Cloud native comes of age

What businesses need to know

People matter, results count.

Contents

Executive summary

When business leaders discuss digital disruption, what do they really mean?

More often than not, it's the transformation of their sector by companies that have used technology to create highly innovative, hyper-convenient products and services that are not only continually evolving, but can also be scaled at speed. The masters of this business model include Amazon, Apple, Google, Netflix, Airbnb, Uber, and Deliveroo.

These organizations are defined by their knack for using software as a key differentiator and source of competitive advantage. Above all, however, their success is driven by their ability to fully harness the elasticity of the cloud by adopting a "cloud-native" approach to application development. Building applications directly in the cloud, and using a modular, microservices architecture, means these innovators can rapidly innovate and scale new products— achieving a business velocity and flexibility that is simply impossible for organizations tethered to monolithic systems.

While the shift to cloud-native applications is most concentrated in Silicon Valley, the approach is about to transform organizations of all types. CIOs should pay attention: application development is moving fully into the cloud, and the days of the traditional, monolithic architecture are numbered.

Capgemini's research for this report, based on a survey of 902 executives from 11 countries, finds that a small number of companies today are adopting cloud-native applications for their new services; others are just starting to shift to the new environment. A final group continues to develop and run monolithic applications, and these organizations risk falling dangerously behind.

> ' Application development is moving fully into the cloud, and the days of the traditional, monolithic architecture are numbered. '

Key findings

1   ## The shift to cloud native is under way.

One-sixth (15%) of respondents' firms' new applications are built today in a cloud-native environment. Judging by their intentions, this figure will more than double (to 32%) in the next three years. The key driver for this is the desire to improve agility and scalability and increase velocity, thereby reducing time to market.

2   ## Cloud-native leaders are moving ahead at speed.

A small subset of the survey sample—the cloud-native leaders—already develops at least 20% of its new applications (and 43% on average) using a cloud-native approach. Many of them are high-tech, manufacturing, and retail companies. Compared with the laggards—those who develop a maximum of 10% of new applications in a cloud-native environment—leaders emphasize strategic imperatives, such as improving business velocity, scalability, the customer experience, and entering new markets.

3   ## Leaders are registering tangible business gains.

They are developing and deploying applications faster than the others and are further ahead in monetizing their application programming interfaces. The impact extends to the bottom line: more than eight in ten (84%) in the leader group say moving to cloud native has helped them to increase revenue and reduce operating costs. Almost as many (83%) say they are ahead of their peers when it comes to financial performance.

How can businesses become cloud-native leaders?

A first step is recognizing that it is less a matter of technology adoption and more one of inculcating new skills and changing old attitudes and practices.

They need to embrace a culture of agile, continuous development, and a greater openness to collaboration and receptivity to new ideas from a variety of partners, both internal and external. They will also have to acquire new skills—notably those required to run a microservices architecture on Platform-as-a-Service (PaaS)—and adopt automated testing, provisioning, and deployment. And they will need to become adept at communicating the value of cloud native to the C-suite and the rest of the business in understandable terms.

4

Skills and cultural change are the toughest challenges.

Both legacy infrastructure and vendor lock-in are obstacles, but the most formidable barriers involve people and culture. When asked to compare several types of challenges, skills emerged as the most significant, cited by 70% of executives. Cultural issues followed closely, with cost and technology issues deemed to be of lesser difficulty.

5

CIOs will also need to change business attitudes.

Convincing business peers of the value of cloud native is likely to be as tough as overcoming monolithic-era attitudes within IT. Our survey suggests that business managers do not trust the CIO or IT to deliver much more than cost reduction. To change such attitudes, CIOs will need to demonstrate a direct connection between cloud native and business velocity, flexibility, continuous innovation, and scalability.

Defining cloud native

Cloud-native applications are built to perform optimally in the cloud.

In contrast with traditional monolithic applications, which are deployed as single entities (and which might be run on-premises or migrated to the cloud), cloud-native applications are composed of microservices that are independent of each other.

They are usually built and run using Platform-as-a-Service (PaaS). Continuous delivery, microservices, containers, and DevOps are core features of cloud-native architecture.

About the research

The analysis in this report draws on an online survey of 902 executives conducted in January and February 2017 by Capgemini and Longitude Research.

Half of the sample consists of senior IT professionals, and 39% of these are chief information officers or chief technology officers. The other half of the sample comprises senior executives from other parts of the business; 27% of these hold C-suite roles.

The respondents come from a range of sectors, with the largest numbers working in banking, insurance, consumer products, and retail and distribution companies. The respondents are relatively evenly distributed across 11 countries in Europe and the Americas. (Australia is also included.)

To complement the survey, in-depth interviews were conducted with the following executives and industry experts (listed alphabetically by surname):

- **Mike Houston**
  senior manager, information services, Altria

- **Abby Kearns**
  executive director, Cloud Foundry Foundation

- **Alex Lorke**
  IT portfolio director, Royal Mail

- **Brian Sondergaard**
  CIO, digital banking, Fiserv

- **Matt Stine**
  principal architect, Pivotal, and author of *Migrating to Cloud-Native Application Architectures* (O'Reilly Media, 2015)

- **Vincent Vainius**
  head of open banking product management, Citi FinTech

- **Anonymous**
  vice president, technical services, US restaurant chain

Figure 1 | Respondents by industry or sector

Other 3.8%
Hospitality & Leisure 1.3%
Life Sciences 1.8 %
Aerospace & Defense 2.2 %
Automotive 2.3%
Education & Research 2.4%
Energy & Utilities 3.3%
Logistics & Distribution 4.2%
Healthcare 4.8%
Consumer Products 5%
Public Sector 5.3%
Telecoms & Media 6.4%
High Tech 10.3%

Banking 14%
Insurance 11.9%
Industrial Manufacturing 10.6%
Retail 10.3%

Figure 2 | Respondents by country

Norway 2.5%
Denmark 3.5%
Sweden 5%
Brazil 11.1%
Canada 11.1%
France 11.1%

Germany 11.2%
Australia 11.2%
United Kingdom 11.1%
United States 11.1%
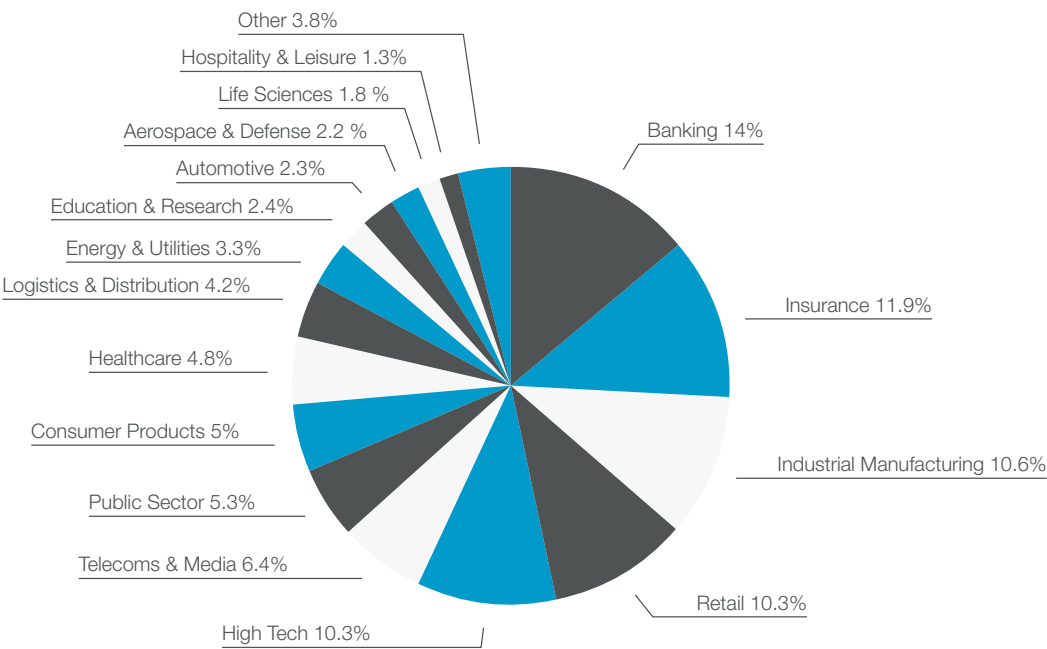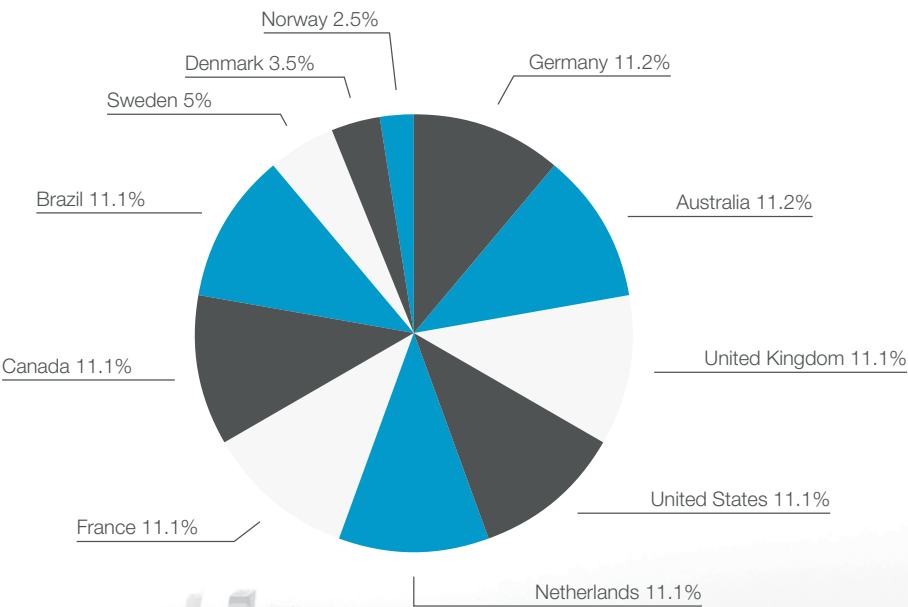Netherlands 11.1%

Introduction

Today's most disruptive companies use software to develop their differentiating characteristics and their business velocity. Many are building applications in the cloud, taking advantage of the speed and flexibility that are hallmarks of the cloud environment. Such companies are early movers to cloud-native applications, and are achieving phenomenal growth as a result.

