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Cloud 2030

Capturing Poland's potential for accelerated digital growth

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McKinsey's Poland office opened its doors more than a quarter of a century ago. Since then, we have become the largest strategic consulting firm in Poland, employing more than 1,500 people. We advise Poland's biggest companies and public institutions and have played a part in the transformation of key enterprises, contributing to the development of companies that today are leaders in banking and insurance, consumer goods, energy, oil, telecommunications, mining, and many other sectors. In total, we have carried out around 1,000 projects for our Polish clients. In 2010, we opened our Knowledge Center in Wrocław, where we currently employ around 250 top analysts. A year later, we established a Shared Services Center in Poznań, where more than 1,000 people now work. A McKinsey Digital Lab has operated in the Warsaw Office since 2017. Our developers, experts in big data, and business consultants support companies undergoing comprehensive digital transformation and perform advanced data analytics. For more information, visit www.mckinsey.pl.

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Preface

The COVID-19 pandemic has been a tipping point for digital transformations. It has shown that organizations—and, indeed, entire economies—need to be ready for unpredictable circumstances and adapt their ways of working accordingly. Cloud computing has been an important enabler facilitating and accelerating this transformation, with a track record of helping disrupt and reshape modern economies. No industry is an exception here: From retail and transportation to food services and banking, cloud is causing disruption everywhere and will remain a key enabler of further innovation.

Accelerating the adoption of cloud computing can also unlock innovation and help Poland with its Digital Challenger agenda and support its adaptation to a more digital, post-COVID next normal. As indicated in this report, by 2030, the widespread adoption of cloud technology across Polish companies and public institutions could generate value that's equivalent to 4 percent of Poland's annual GDP. Our analysis finds that Poland has strong foundations in terms of its scale, momentum, and digital starting point. These form a solid platform on which organizations can capture the potential of cloud technology. But with technological changes coming thick and fast, the time to act and realize the potential of cloud computing is now.

In this report, we lay out the facts concerning the current state of technology, the potential that the cloud could unlock for the economy, Poland's strong starting point, and the perceived and real barriers that need to be overcome. We also discuss the implications for policymakers, businesses, and individuals.

The ideas we present here build on those outlined in previous McKinsey publications, including the *Digital Challengers* report series, the 2021 Global Digital Sentiment Survey, and the article "Cloud's trillion-dollar prize is up for grabs." We would like to take this opportunity to thank the authors of these publications, in particular William Forrest, Klemens Hjartar, Raghav Sharma, and Lars Vinter for their expertise, inspiration, and guidance.

The work on this report was led by: Solveigh Hieronimus, senior partner; Tomasz Marciniak, managing partner in Poland; Jurica Novak, McKinsey's managing partner in Central Europe; Borys Pastusiak, local partner; Marcin Purta, partner; and Oskar Sokoliński, partner. The work was supported by a team comprising consultants Piotr Dziadosz, Ewa Granosik, and Jan Mier; communications experts Joanna Iszkowska and Milena Malinowska; graphic designer Małgorzata Leśniewska; and many others. Significant contributions were made by other individuals working at McKinsey around the globe, including Anupama Agarwal, Thomas Delaet, Alexandru Filip, Rodrigo Flores, Anton Fortunatov, and Mateusz Masiowski. We also wish to thank the many area experts from the public, private, and social sectors who provided insights and source data and helped to advance our thinking. In particular, we would like to acknowledge our collaboration with Google on this research, including its contribution of analytical inputs and insights used in this report.

Executive summary

Cloud is an accelerator of transformation. It has a track record of helping disrupt and reshape modern economies. No industry is an exception here. Whether it's retail with Allegro and Booksy, transportation with Uber and Bolt, music with Spotify and Deezer, food services with Glovo and Uber Eats, or banking with Revolut and N26, disruption can be seen everywhere. And the signs are clear that cloud will be a key enabler of further innovation.

