Only 3 out of 10 businesses that are not currently using those models plan to do so in the future, a 10% drop from last year. The drop comes mostly among small and medium businesses—large business interest remained flat at 33%. These companies have extensive infrastructure and greater requirements for test/dev environments, so continued interest here shows that late adopters clearly see potential in moving to a cloud model.

Market sizing estimates also indicate stability and maturity. The following data points all suggest robust spending on cloud services:

- Gartner estimates that the global public cloud services market will account for $131 billion in revenue in 2013, an 18.5% increase from 2012. This includes direct spending on the three primary cloud models as well as indirect spending on business process outsourcing that is offered from a cloud foundation.

- According to IDC, worldwide spending on hosted private cloud solutions will grow at a compound annual growth rate of over 50% during 2012-2016, eventually totaling $24 billion in revenue by 2016. The solutions include both dedicated private clouds, where physical infrastructure is assigned to a single user, and virtual private clouds, where private clouds for a single user are built virtually within a public cloud provider.

- Analysys Mason—a research consultancy focused on telecom, media, and technology—predicts that enterprise cloud services revenue will reach $31.9 billion by 2017. They include only SaaS and IaaS in this projection. In their study year-over-year growth slows from 17% in 2013 to less than 5% by 2017, but emerging markets will experience greater growth, accounting for slightly more than 10% of the overall cloud spend by 2017.

- Individual cloud providers differ in their approach to releasing financial information as they contend for market position, but cloud services are clearly playing significant roles in overall operations. Amazon chooses to place Amazon Web Services under “other operating segments” rather than break out the details separately, and McQuarrie Capital estimates that AWS will generate $3.8 billion in revenue in 2013. In contrast, Microsoft publicly touted their cloud services as a $1 billion business, and IBM reported that cloud revenue grew over 70 percent from 1Q 2012 to 1Q 2013 (without disclosing the actual revenue number).

It seems, then, that cloud computing has become well established as an option for IT operations. Twenty-seven percent of companies with cloud as part of their architecture have been using cloud solutions for three years or more, and they have moved past experiments and towards a view of cloud technology as a given piece of their overall infrastructure.

Cloud Business Models Still Elusive

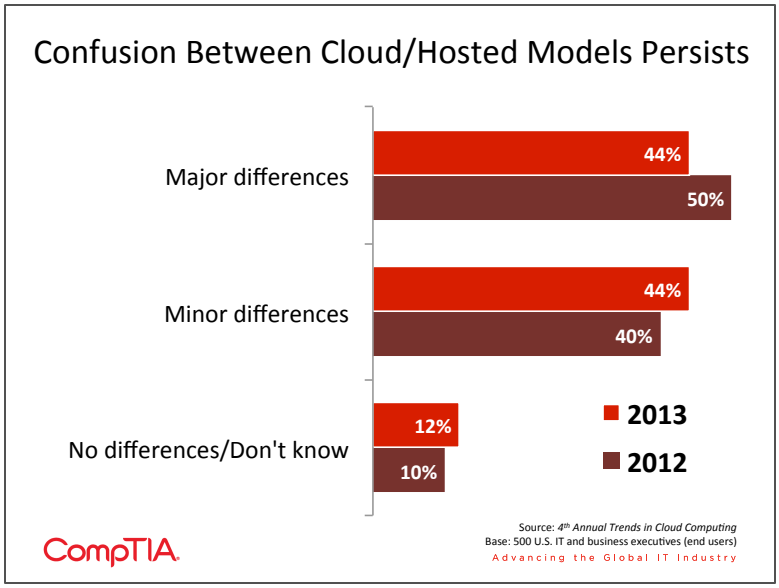
The impressive market numbers and high adoption rates may not tell the whole story, though. There are many factors that could still be contributing to confusion about cloud computing (see sidebar). Companies may not actually be using cloud solutions to the extent they believe, and true business transformation will certainly lag simpler technology adoption. Companies that are completely comfortable with cloud computing concepts such as self-service and dynamic resource allocation will adopt operational models that differ greatly from models that rely on more traditional IT systems. Moving towards these new models is more of a challenge than transitioning selected systems into cloud technology.

CompTIA's data from channel firms demonstrates this difficulty. Of 400 firms who offer cloud solutions, only 46% described their cloud business as completely mature—an established, strategic part of business plans. The remainder described their cloud business either as a portion of the business running alongside other offerings or as pilot/evaluation initiatives. As both channel firms and end users truly embrace cloud operations, there will be less distinction between cloud offerings and non-cloud offerings, and the final solution will simply be produced regardless of the infrastructure used.

Confusion among end users will delay their move to a complete cloud business model. If a company's IT solutions are meeting their needs, it may not be critically important to know the differences between hosted offerings vs. cloud offerings. If the

Sources of Confusion in the Cloud Market

- **Cloudwashing:** As products and services are increasingly labeled with "cloud" in order to capture the growing market, the characteristics of a true cloud offering become less distinct.
- **Downplaying the cloud trend:** Many IT professionals or industry watchers are quick to dismiss cloud as "nothing new." While there are aspects of cloud that can be found in computing models dating back to the introduction of the mainframe, there are also unique aspects that may get overlooked without the proper education.
- **Hype and fatigue:** Some end users may be overly eager to describe their infrastructure as cloud-based to have the appearance of keeping up with the trend. Similarly, some users may simply apply the label to their systems without much thought in an effort to avoid any further discussion on the topic.

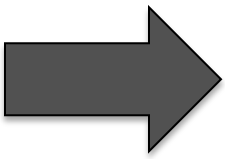


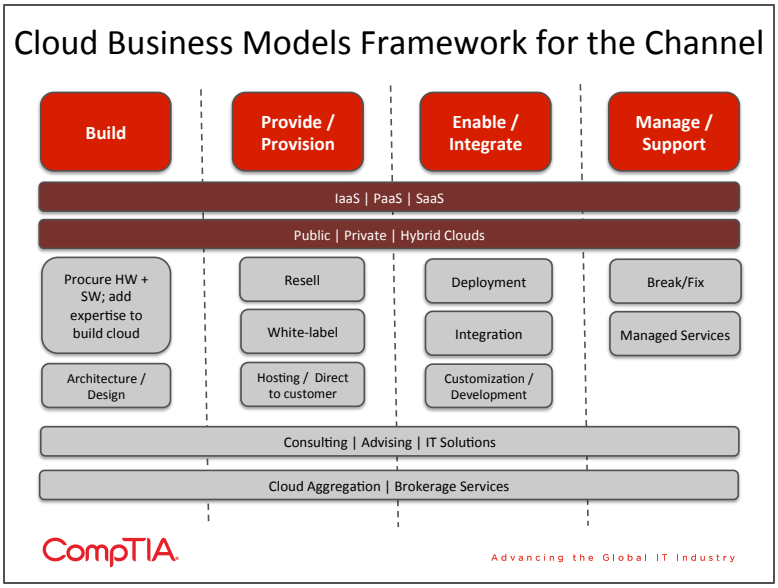
company decides to pursue cloud-specific benefits, though, they may be surprised to find that their systems are not as cloud-enabled as they might have imagined.

This confusion is also present in the general ecosystem, as evidenced by cloud provider brand awareness. More than 9 in 10 end users believe there is a high or moderate degree of differentiation among cloud providers, but the perception of top providers favors traditional IT companies (such as Microsoft, IBM, and HP) over companies that are generally regarded as leaders within the cloud industry (such as Amazon and Rackspace). While the traditional companies do offer cloud solutions (and the awareness levels may be a good indicator for their future prospects), lower awareness of leading cloud providers likely implies lower awareness of leading-edge innovations.

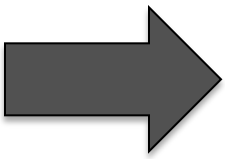
To better describe the many nuances of the cloud trend, both from the end user perspective and the IT solution provider/cloud provider perspective (aka "the channel"), this report will use the following models. See Sections 2 and 4 for additional details and analysis.

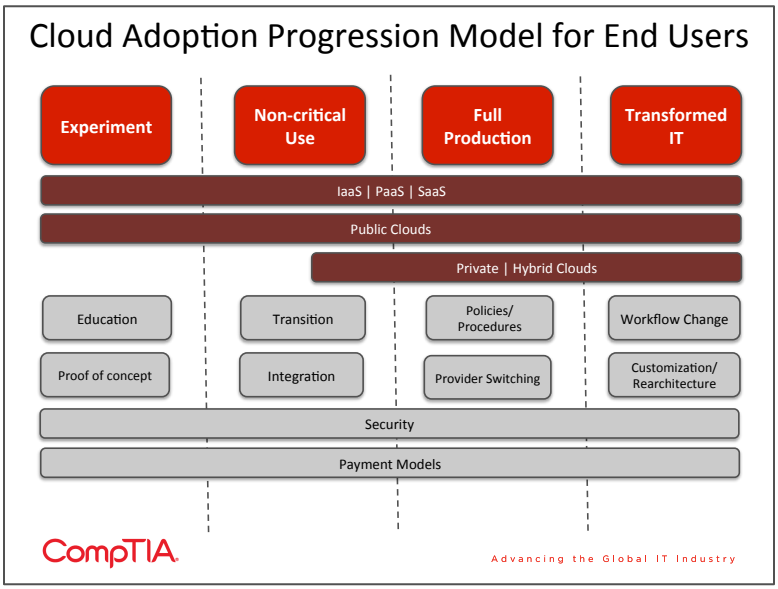
Channel Perspective





End User Perspective

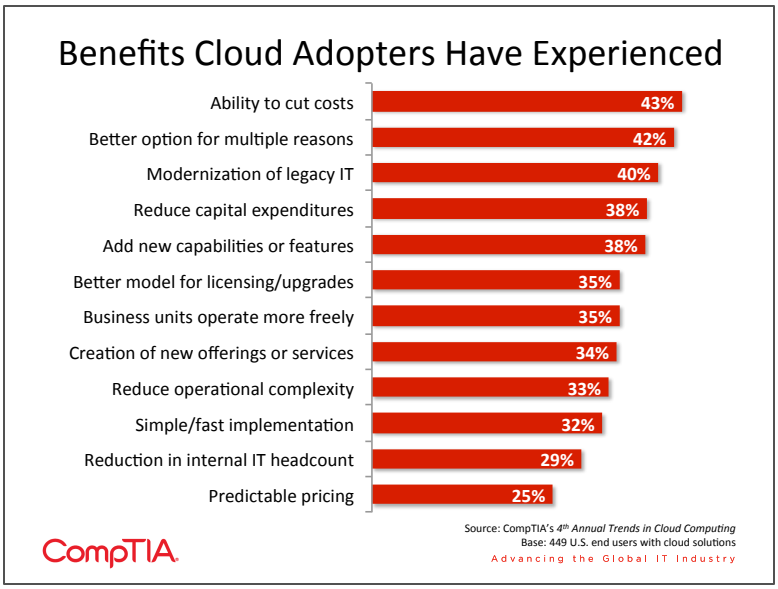




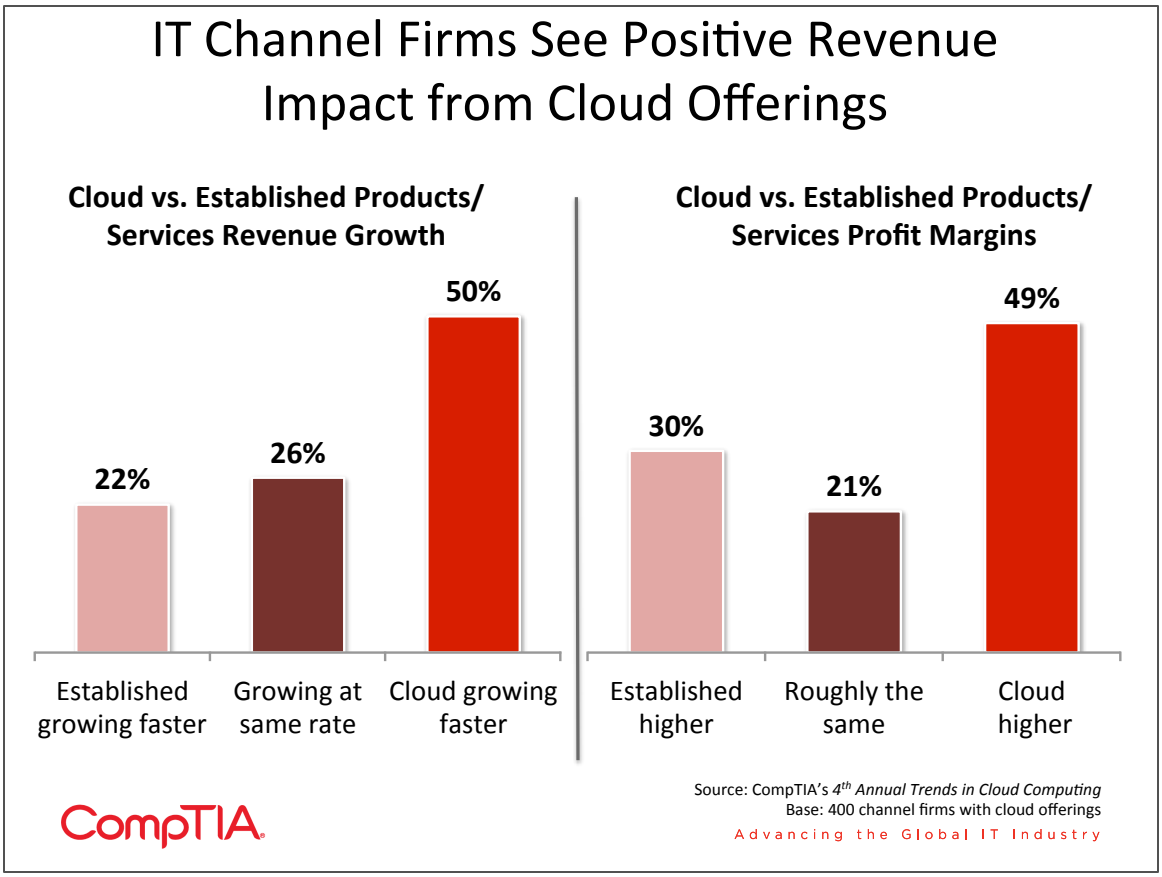
Impact of Cloud Computing

As companies gain more clarity about cloud systems and move towards a mainstream view of cloud as an IT option, the impacts of moving to a cloud model are being seen across the technology and business landscape. Continuing a trend from previous years, many respondents view cloud as the best option for a variety of reasons, with no single reason standing out as the lone driver or benefit. Also, the realized benefits are tightly clustered together, lending weight to the argument that cloud computing offers many advantages.

Research from cloud management company Rightscale shows that cloud benefits are more widely experienced as companies gain maturity with the cloud model, and CompTIA's data corroborates this finding. Looking at the benefit of "better option for multiple reasons" in CompTIA's survey, 30% of late adopters (less than one year of cloud experience) rank this as a benefit. This number rises to 39% with middle adopters (between 1 and 3 years of cloud experience) and jumps to 56% for early adopters (more than 3 years of cloud experience). Clearly, more time spent using cloud systems leads to a wider appreciation of the advantages they offer.



From a channel perspective, the most relevant impact is the effect cloud is having on the bottom line. As expected, the maturity of a firm's cloud offerings has a direct correlation to the financial impact they are seeing. Twenty-nine percent of firms that described their offerings as "not mature" saw faster cloud revenue growth compared to 54% of "mature" companies. For profit margin, the difference is even more drastic—21% of "not mature" companies see larger cloud profit margins compared to 58% of "mature" companies.



For both end users and channel firms, one of the largest challenges in moving towards more robust cloud architecture is finding or building the right skills. According to a joint study by IDC and Microsoft, 1.7 million cloud-related jobs worldwide went unfilled in 2012. Hiring managers cited difficulty in finding higher-level skills such as building migration plans or assessing the risk of a cloud transition. Data from Burning Glass Technologies Labor Insights also shows demand for cloud skills growing: from 2011 to 2012, the number of postings referencing cloud grew by 30%. Over that same time period, the number of core IT job openings actually declined, showing how important cloud computing is in the modern IT landscape.

IT workers are aware of this skills gap. Data from CompTIA's *2nd Annual IT Career Insights* study shows that cloud computing is the third-highest skill area that IT professionals would like to develop. The top areas are networks/infrastructure and servers, both of which are certainly involved in cloud solutions. As cloud computing becomes even more mainstream, the demand for the proper skills will continue to rise as companies seek to gain the benefits of this powerful model.