The shift to cloud native is not, for the moment, well understood outside the technology community, but it is likely to be transformative for organizations of all types.

Matt Stine, principal architect at Pivotal, a US-based software and services company, explains why: "We're getting away from delivering software as a down-time event, with one or two major releases a year, to software that is constantly changing, and we don't even notice the subtle changes. Amazon.com delivers software changes every 11 to 12 seconds, in very subtle ways. Companies like that are making the deployment of software a non-event. That's where everybody's trying to get to."

What is cloud native?

Cloud-native application development allows organizations to build, test, and deploy new software-based products and services at high velocity and with low risk.
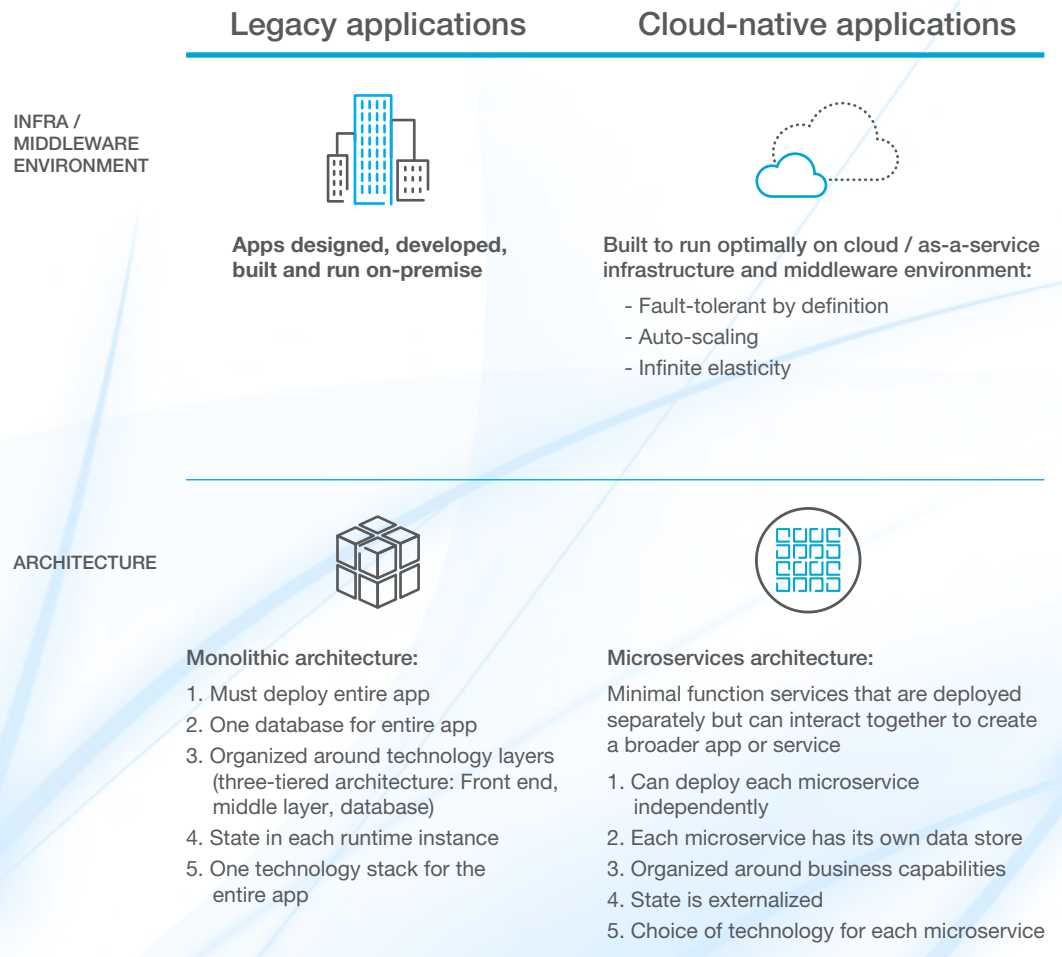
Cloud-native applications do not just run in the cloud, they embrace the elastic scalability and "anti-fragility" (when stresses and failures add strength, not weakness, to a system) enabled by it. Applications built this way can scale and deploy rapidly, allowing their development teams to add new features and react quickly to market changes.

Among the features of the cloud environment that enable such flexibility are microservices architecture, which breaks down code into modular units that can be independently scaled; containers, which allow units of code to easily be moved around without risk to the environment; and DevOps, the culture and process of continuous delivery that organizations use to implement microservices.

The methodology behind Twelve-factor applications is another critical element. Developed by Heroku co-founder Adam Wiggins, these define cloud-native applications as using an agile, self-service infrastructure, with collaboration based on the use of application programming interfaces (APIs); they feature a single code base and have no filing system.
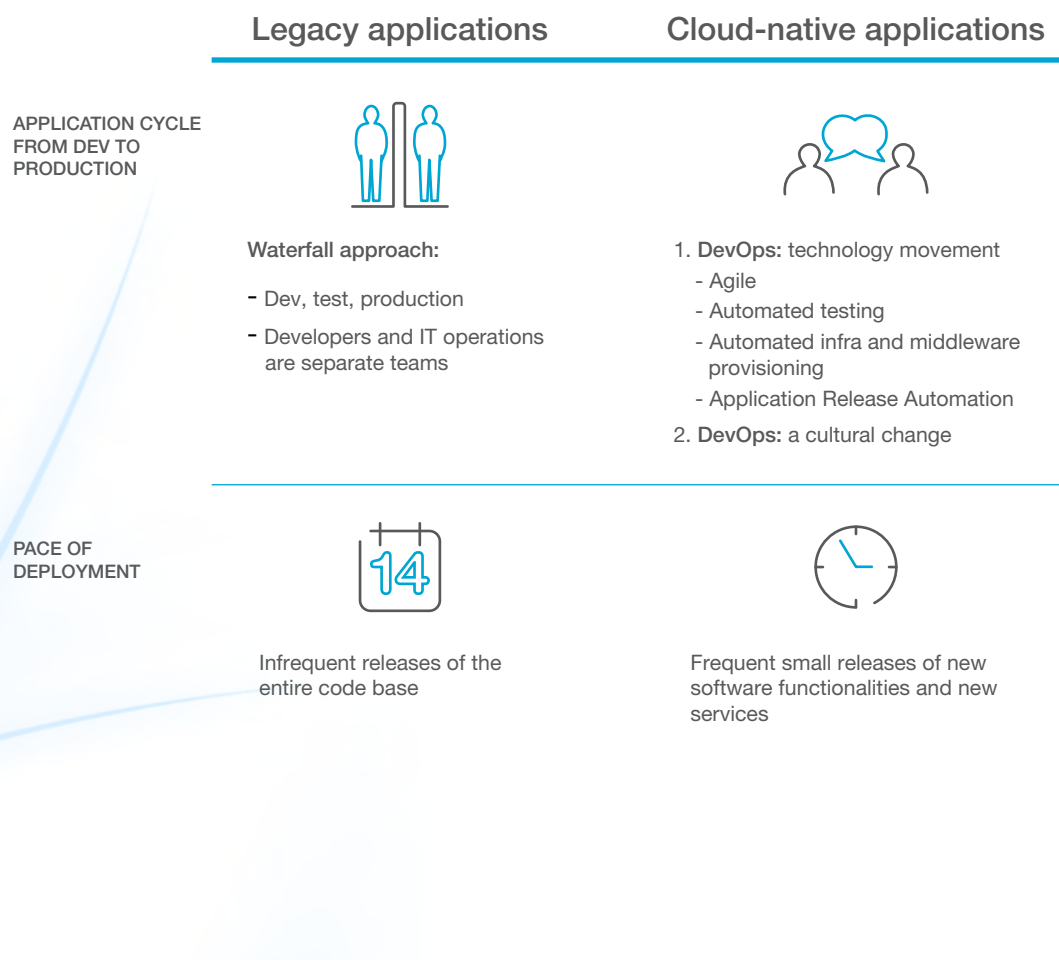
Figure 3 | Key differences between legacy and cloud-native applications

	Legacy applications	Cloud-native applications
INFRA / MIDDLEWARE ENVIRONMENT	**Apps designed, developed, built and run on-premise**	Built to run optimally on cloud / as-a-service infrastructure and middleware environment: - Fault-tolerant by definition - Auto-scaling - Infinite elasticity
ARCHITECTURE	Monolithic architecture: 1. Must deploy entire app 2. One database for entire app 3. Organized around technology layers (three-tiered architecture: Front end, middle layer, database) 4. State in each runtime instance 5. One technology stack for the entire app	Microservices architecture: Minimal function services that are deployed separately but can interact together to create a broader app or service 1. Can deploy each microservice independently 2. Each microservice has its own data store 3. Organized around business capabilities 4. State is externalized 5. Choice of technology for each microservice

Traditionally, IT teams have used a "waterfall" approach to develop applications, with discrete design, build, and run phases lasting a few months or more, culminating in a product release of the entire unit of software. In a cloud-native environment, development is continuous and cycle times are shorter. A key principle of microservices is that they operate independently of each other: One service can be designed, tested, deployed, or replaced without impacting the others. The ability to make updates by changing a single microservice enables organizations not only to scale quickly, but also to contain and address failures swiftly, reducing technology and business risk.