Cloud is the next paradigm shift in computing technology, following the internet in the 1990s and smartphones in the 2000s. It has two complementary value propositions that should be considered: IT modernization and the acceleration of digital innovation and pioneering. The latter stems from what we call the three freedoms of cloud: the freedom to experiment, the freedom to fail, and the freedom to be agile. Together, these freedoms open up the space needed for innovation to thrive.

Poland lags behind European leaders in both the level of cloud adoption and the rate at which adoption is progressing. The country's current level of cloud adoption is 14 times lower than that of the group of countries we call European Frontrunners and 1.5 times lower than the average for Central and Eastern Europe (CEE). Adoption is progressing at an annual rate of 23 percent, below the 25 percent rate of the European Frontrunners and the 24 percent for Europe's five largest economies.[1] Indeed, Polish policymakers and business leaders need to make a conscious effort to significantly accelerate cloud adoption if they don't want to see Poland falling further behind its peers and its competitiveness erode.[2]

Poland viewed the digital economy as the new engine of growth in the 2010s. In the 2020s, cloud technology could be a key enabler of Poland's journey to being what we call a Digital Challenger, supporting its fast adaptation to a more digital, post-COVID-19, next normal. In fact, all seven key enablers to maximizing Poland's productivity gains from digital transformation noted in this and previous McKinsey reports are connected to cloud technology. Four of those enablers, relating to soft infrastructure and innovation, directly benefit from cloud adoption, namely:

- Increase the adoption of digital tools by Poland's small, medium, and large enterprises
- Increase the adoption of digital skills and take-up of internet services by Poland's general population
- Develop, implement, and promote e-government solutions in Poland's public sector
- Foster entrepreneurship in Poland to stimulate the start-up ecosystem

The remaining three enablers are essential for increased cloud adoption:

- Leverage and grow Poland's information and communications technology (ICT) specialist labor pool
- Increase the training Polish enterprises provide to develop or upgrade the digital skills of employees
- Improve Poland's ICT regulatory environment to attract investments

According to our analysis, the widespread adoption of cloud technology by Polish companies and public institutions could generate value that is equivalent to 4 percent of Poland's annual GDP by 2030, or €27 billion. Of this, 82 percent is expected to come from new business and innovative digitization that cloud architecture has unlocked

or accelerated. The remaining 18 percent is likely to come from direct gains in regular business, including IT cost reduction, less downtime, and business automation. Future pioneering technologies facilitated by cloud architecture represent an additional, unsized source of value.

The retail, consumer packaged goods (CPG), and transportation and logistics industries are likely to gain the most from the broad adoption of cloud computing in Poland. Together, they account for 28 percent of the total impact, with a further 15 percent coming from the construction industry and the automotive and assembly industry. In retail alone, €2.7 billion can be generated from dynamic pricing, smart promotions, and inventory optimization accelerated by cloud technology, while a further €2.5 billion can be generated in CPG, for example, from manufacturing automation and the optimization of yield, energy, and throughput.

Our analysis found that Poland has a strong foundation in terms of its scale, momentum, and digital starting point. These form a solid platform on which organizations can capture the potential of cloud technology. Thus, Poland's GDP in 2019 was €500 billion, making it by far the largest economy in CEE, accounting for 36 percent of the region's GDP. Orchestrated initiatives such as the creation of cloud-solution provider Operator Chmury Krajowej (OChK) are underway to facilitate the cloud migration of Polish companies. And Poland is a leading Digital Challenger, with a solid technological infrastructure to support cloud transformation and a growing digital economy that can directly benefit from it.