Appendix

Use of Cloud-Based Applications

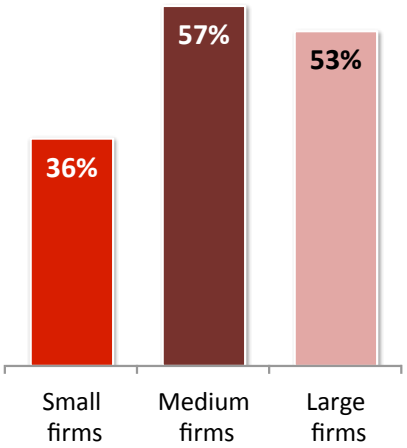
Application	Small Firms	Medium Firms	Large Firms
Business productivity	45%	45%	48%
Email	51%	59%	49%
Web presence	48%	55%	46%
Virtual desktop	34%	43%	47%
Collaboration	36%	52%	48%
Analytics	34%	43%	47%
CRM	32%	49%	44%
HR management	28%	43%	32%
Expense management	25%	47%	39%
Help desk	26%	38%	35%
Financial Management	36%	45%	33%
ERP	23%	37%	37%
Call center	15%	35%	31%

Source: CompTIA's *4th Annual Trends in Cloud Computing*
Base: 501 U.S. IT and business executives (end users)
Advancing the Global IT Industry

Use of IaaS/PaaS

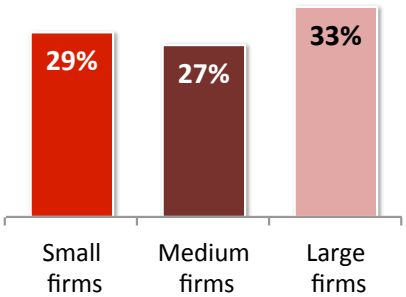
Currently Using IaaS/PaaS

Overall = 48%



Plan to Use in Next Year

Overall = 29%



Source: CompTIA's *4th Annual Trends in Cloud Computing*
Base: 501 U.S. IT and business executives (end users)
Advancing the Global IT Industry

CompTIA

TRENDS IN CLOUD COMPUTING

SECTION 2: CHANNEL BUSINESS MODEL ANALYSIS

RESEARCH

FOURTH ANNUAL • AUGUST 2013

www.comptia.org

Key Points

- Half of channel firms today describe their cloud business as "mature," while another 4 in 10 claim to have reached at least a degree of cloud services' maturity alongside their more established lines of business. By contrast, just 13% said their current cloud business is not mature at all today.

- CompTIA has identified four primary cloud business models for the channel: Build, Provide/Provision, Enable/Integrate and Manage/Support. Seven in 10 solution providers involved in cloud started with the Build business model but are now involved with one or more of the other three frameworks. Twenty-six percent of them are conducting business across all four areas.

- Six in 10 channel firms involved in the Manage/Support business model have created IT dashboards that allow customers to track their cloud utilization, costs and other metrics to understand their investments.

Business Transformation within the Channel: Path to the Cloud

For the channel's part, the topic of cloud business models has been one of the most heavily debated among industry firms. The discussion has moved from early-day concerns that shifting IT to the cloud would threaten the channel's very existence to today's realization that cloud has in fact spawned a wide variety of business models from which to gain a foothold in this arena.

Perhaps the spate of business model options is helping to drive cloud's continued acceleration across the IT channel both in terms of adoption and strategic value. CompTIA's *4th Annual Trends in Cloud Computing* study found that half of solution provider firms today describe their cloud business as "mature," while another 4 in 10 claim to have reached at least a degree of cloud services' maturity alongside their more established lines of business. By contrast, just 13% said their current cloud business is not mature at all today. Smaller firms (47%), interestingly, were more likely to self-select as having a cloud operation that is mature and established, compared with the largest companies (40%). This is likely due to the fact that many of the smaller firms could very well be "born in the cloud" versus larger and more traditional solution providers that will need time to pivot to a new model.

The growing business acumen around cloud also correlates to the level of importance businesses are placing on the model as a revenue opportunity. On average, a little more than half of channel firms in the CompTIA study describe the cloud revenue they generated in the past year as strategic and core to their business, as opposed to simply opportunistic dollars. In past years, cloud revenue was typically of a more tactical nature, an adjunct to more established streams of business such as product transactions or services engagements. Consider the situation in 2010, the first year the CompTIA study was conducted, when barely a blip of channel companies reported heavy cloud involvement and in fact, the majority reported none at all.

Low Stage of Cloud Maturity: What is the Future?

39% — Confident on the right path

51% — Somewhat confident

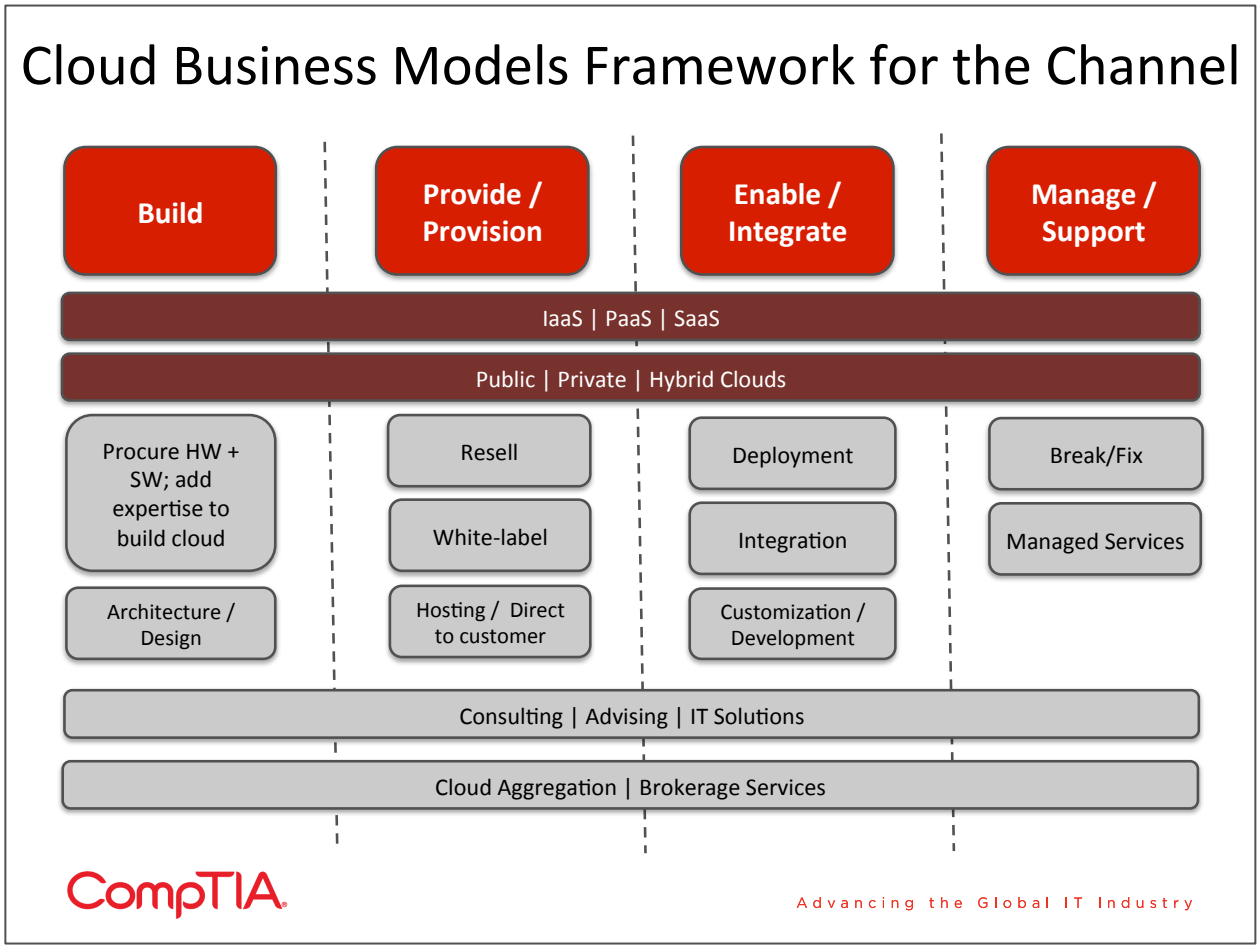
8% — Not that confident

Given the more advanced involvement in cloud, the 2013 research captures additional nuts and bolts information on channel firm business model choices, cloud-based profit margins, customer and vendor relationships and initial entry points to the cloud world. On that last point, 3 in 10 respondents describe themselves as "born in the cloud," starting from scratch as cloud-based entities. That revelation suggests that a number of new channel companies have come into existence in the last few years, perhaps offsetting the wave of attrition among established solution provider firms, some of whom are reaching a natural business end of life and others that have been forced to shutter due to poor business decisions, such as failing to diversify.

While "born in the cloud" companies are multiplying, the fact remains that most channel firms that have adopted cloud have done so from their existing position reselling IT products, services and consulting. Nearly half (45%) of these traditional solution provider companies described their transition to cloud as rapid, while another fourth characterized their addition of cloud solutions as having happened gradually.

No matter the pace of change, all of these firms have had to make strategic and tactical decisions about which cloud business model or models to pursue. They base these directional choices on a number of factors, including the company's current operating model, specific capabilities and staffing, as well as focus areas in the market. To capture information about their cloud business, the CompTIA study presented respondents with four broad types of cloud operating models and asked which, if any, they have engaged in during the past year.

Business model decisions pose a tricky task for channel firms making – or having made – a cloud transition. Primary considerations depend on where a company wants to go with cloud: Resell a vendor's cloud solutions? Aggregate and broker cloud services from a variety of different sources? Integrate and customize cloud-based apps and services, or simply sell the infrastructure to an end user and provide consulting? Each of these paths and more are possibilities, as are varying revenue models available for all. Forty-five percent of channel companies from CompTIA's *4th Annual Trends in Cloud Computing* say determining the appropriate business model around cloud presented a significant challenge in the past year. That assertion falls just behind the most difficult challenge cited in the findings: Developing cloud expertise across both technical and sales arms within a company, a task that logically flows *after* the initial business model decision is made.



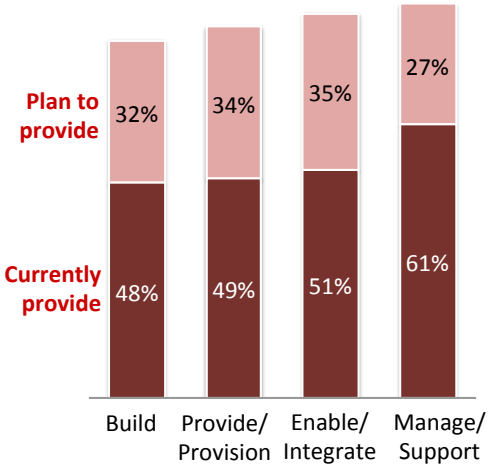
The above diagram defines the four business model areas, along with the subcategories of work activity that are associated with them. The longer bars, such as IaaS/PaaS/SaaS and Consulting/Advising/IT Solutions represent activities that can accompany any of the four main business models. See subsequent pages for additional details.

It should be noted that these four buckets are by no means reflective of every possible type of channel model applicable to cloud; however they do represent a fairly complete picture of the type of cloud work being done across today's channel.

The charts below provide a glimpse into the level of activity each cloud business model has garnered to date in the channel, along with the relative value being placed on each of the four areas. Many solution providers are involved with more than one of the models below, with 26% of them conducting business across all four areas. Additionally, the second chart indicates the order in which those channel firms involved in two or more of these business models got started. The majority launched into cloud with offerings and work in the Build category.

Cloud Business Model Activity/Importance

Cloud Business Model Involvement among Channel Partners



Value of Business Model Activities to Channel Firms

	Strategic	Opportunistic
Build	46%	37%
Provide/Provision	49%	38%
Enable/Integrate	53%	33%
Manage/Support	58%	32%

Source: CompTIA's *4th Annual Trends in Cloud Computing*
Base: 400 U.S. IT channel firms with cloud offerings

Advancing the Global IT Industry

Rank Order in Which Channel Firms Adopted One or More of the Various Cloud Business Models

Of firms providing...	1st	2nd	3rd	4th
Build	71%	15%	5%	9%
Provide/Provision	30%	35%	29%	7%
Enable/Integrate	32%	32%	25%	10%
Manage Support	29%	34%	17%	20%

Among those channel firms providing services in all four cloud areas today, **64%** started their cloud practice in a Build mode. But while Build is the most common starting point for cloud adoption, the Manage/Support bucket is the most prevalent among firms today.

Source: CompTIA's *4th Annual Trends in Cloud Computing*
Base: 400 U.S. IT channel firms with cloud offerings

Advancing the Global IT Industry

Cloud Model Element 1: Build

A strong starting point for the cloud for many firms is the category of Build, which is defined in the study as:

Typically this involves firms procuring vendor-based hardware and software products to construct private and/or hybrid clouds for customers. They may also offer consulting guidance on the best IT architecture, configuration and product choices for the project.

Roughly half (48%) of channel firms today report currently offering some form of Build services, with another third planning to add this flavor of cloud to their lineup in the coming year. Build represents a bit of a cloud launching pad; of those firms that are also operating one of the other three cloud business models, 7 in 10 started with a with Build practice before adding the others. This makes sense if you think back three to five years ago as the industry and channel began its cloud transition. At the time, many channel firms were looking for the most obvious place to plug in, with many of them admittedly worried that cloud would disintermediate them in the market. So where did they turn in conjuring a business model that made sense? They leveraged traditional solution provider strengths in infrastructure products sales and implementation work. In doing so in a cloud context, these companies positioned themselves as builders of private clouds within existing customers' on-premise environments.

Additionally, a number of vendors including HP, VMware, CA and others have brought to market "cloud-in-a-box" type products that outfit channel partners with a turnkey way to sell and deploy private cloud solutions for their end customers. Large-scale enterprise private cloud deployments are not the mainstay of most of today's channel, whose bread and butter customers typically reside in the SMB space. So these cloud-in-a-box solutions and toolsets have allowed many of them to provide Build-type cloud services within the confines of their skill sets, customer needs and finances. They also allow for much faster time to completion than a major private cloud enterprise deployment from scratch.

Further evidence that Build activities seemed a logical jump-on point for channel firms mulling cloud appears when you look at which types of companies have adopted this model. Six in 10 channel firms that identify as resellers are currently offering Build services vs. 47% of channel companies that align more in the services bucket (break/fix, managed services, consulting). It's not an overwhelming difference, but the resellers, with their foothold in infrastructure product sales, would find Build a natural entry point to cloud.

In terms of focus areas within the Build framework, 31% of respondents characterized what they do as mostly procuring hardware and software tools, then reselling to customers to build private clouds. Another 2 in 10 say their Build business is primarily about leveraging an existing customer's on-premise hardware and layering software and management tools to build a private or hybrid cloud solution. What's more common than either of these activities in isolation is a model in which channel firms do both, which roughly half of respondents said they did.

Thirty-eight percent of small firms participated in both types of Build activities compared with 55% of medium and large companies that did.

Cloud Model Element 2: Provide/Provision

This business model for cloud positions the solution provider as the hub for provisioning various vendor-based and homegrown cloud services to the end customer. Half of channel firms doing cloud today are participating in the Provide/Provision model, with a third of all respondents in the study believing that this business model for cloud has the most growth potential in the next two years – regardless of whether they are involved in it or not today. That compares with roughly a quarter of firms that deem each of the other three business models as the fastest growth drivers.

A quick definition:

Typically these firms are reselling and provisioning IaaS offerings such as storage and compute capacity from Amazon Web Services or SaaS offerings such as Google Apps. They are also evaluating and aggregating various cloud services for customers.

Within this model, there are several subcategories of activities that channel firms pursue today. Many participate in a number of these areas. Six in 10 channel firms involved in cloud report white labeling a vendor's cloud offerings, in effect leading with their own brand on what is typically a SaaS deal. Another six in 10 said they operate their own data center and sell homegrown cloud services, while just more than half (54%) are reselling vendor-based cloud services that can include SaaS and IaaS offerings in most cases. Think Microsoft Office 365 or Google Apps, as mentioned above.

Not surprisingly, resellers are much more likely among channel firms doing cloud to sell vendor-based cloud offerings. Seventy-two percent of channel firms that identify as resellers did so in the last year, as opposed to half of channel companies that are mainly steeped in the services business. The Provide/Provision model has perhaps the lowest barrier to entry of all four of the cloud business frameworks. It's not a big leap to resell a vendor's SaaS applications if you are already reselling that vendor's other products and services. However, the margins on vendor SaaS sales tend to be on the lower side, which requires channel firms to find ways to add value to increase profitability. Some avenues to pursue: Industry sector specialization (e.g. selling SaaS-based Electronic Medical Records (EMR) systems to the healthcare industry), or developing capabilities in the third business model area, Enable/Integrate (discussed below) to increase margins.

Top Cloud Services Sold by Channel Partners Last Year

- Email
- Virtual desktop
- Help desk
- Storage
- Analytics
- Productivity apps
- Business continuity (DR)
- Finance-related apps
- Collaboration tools
- CRM
- Call center

Those firms farthest along with cloud are far more likely to be operating their own cloud and selling homegrown services direct to customers. Seven in 10 companies that claim a mature and strategic cloud business or have driven stakes in all of the four cloud business models said they are operating their own cloud data center operation and services. This compares with less than half of companies that are either less mature overall with cloud or participating in fewer than four of the outlined business models.

Which cloud services are they selling? The usual suspects of storage, email and virtual desktop are among the most popular cloud services moving through the channel today. Nearly two-thirds of channel

firms have these services in their cloud portfolio. One surprise? Sixty-two percent also said they sold cloud-based business intelligence and data analytics in the past year, a major leap from previous years of this study when that tech category landed low on the channel offerings list. In fact, 73% of reseller-based channel firms are offering BI and data analytics as a cloud service to customers. Now it should be noted that the sample size for the BI responses is smaller than other areas of the CompTIA study, but directionally speaking the rise in cloud-based analytics in the channel indicates a new level of sophistication among these firms and quite likely belies the influence of Big Data. With cloud versions of analytics tools now available, solution providers have an opportunity to sell their predominantly SMB customers solutions that may have been beyond financial reach in the on-premises form.