"Traditional software is typically monolithic, meaning it's large and complex and takes a lot of time to make updates," says Abby Kearns, executive director of the Cloud Foundry Foundation, a US-based open-source software organization. "Smaller cloud-native applications are easier to develop, easier to deploy and easier to iterate on…This makes them more resilient and adaptive to use on a variety of cloud platforms." Companies that marry this capability to a digital transformation strategy, Kearns believes, can become entirely new businesses.

	Legacy applications	Cloud-native applications

APPLICATION CYCLE FROM DEV TO PRODUCTION

Waterfall approach:

- Dev, test, production
- Developers and IT operations are separate teams

1. **DevOps:** technology movement
   - Agile
   - Automated testing
   - Automated infra and middleware provisioning
   - Application Release Automation
2. **DevOps:** a cultural change

PACE OF DEPLOYMENT

Infrequent releases of the entire code base

Frequent small releases of new software functionalities and new services

This opportunity is not just open to technology companies. Banks, insurers, consumer goods firms, and manufacturers are increasingly becoming software-driven. Their competitiveness hinges on velocity, flexibility, continuous innovation, and scalability. Cloud-native application development creates the technological conditions in which organizations can develop these attributes.

This report finds that many companies in these and other sectors are beginning to make the shift. But it also identifies the hurdles companies must overcome in the process. As with most technological changes, the toughest challenges are cultural, so chief information officers (CIOs) need to show the strong leadership necessary to thrust their organizations into the age of cloud native.
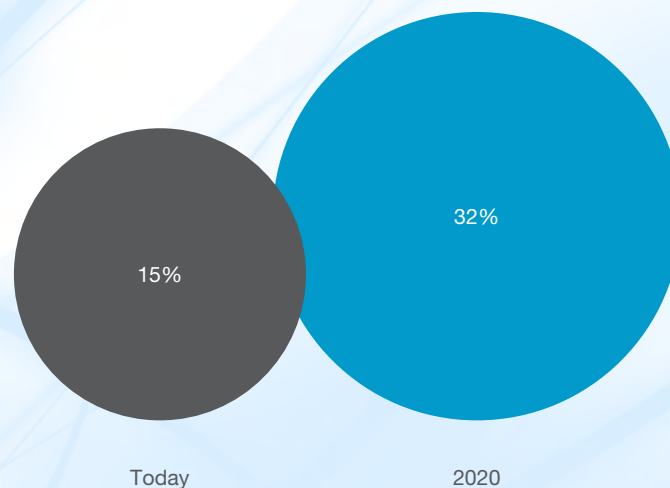
Section 1:
A transformation takes shape

The shift to a cloud-native environment is under way among the businesses in our survey.

One-sixth (15%) of respondents' firms' new applications are built in a cloud-native environment today, and they tell us that they intend for this figure to more than double in the next three years. However, these figures could be understated, as they refer to new applications built using a cloud-native approach.
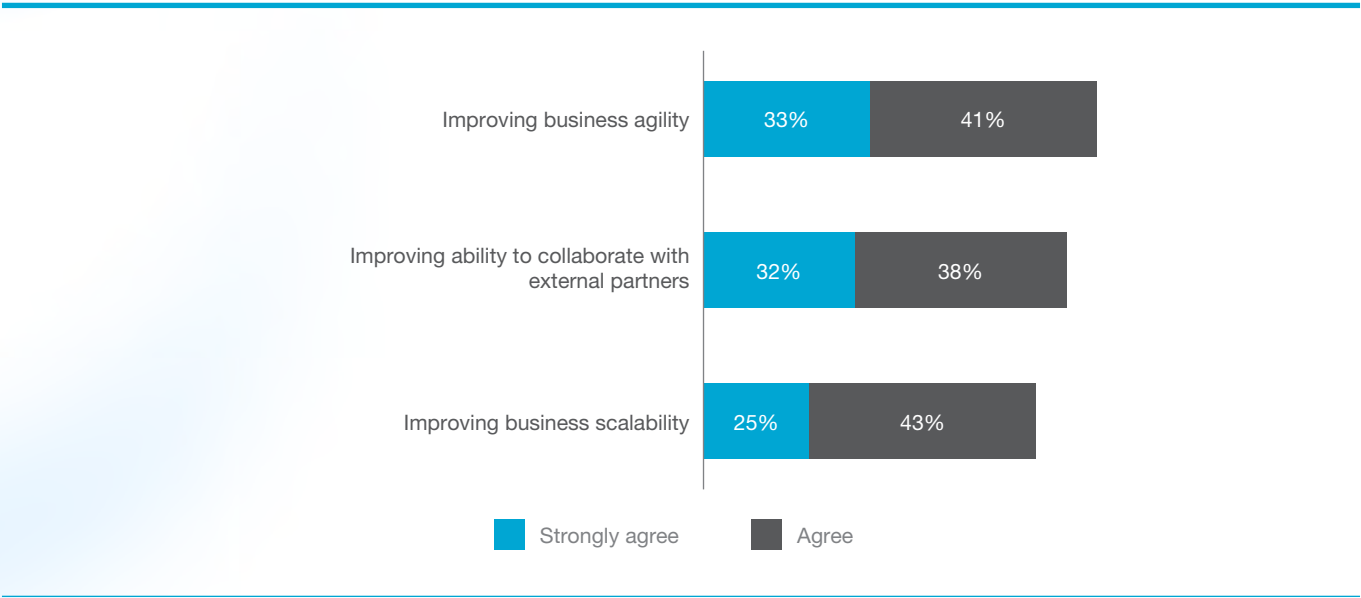
Figure 4 | Proportion of new apps that are cloud native today and in 2020

15%

32%

Today

2020

What are CIOs and IT directors seeking to achieve with cloud native?

Improved agility—that is, business velocity and flexibility—is the main prize. "The pressure to shorten time to market and increase agility are the key drivers," confirms Brian Sondergaard, CIO of digital banking at Fiserv, a US provider of financial services technology. He describes this as the ability to learn quickly what the market needs and respond with solutions that closely address those needs.
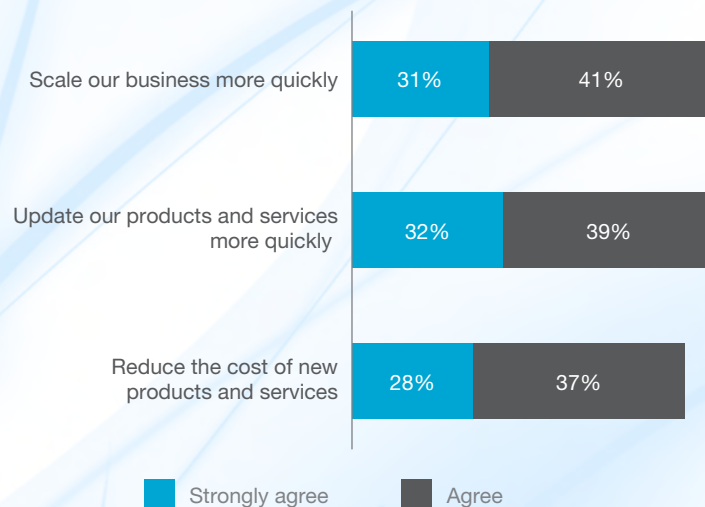
Figure 5 | Key drivers behind a cloud-native strategy

Driver	Strongly agree	Agree
Improving business agility	33%	41%
Improving ability to collaborate with external partners	32%	38%
Improving business scalability	25%	43%

The vice president of technical services for a US restaurant chain describes how transformative cloud native could be for retail. "Let's say something becomes hot in the fashion space, and a retailer wants to capitalize on an event such as "back to school," and be able to sell a piece of clothing as quickly as possible," he says. "The retailer needs to be able to incentivize prospective customers, or be able to target loyalty customers. How can they get something out there as quickly as possible that's going to be consumable on mobile devices, iPads, notebooks, or whatever else?" In a cloud-native environment, an existing application can be modified, or a new one created, rapidly.

A related driver, says Sondergaard, is relentless pressure on resiliency. Bank business processes, for example, historically ran overnight. "If they didn't work for a minute or two before starting again, that was okay for lower levels of reliability," he says. "Now, the consumer expects an application to work all the time, every time, without exception." Cloud-native architecture's fast and automated fault-isolation and recovery features can meet such demands.

Figure 6 | Expected benefits of cloud native between now and 2020

	Strongly agree	Agree
Scale our business more quickly	31%	41%
Update our products and services more quickly	32%	39%
Reduce the cost of new products and services	28%	37%

Efficiency is another driver for cloud native, as illustrated by the experience of a leading insurance company in the US. Using cloud-native microservices and intelligent document processing to remove underwriting bottlenecks, the company slashed its underwriting times: 80% of its underwriting now takes less than two hours, with the remaining 20% delivered within six hours, against an industry average of 24 hours.

Leading US bank uses cloud native to cut time to market

In the banking industry, traditional revenue streams are shrinking with new digital-ready competitors seeking to erode the market share of established players.

Yet established banks recognize that their extensive customer data gives them an advantage over FinTechs. The challenge is how to turn this data into competitive advantage. Some are looking to use APIs to enable collaboration with the more agile FinTechs and bring new products rapidly to market.