To accelerate cloud adoption, Poland now needs to focus on resolving five key limiting factors: lack of awareness, regulatory ambiguity, security concerns, lack of required capabilities, and financial burden. First, companies admit to having insufficient knowledge about cloud solutions; some 42 percent still see cost reduction as the primary reason to migrate to cloud, and they are unfamiliar with the more advanced tools that could unlock the cloud's full impact.[3] Second, around one-third of Polish companies are uncertain about the location of data storage. This is particularly important in highly regulated sectors, where companies may refrain from migrating due to complex legal requirements.[4] Third, one-third of Polish companies mention security concerns regarding cloud services,[5] and 63 percent of IT providers say that security policy prevents wider cloud adoption in Poland.[6] Fourth, skills gaps exist with regard to cloud, along with a more general scarcity of talent in the area of ICT: In 2019, 44 percent of Polish enterprises reported difficulties filling ICT vacancies,[7] a gap that could grow further unless action, such as investing in more on-the-job training, is taken. Finally, companies cite the upfront investment costs of migration to the cloud as the main reason for not pursuing this strategy. Too often, they carry out little analysis of the areas of greatest impact, and instead "lift and shift" existing solutions, resulting in unoptimized transformation costs.

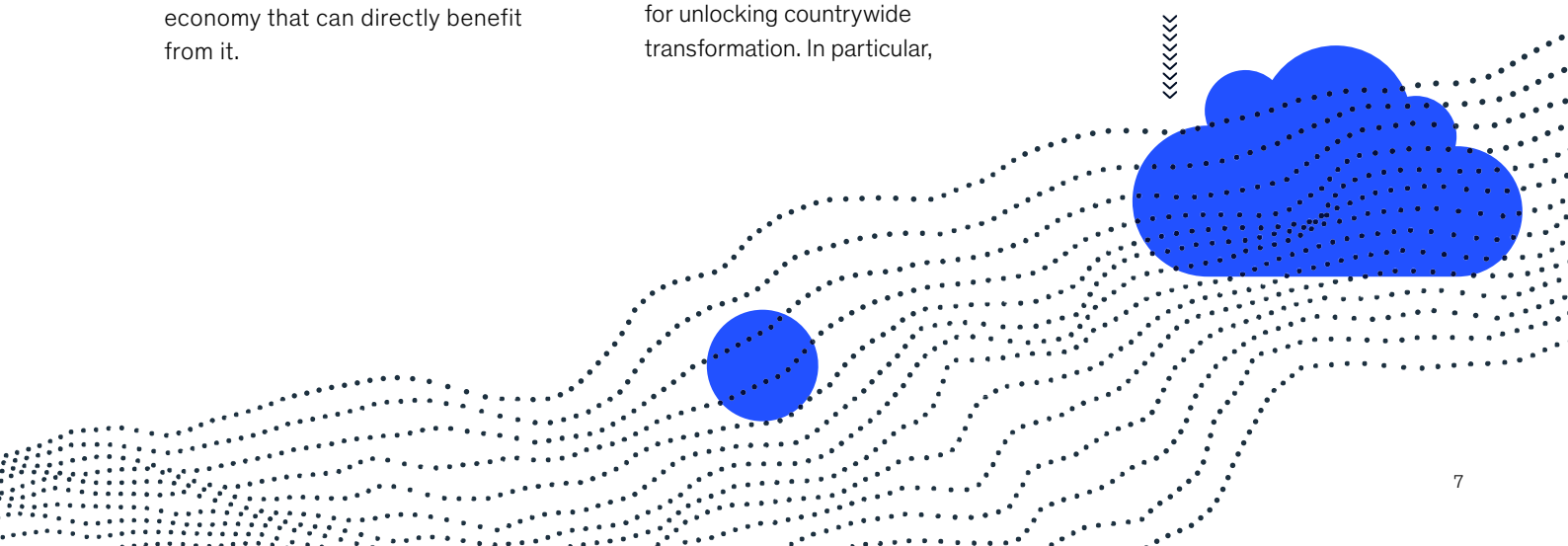
To accelerate cloud adoption in Poland, we recommend that policymakers, organizations, and individuals consider taking the following actions:

— Policymakers can commit to cloud adoption. This is fundamental for unlocking countrywide transformation. In particular, policymakers can facilitate cloud adoption (for example, by offering financing and reviewing how legislation is interpreted) and lead by example in public-sector institutions