Cloud Model Element 3: Enable/Integrate

The Enable/Integrate business framework for cloud has been a sweet spot for channel firms over the past several years. It makes sense. Beyond the reselling of products, channel firms have made their name providing integration and implementation work that links customers' various hardware and software solutions, as well as offering vertical industry and other types of customization. Cloud solutions and multicloud environments only add more layers of technology to connect into that infrastructure. Consider the following definition for the model:

Typically they are providing integration and implementation services that may include tying a customer's on-premise IT solutions to its cloud-based solutions or customizing cloud-based solutions to fit a particular business need or vertical.

For the past three years of CompTIA cloud studies, the number one source of post-sale dollars has been integration work. This area has routinely been a place where the channel cushions its overall profit margins. Since most solution providers charge customers on a recurring revenue basis for cloud solutions (by consumption or by number of users etc.), the project work associated with the Enable/Integrate category allows them to add revenue not included in the base contract.

The business model encapsulates a number of activities. Roughly two-thirds of companies involved in Enable/Integrate are currently providing the following: deployment of cloud solutions, integration of on-premise tools and infrastructure to cloud solutions and customization, often to meet vertical industry needs. Another 6 in 10 are engaged in cloud-based application development, most likely building SaaS apps or extensions to apps that tie cloud in with an end customer's current environment. Many of the PaaS platforms in the cloud simplify this

Medium-Sized Channel Firms Most Likely to Consider Cloud Activities Across all Models Strategic

Strategic to Business	Small (1-99 employees)	Medium (100-499)	Large (500+)
Build	40%	56%	49%
Provide/Provision	44%	58%	50%
Enable/Integrate	49%	66%	50%
Manage Support	55%	67%	55%

8 in 10 medium-size channel firms are involved with Enable/Integrate activities compared with just more than half of their smaller cohorts.

CompTIA

Source: CompTIA's 4th *Annual Trends in Cloud Computing*
Base: 400 U.S. IT channel firms with cloud offerings
Advancing the Global IT Industry

type of work. Meanwhile, a smaller percentage (54%) of companies have gone down the road of mobile application development to synch and interact with cloud solutions. As mobile continues to grow in stature across all types of applications, expect that category to accelerate. Consider resellers alone: the data find that 75% of them are doing some work in this mobile application development versus 57% of channel firms that identify more strongly as service providers.

In terms of other segmentation differences, firms that consider themselves mature with cloud are more likely than those with moderate to no maturity to provide work in the Enable/Integrate category. Nearly 8 in 10 companies with strategic cloud business acumen are planted in this category compared with just 29% of those with little cloud experience.

Cloud Model Element 4: Manage/Support

The glue binding a channel firm to its customers often hinges on the management of IT after the initial sale and implementation. Many customers need post-sales attention frankly, especially smaller businesses with no IT staff. This is one reason that managed services is viewed as a must-enter market for today's solution providers; not only does it provide a more predictable stream of recurring revenue, but also creates a contractual arrangement for ongoing IT service and support. The management and support of cloud solutions is no different and offers a compelling business model for the channel, as defined below:

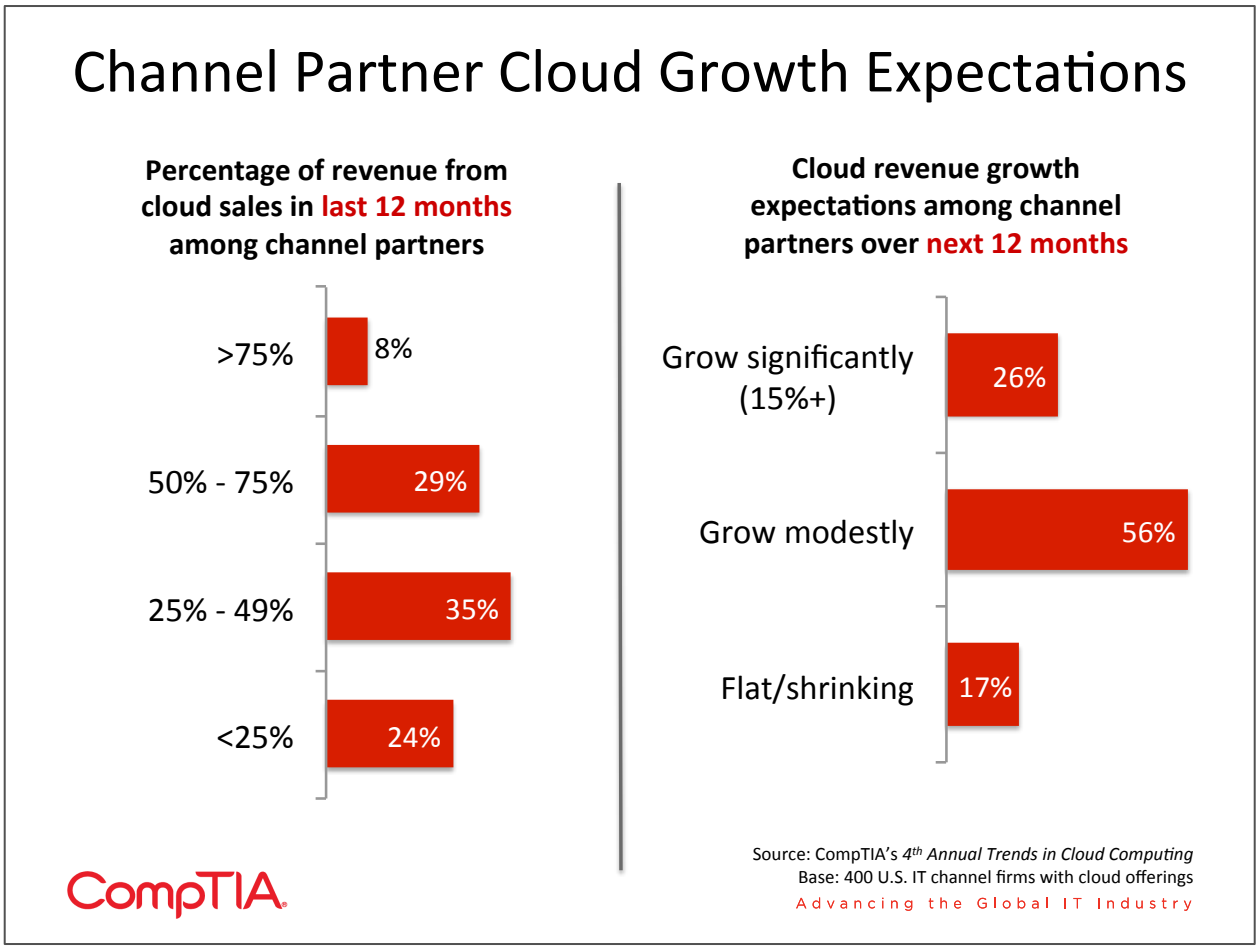
Typically they are delivering the ongoing management and support of cloud-based services as project work or in a contractual, recurring revenue model. They are also adding, scaling or troubleshooting cloud services as needed.

Management of cloud solutions includes the basic services, such as troubleshooting or repairing of cloud-based IT on a project basis, which a third of channel firms in this model did last year. Another 6 in 10 are conducting remote monitoring of cloud solutions for customers and/or managing solutions that reside in a multicloud environment. Multicloud management is a solid opportunity area for the channel as myriad cloud apps and other solutions mushroom in the market. Customers are accessing solutions from an array of different providers and data center locations, often with little real handle on the source of these services. Channel firms are optimally positioned to serve as a gatekeeper. Along a similar vein, cloud-to-cloud migration is becoming more prevalent as customers experiment with different cloud providers to gauge performance levels and satisfaction rates. Just more than half of channel firms are engaged in this type of activity today.

Likewise, the channel is wisely developing ways to demonstrate cloud ROI to customers. In fact, 6 in 10 channel firms involved in Manage/Support have created IT dashboards that allow customers to track their cloud utilization, costs and other metrics to understand their investment. Seventy-two percent of medium-sized solution providers are building these types of dashboards, a clear value-add.

Another reason that the Manage/Support model is likely to flourish is the fact that while cloud often abstracts complexity from the customer's view, the solutions typically enable more connections, more end points and reliance on networks. These are all areas needing ongoing support.

Appendix


Channel Partner Cloud Growth Expectations
Percentage of revenue from cloud sales in last 12 months among channel partners
>75%
8%
50% - 75%
29%
25% - 49%
35%
<25%
24%
Cloud revenue growth expectations among channel partners over next 12 months
Grow significantly (15%+)
26%
Grow modestly
56%
Flat/shrinking
17%
CompTIA
Source: CompTIA's 4th Annual Trends in Cloud Computing
Base: 400 U.S. IT channel firms with cloud offerings
Advancing the Global IT Industry

CompTIA

TRENDS IN CLOUD COMPUTING

SECTION 3: CHANNEL RELATIONSHIPS: VENDORS, CUSTOMERS, AND DISTRIBUTORS

RESEARCH

FOURTH ANNUAL • AUGUST 2013

www.comptia.org

Key Points

- Two thirds (63%) of channel firms characterize customer demand for cloud-based IT solutions and services as either very high or high, with another 3 in 10 describing demand as somewhat high. Just 9% said demand for these solutions was low.

- Six in 10 channel firms say that cloud has generally strengthened their customer relationships, with just 15% claiming it has weakened them and roughly a quarter that said that their client bonds have remained the same. That said, not all channel firms that adopt cloud will engender more good will with customers; some may simply have a customer set that is not cloud-friendly, others may not gain sufficient expertise to provide value.

- Four in 10 channel firms said they experienced cases where customer demand for cloud solutions outstripped their capacity to deliver, while another 20% lost a deal because a customer desired a cloud solution they did not offer.

Cloud Demand and the Customer Relationship

Cementing a successful customer relationship requires channel firms to possess a keen understanding of their customer's business goals, needs and pain points, and also have the ability to apply that knowledge to the solutions recommended and sold. This basic business reality is no different whether you are selling traditional on-premise hardware and software or cloud-based solutions. In fact, the options that cloud provides have only upped the ante when it comes to channel business relationships with all of their constituents: customers, vendors and distributors. In this section, we will explore the impact cloud has had on all three affiliations.

First let's take a look at customer demand for cloud, which in many ways drives channel behavior. Consider the following:

> *Gartner forecasts the public cloud services market to grow 18.5 percent in 2013 to total $131 billion worldwide, up from $111 billion in 2012.*
>
> *IDC research shows that worldwide spending on public IT cloud services is expected to approach $100 billion in 2016. Over the 2012–2016 forecast period, public IT cloud services will enjoy a compound annual growth rate of 26.4%, five times that of the IT industry overall., and by 2015, one of every seven dollars spent on packaged software, server, and storage offerings will be through the public cloud model.*

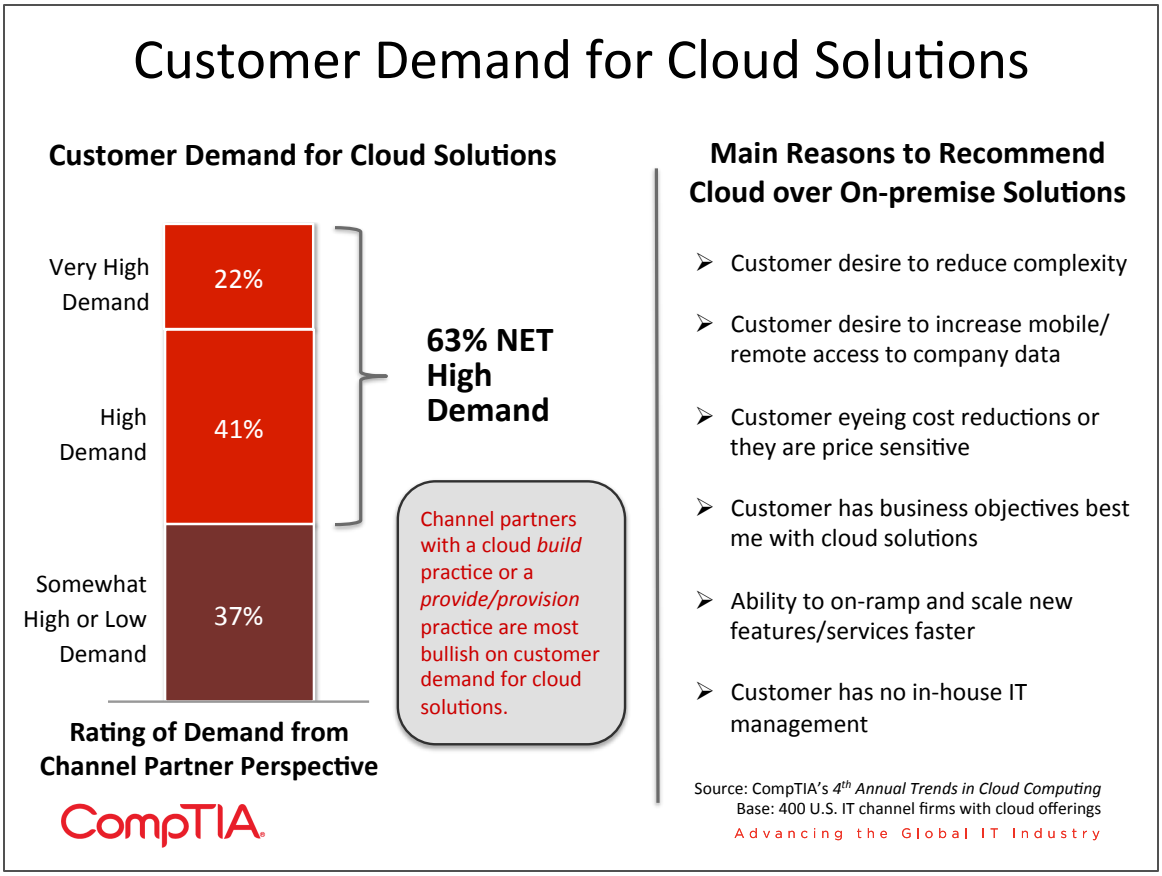
Cloud demand acceleration extends to the channel as well, according to the CompTIA study. Two thirds (63%) of channel firms characterize customer demand for cloud-based IT solutions and services as either very high or high, with another 3 in 10 describing demand as somewhat high. Just 9% said demand for these solutions was low.

Among channel firm types, resellers in the study cited the highest demand. Seventy-four percent of these companies said demand was either very high or high, compared with 62% of services-oriented channel firms that did so. One explanation is that resellers as a group tend to be invested heavily in selling vendor-based cloud solutions, in particular SaaS applications such as Microsoft Office 365 and Google Apps. This is an activity that fits into the cloud business model framework called Provide/Provision, and across all frameworks in the CompTIA study the Provide/Provision cloud model was predicted to experience the greatest growth potential for the channel in the next two years. (*See Section 2 of this report for more details on the various cloud business model framework*s)

Indeed, channel firms reported high demand for cloud services in general. Considering the four business models outlined in this report, IT companies with a Build practice report the highest levels of customer interest in cloud solutions. Presumably, these are customers engaging in Build projects, such as deploying a private cloud, but since many channel partners are involved in multiple cloud offerings, it could be demand stemming from a range of customer cloud needs.

Additionally, the demand levels for each distinct business model also map to the rank order in which many channel firms entered these four spaces. Most of the companies that are offering two or more types of cloud frameworks started with the Build category, then moved along adding Provide/Provision,

Enable/Integrate and finally Manage/Support. It's unsurprising then that demand is reported to be highest in the first two categories, as they are the most prevalently practiced across the channel today. Expect customer demand for the management and support of cloud services – the fourth business model category -- to grow in coming years as more end users migrate from the purchase of cloud solutions to the need to tend and monitor the services over their lifecycle.

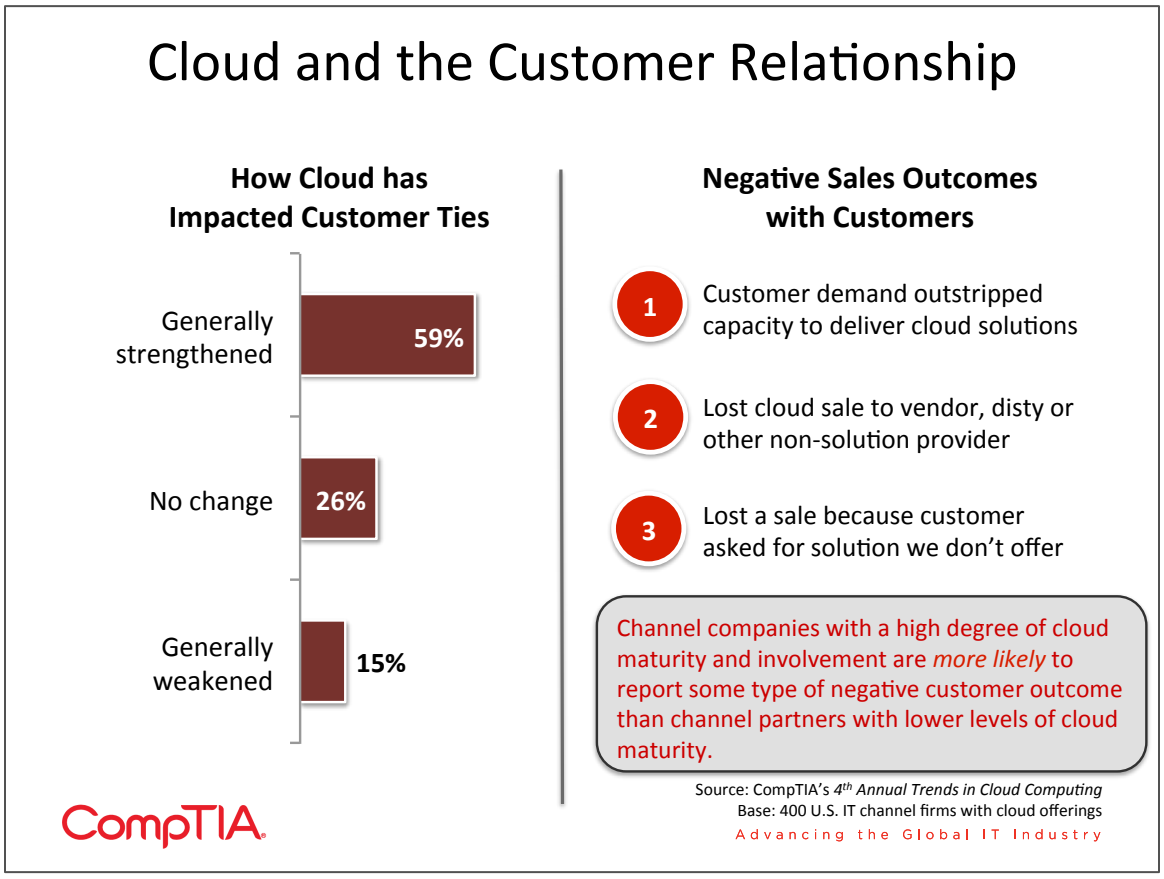


With customers curious about cloud and demand up, fresh conversations have been sparked between channel firms and their existing clients, while doors are opening to potential new customers seeking, in some instances, a better mousetrap to meet their technology needs.