One leading US bank in particular identified an urgent need to address its slow innovation cycle, a lack of co-creation with its external ecosystem of FinTechs, and its slow speeds to market with new releases.

To do so, the bank sought to unlock its siloed development activity and move to a new API platform built around a product orientation development cycle supported by a cloud-native architecture and automation.

The bank is now using the platform to work collaboratively with external FinTechs to be in the market within weeks instead of the more typical six-eight month timeframe—a massive transformation. Furthermore, the ability to innovate at a fraction of the cost removes the fear of failure as a barrier to new development. The bank has a fresh thirst for innovation.

> " A cloud-native approach means organizations can develop and deploy code much more frequently than before. This has transformed the relationship between the business and its customers by enabling it to continuously improve software in response to customer feedback. "

Abby Kearns
executive director, Cloud Foundry Foundation

The cloud-native leaders

A small group of surveyed firms—one-fifth (20%) of those in the survey sample—are moving to a cloud-native environment faster than the rest. These are organizations in which 20% or more of new applications are built today using a cloud-native approach.

We refer to these firms as the cloud-native leaders. They can be contrasted with the laggards—just over half of the sample—where less than 10% (and as low as 0%) of new applications are built in such an environment. The mean share of such cloud-native applications across the leader group is 43%; among the laggards, it is just 4%.
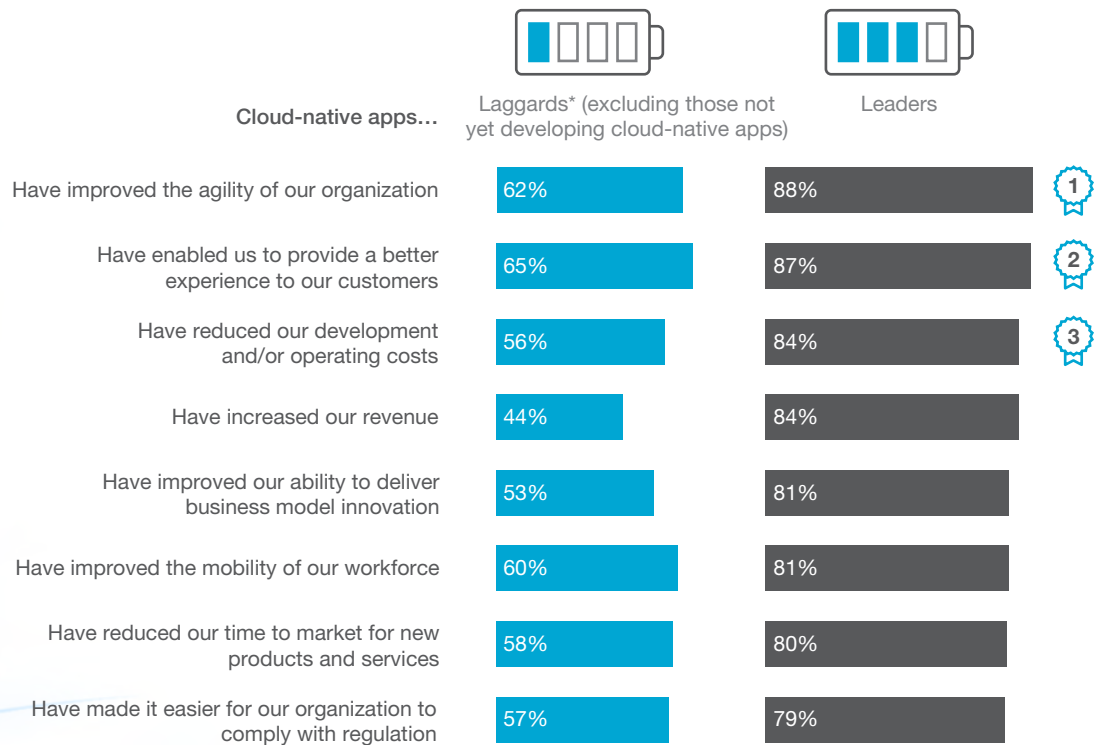
One way in which cloud-native leaders differ from the laggards is that they appear more driven in terms of overall business priorities. For example, they place much greater emphasis on improving business scalability, improving their customers' experience, and entering new markets. In terms of IT priorities, leaders are much more focused than laggards on improving customer experience, agility, business velocity, scalability, and integration of systems.

These are differences of emphasis (laggards also consider these to be priorities), but they create an impression of cloud-native leaders being freed up to pursue strategic initiatives while laggards spend more time on their day-to-day activities.

A similar picture is created by the two groups' approaches to application development. Leaders are considerably more likely than laggards to describe their overall approach as agile and their testing and deployment as automated; their middleware is more likely to be Platform-as-a-Service (PaaS)-based or middleware, versus Infrastructure-as-a-Service (IaaS), and their DevOps teams are more likely to be integrated.

Almost certainly as a result, the leaders are seeing more tangible impacts on their performance from cloud native. For example, they are developing and deploying applications faster, and are further ahead in monetizing their external interactions through APIs.

It is no coincidence that leaders also report a much more positive impact of the shift to cloud native on several business capabilities—notably organizational agility, providing a better experience to customers, increasing revenue, and reducing development and/or operating costs.

Figure 7 | Cloud native's impact to date

Cloud-native apps…	Laggards* (excluding those not yet developing cloud-native apps)	Leaders	
Have improved the agility of our organization	62%	88%	1
Have enabled us to provide a better experience to our customers	65%	87%	2
Have reduced our development and/or operating costs	56%	84%	3
Have increased our revenue	44%	84%	
Have improved our ability to deliver business model innovation	53%	81%	
Have improved the mobility of our workforce	60%	81%	
Have reduced our time to market for new products and services	58%	80%	
Have made it easier for our organization to comply with regulation	57%	79%	

For leaders, the impact extends to the bottom line. More than eight in ten respondents (84%) in the leader group report that moving to cloud native has helped them both to increase revenue and reduce development and operating costs. Almost the same proportion (83%) says they are ahead of their peers when it comes to financial performance.

Abby Kearns relates the impact of a cloud-native strategy on one of Cloud Foundry Foundation's clients, cable TV company Comcast. "It went from having a couple of people develop a few small proof-of-concept applications to a thousand developers and billions of transactions a year going across the platform," she says. "For them, it was a game-changer—both in the way they develop software and iterate on that, and in their ability to hire and retain talent and get people excited about developing software for Comcast."

'We're now delivering in excess of 99.9% availability across many of our digital banking products. We're delivering those now—actual releases, not just patches—at least quarterly, and in some cases at monthly or more frequent intervals. We didn't have the ability to move at that rate until we started getting these sorts of architectural patterns and underlying platforms and services capability in place.'
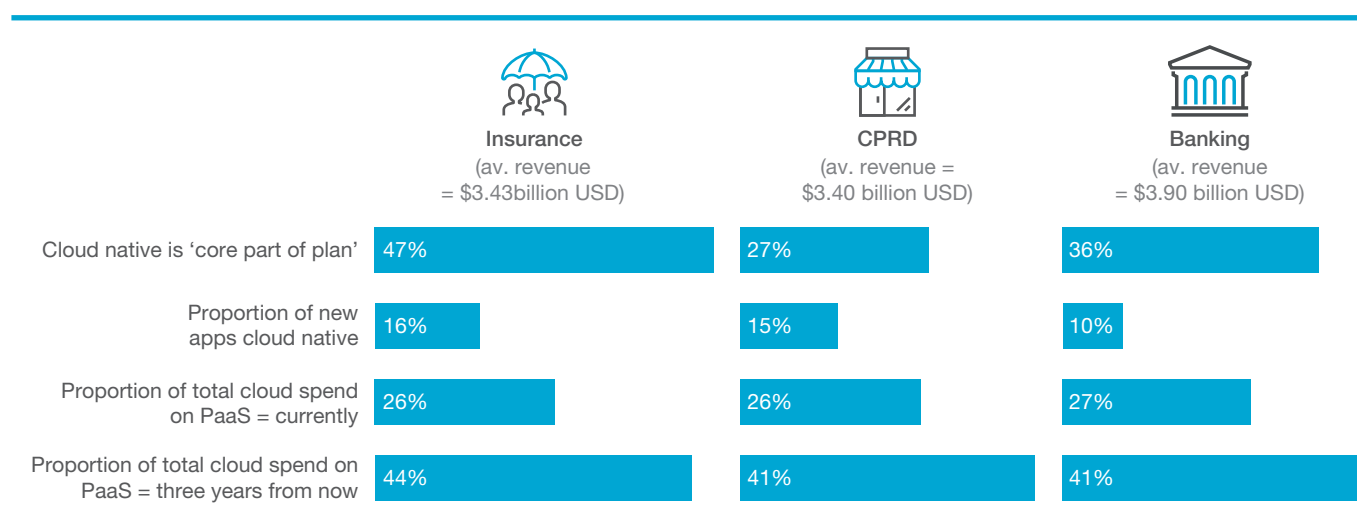
Brian Sondergaard
CIO, digital banking, Fiserv

The shift to cloud native: a sectoral view

High-tech, manufacturing, and retail companies are prominent among our survey's cloud-native leaders. Consumer goods firms, insurers, and financial services providers have been slower to make the shift, but there are promising signs:

Figure 8 | Cloud-native implementation by sector

	Insurance (av. revenue = $3.43billion USD)	CPRD (av. revenue = $3.40 billion USD)	Banking (av. revenue = $3.90 billion USD)
Cloud native is 'core part of plan'	47%	27%	36%
Proportion of new apps cloud native	16%	15%	10%
Proportion of total cloud spend on PaaS = currently	26%	26%	27%
Proportion of total cloud spend on PaaS = three years from now	44%	41%	41%

- Insurers now build 16% of their new applications using a cloud-native approach—more than the average for the sample as a whole, while banks are only slightly behind (with 10% of new applications built using a cloud-native approach)
- Almost half of insurers (47%) and almost one third of consumer products, retail and distribution (CPRD) firms (27%) in the survey say that cloud native forms a core part of their technology strategies.
- All three groups—banks, insurers, and CPRD firms—plan to spend considerably more on PaaS in three years than they do today.