— Organizations cannot ignore the opportunity offered by cloud transformation. They need to understand how cloud can bring them value (for example, through faster innovation and cost optimization). In response, they need to prepare a cloud strategy (including building the right capabilities) and then consistently implement that strategy

— Individuals need to acquire cloud-native technical and business skills. Such abilities will be essential in the coming decade

The COVID-19 pandemic has shown that organizations—and, indeed, entire economies—need to be ready for unpredictable circumstances and adapt their ways of working accordingly. Cloud computing has been an important enabler of this transition, making the mass shift to remote working possible, for example. We hope that this report will raise awareness about the potential of accelerating cloud adoption for the Polish economy. With technological changes coming thick and fast, the time to act and realize the potential of cloud computing is now. We believe that our analyses can help stakeholders make the right decisions—and seize the opportunity while it is still available.

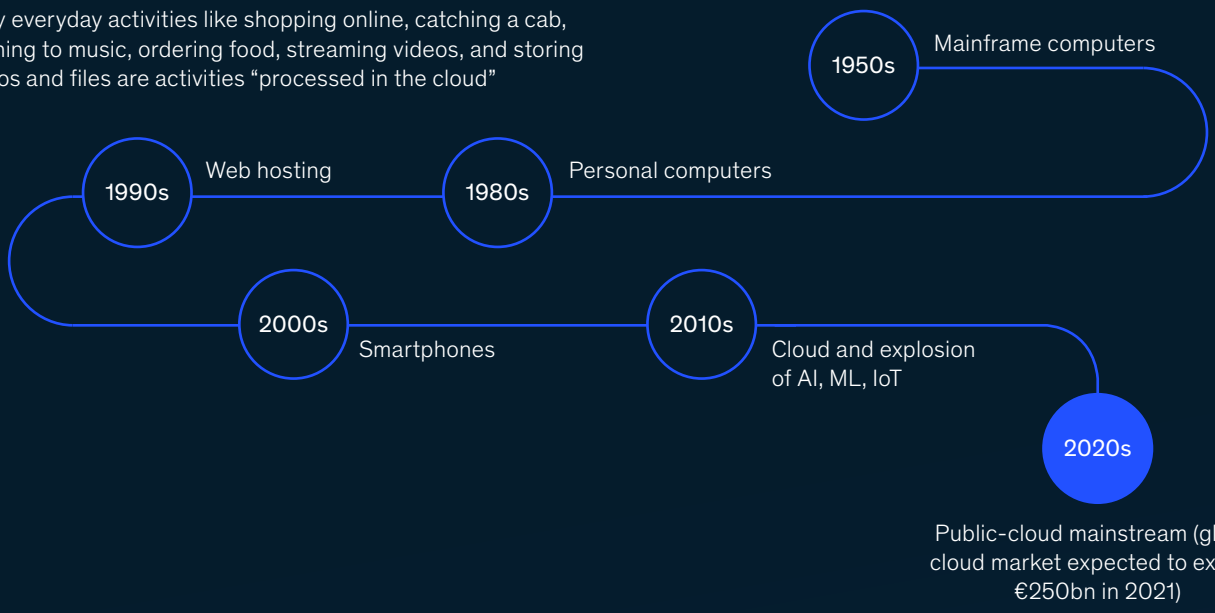


Key findings

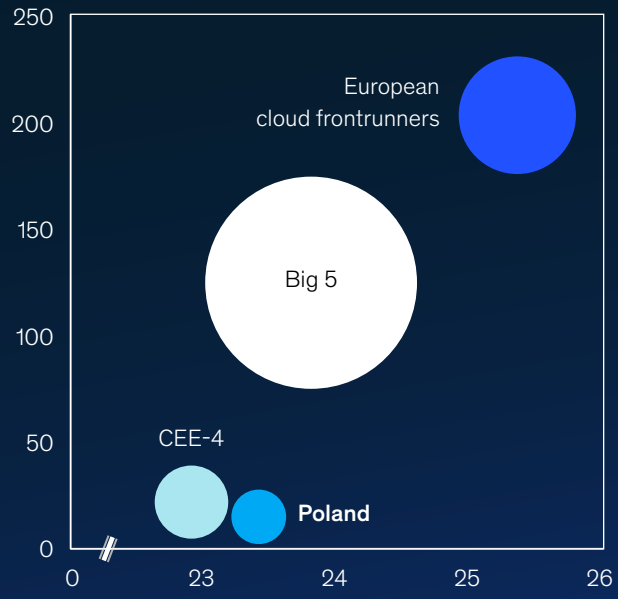