Case in point? Six in 10 channel firms say that cloud has generally strengthened their customer relationships, with just 15% claiming it has weakened them and roughly a quarter that said that their client bonds have remained the same. This is encouraging news given the fact that many in the channel have feared publicly that cloud would drive a wedge between them and their customers. There's been rampant apprehension about such ill effects as a resurgence in vendor direct sales and end user customers choosing a self-service model for their IT solutions, i.e. procuring SaaS applications over the Internet. And while both of these trends are happening to a certain extent, CompTIA data suggest not at such dire expense to most of the channel, especially those that have reached a high level of cloud maturity today and intend to remain committed. That said, not all channel firms that adopt cloud will engender more good will with customers; some may simply have a customer set that is not cloud-friendly, others may not gain sufficient expertise to provide value, etc.

In fact, channel firms can play a critical role in determining when cloud versus on-premise works best for their customers. The savvy 'trusted advisor' should be moving far beyond a product speeds-and-feeds sales pitch to a business-oriented consulting approach to the engagement. Respondents to the CompTIA study said the primary reasons that they are recommending cloud typically map to a customer's business priorities. They also fall in line with macro realities such as the growth of the remote work force. As one example, the percentage of channel firms that said their customers' desire to increase mobile/remote access to company data sparked the reason to recommend cloud jumped to 46% of respondents compared with 38% last year. This underscores the surge in mobility solutions, as well as BYOD and telecommuting trends that are happening in the marketplace. It also demonstrates the channel's ability to tie the value of cloud into these burgeoning areas.

A customer's desire to reduce complexity across their IT environment remains the No. 1 reason that solution providers recommend cloud offerings in place of on-premise. Six in 10 medium-sized channel firms cited this as the primary cloud recommendation driver. Over the next several years, more proof points will emerge on TCO and true cost savings enabled by cloud, however. But today, customers increasingly are open to exploring cloud solutions in lieu of spending on new hardware, packaged software and other in-house infrastructure. The challenge for the channel is going to be demonstrating those cost savings over time to the customers while warding off competition from giants like Amazon, whose cloud pricing has continued to drop quarter over quarter.



Another challenge lies in the ability to deliver cloud services in lockstep with demand. It sounds like a problem you shouldn't mind having: too much demand for your services. But unless a channel firm has

adequate capacity and skills to meet that demand, they will have to either turn away or lose business. In fact, 4 in 10 channel firms said they experienced cases where customer demand for cloud solutions outstripped their capacity to deliver, while 20% lost a deal because a customer desired a cloud solution they did not offer. Another negative sales outcome involved losing a cloud deal to another solution provider, vendor or distributor, which a third of respondents said occurred last year. This latter issue is not confined to cloud obviously, and happens with regularity in the on-premise sales arena as well.

Interestingly, channel firms with high levels of maturity with cloud and those that are involved in four of the outlined cloud business models were more likely to experience capacity or inability to deliver issues around cloud. More than half of these types of companies, for example, experienced demand for cloud solutions beyond what they were able to execute on versus an average around 4 in 10 of all other categories of channel firms. This is most likely explained by the fact that they are so heavily involved in cloud – cloud experts, as it were – that demand naturally gravitates their way, and in some cases is beyond their means.

The emphasis on demand should not overshadow the fact that not all end user companies are buying into cloud yet. Today's channel firms continue to encounter some difficulty selling to certain customers. A perennial concern is security wariness, which continues to rank as the chief roadblock to cloud acceptance based on what channel companies of all sizes say they are hearing from customers. On average, more than half of respondents cited security as the chief hurdle to a cloud sale. Concern about Internet downtime moved up the list of customer objections to cloud this year, which may be the result of the past year's very public outages. There are many examples, some involving financial institutions as well as one that took down portions of Microsoft's Outlook services for several days or a more recent, albeit very brief, outage at Google.

Top Customer Objections to Adopting Cloud

56% Security concerns
44% Internet downtime
40% Integration concerns with on-premise infrastructure
39% Data portability issues
37% Total cost of ownership concerns
36% Lack of understanding of options/tradeoffs of cloud
31% Resistance to change by internal IT

Two of the main customer objections actually pose potential opportunities for channel firms if they are handled well. Integration concerns about tying cloud into existing infrastructure and worries about data portability need not be deal breakers – instead they provide a chance for the solution provider to flex their value, knowledge and skill set. Being able to explain to a potential customer in detail which party ultimately "owns" data placed in the cloud, particularly in a situation where a cloud provider might go out of business or the customer falls behind on payments, demonstrates the channel firm's knowledge of cloud-based models. Data portability moves from a sales obstacle to overcome to a value-added service to sell. Likewise with integration. For channel firms selling cloud today, the greatest source of revenue after the sale lies in integration work – cloud to on-premise and cloud to cloud. A proven track record here with existing customers can serve as a blueprint or proof point to persuade more reluctant customer prospects, much like case studies are used.

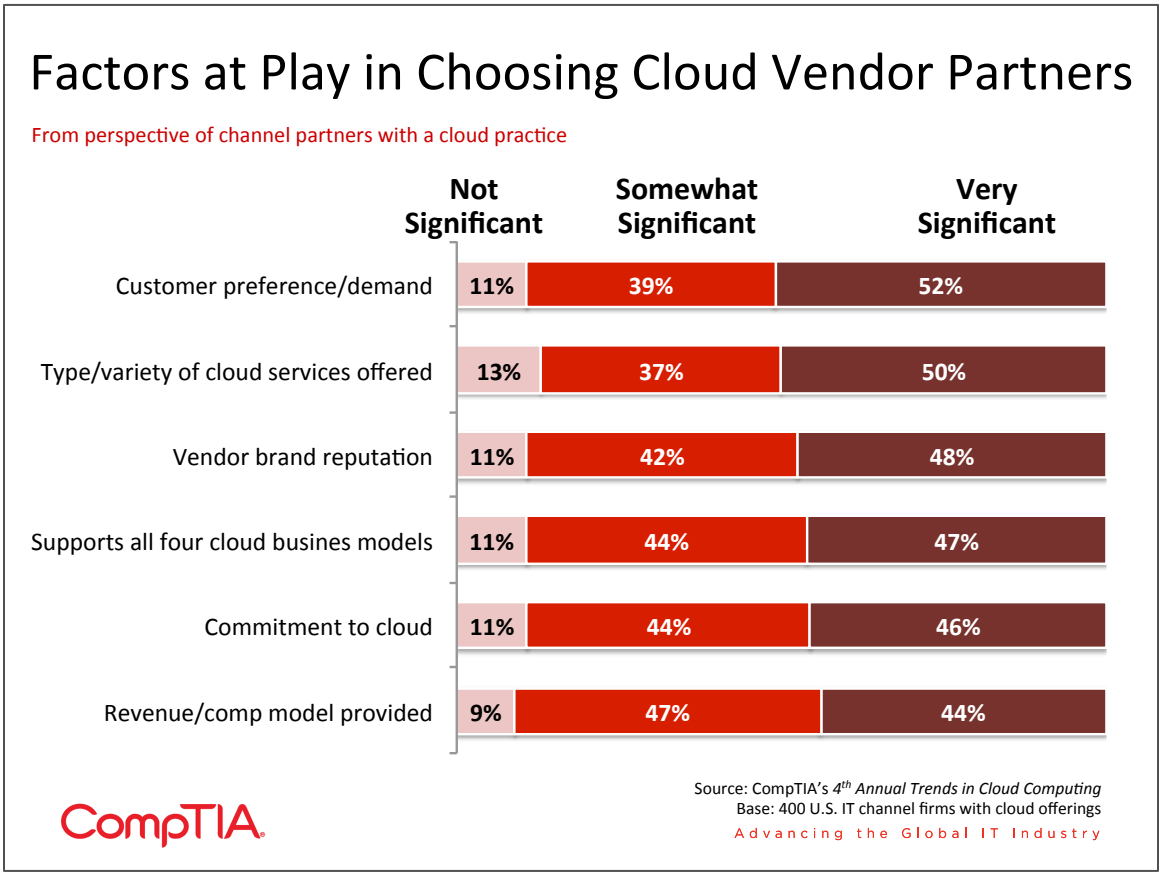
Total cost of ownership is creating some doubt in the minds of customers initially looking at cloud as a cost-reducer of IT. While the barrier to entry for cloud – depending on the solution – will often appear far more affordable than the expense for new IT equipment or software on-premise, the longer-term costs associated with cloud solutions and their management are not entirely transparent.

Vendors and Distributors

Customers aren't the only relationship that channel firms need to reconsider after diving into cloud. Vendors and distributors, key elements to the IT supply chain and fundamental business partners to the channel, must also be considered.

With respect to vendors, channel firms are evaluating them on their cloud strategies, including such considerations as a vendor's cloud offerings, business model, routes to market (direct or indirect) and compensation plan for partners selling cloud. This evaluation could result in continued alignment with existing vendors that have added cloud, or it could mean a switch to vendors either more invested in cloud or more channel-friendly in how they deliver cloud offerings.

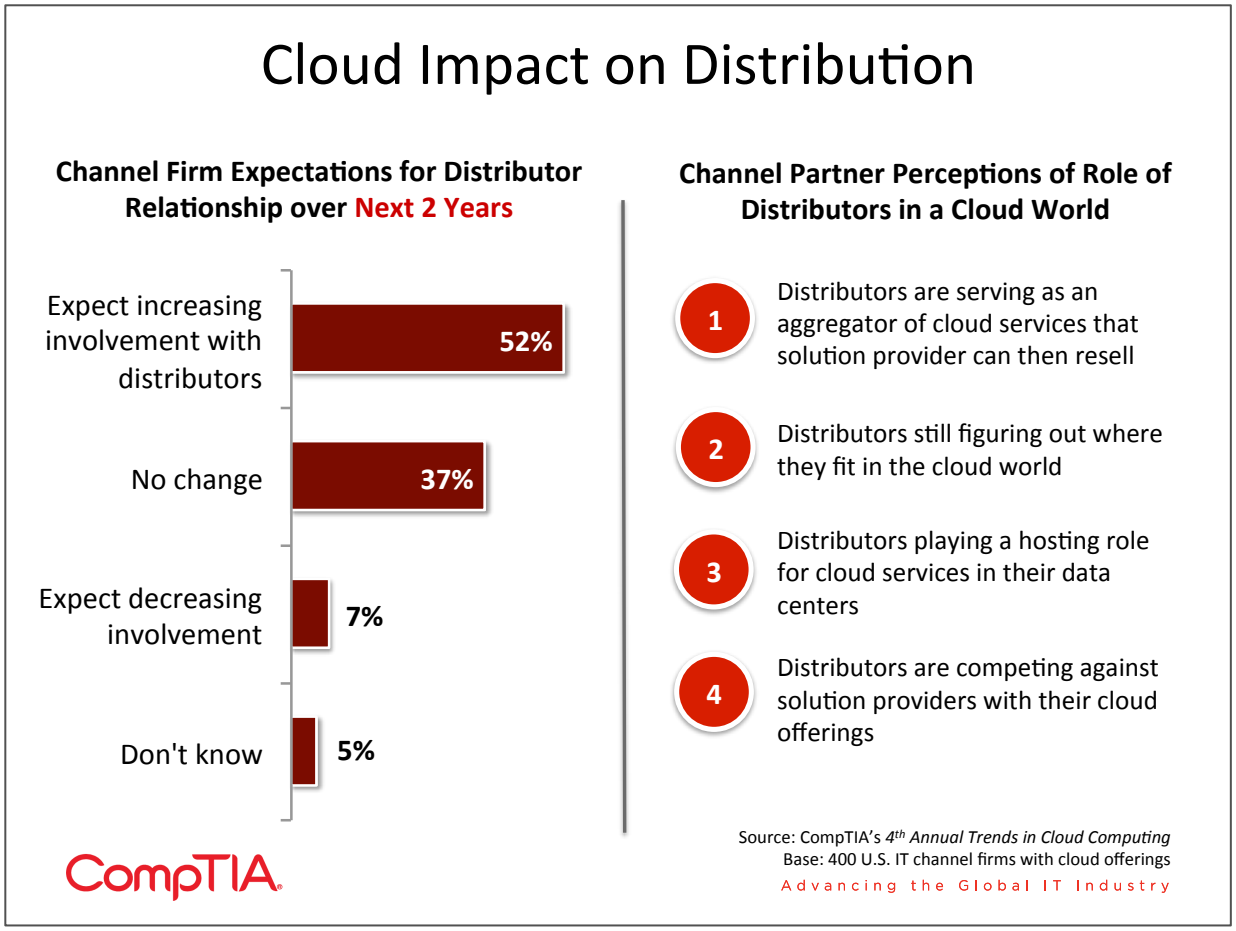
On what basis are channel companies choosing cloud vendors to work with? Last year, vendor brand reputation was the main reason, despite predictions that the cloud model will erase the importance of vendor branding in the sales process because services are intangible and invisible to the customer. Not so this year. The chief reason to select a vendor to work with related to cloud is customer preference.



This a highly telling finding, demonstrating just how much leverage customers today have in the IT marketplace, even with something as new as cloud. What's unclear is whether customers are demanding to work with a particular cloud vendor or if they are zeroing in on a specific type of cloud service that in turn drives the channel partner to seek out a vendor match.

Regardless of whether the customer is demanding it or not, channel firms selecting a vendor to work with are also interested in the vendor goods. Findings show that they place great emphasis on the type and breadth of cloud offerings that the vendor has in its quiver, especially among those with a steep investment in their own cloud practice. Six in 10 firms that have high levels of cloud maturity, high cloud profit margins or partake in all four cloud business models said a vendor's cloud portfolio is paramount in the selection process. Likewise, those channel firms with strong cloud investments also value the vendor's level of commitment to the model as selection criteria. More than half of these types of firms versus, for example, 2 in 10 low cloud maturity companies, say they are keen on aligning with vendors that take cloud and their channel's involvement in it seriously.

Companies with the deepest cloud experience and involvement were also the most likely to have experienced major change in the makeup of the vendors they work with compared with those with less cloud experience. This could signal the fact that those firms have moved away from some of the more traditional IT manufacturers to join forces with some of the newer, cloud-focused vendors that have emerged on the scene.



Meantime, the other piece of the value chain to consider is distribution. Most channel firms have well-established relationships with broadline distributors such as Tech Data, Ingram Micro and Synnex, as well as working with value-added distributors such as D&H. Just as channel firms have wondered what role they would have in a cloud-based world, distributors – long the fulfillment arms for the channel in terms of products – have had their share of angst about where they fit in.

Based on what the channel has to say, distributors will assume just as central of a role in the delivery and packaging of cloud services as they do in the product-based world. In fact, half of channel firms expect to see increased involvement with distributors as a result of offering cloud, while only 7% plan to decrease their alliances. Where most channel firms see value coming from distribution is in their ability to serve as aggregators of cloud services, effectively packaging up offerings and solutions from various vendors in an easily consumable way for solution providers to resell. It's a logical extension of what distribution already does for product-related solutions.

That said, the positive data might belie some potential realities around distribution and the cloud. First off, channel firms could be hedging their bets in predicting a stronger engagement with distributors brought on by cloud. It doesn't cost solution providers much to work with a distributor, so it's not a stretch for them to wax positively about the future potential around cloud and these alliances. But from the distributor perspective, success in cloud is going to require some reengineering of operations and financial investment – likely significant. How nimbly and successfully distributors execute on this transition is what will ultimately determine how well their channel partners view them. And will their investment in cloud deliver enough revenue to offset losses in more established parts of their business?