Large banks that once felt protected by high barriers to entry to their markets are beginning to come under threat from challenger banks and other online providers that have fully embraced cloud native. Many banks are shifting some applications to a cloud-native environment as a result.

The insurance industry is heavily burdened by legacy systems, and digital disrupters are taking advantage of that. In retail, for example, aggregators and comparison sites have changed how consumers shop for cars, health, and home insurance. And insurers are starting to recognize the benefits of developing automated risk-assessment and claims capabilities, for example, using a cloud-native approach.

Consumer products and retail firms have long been disrupted by digital challengers, which helps to explain why almost three-quarters (73%) of these respondents claim to develop and deploy new web applications in less than 14 days. A similar number (74%) of surveyed bank executives say the same.
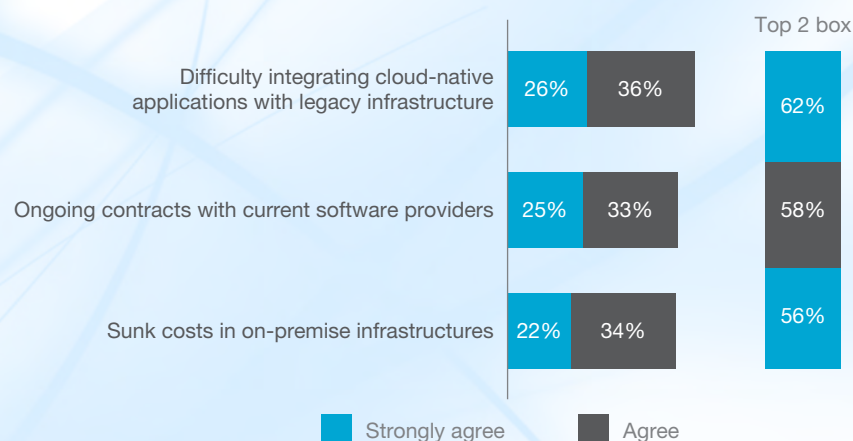
Section 2:
A difficult process

The advantages accrued by cloud-native leaders point to an increasing polarization of software capabilities between those companies which can react to market needs, scale quickly, and innovate continuously at low risk, and those that are unable to meet the same standards.

This will be determined in part by their success in adopting a cloud-native approach for the applications that are most critical to their customer experience and competitive differentiation. Organizations need to assess their portfolios, and prioritize the applications to rearchitect or replace. Companies that depend heavily on monolithic applications to underpin their most differentiated and competitive products and services risk falling behind in the move to digital business, due to the difficulty of iterating and redeploying those applications.

However, the barriers to implementing a cloud-native strategy are formidable. CIOs and IT managers cite as their main hurdle the difficulties of integrating cloud-native applications with legacy infrastructure. Existing contracts with software vendors are another, as are concerns about cybersecurity and data protection. Sunk costs in on-premises infrastructure also hold many companies back from accelerating the development of cloud-native applications.

Figure 9 | Cloud-native development barriers

Top 2 box

	Strongly agree	Agree	Top 2 box
Difficulty integrating cloud-native applications with legacy infrastructure	26%	36%	62%
Ongoing contracts with current software providers	25%	33%	58%
Sunk costs in on-premise infrastructures	22%	34%	56%

These obstacles are surmountable with careful technological and financial planning. Migrating legacy applications, for example, forces organizations to make decisions about existing applications. The vice president of technical services for a US restaurant chain says that there's often no value in migrating applications running on monolithic or legacy systems to cloud native: "You're probably better off letting them die in their own lifecycle."

Organizations should categorize those applications suitable for migration and those it makes sense to maintain on existing infrastructure. They can allow the rest, in the vice president's words, "to die a slow death."
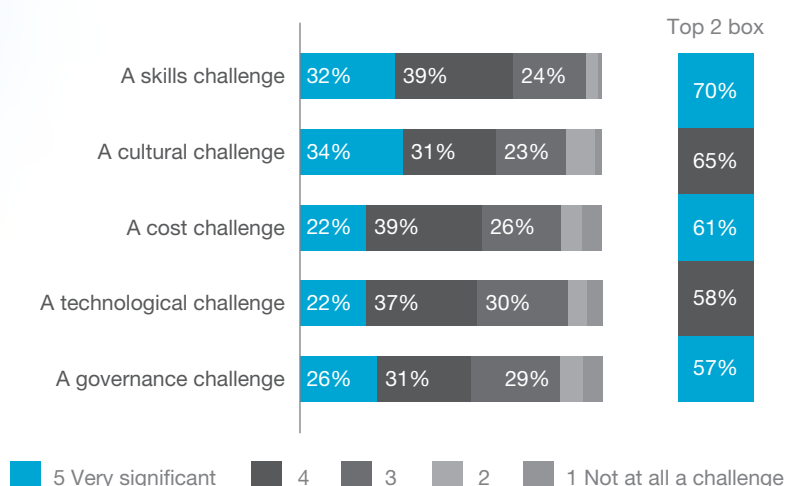
Skills deficit and culture clash

Skills shortages and cultural resistance to change will be more difficult for companies to overcome. To move from a traditional technology environment to one that is continuously delivering software, firms need to take advantage of agile practices. This means that the key transformations are of people and culture.

"Legacy is certainly a challenge, but the bigger challenge involves people and culture," says the vice president of the restaurant chain. "Moving to cloud native requires organizations to change the mindset of the application development community and how they develop applications today." Additionally, agile development demands a change of mindset from business executives and business leaders, who need to invest more time in providing feedback and developing new funding models.

The survey respondents agree. When asked to compare five types of challenges—skills, culture, cost, technology, and governance—skills, cited by 70% of executives, emerges as the most significant. Cultural issues follow at 65%, with cost and technology accorded less prominence.

Figure 10 | Cloud-native challenges

‘ If you're an experienced executive with a large portfolio of applications across the globe, figuring out where to begin can be overwhelming. My advice is, start with something that you can really get behind, showcase, and talk about, and build the momentum organically from there. ’

Abby Kearns
executive director, Cloud Foundry Foundation

A disconnect emerges in relation to skills: less than one-quarter of respondents (23%) seek external support when implementing PaaS. PaaS is a significant upfront investment when shifting to a cloud-native environment, and it demands specialized skills, skills that the survey suggests are in short supply.

The vice president of the restaurant chain says that companies in his industry do have people with the right experience and talent to support cloud-native development, but they are few in number.

"As you move toward a cloud-native architecture, the application development community needs to factor in more of the service qualities within the application around performance, scalability, and location transparency," he explains. "Those qualities aren't necessarily inherent in the mindset of application developers today."

Fiserv's Brian Sondergaard has not found the shift to cloud native to be straightforward, and gives cultural resistance as the main reason. "Our company has been around for a long time," he says. "We have very strong, mature operational practices that have been tried and trusted over a number of years. Now, we're going in and changing something that is a fundamental, core capability of the company, relied upon to avoid risk and maximize quality. That's very uncomfortable. The way we're changing it is completely unintuitive to most of the people who have spent their lives in that space."

Moving to cloud native requires some staff to "un-learn" monolithic-era concepts and learn new fundamentals—a very tall order, especially in older enterprises. Mike Houston, senior manager of information services with Altria, a US tobacco company (and parent of Philip Morris), found training its IT staff internally for the new environment extremely challenging. "Some just took to it and became experts in a short period of time, without much investment in training. Others continue to go through the training, and it's a difficult transition. This is especially the case with people who've worked lower in the stack, the hardware guys and network guys."

'When we created the digital labs, I put my foot down and said all application development will be done on PaaS, mainly because of the advantages it offers in managing application scalability.'
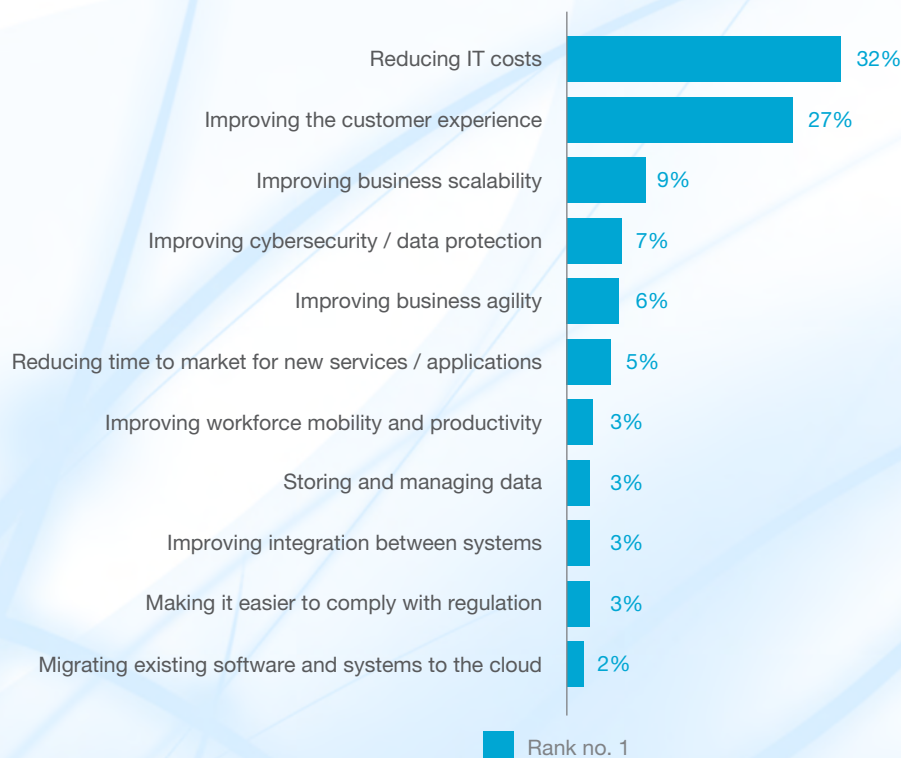
Alex Lorke
IT portfolio director, Royal Mail

Not just the developers

Changing mindsets within IT is challenging, but the survey shows that convincing skeptics elsewhere in the business will be just as difficult. When asked which of several objectives their IT function should prioritize over the next two years, business managers in the survey (including many in the C-suite) put reducing IT costs at the top of the list. Improving the customer experience is also deemed important, but strategic goals such as increasing the organization's agility and scalability, are low down the list.