Cloud 2030

Cloud is the next paradigm shift in computing technology with a track record for helping remake economies

Many everyday activities like shopping online, catching a cab, listening to music, ordering food, streaming videos, and storing photos and files are activities "processed in the cloud"



Cloud adoption
Public-cloud vendor revenue per capita, 2020, €



Rate of change in cloud adoption
CAGR 2019–20 in public-cloud vendor revenue, %

Poland has potential to grow its cloud adoption and improve its competitivenes vis-à-vis frontrunners

50–60% year-over-year increase in cloud adoption needed for Poland to reach levels similar to those of European leaders by 2030

○ Bubble size corresponds to GDP

Widespread cloud adoption could generate value equivalent to 4% of Poland's annual GDP by 2030 (€27bn)

Rejuvenate

€5bn

IT cost optimization
Risk reduction
Core operations digitization

Innovate

€22bn

Innovation-driven growth
Accelerated product development
Hyperscalability

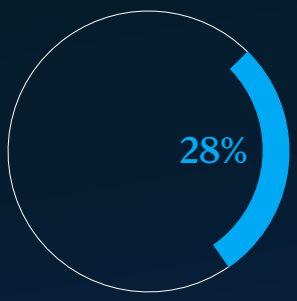
Pioneer

Additional opportunity (not measured)

Early adoption of cloud technology

Retail, CPG, and Transport & Logistics are expected to benefit most from cloud adoption, generating 28% of total impact