CompTIA

TRENDS IN CLOUD COMPUTING

SECTION 4: END USER BUSINESS MODEL ANALYSIS

RESEARCH

FOURTH ANNUAL • AUGUST 2013

www.comptia.org

Key Points

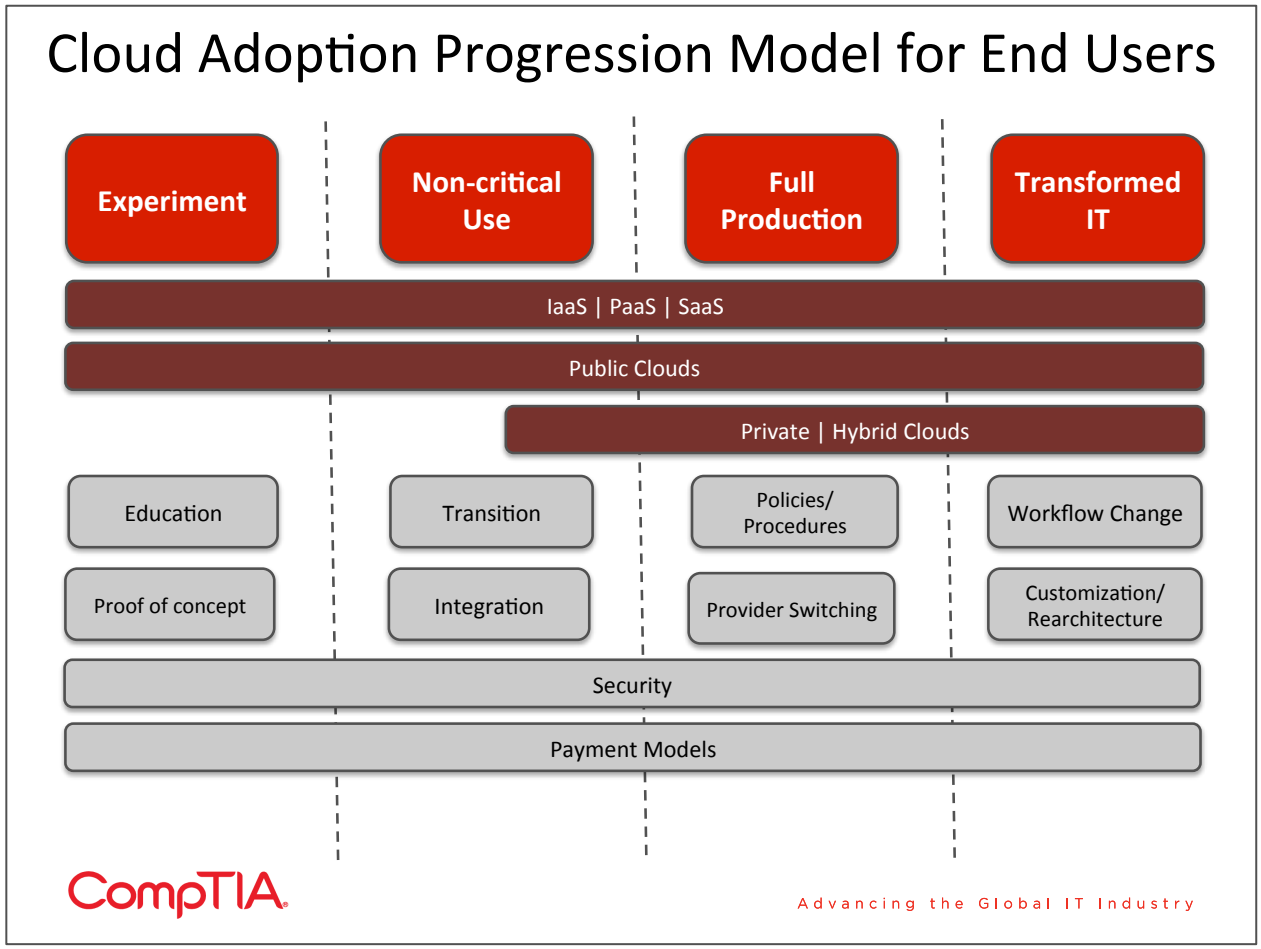
- As end users mature in their adoption of cloud technologies, they will progress through phases of increasing competence and complexity. Beginning with an Experiment phase where companies will learn about cloud concepts and build proof-of-concept models, firms will pass through stages of Non-critical Use and Full Production while aiming to have fully Transformed IT practices.

- In moving towards Transformed IT, businesses will experience many changes to their IT operations. Primary examples include changes to policies and procedures regarding technology (which require some level of enforcement to be effective) and changes to the IT department (which may involve retraining or hiring for specific skills).

- Surprisingly, the number of companies that contracted with outside firms for cloud work dropped from 21% in 2012 to 11% in 2013. While this is partly due to large companies building their own capabilities in-house, channel firms should also be alert to ways of describing the value of their cloud services and building capacity for increased cloud demand.

End User Progression

With at least five years of cloud adoption history, distinct phases are beginning to emerge as businesses become more comfortable with the cloud model. In each phase, there are certain concepts that must be learned or activities that must be mastered in order to gain the full benefits available through cloud usage.



In the **Experiment** phase, companies are simply building familiarity with the cloud model, including terminology and basic working principles. Companies that were early cloud adopters passed through this phase several years ago, but it is important to remember that those companies represent a small percentage of overall business adoption, and many firms are still entering this stage as mass adoption takes place.

During this stage, a company may test out cloud systems by building sample virtual instances or using software on a free trial basis. These proof-of-concept undertakings will most often be performed on public cloud systems, since they are readily available and require minimal investment. Companies may investigate the pros and cons of private clouds, but very few will begin building out those systems at this time.

Next, companies will move into a **Non-critical Use** stage. Here, cloud systems will actually be used for operational workflow, though businesses will not choose to migrate their most important systems or most sensitive data. Typically, a peripheral system will be chosen or testing and development work will be moved, with the full production systems still maintained in-house.

By moving an operational system or application to the cloud, companies can learn the fine details behind a cloud transition and also gain a first-hand appreciation for the integration challenges. Through regular use, the true costs of a cloud solution will become apparent, and companies may find areas of unexpected expenditure, such as network upgrades. Those businesses that plan on pursuing private clouds may begin building those at the end of this stage in order to gain experience with managing cloud infrastructure.

Once a certain level of comfort with the cloud model has been achieved, companies will move into **Full Production**. Businesses at this stage have understood and mitigated their security concerns and view cloud systems as a viable option for IT operations. Policies and procedures will be built and modified as firms change the way they procure and utilize technology.

Another activity that begins taking place in this stage is cloud provider switching. For a variety of reasons, companies may move from one public cloud provider to another, move from a public cloud into a private cloud, or even move from a public cloud back to an on-premise system. As more organizations begin to employ this "multicloud" approach, there will be new areas of opportunity. Section 5 of this report examines migrations in more detail.

Many companies with legacy IT architecture are currently in the full production phase, with very few having moved to a model of **Transformed IT**. Those companies that are born in the cloud, having completely built their business systems around cloud solutions, are the primary residents of this category at this point in time. Here, companies are not simply moving existing systems or applications into the cloud; they are changing the way they work in order to reap the full benefit.

Options for Private Cloud Construction

As interest grows in building private clouds as part of an overall IT infrastructure, there are several options that can be considered for the underlying technology. These software packages provide the mechanisms for turning hardware into cloud components, including virtualization support, APIs for end users, and fabric controllers that manage aspects such as dynamic allocation. These examples demonstrate the range of options available.

- **OpenStack:** Originally a collaboration between NASA and Rackspace, this open source software has backing from companies such as HP, IBM, and AT&T, who have all stated that they will use this platform for their private cloud offerings.
- **CloudStack:** Citrix acquired this technology as part of their 2011 purchase of Cloud.com and released it as an open source project in 2012. Thanks to the previous user base, CloudStack claims that $1 billion worth of business transactions take place annually on their platforms.
- **Eucalyptus:** While OpenStack and CloudStack both provide some level of compatibility with Amazon APIs through translation mechanisms, Eucalyptus has licensed the APIs directly. This provides the most direct link between a private cloud and Amazon Web Services, though it also increases the risk of vendor lock-in.
- **vCloud:** This offering from VMware may hold appeal for customers who have heavily virtualized using VMware tools, but they may find that there is a tradeoff in seamless interoperability with a variety of other cloud vendors.

The key to Transformed IT is optimization. Rather than using the same workflow and incorporating cloud-based systems, workflows will be altered to take advantage of unique cloud characteristics. Similarly, existing applications that do not have built-in monitoring or security features will be rebuilt or replaced with software that is more cloud-enabled. This is not to say that a company will have their entire IT architecture in the cloud; Transformed IT will usually still employ on-premise models along with public cloud and private cloud options, and workflows may be individually optimized as a company moves towards a holistic transformation.

The transition to Transformed IT is challenging, and the conversion may take place over several years since many companies are realizing benefits just by reaching the Full Production stage. As competition increases, though, businesses will need to claim any advantage they can gain and will become more interested in the investment required to fully utilize cloud computing.

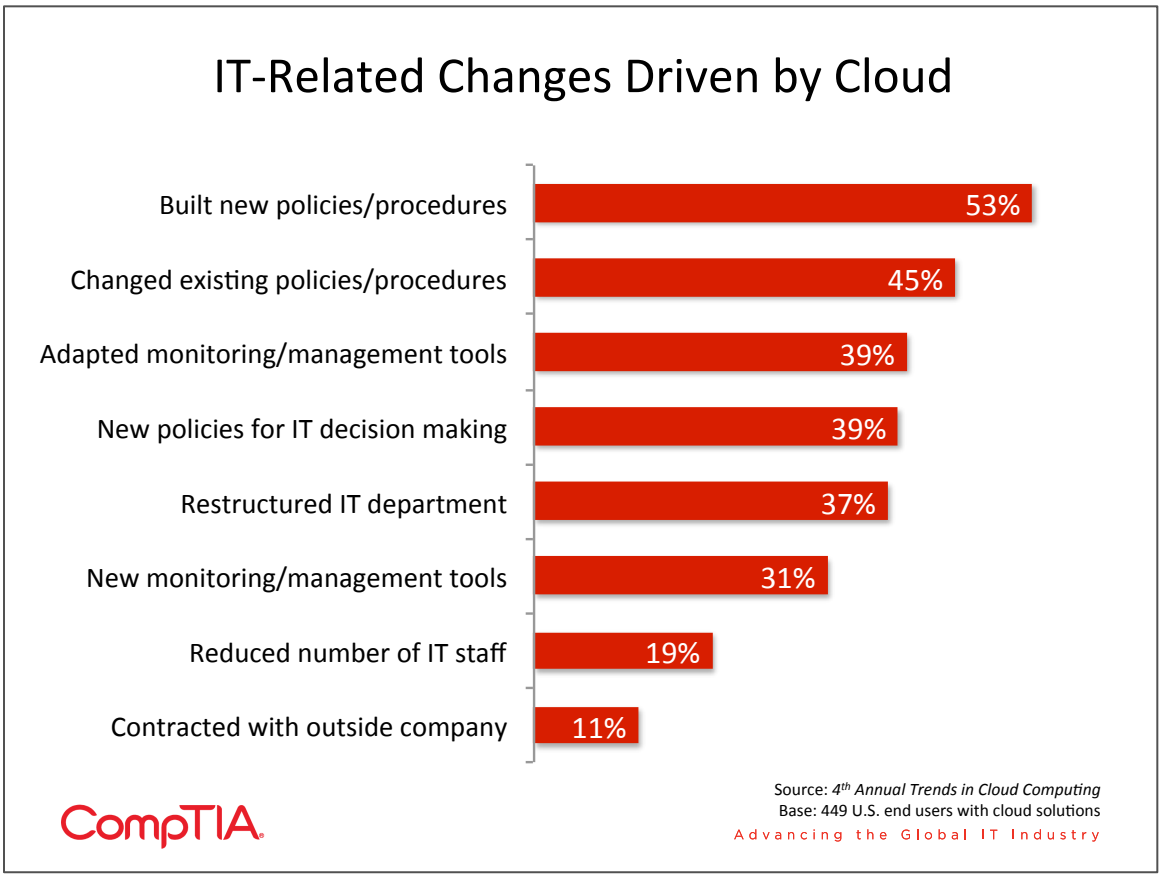
New Cloud Models Drive New Behavior

As companies progress from experimentation with cloud models to a full transformation of enterprise IT practices, they will increasingly find that there must be changes to the overall IT approach. Rather than simply transferring a given IT system to the cloud and allowing work practices to continue as before, a business can gain further benefits and more properly secure its assets by undertaking some behavioral changes.

For certain use cases and early stages of adoption, cloud computing may present only a slight change to the operations of an IT team. For others, the change can be much larger, impacting not only the IT team but also the business processes of an entire company. This is the reason for the momentum behind IT becoming more of a partner to the lines of business rather than simply a supplier. The ability to use technology through the cloud can streamline the way IT is provided, but it can also streamline general workflows. By combining thorough technical knowledge with operational procedure and strategic objectives, IT can be a major player in moving a business forward.

That transformation does not come from a business simply applying the current knowledge and skills of an IT department to the task at hand. The IT department itself should be carefully examined to determine how well it is equipped to understand and utilize cloud technology. In addition, organizational policies and procedures may have to be modified or created to define the proper interaction with cloud providers or the IT team.

Small businesses especially should take care to examine their IT and business operations. Twenty-three percent of small businesses (1-99 employees) using cloud solutions have not undertaken any operational changes at this point, compared to just 7% of medium-sized businesses (100-499 employees) and 7% of large businesses (500+ employees). Partly, this is due to the amount of time spent in the cloud so far—operational changes are less common among late adopters, where there is a heavier concentration of small businesses. It is also likely that many small businesses have less bandwidth to review their operational procedures. With cloud computing being a less direct method for building and using IT, it may be advisable for smaller companies to begin building more operational aptitude in order to optimize their workflow with cloud systems.



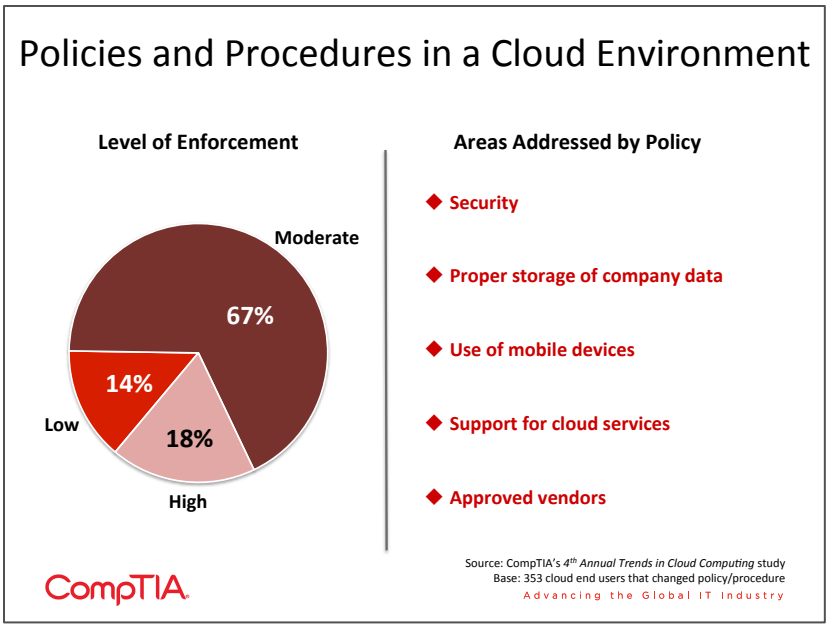
There is an unfortunate side to this disruption and streamlining. Cloud computing has caused some amount of trepidation among IT staff thanks to the possibility of outsourcing compute resource (and the subsequent maintenance). Nearly one in five companies reports reducing the number of IT staff, showing that this may be a logical step for some businesses. However, it should be noted that this is near the bottom of the list of changes a company may have undertaken, just as it is near the bottom of the list of benefits listed by cloud users. As the job market adjusts to the realities of cloud, proactive IT workers can get involved in a variety of other actions their business may be taking to better utilize cloud resources.

Policies and Procedures

Changes to policy or procedure are the most common action taken by companies who have moved into a cloud environment. Whether it is redefining steps that the IT team must take as they administer IT solutions or building new processes for making decisions on technology, actions related to policy and procedure occupy three of the top four spots on the list of changes driven by cloud computing.

For the second year, security tops the list of items that companies are addressing as they modify policies. Through the early days of cloud adoption, security has been commonly cited as the prime factor preventing companies from moving to cloud solutions. With the vast majority of companies having started some form of cloud adoption, it is apparent that companies are either accepting some level of risk or finding ways to mitigate cloud security concerns—at least for the applications they are placing in

the cloud. However, the discussion around security has now shifted from addressing basic concerns (which drives initial adoption) to focusing on finer details (which drives full production use).



Another area frequently addressed in policy changes is the proper storage of company data. CompTIA's studies on the Big Data trend show that many companies feel that their use of data is less than optimal, in part because they do not have strong overarching data management practices. The use of cloud systems for storage and backup only complicates an already complex situation, and many companies may benefit from a data audit and education on best practices in managing data in a cloud environment.