While it is now accepted that the CIO should be a strategic partner to the business, this stark result illustrates that too many C-suites and lines of business still view IT as a cost center. CIOs have a lot to do to demonstrate the value of cloud native to the chief executive and the business.

Figure 11 | Business respondents' IT priorities for the next 1–2 years

Reducing IT costs	32%
Improving the customer experience	27%
Improving business scalability	9%
Improving cybersecurity / data protection	7%
Improving business agility	6%
Reducing time to market for new services / applications	5%
Improving workforce mobility and productivity	3%
Storing and managing data	3%
Improving integration between systems	3%
Making it easier to comply with regulation	3%
Migrating existing software and systems to the cloud	2%

Rank no. 1

Royal Mail's digital labs innovate while minimizing risk

It can be risky to develop new applications in a traditional technology environment, with weeks or months often invested in the process. For the UK's Royal Mail, service failures can invite widespread public criticism or even regulatory sanctions.

The speed of development in a cloud-native environment greatly reduces the risk of failure, and about a year ago, Royal Mail's CIO Catherine Doran approved the creation of autonomous digital labs to pave the organization's way to use a cloud-native environment.

It is not easy, however, to convince senior management of the benefits of this sort of investment, and Alex Lorke, the IT portfolio director, says this has been challenging: "In the first year, we had to build a new operating model alongside the technical developments to allow us to fully exploit the flexibility and speed offered by the technical capabilities. We had to demonstrate how we could evolve our control processes without putting the organization at risk."

This meant convincing senior management that developing a new application in that environment risks only the application, and nothing more.

"We were able to demonstrate that PaaS is proven for enterprise use, secure and scalable on demand," explains Lorke. "This allows us to work much more flexibly with the business in trialing whether a new service can succeed or fail in the market."

Approaching it in this way allowed Royal Mail to comfortably factor in some degree of application failure. "We assumed that we're probably going to withdraw some applications and products from the market," says Lorke. "And it probably won't have a significant commercial effect on us as we have little stranded IT investment."
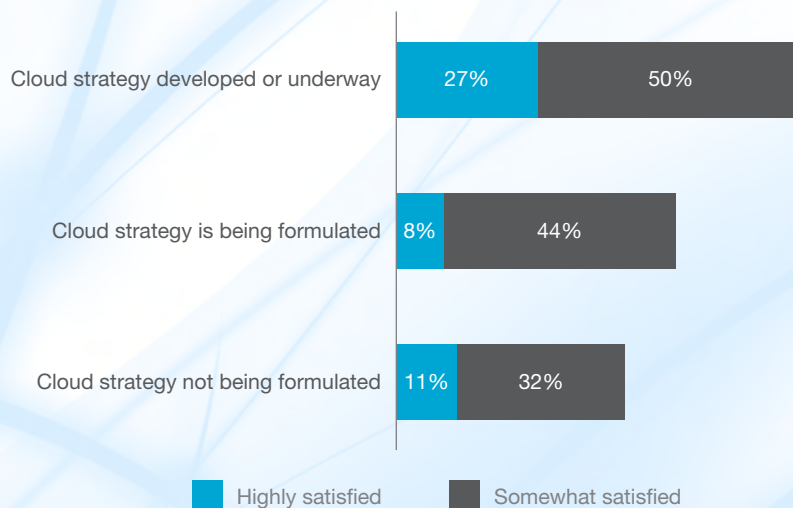
Section 3:
Going native

A clear roadmap to the cloud—including the move to cloud-native application development—can dramatically improve the reputation across the business of IT and the CIO by extension.

More than three-quarters of business (non-IT) respondents in companies with a fully developed cloud strategy express satisfaction with the performance of their IT functions. This pertains in particular to IT's ability to support the design, development, and deployment of new or improved applications.

Figure 12 | Business respondents' satisfaction with the IT function

	Highly satisfied	Somewhat satisfied
Cloud strategy developed or underway	27%	50%
Cloud strategy is being formulated	8%	44%
Cloud strategy not being formulated	11%	32%

Highly satisfied   Somewhat satisfied

'Cloud native has changed the nature of our relationship with the business. We're now involved in every conversation from idea forward. When the business is thinking about an opportunity, we are there at the beginning. Rapid delivery changes the relationship.'

Mike Houston
senior manager, information services, Altria

> ' Our Pay with Points API does more than deliver new redemption options to our customers. It also engages them through the loyalty program, making it much more likely they choose that Citi card the next time they make a purchase. We've also driven tremendous efficiency with it. Between the first partner we launched with the API and the most recent one, we've achieved an eight-fold improvement in time to market. '
>
> **Vincent Vainius**
> head of open banking product management, Citi FinTech

Agile development is central to a clear cloud strategy. Most importantly, a commitment to agile enables firms to use cloud to drive top-line business growth rather than just IT cost reduction. Business respondents from organizations that identify as agile rate their firms as ahead of their rivals in several performance metrics, Particularly time taken to deploy new technologies, customer satisfaction, and business model innovation. Most importantly, it extends to financial results.
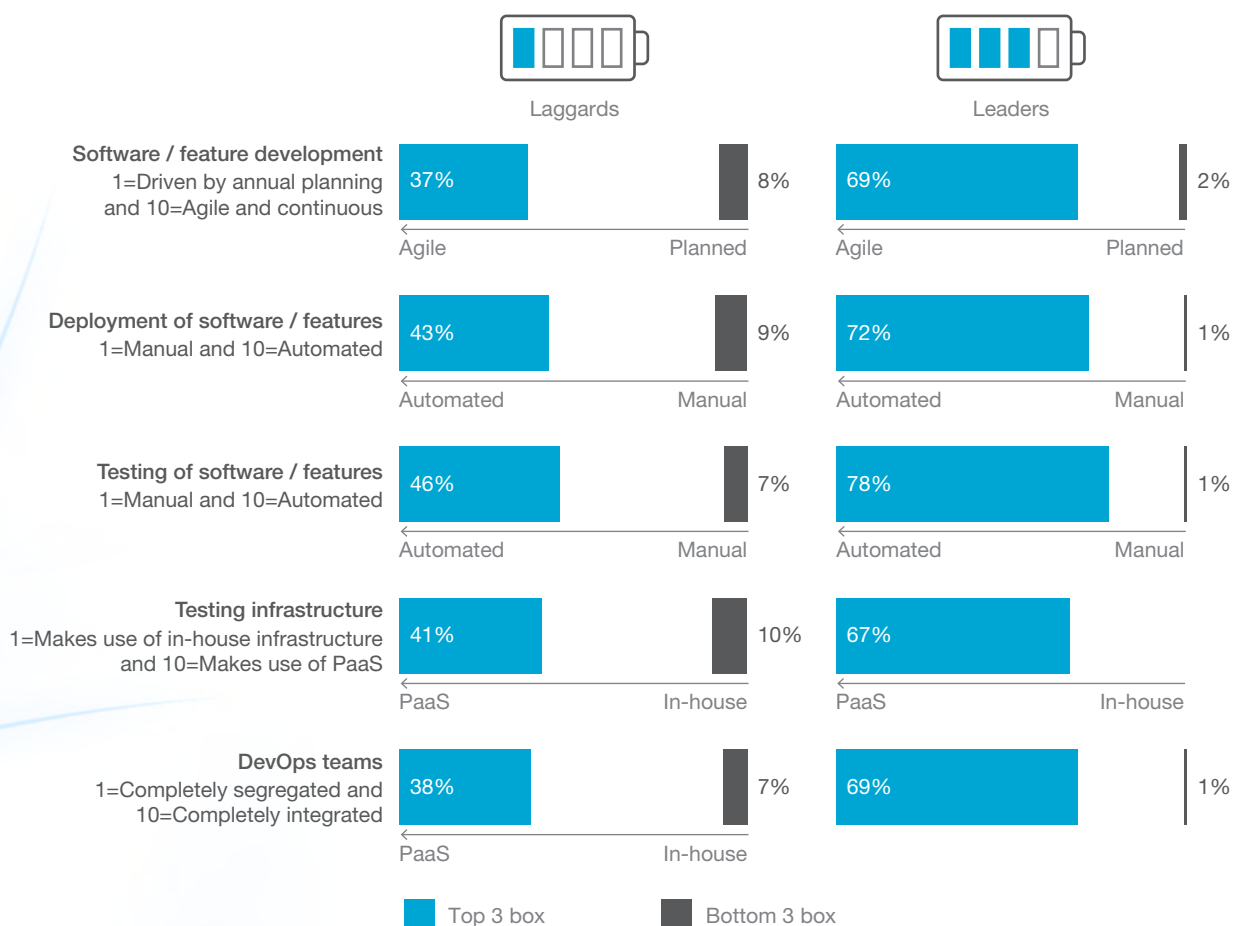
CIOs at these organizations have therefore had some success at bringing about the changes needed to become cloud native. Our survey's cloud-native leaders can help us to understand how they have done this.