€27bn



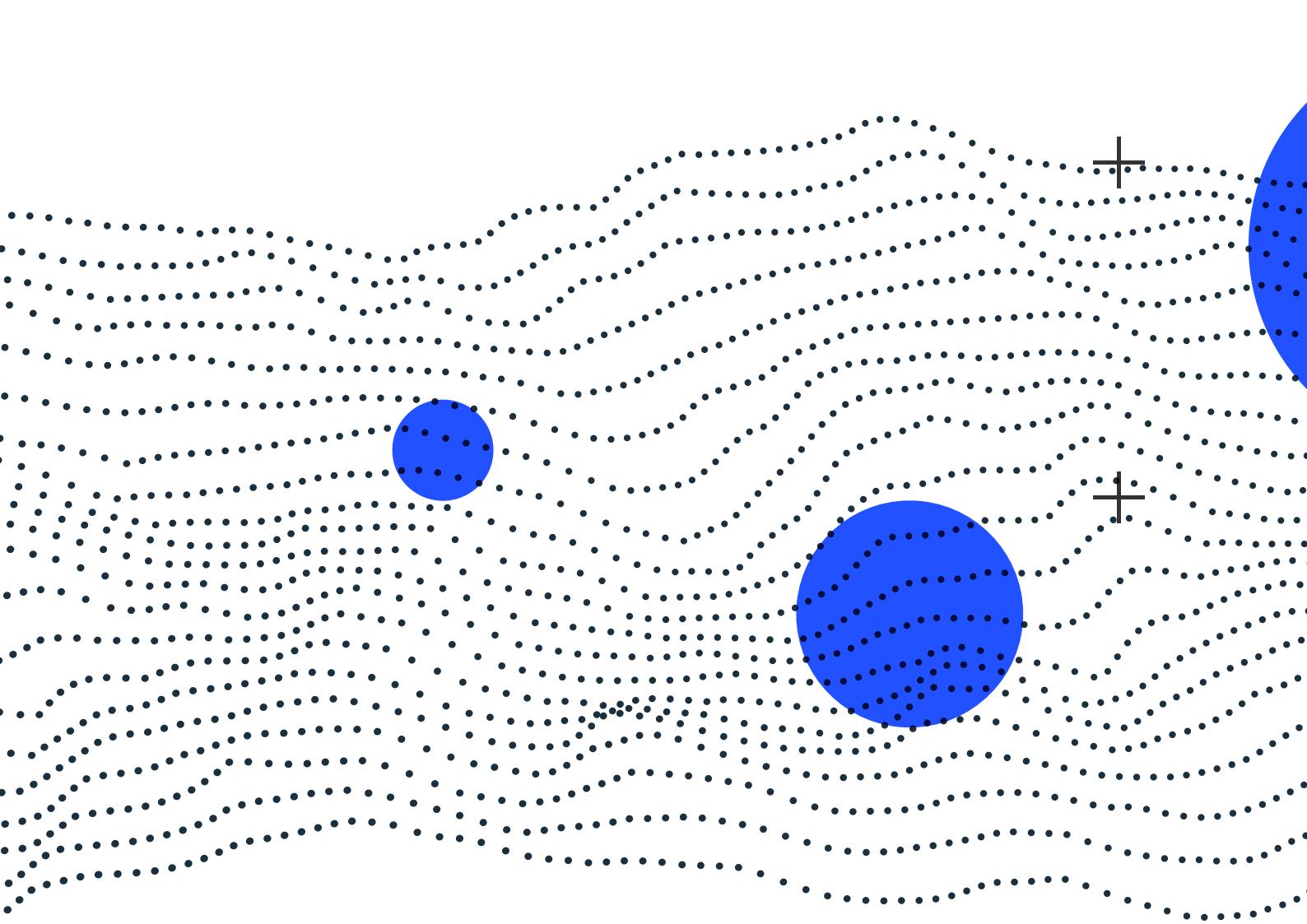
	Annual value generated from cloud by 2030, € billion	2030 sector contribution to GDP	Value generated as a percentage of sector GDP contribution
Retail	2.7	80	3.3%
Consumer Packaged Goods	2.5	56	4.4%
Transport & Logistics	2.3	58	3.9%