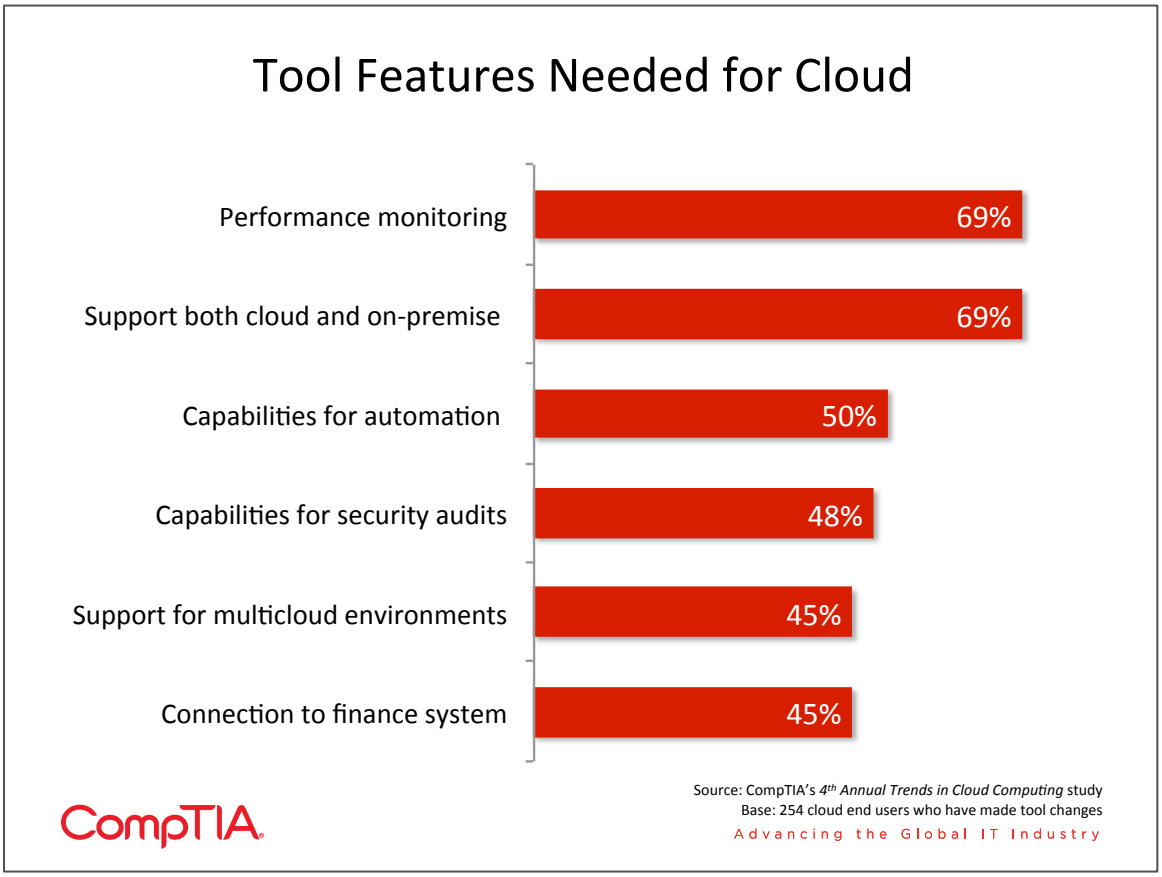
Security and data management are examples of policies that are broader in nature and apply to the entire company. These may be less frequent than changes that apply only to an IT department, but organization-wide changes are more likely to be truly disruptive and may be more necessary. As lines of business gain more understanding of cloud solutions and the potential benefits, there is an increased chance that they will use their own budget for procurement. The intent may not be malicious, but the result can be detrimental if they put company data at risk or cause a work stoppage when the solution goes down.

Building policies that address these issues will be a cross-departmental effort, but should still involve significant input from the IT team. The IT team must learn how to meet the needs of the business with minimal delay, and they also must properly understand and convey the need to maintain a company's risk posture. The best policies will represent an agreement at all levels of the company on how cloud resources will be procured and used. This will not necessarily mean that all information flows through the IT team for approval, but the IT team should be comfortable with their level of awareness and responsibility in the process.

Policies are only effective if they are enforceable, and it appears that companies are moving more towards that model. Compared to last year, there is an even higher incidence of companies claiming a high or moderate level of enforcement. Many companies enforce policy by performing periodic reviews to ensure compliance, and some also use monitoring tools to track IT activity across the company or require the approval process for cloud resources to come through IT.

Internal IT Department Changes

Aside from policies and procedures that get created or altered within an IT department, other changes may take place that allow IT to be better equipped to deal with a cloud environment. These changes may be peripheral to the specific cloud solutions being put in place, but they still have an effect on the overall implementation cost. Companies pursuing cloud projects should consider whether these actions would be a worthwhile part of their cloud investment given their business objectives.



The first area to consider is the need for new or improved tools to control or monitor a cloud solution. In some cases, this could be a simple extension. For example, a system administrator may use software provided by his virtualization vendor to spin up new virtual machines. In a cloud situation, this will likely be handled through a web front end, and there may be little training required to create new servers. There may even be generic machine images that have been saved by other users to eliminate the more tedious steps involved in getting a VM or instance up and running.

Other tools will be new additions to the IT toolbox. Third party software may be needed that can provide a comprehensive view of an architecture, allowing administrators to see vital information from both cloud systems and on-premise systems in a single pane of glass. There may be a requirement to tie a company's financial system to a cloud provider to determine usage for billing purposes. These are examples of tools that can be major projects on their own, driving costs higher and necessitating a heavy time investment as well.

The other primary area to consider within the IT department is the personnel. As mentioned before, staff reduction may be an aftereffect of a cloud transition, but the more likely scenario is that companies will restructure the IT department in some way. In fact, 30% of companies that have performed IT restructuring have hired new workers to bolster IT efforts—a slight bump from last year. This may be especially true where cloud computing is used to add new capabilities to a business, and a sizable of amount of equipment remains on-premise.

At an organizational level, the movement towards transitioning the IT department from supplier to partner seems to be making good progress. Half of the companies in the survey say that the IT team has been able to move away from maintenance tasks and become involved in more innovative work. An even greater number (57%) say that the IT department has become more integrated with other lines of business to understand how to meet their needs through cloud solutions. The implication is that the technical knowledge held by these workers is still valuable, and new roles are being developed that require new skills.

Types of Skills/Roles Companies Have Added to IT Departments

73%	Cloud architect
72%	Skills to build private clouds
58%	Departmental liaisons
47%	Integration specialists
32%	Compliance specialist

IT staff are taking action to build these new skills. Two thirds of companies in the survey who reported IT department restructuring also reported that their IT staff had taken training to build new skills. This training may often be initiated by the employees. Data from CompTIA's *State of the IT Skills Gap* study shows that while 57% of companies train or retrain existing staff to build new skills, 56% of companies had no formal process for identifying IT skills gaps. A fast-moving field such as cloud computing requires a proactive approach, and employees may be more adept at understanding which technical skills they need to learn. To make sure these skills are complemented with the business skills to drive priorities, a company must take an active role in defining the skills needed and supporting training.

Use of Outside Companies

One of the biggest surprises with IT-related changes is that only 11% of companies have contracted with an outside firm for their cloud initiatives. In 2012, 21% of companies had contracted with outside firms, and the expectation was for this number to rise as more businesses (especially SMBs) adopted cloud solutions and became more mature in cloud usage.

One of the factors contributing to the decline is that large companies have experienced a significant dropoff in their use of third parties. While these enterprises may have initially used a consulting firm or a specialist to get their project started, they have likely built the skills internally that are needed to maintain their projects and push into new areas.

Still, the number of small companies that have contracted with an outside firm has not risen dramatically, and there are several reasons that this partnering has not taken off. Among companies that did partner with a solution provider, the top reason that they eliminated potential candidates was that the costs were too high. Although lower costs is still the top driver for cloud solutions, many companies find that particular applications do not actually have lower costs, mainly due to unexpected

expenses. As companies more closely examine their transition cost, the additional overhead required to contract the work might be enough to deter them completely from outsourcing.

Looking at channel firms that are providing cloud services, 42% say that they experienced a demand for cloud services that outstripped their capacity to supply a solution. This could be a statement of technical capability or simply raw bandwidth. In addition, 33% said that they lost a sale to a non-traditional IT solution provider, such as a vendor, distributor, or telecom carrier.

Taken together, these data points suggest that there are some gaps—either real or perceived—in the ability of solution providers to adequately support cloud services. For SMBs, the hurdles of additional overhead cost and struggles with solution provider capacity may be too large to overcome. As a result, these companies may work directly with cloud providers in many instances. Even though they may receive services beyond the actual product being procured, this is likely not considered "contracting" by the end user since it all comes directly from the provider.

Solution providers should be aware that these perceptions may exist and should take action to address them. For the issue of cost, solution providers will need to be prepared to fully explain the value of a cloud solution and the added benefit that the provider is able to deliver. The issue of capacity may be more challenging. If a customer desires a solution beyond the technical capability of a provider or if the provider is fully booked, hiring or training can solve the problem but are not immediate fixes. One suggestion for solution providers is to look for partners with specialized expertise, then act as a focal point with the customer to provide a complete solution.

CompTIA

TRENDS IN CLOUD COMPUTING

SECTION 5: END USER CLOUD MIGRATION ISSUES

RESEARCH

FOURTH ANNUAL • AUGUST 2013

www.comptia.org

Key Points

- Cloud migrations are picking up steam as companies become more familiar with the cloud model and seek to optimize their cloud usage. A healthy percentage of companies are either moving from one public cloud provider to another, moving from a public cloud provider to their own private cloud, or moving applications back on-premise.

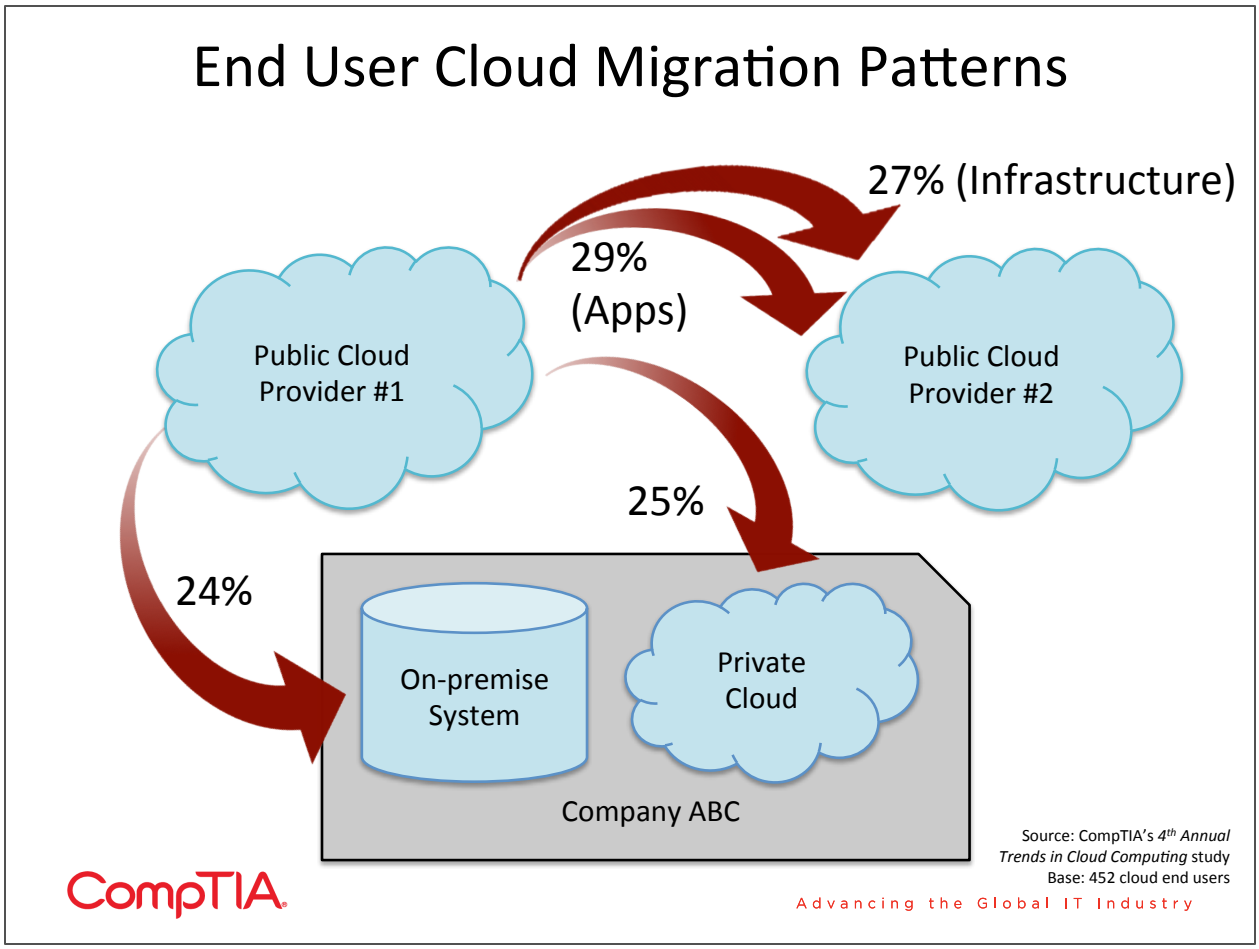
- Switching public cloud providers could involve either migration of infrastructure or of applications. There are a wide variety of reasons that companies switch providers, including security concerns (45%), costs (42%), and feature sets (41%).

- Moving to a true private cloud is a complicated task involving specialized skills. Many companies elect to work with an outside firm, but building internal skills is also a popular option. Fifty-one percent of large companies have retrained staff compared to 31% of small companies. For hiring, the gap is even wider—63% of large companies have hired new skills compared to just 38% of small companies.

- Cloud migration will become an even greater focus area in the future, as 44% of companies that have not yet performed a secondary migration plan to do so in the next 12 months. These companies will want to carefully examine the effort required, as the data shows that they may be underestimating the challenges.

Migration Patterns Signal New Adoption Phase

Once companies hit a stage where they are using cloud systems as a standard part of IT architecture, it is natural to assume that they will begin weighing the pros and cons of various providers and various models and continually shift to achieve the optimal mix. Up to this point, there has been a great deal of focus on the hurdles to cloud adoption (such as security) and the challenges in the initial transition of functional systems into the cloud. Many companies are still concerned with these areas, but early adopters are beginning to explore further issues related to cloud migration.



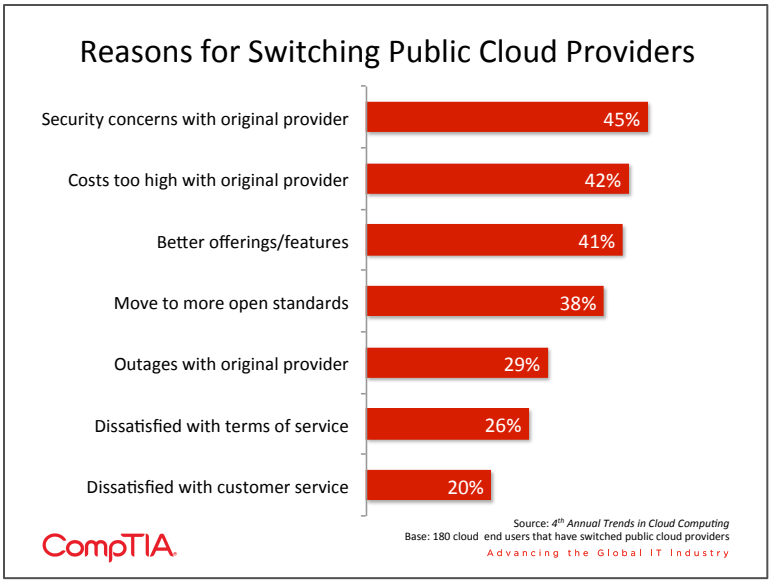
CompTIA's study found that a healthy percentage of companies have begun shifting infrastructure or applications following their original transition to the cloud. While there are some companies that have made multiple moves, approximately 10%-15% of the sample have only made one of the moves in the chart above, so that more than six in ten cloud users have made a secondary move of some type.

It should also be noted that migrations indicate a spate of acceptable options for IT systems. This has implications for the future approach to building out architecture. While the term "hybrid cloud" has been in use since the early days of the cloud era, it has carried a connotation of a single application that resides in both a private cloud and public cloud. Examples might include a production system on a private cloud with backup in a public cloud or a private cloud application that uses a public cloud for cloudbursting.

Going forward, the reality is that companies will have their systems spread across multiple clouds, choosing the option that best suits their needs for a particular application. This is no different than a traditional data center with servers that are configured for different purposes, but the management challenges are much greater. As the industry moves toward a multicloud paradigm, there will be ample opportunity to help manage the growing complexity.

Public ➔ Public

Each of the individual migration styles has particular characteristics. The most popular type of move is from one public cloud provider to another. Here, there can be two different components involved: infrastructure and applications (infrastructure is implied in the other two styles). There are many reasons that customers are switching cloud providers, each of which is worth consideration for both cloud vendors and solution providers managing clients' cloud systems.



- **Security:** With over 90% of companies reporting some form of cloud usage, the hurdle of security in making an initial cloud transition seems to be mostly cleared. However, it is obviously still a general concern once the transition has been made. As companies desire to have more critical and sensitive data in the cloud, they may continue to have questions around security and seek out providers with the most up-to-date technologies and practices.
- **Cost:** One of the primary characteristics of Amazon Web Services has been frequent price cuts—in June 2013, Amazon lowered prices on dedicated servers, racking up the 37th price cut across all services since the AWS launch in 2006. Amazon enjoyed a first mover advantage in pricing for several years, but new entries in the marketplace such as Google Compute Engine and Microsoft Azure are creating downward pressure on prices.
- **Offerings/features/open standards:** Large cloud providers can provide a wide array of services to suit an equally wide range of needs, but there can still be instances where a cloud provider stands out. A provider's cloud services may tie very well to on-premise equipment from the same vendor. Conversely, open standards may be appealing to customers wishing to avoid vendor lock-in.
- **Outages:** Much is made of cloud outages, but the reality is that systems fail. Whether in the cloud or in an on-premise datacenter, downtime must be accounted for. Cloud outages tend to make headlines thanks to the widespread impact if a popular service goes down. Outages are unlikely to be greatly improved from one provider to another—a better solution is to build resiliency and redundancy directly into applications.
- **Dissatisfaction with service:** As with outages, terms of service are unlikely to differ greatly from one cloud provider to another, especially in the long term. As for customer service,

one of the draws of cloud computing is self-service capability, which may explain why this is not a major driver for switching. Still, with one in five companies looking for better customer service, there are opportunities to provide an improved experience.