Strategic thinking

The leaders have an altogether different, more urgent attitude toward the need to shift to a new application environment. About eight in ten leaders state that entering new markets, improving the customer experience, and improving business scalability are the top strategic challenges faced by their firms today. Nearly nine in ten say the same about managing cyber security risk, which shows its level of importance on the corporate agenda.

Laggards also recognize the need to address these challenges, but they display considerably less urgency than the leaders. For the laggard group, cost reduction is accorded as much attention as the growth-oriented objectives of scalability, customer experience, new markets, and others.

A similar gap can be seen in the groups' views of their IT priorities. Leader-group executives are much more emphatic than the others about the importance of improving the customer experience, business agility and scalability, interoperability of systems, workforce mobility, and improving cyber and data security. All of these motivations underpin their early adoption of a cloud-native approach to application development.

Figure 13 | The top strategic challenges of cloud-native leaders and laggards

Laggards   Leaders

Software / feature development
1=Driven by annual planning
and 10=Agile and continuous

| 37% | | 8% | | 69% | | 2% |
Agile   Planned   Agile   Planned

Deployment of software / features
1=Manual and 10=Automated

| 43% | | 9% | | 72% | | 1% |
Automated   Manual   Automated   Manual

Testing of software / features
1=Manual and 10=Automated

| 46% | | 7% | | 78% | | 1% |
Automated   Manual   Automated   Manual

Testing infrastructure
1=Makes use of in-house infrastructure
and 10=Makes use of PaaS

| 41% | | 10% | | 67% | |
PaaS   In-house   PaaS   In-house

DevOps teams
1=Completely segregated and
10=Completely integrated

| 38% | | 7% | | 69% | | 1% |
PaaS   In-house

■ Top 3 box   ■ Bottom 3 box

Collaborative thinking

The new business models and new routes to market on the agendas of cloud-native leaders are all about experimentation. The business needs a safe way to develop new products or services, to test their adoption and adapt what they learn from it. Cloud-native development strategies support this approach from a technological standpoint.

In the digital era, the ability to develop new ideas for products and services hinges on the breadth and depth of collaboration with external partners, whether organizations or individuals. The survey respondents identify this as one of the key motivations for their cloud-native strategies, along with improving agility and scalability.

APIs used within a cloud-native approach can take this mode of collaboration to higher levels. Citi FinTech has launched several APIs in the past two years. According to Vincent Vainius, its head of open banking product management, their future development figures prominently in the bank's technology and business strategy: "We will press harder to drive more partnerships with our APIs, to be more open with them and improve access to them, and to cover more areas of our bank with them…This will help us to build a much larger portion of our business around strategic partnerships and integration."

> ' You have to be doing DevOps and continuous delivery in order to be able to do microservices. But that shouldn't be the goal; the goal should be delivering business agility and enabling resiliency. It's ultimately about delivering business value through software. '
>
> **Matt Stine**
> principal architect, Pivotal

When it comes to application development itself, companies making the shift to cloud native emphasize how this environment is making more effective collaboration possible. Alex Lorke explains how cloud native has made collaborative working with Royal Mail's partners substantially easier: "Managing appropriate security perimeters is essential for the Royal Mail estate and protecting access to the core is an undeniable necessity. For entirely cloud-based digital apps, we are able to drive a different approach to managing access and risk, allowing us to onboard partners within a day."

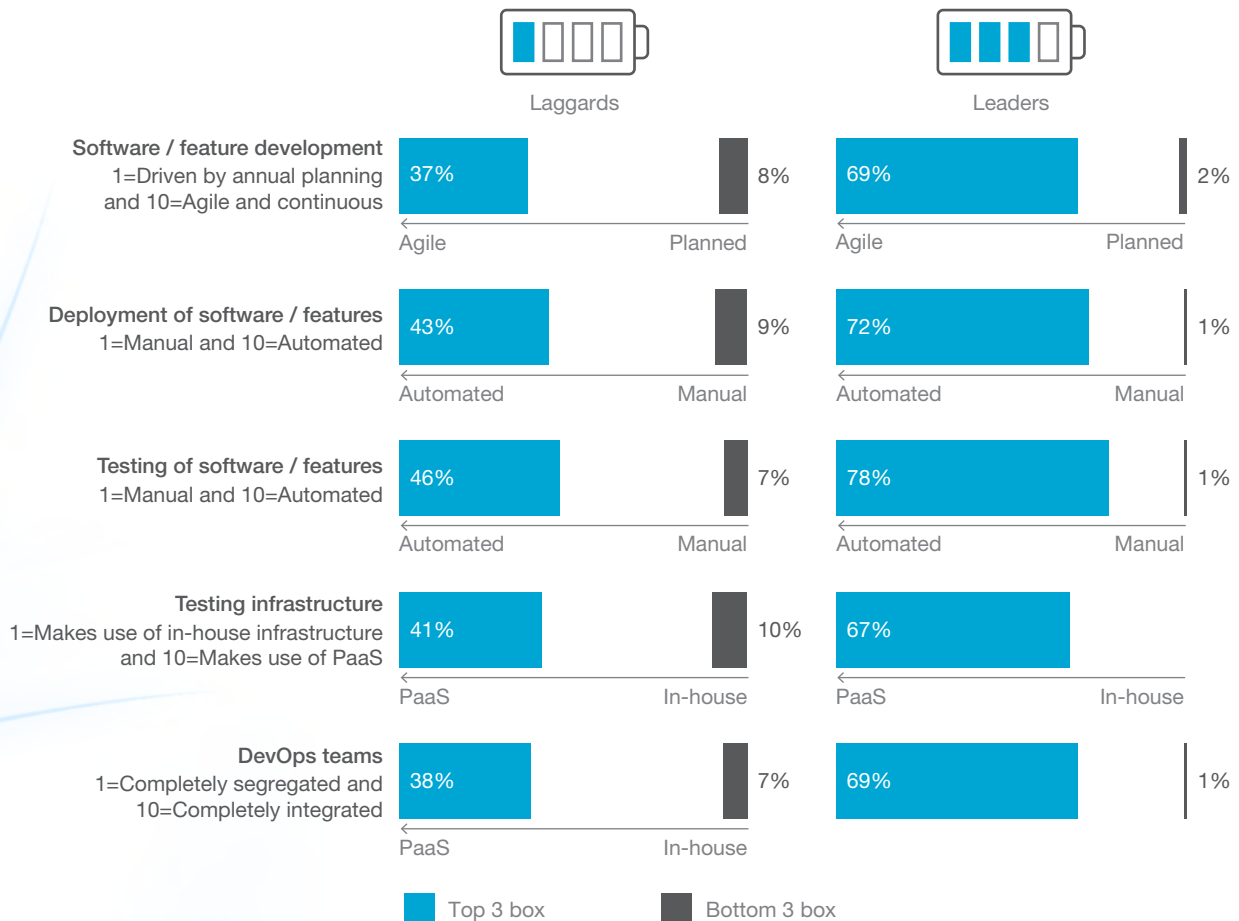## Agile, automated, integrated, and fearless

Collaborative working is inherent to a DevOps culture, and cloud-native leaders think of their application development approaches as agile, automated, and integrated.

Seven out of ten leaders describe their DevOps teams as integrated—a substantially higher number than in the laggard group, where siloes appear to be the norm. The same proportion of leaders describes their software development as agile and continuous, compared with less than four in ten laggards. Likewise, deployment and testing of software is much more likely to be automated among the leaders, and the testing infrastructure is more often PaaS-based than on-premises.

Such attributes are not simply adopted by executive decree. Cloud-native leaders have benefitted from strong CIO leadership, which has laid the groundwork for an eventual shift to a new development environment.

Buying into a cloud-native approach also means accepting a higher tolerance of failure. This is because features such as microservices and containerization ensure that application failures can be easily contained.

According to Matt Stine, cloud pioneers even encourage failure. "Instead of trying to prevent mistakes, they optimize for the ability to respond, around a metric of mean time to recovery," he says. "If we can recover from anything very quickly, then it doesn't really matter if we fail." Responding faster, in other words, helps to build competitive advantage.

Figure 14 | Characteristics of cloud-native leaders and laggards

	Laggards	Leaders
Software / feature development 1=Driven by annual planning and 10=Agile and continuous	37% / 8% — Agile ← Planned	69% / 2% — Agile ← Planned
Deployment of software / features 1=Manual and 10=Automated	43% / 9% — Automated ← Manual	72% / 1% — Automated ← Manual
Testing of software / features 1=Manual and 10=Automated	46% / 7% — Automated ← Manual	78% / 1% — Automated ← Manual
Testing infrastructure 1=Makes use of in-house infrastructure and 10=Makes use of PaaS	41% / 10% — PaaS ← In-house	67% — PaaS ← In-house
DevOps teams 1=Completely segregated and 10=Completely integrated	38% / 7% — PaaS ← In-house	69% / 1% — PaaS ← In-house

■ Top 3 box   ■ Bottom 3 box

Recommendations

The shift to cloud-native development demands a transformation in people and process as well as technology. How can CIOs define a roadmap that turns their organizations into cloud-native leaders?