Public ➔ Private

Just as cloudwashing has caused confusion between true public cloud systems and hosted systems, many end users may give the label "private cloud" to a virtualized set of resources. A true private cloud employs software that manages resources automatically, dynamically allocating as needed without manual intervention. A private cloud should also offer the same self-service capability as found in any public cloud provider. A standard virtual datacenter does not inherently have these features (see Section 4 for examples of software platforms used to build private clouds).

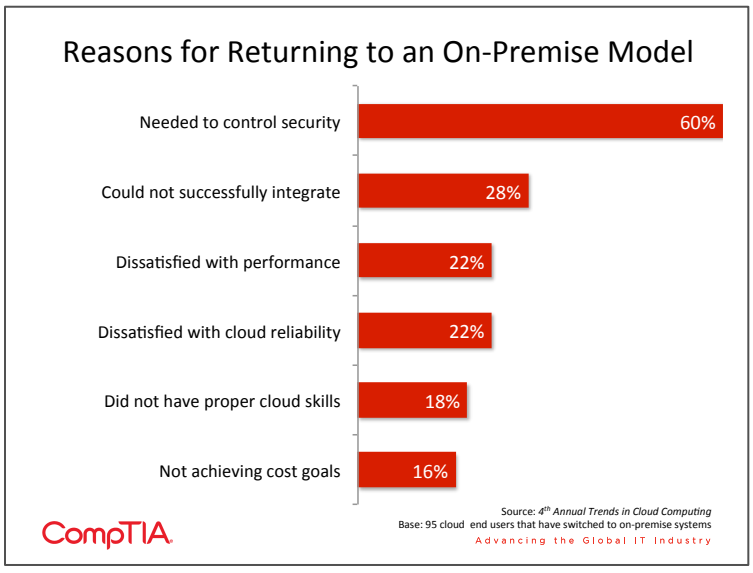
A move from the public cloud into a true private cloud may be the most complicated type of migration, thanks to the technical skills necessary to build and operate the private cloud infrastructure. The most popular way to build out a private cloud is to look to a third party. Seventy percent of companies have either worked with their existing IT provider or contracted with a specialist in building private clouds. Some companies have done both, possibly beginning work with their original provider and changing to a specialist if the work became too complex. The incidence of contracting with third parties is relatively consistent from SMBs to large companies, indicating that this specialized skill within the Build channel model is in high demand.

The other strategy used when building private clouds is to retrain existing staff or hire the appropriate skills. Here, there is more differentiation depending on company size. Fifty-one percent of large companies have retrained staff compared to 31% of small companies. For hiring, the gap is even wider—63% of large companies have hired new skills compared to just 38% of small companies. Clearly, large companies have the capability to train or hire while also maintaining current operations. For this reason, they may come to depend less on third parties for private cloud support, whereas small companies may still require outside expertise.

Public ➔ On-Premise

If a move to a private cloud is the most complicated type of move, a move back to on-premise systems is likely the simplest. Unless the move includes some additional architectural changes, the company is reverting to the methods used prior to the cloud transition. There will still be work involved, but the end result is a known quantity.

It is more interesting to look at the drivers for such a move. There were a wide range of options for switching public cloud providers, but by far the

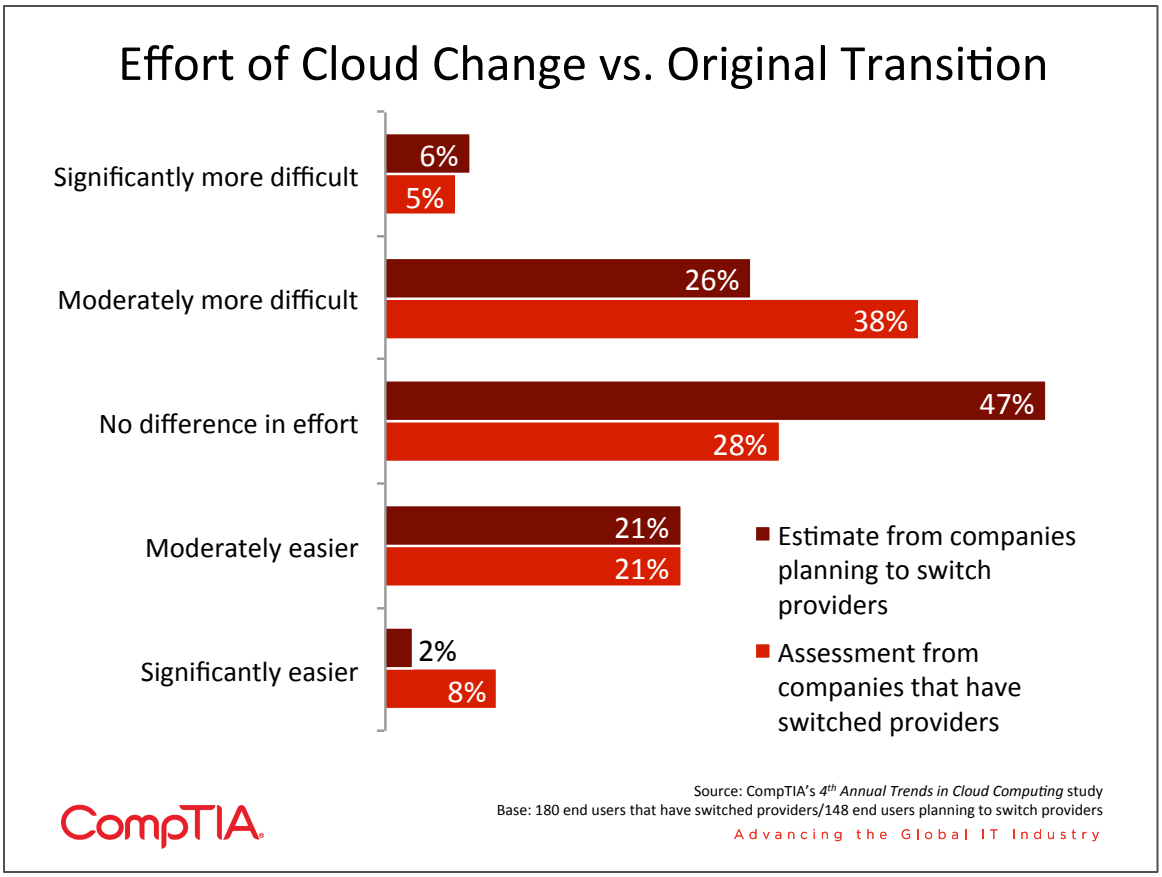


primary motivation to move back to an on-premise system is security. This does not necessarily mean that security has caused companies to completely retreat from the cloud. Companies could simply have moved a particular application that gives them concern, and they still have less sensitive applications on public cloud platforms. Still, it is another indication that cloud security will remain a hot topic for the foreseeable future.

Non-Movers

Although cloud migrations have rapidly become a part of cloud adoption for many companies, many firms have not yet started this type of activity. Even in the next year, though, cloud migration numbers may approach overall adoption rates: 44% of those companies that have not yet switched providers or moved to company-owned systems predict they will do so in the next twelve months.

As these companies begin to perform migrations, they may be in for somewhat of a surprise. Compared to companies that have already switched from one public cloud provider to another, companies that are expecting to move underestimate the effort it will take to transfer their cloud solutions. This will be dependent on the details of the two providers—for example, switching from one public OpenStack cloud to another would probably entail less effort than the original transition. If the underlying platforms are different, though, there will be differences in APIs and in the overall structure of the cloud solution that will require changes to implementation and integration.



CompTIA

TRENDS IN CLOUD COMPUTING

SECTION 6: CLOUD CHALLENGES & OPPORTUNITIES

RESEARCH

FOURTH ANNUAL • AUGUST 2013

www.comptia.org

Key Points

- While cloud computing is becoming highly adopted and well accepted, there are still many challenges to be dealt with as companies transform themselves. The first hurdle is procurement. The incidence of rogue IT—where lines of business are procuring their own cloud solutions without necessarily involving the IT department—has dropped slightly, but companies must still find ways to ensure that both business needs and IT concerns are being addressed.

- Cost tracking is the second hurdle, with 9% of companies not even tracking costs and another 12% finding savings to be lower than estimated. Higher usage costs, staff training, and network upgrades can all contribute to cost surprises.

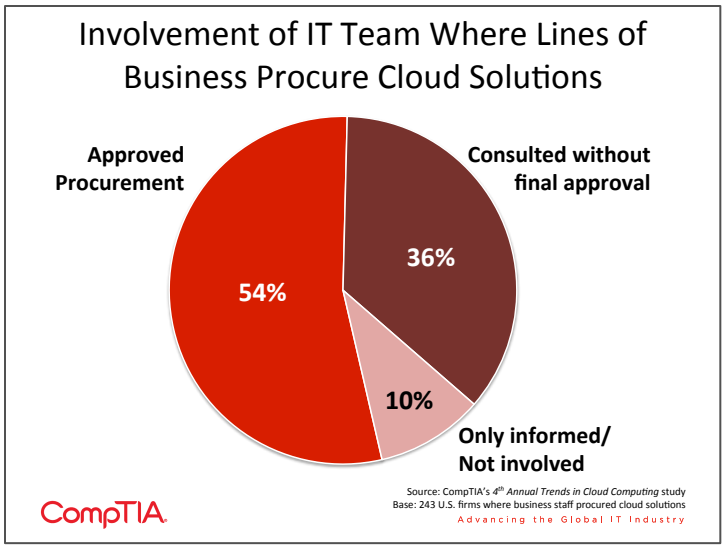
- End users continue to have a spate of challenges in the implementation stages, led by integration with existing systems. However, companies that have 3+ years of adoption history find that modifying policy has become a greater challenge than integration, showing that transforming business practices is just as difficult as a technical migration.

- Transformation can be even more challenging for channel firms, whose livelihood depends on successfully transitioning to a new model for offering services. The top challenge cited by channel firms is developing expertise among their technical and sales staff—clearly an important piece in building service offerings and communicating value.

Procurement: The First Logistical Hurdle

While business model transformation and multicloud strategies may signal the shape of things to come in the cloud era, many companies are still dealing with more basic logistical issues. Partly, this is due to the large number of companies that are starting cloud adoption after waiting for the early adopters to blaze a trail. Partly, it is due to the fact that the logistics of cloud computing transitions are complicated and require significant time and energy from companies as they sort through the issues.

The hurdles begin with procurement. Compared to last year, the incidence of rogue IT—where lines of business are procuring their own cloud solutions without necessarily involving the IT department—has dropped slightly. Companies may have experienced issues with systems procured without IT involvement, such as security breaches, downtime, or integration problems. These complications, which end up costing the company more than installing the proper solution to begin with, could be leading to mandates from executive management to better centralize technology decisions.



Centralizing technology decisions does not necessarily mean giving the IT department full control and final approval in every situation. The applications that are currently most likely to be procured by a line of business are those applications with specific business use cases—finances, HR, or customer relations. The business owners will have the best sense of which technology meets their needs, and they need to be able to communicate those needs just as much as IT needs to be able to raise a flag over security or integration concerns.

For now, the IT department is primarily the procurement agent for applications that have more company-wide impact, such as email, collaboration, or business productivity. As lines of business become more technically savvy, they may show greater interest in building out their own

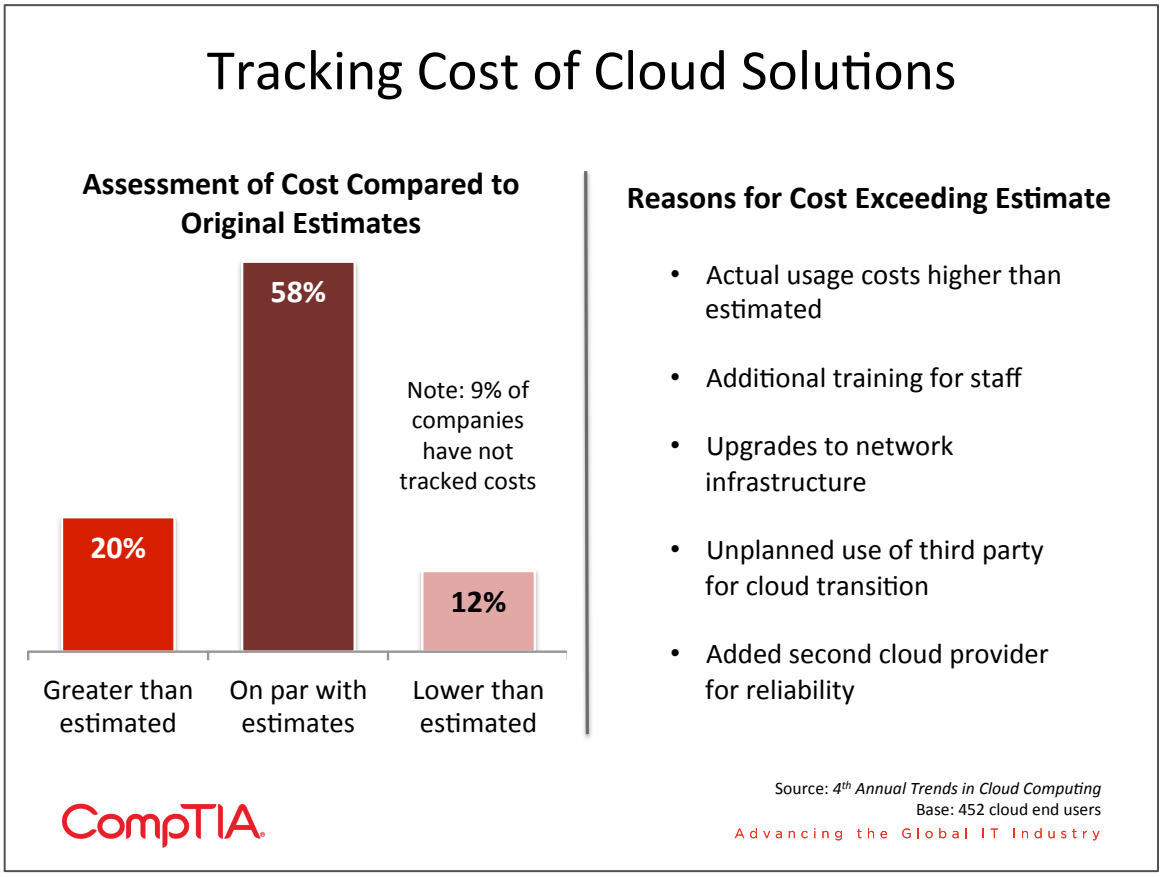
Application	Line of Business	IT
Financial Management	37%	62%
HR Management	36%	63%
Expense Management	34%	63%
Call Center	30%	68%
CRM	29%	69%
ERP	27%	72%
Help Desk	27%	72%
Business Productivity	25%	74%
Web Presence	24%	75%
Collaboration	22%	76%
Email	22%	77%
Analytics	19%	79%
Virtual Desktop	17%	82%

versions of these applications, leading to fragmentation across departments.

Coming up with a procurement and usage plan that meets the needs of all parties is one of the great challenges not just for cloud computing, but also for many technologies that are entering businesses today. Companies need to build a top-down understanding of how needs will be presented, how tradeoffs will be made, and how risks will be accepted or mitigated. The data shows that organizations are moving in the right direction, but this remains an area where best practices can be established and shared.

Cost: The Followup to Procurement

With a solution procured, most businesses will want to track costs in order to justify the investment, especially with cost savings being a top driver for adoption. This tracking alone can present a challenge. Nearly one in ten companies state that they have not tracked costs closely enough to validate the original estimates. Cost tracking could be a lower priority for some firms, especially if they are experimenting or placing low-impact applications in the cloud. Other firms may not have the proper tools needed to monitor usage and costs.