1

Assess the application portfolio and identify priorities for cloud-native development.

Because the cloud-native approach demands significant upfront investment in platforms, people and skills, it is rarely the best way to achieve short-term, bottom-line cost reduction. Few enterprises will find there is a business case for migrating all their existing applications to cloud-native architectures.

CIOs need to evaluate which of their existing applications will benefit most from being rewritten as cloud native; but also which business initiatives and strategic priorities justify the investment of creating net new cloud-native applications.

Cloud native brings the greatest benefits when building new applications or services that drive competitive differentiation and top-line revenue growth. It makes sense where business velocity and resilience matter most: When you need to move changes into production rapidly, to survive failures and ensure your apps stay available in production. These will often be web, mobile, IoT or big data apps. They will usually co-exist with legacy and commercial-off-the-shelf applications in a range of environments, and SaaS, as part of a hybrid, multi-cloud strategy.

2

Build credibility with the CEO and line of business leaders by demonstrating a cloud roadmap and ability to deliver growth.

Before they can deliver a cloud-native transformation, CIOs must justify the investment that transformation demands. This means selling the benefits of agile development and continuous delivery to the business.

CIOs must challenge perceptions of the IT function as a cost center, and reposition their teams as innovation partners for the business, rather than simply custodians of existing systems. They should offer a compelling vision for the transition to digital business, in which technology underpins the enterprise's ability to innovate, to attract and retain customers, and to evolve ahead of the competition. The CIO must demonstrate an ability to deliver growth, scale, and reduced time to market for new services to convince their CEOs of the value IT brings.

3

Start small, and then scale up to develop a skilled team.

Teaching thousands of developers new cloud-native skills at once introduces too much change and risk. A more feasible starting point is a single program, involving one small team in a contained area, that allows the value of these new methods to be proven in a relatively low-risk manner. CIOs should identify those members of their teams who are change agents and future leaders to drive these early programs.

Skills learned from these pilot projects can then be fed into further initiatives on a more ambitious scale. The early pioneers can be leveraged as trainers, mentors, or evangelists when new team members take their first steps in agile development. This delivers a gradual, sustainable increase in the in-house skills base. Recruiting experienced talent and working with external vendors is also essential to incubating new skills, but will only be effective where enterprise processes are adapted to enable them to work optimally.

‘ One of the biggest mistakes is to initiate a pilot project just to make sure there is a check mark saying 'yes we are doing cloud native.'

The most successful organizations are those that test, learn, and apply those learnings on an industrial scale. ,

Vikrant Karnik,
cloud and cybersecurity financial services leader, Capgemini

4

Adapt the IT operating model to support both business agility and stability.

DevOps is the essential enabler of cloud-native development. While shifting teams towards DevOps methods, CIOs also need to maintain a sustainable IT operation—to innovate while keeping the lights on. Organization structures must evolve to support both the established and the new ways of working.

DevOps is both a cultural shift, and a technology movement. The cultural changes that DevOps brings include the removal of barriers between organizational units to enable collaborative discussions within teams:

- Ops must be in Dev discussions
- Dev must be in Ops discussions
- Ops must give Dev access to systems on demand
- Dev and Ops must work together on automating the release of applications
- Dev's responsibility does not end when the app is developed, but only when it is in production
- Both Dev and Ops must avoid finger-pointing when difficulties arise.

DevOps is underpinned by technology: specifically the combination of agile tools, automated testing, and the automated provisioning of infrastructure and middleware, typically using a Cloud Management Platform (CMP) and Application Release Automation (ARA):

- The CMP accelerates Ops to the speed of Dev. It enables the design and operation of a self-service portal for IT services, and the automated provisioning of infrastructure and middleware.
- In ARA, tools, scripts and products automatically install and correctly configure a given version of an application in a target environment, ready for use.

The gradual shift from waterfall development to DevOps does not remove the need to document and test in a repeatable process with strong governance. Key safeguards must remain in place without slowing the process.

5

Be pragmatic in selecting technologies: Lock-in risks and integration challenges are not insurmountable.

If you are an enterprise with the appetite to build engineering expertise on the scale of Netflix or Google, and you need to use special features not available in an off-the-shelf Platform-as-a-Service, you could consider building a custom PaaS with open-source components. Otherwise we recommend you use an off-the-shelf PaaS: Either already pre-packaged (such as a Cloud Foundry or public cloud PaaS), or a combination of containers and container orchestrator (Containers-as-a-Service).

No technology is entirely free from lock-in. Selection of a PaaS platform should be approached in a way similar to outsourcing a contract, where the likely cost and complexity of leaving must be factored into the purchasing decision. Complete portability may not always be practical, or justifiable in cost terms, but containerization and open source offer the flexibility to build applications in a hybrid model where they exist seamlessly in different environments.

'Valid concerns about lock-in and integration challenges are not reasons to resist the move to cloud native if there is a business case for continuous delivery. They are factors to be managed as with any other technology.'

Franck Greverie,
cloud and cybersecurity group leader,
Capgemini

'It's not about whether you currently need to deploy new code several times a day, like Netflix. The question is: What if you had to? If the business needed that type of velocity, could you deliver it?

With business dynamics evolving so rapidly, CIOs need to invest in the capability to give the business competitive edge. '

Franck Greverie,
Cloud & CyberSecurity group leader,
Capgemini

6

Incubate a culture of innovation, collaboration, testing and learning.

To go cloud native, CIOs must lead their teams on a path of transformation that will bring new ways of working and cultural change.

Developers who were previously insulated from the business will be more exposed to the issues of customer experience and the challenges that business leaders face in ideating and launching products and services. They must learn to be business thinkers, articulating value propositions, and demonstrating their revenue generating potential, as well as managing project costs and timelines as before. Testing and learning will now apply not only to applications and functionality, but to new business ideas as well, with occasional failures in both as a necessary cost of experimentation.

The business value of the new agile approach needs to be measured by KPIs agreed upon jointly with business stakeholders. Corporate functions, with their often inflexible processes, must adapt to become innovation enablers. Examples include rapid and automated procurement, financing on an OpEx basis, on-demand training and skills transfer initiatives, and new platforms for communication and knowledge capture. Town hall meetings, centers of excellence, focus groups, happy hours, internal award schemes, and innovation labs: All can help create an open, collaborative culture that fosters innovation by encouraging team members to learn from each other's successes.

Fiserv starts small

For young companies, adopting a cloud-native approach is mainly a matter of migrating a few applications and building all-new ones in the new environment.

Older companies typically face a much greater challenge. Thirty-three-year-old Fiserv's approach, according to Brian Sondergaard, was to begin the shift very gradually.

"What we did in most cases," he says, "is adapt existing products that, since they're in the digital banking space, are not all that old—anywhere from five to eight or nine years. Thus the architectures weren't completely different to the patterns used in a cloud-native world. That was our first step, and then we began slowly to build new applications entirely in the cloud-native and microservices pattern."

Other applications have been left in place in the monolithic environment. "We have older products such as big overnight batch engines for a bank," says Sondergaard. "There's no reason in the world to re-platform some of those kinds of things. Our emphasis is on the ones that are under the greatest pressure in terms of ensuring agility and faster time to market."

This gradual approach allowed the CIO and IT management to build confidence within their team and elsewhere in the business. "The idea has been to encourage a culture of learning in the team," says Sondergaard. "Then get those new capabilities in front of clients and start getting feedback. Now, clients' confidence is growing, our partners' confidence is growing, and we're seeing that the new model is working."

That, he says, allows momentum to build and to gradually scale up the cloud-native approach so that "the practice becomes self-perpetuating."

Conclusion

Software is becoming ever more integral to what companies sell and how they sell it. Cloud-native applications are the key to developing high quality software continuously, and gaining advantage through digital business. But CIOs will need all their leadership skills to pull the IT team and the broader business into the cloud-native era.

Not only are old, monolithic-era habits ingrained in their development teams, but many of their business peers do not seem to trust the CIO and IT to deliver much more than cost reduction.

Cloud native presents a perfect opportunity for CIOs to change attitudes and demonstrate the innovation power that IT can give to the business. But articulating the case will not be easy: the benefits of microservices and DevOps, for example, can be lost on a chief executive, chief marketing officer, or line-of-business manager.

Gartner's 2017 CEO Survey finds that "growth is the top business priority for CEOs," and that "CIOs should be particularly attentive to a triangular relationship forming in the minds of CEOs on technology, product improvement and growth." CIOs should show how growth can be delivered by digital business, which means high-velocity, low-risk application development and highly agile, innovative, and scalable business operations.[1]

CIOs must also argue that to make the connection a reality, the business lines must be ready to capitalize on the speed and flexibility cloud native gives them.

1 Gartner, Inc: '2017 CEO Survey: CIOs Must Scale Up Digital Business', Mark Raskino, 31 March 2017

Companies making the shift to cloud native may even face the novel situation of the business having to catch up with IT.

Some CIOs will find that their organizations need external help to kick-start the shift to cloud native. This is because internal skills deficits, as our research shows, are a serious constraint on progress. Collaborative thinking, as we argue here, is part of a cloud-native mindset, and it applies as much to the CIO's own openness to ideas from outside as to that of the business as a whole. Once momentum builds, the CIO should find it easier to demonstrate the business impact of the shift to cloud native.

CIOs' career prospects may hinge on their ability to achieve this. As more organizations build their business models around services that are supported by software, those that do not embrace cloud native will ultimately fall behind. And if that comes to pass, no executive's job security can be assured.

> ❛Cloud native presents a perfect opportunity for CIOs to change attitudes and demonstrate the innovation power that IT can give to the business.❜

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