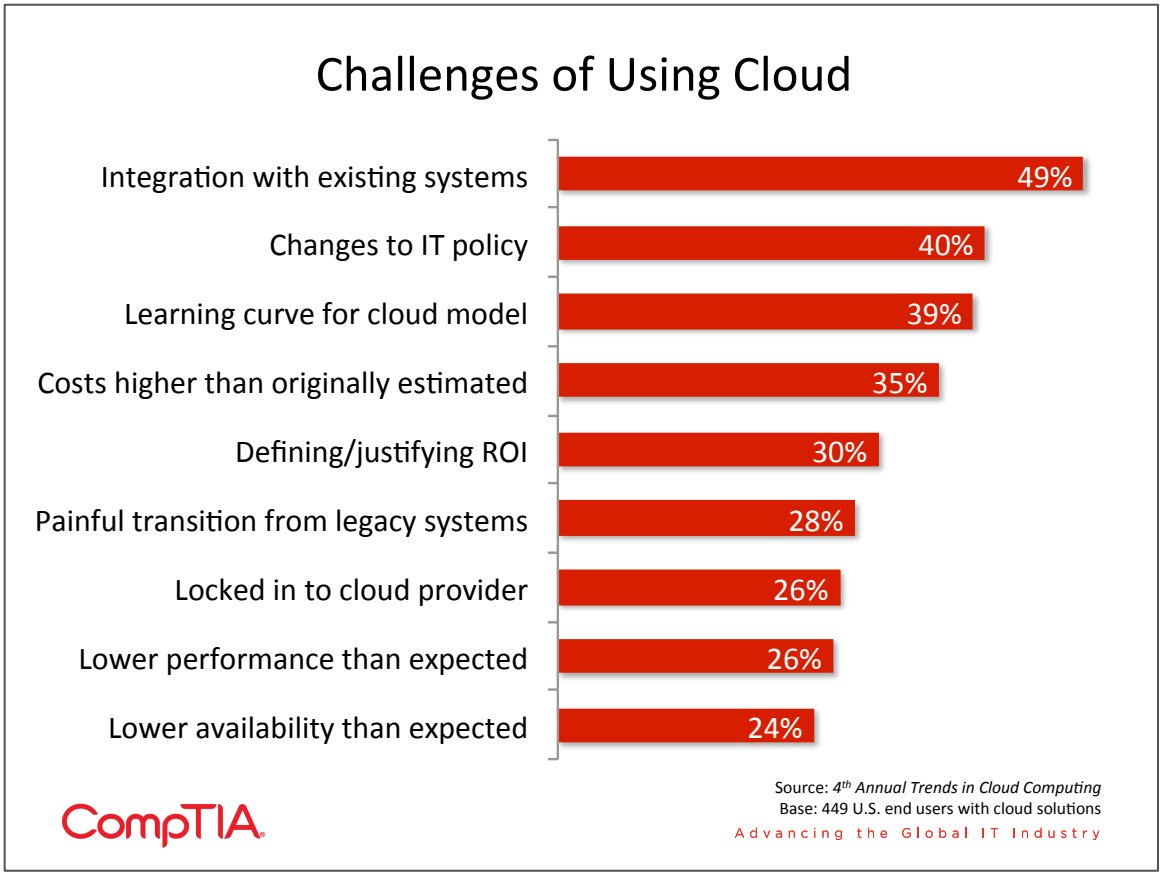


For those companies that have tracked costs, most say that the costs have met or exceeded original estimates. However, a number of companies have experienced complications or surprises that have led to costs being higher than anticipated.

It should also be noted that the cost equation for many cloud solutions is becoming better understood, and many companies may be setting their expectations based on what they are seeing in the market. For example, an application that has dramatic peaks and valleys in its workload may indeed be more cost-effective in a cloud setting, whereas an application with a relatively steady workload may be cost-neutral or even more expensive. However, a company may still prefer the cloud solution for the steady workload thanks to other benefits, such as self-service or automatic upgrades. Companies entering this type of arrangement may be well aware of the cost issues, so they are not surprised even though they were not necessarily anticipating huge savings.

Implementation: A Host of Challenges for End Users

Beyond cost tracking, there continue to be a number of implementation challenges that are more technical or business-related in nature. At a top level, there is not much change year over year in the variety or impact of challenges. However, there are differences in the details that provide insight into the dynamics behind these issues.



Once again, integration tops the list of challenges across all companies. The difficulties in enabling operation between cloud systems and legacy systems involve learning and fine-tuning APIs, typically on the client side for SaaS applications and both client and server side for IaaS/PaaS. End users must learn how to hook systems together and also react quickly when there are unexpected results.

However, integration has slipped to the second largest issue for early adopters, trailing changes to IT policy. On one hand, it is somewhat surprising to see how strongly integration struggles persist as companies mature in their cloud usage. Newer and more business-critical applications certainly bring a different set of challenges, forcing IT teams to constantly learn and innovate. On the other hand, this is an indication of the difficulty in forming new policies around cloud models. The step to a fully transformed business appears to be at least as difficult as the step to a first-time cloud user.

Similarly, significantly more early adopters experience the problems listed towards the bottom of the list: vendor lock-in, availability, and performance. Vendor lock-in is not surprising, since early adopters have reached a stage where they are exploring other cloud options to find the best fit for their business (see Section 5 for more details on cloud migration). Availability and performance, though, are slightly more surprising. One might expect that companies would set their expectations in these areas early in the adoption process and adjust as they build out more robust systems. It seems that the opposite is happening—companies become more concerned as they spend more time with cloud systems and consider placing more business-critical applications in the cloud. Clearly, mitigating risk around downtime or performance is not a task limited to companies just beginning their cloud journey.

Transition: Challenges Faced by Channel Firms

While end users grapple with procurement decisions and financial proof points around using cloud, IT channel firms similarly face a range of their own challenges in either launching a cloud practice or trying to scale and grow an existing one.

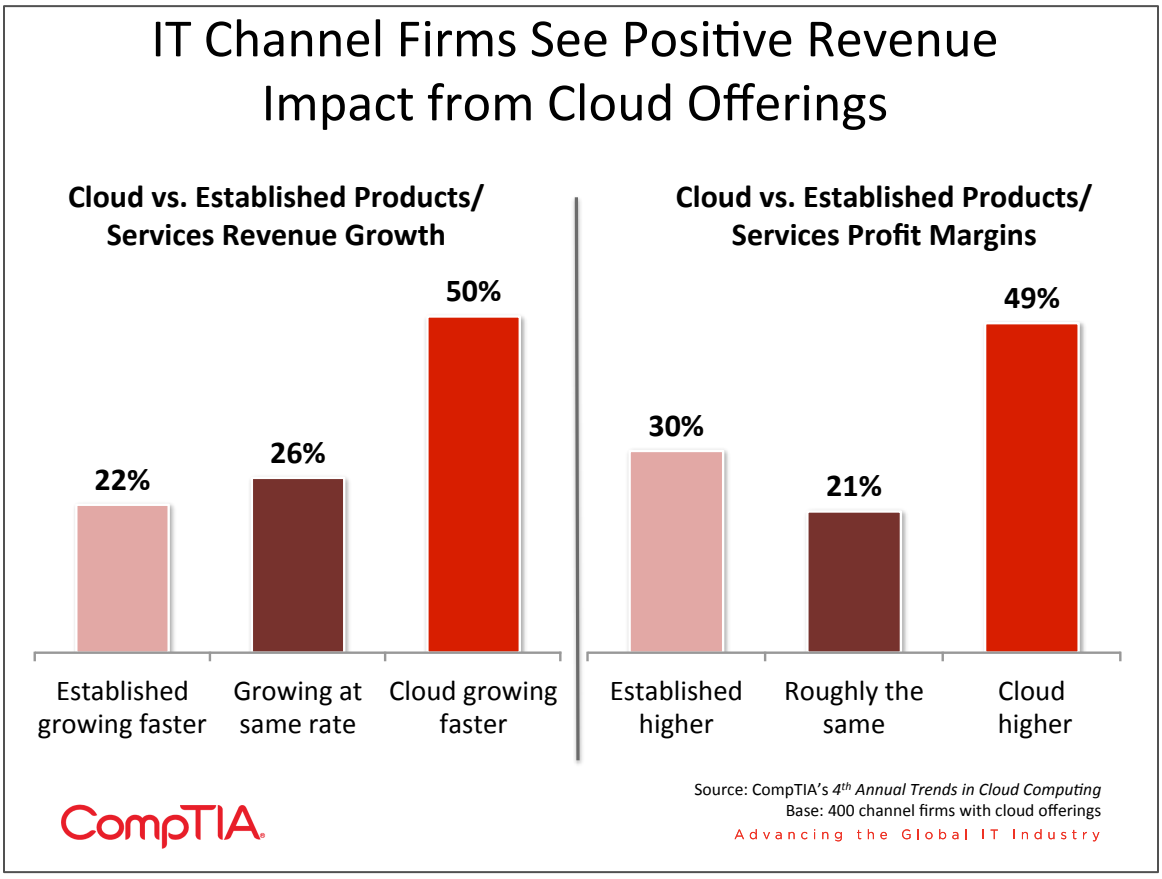
One of the critical questions for channel companies to answer is whether or not cloud makes sense from an ROI perspective and if so, in what capacity and in which customer scenarios. This basic "economics of the cloud" discussion has been front-and-center in the channel for the better part of the last three to five years. The conversation is complicated, due in large part to the wide variety of cloud business model options and potential revenue structures to explore as well as differing customer needs. And yet, we are seeing solution providers move more decisively. Nearly 6 in 10 said they proactively pursued multiple segments of the various cloud business models in an attempt to quickly and comprehensively enter the cloud market, with medium and larger firms more likely to have gone this route than the smallest channel player (see Section 3 of this report for a detailed discussion of business models). As a result, a segment of companies have assembled quantifiable tracking metrics on revenue and profit margin, which can serve as a guidepost for channel companies moving more slowly into cloud.

Some details: Roughly 6 in 10 channel firms that described the state of their cloud business as mature and strategic said that cloud-based profit margins are generally higher than their legacy-based profit margins. Another 6 in 10 companies that are involved in four different cloud-based business models (and therefore one can assume cloud is strategic to them) said that their revenue from cloud was growing faster than their legacy sales. These metrics compare against just 2 in 10 firms with "non-

mature" cloud practices that said cloud profits were higher than profits from existing offerings, for example. Given the fact that many product-focused vendors today are either experiencing a demand slowdown – Dell and HP, for example – or like Cisco forecasting difficult market roads ahead, the decision to place an emphasis on cloud and other types of services by solution providers is a particularly smart one. So while customers might be more reticent to spend capital on products, as some tech manufacturers are seeing, they still need IT services, whether it is managed, professional or cloud.

And yet despite the direction of the market or the enthusiasm of customers, swapping one model for another isn't always smooth sailing for channel firms. The fact is that cloud-based revenue models differ greatly from product-based transactional sales operations, which in turn affects everything from incoming cash flow to the ways in which sales reps are paid. What was once a significant product or product sale paid for in one transaction is now a model based on small increments of recurring revenue each month. Business transformation – considered a must for long-term channel firm survival – isn't for the faint of heart. Also in play is precipitous price dropping among cloud services providers such as Amazon, which puts pressure on channel firms.

On a general level, as evidenced in the chart below, most channel firms involved in cloud, whether mature or otherwise, are beginning to see real returns and a bit of a changing of the guard between cloud- and legacy-based revenue and profit levels.

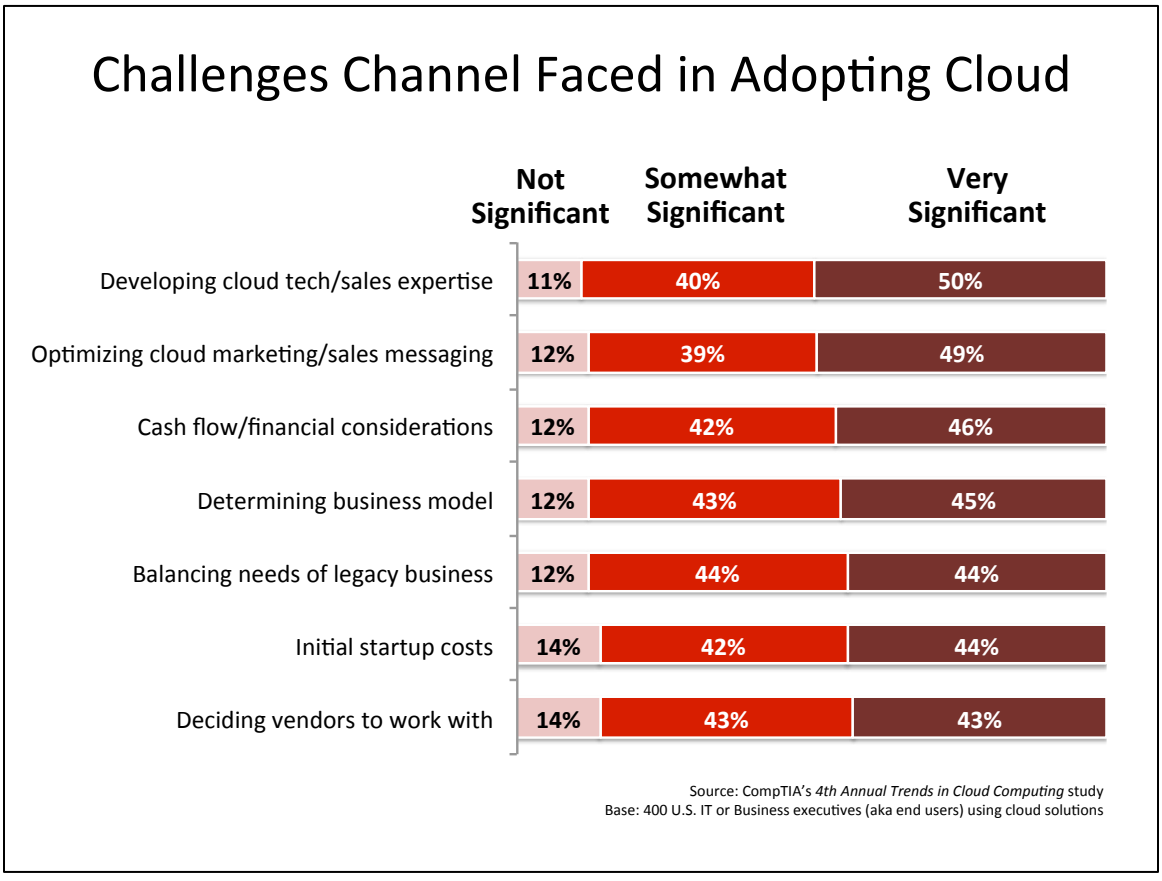


These positive growth and margin rates suggest a decent path for channel firms that make cloud part or all of their business. But there remain significant challenges to doing so. Just as end users have hills to

climb when they decide to try cloud-based solutions for their IT needs, solution providers face internal business challenges in adding cloud to their portfolio. Operational hurdles exist alongside external obstacles such as customer skepticism and the need in many cases to rethink relationships with vendors, distributors and other supply chain partners (see Section 4 for detailed analysis of the cloud's impact on channel partnerships with vendors, customers and distributors).

The types of internal issues that channel firms are navigating through have evolved somewhat over the past year, reflective of a growing adoption rate and maturity of cloud use. New to the top of the list of challenges include two highly specific entries pertaining to human resources. Half of channel firms cited the need to develop cloud expertise in both technical and sales areas as their primary challenge to adopting a cloud focus, while another half (49%) highlighted the effort necessary to optimize their sales and marketing messages around cloud.

The emphasis on sales transition is an important one. Cloud services can be an amorphous concept for customers, which lends itself to sales complexity. Companies that have transitioned to a cloud model



in part or full have discovered that training is paramount to getting an existing sales force or new hires to effectively peddle cloud offerings. Similarly, solution providers are recognizing that they need to make adjustments to their marketing messaging. Typically they have marketed their businesses with a strong promotion of the vendor brands they specialize in. It's not uncommon for marketing material, web sites and other collateral to tout a channel firm's status as a Microsoft Gold Certified or HP Alliance partner, for example. But cloud services are different in that the vendor identification is less visible to

the end customer. The solution provider is the vendor in a sense, especially in cases where the channel firm is white-labeling the offering using its own name and brand. As a result, companies are tinkering with both marketing and sales messaging to reflect a more accurate picture of the value that they bring versus the source of the offering itself.

Nearly equal in significance level are the rest of the challenges cited by channel firms making the move to cloud, with most of those hurdles centered on financial decisions. Initial start up costs, for example, can be minimal or quite large, depending on whether or not they involved building a data center to provide cloud services. Interestingly, the largest channel firms cited this as a major challenge, though they are most likely to have the deeper pockets needed to outfit a new data center if they don't already have one in existence. Meantime, cash flow and other financial considerations ranked highest among channel firms (63%) involved in all four types of cloud business models outlined in this study. This suggests that the level of commitment they have made to cloud has complicated financial fundamentals; one example would be the effects of a decreased reliance on legacy streams of revenue, which in the short-term could create cash flow concerns as they ramp cloud sales.

How have channel firms handled these challenges? The results are straightforward:

46% Invested in technical, sales and business training
42% Transitioned just a portion of their business to cloud, with plans to scale later
40% Pursued vendor-based business training
39% Partnered with other solution providers to combine skill sets
38% Hired new sales reps with cloud experience
32% Pursued new lines of capital/credit

Channel firms with high maturity around cloud were most likely to have partnered with another solution provider to take advantage of complementary skill sets. Forty-six percent of these firms entered into this kind of collaborative relationship compared with a third of those with either some level of cloud maturity or those with a low degree of cloud expertise. The same held for medium and larger channel firms, nearly half of which partnered with another company to enhance cloud skills. This compared to less than a third of the smallest channel firms that have done so.

This partnering is an example of the strategy needed to get on the radar screen for more end users (see Section 4 for details). As end users progress from the Experiment phase towards Transformed IT, channel firms of all models (Build, Provide/Provision, Enable/Integrate, and Manage/Support) can assist with the various steps in the process. From consulting to building private clouds to enabling new workflows, channel firms should take a proactive view of where they can lead their customers using cloud tools.

The biggest challenge may be in cutting through all the confusion surrounding this powerful new model. For many end users, hosted computing models may completely fulfill their needs today, and providers offering these solutions under a cloud label may be experiencing success in the marketplace. As the focus shifts more and more from the delivery methods to the services provided, IT firms will want to make sure they are ahead of the curve in utilizing the technology components at their disposal.

www.comptia.org