Poland could focus on five areas to unlock accelerated cloud adoption in Poland

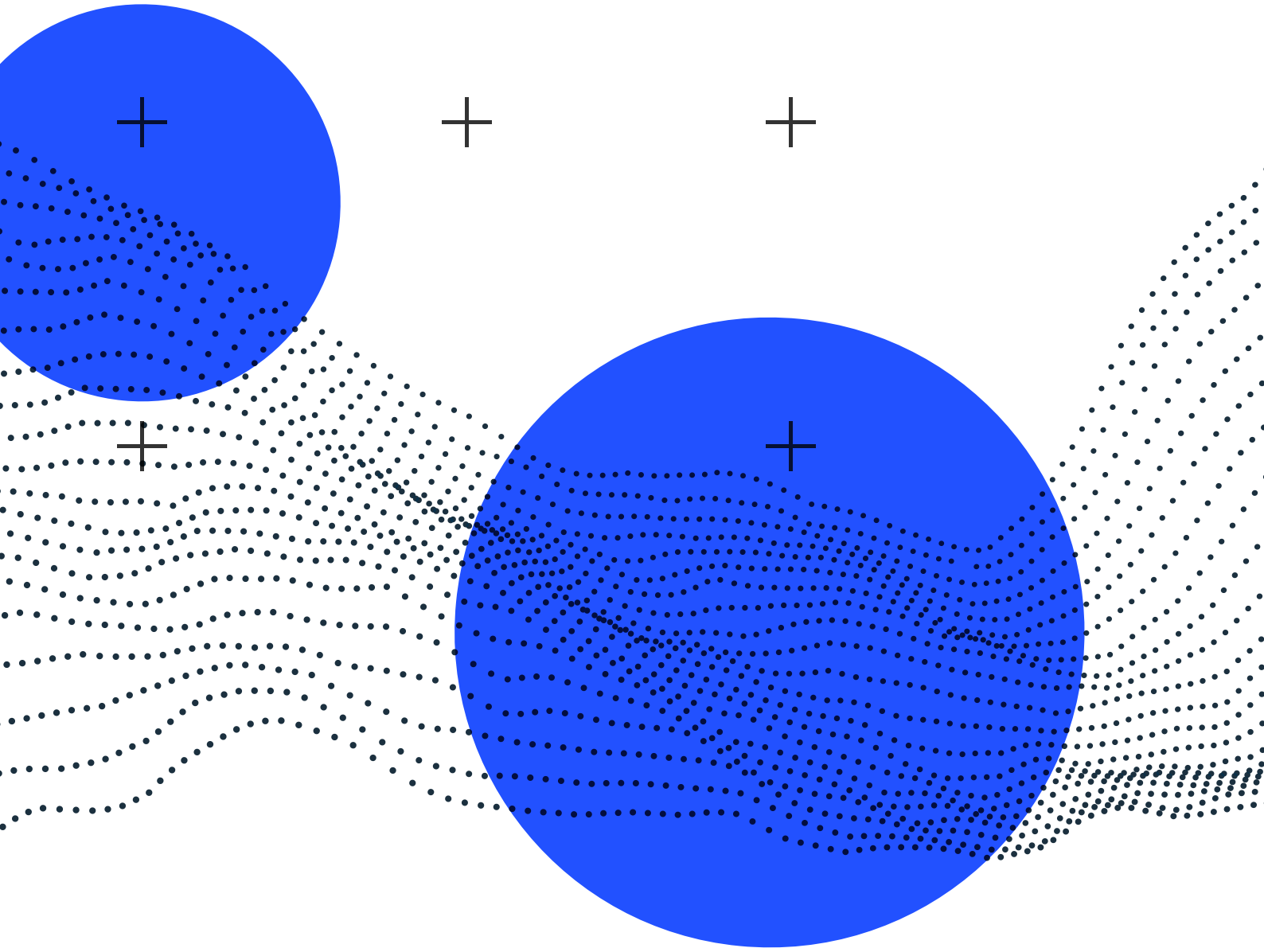
Lack of awareness | Regulatory ambiguity | Security concerns | Lack of required capabilities | Financial burden

Current factors limiting greater cloud adoption in Poland according to studies run by GUS and PMR

Sources: OECD 2015–2020; European Commission; IDC Semiannual Public Cloud Services Tracker; *Chmura Publiczna w Polsce 2019*, IDG, Oktawave; GUS; PMR



01 Global cloud development



Cloud is an accelerator of transformation. It has a track record of helping disrupt and reshape modern economies. No industry is an exception here: Whether it's retail with Allegro and Booksy, transportation with Uber and Bolt, music with Spotify and Deezer, food services with Glovo and Uber Eats, or banking with Revolut or N26, disruption can be seen everywhere. And the signs are clear that cloud will be a key enabler of further innovation.

Organizations of all sizes are capturing the benefits of cloud, especially with the COVID-19 pandemic pushing businesses and public bodies to find new ways to operate. The emergency situation has created multiple challenges: Workforces have shifted to remote work, services have been reconfigured to reflect changes in demand, and new services have been rapidly introduced to help with vaccination programs or ensure touchless interactions. Some businesses have survived the crisis thanks only to their ability to leverage the power of cloud technologies. Indeed, they now find themselves in a better position, ready to thrive in the postpandemic reality.

But these changes are just the tip of the iceberg when it comes to the potential use of cloud computing. Policymakers face an urgent issue: They need to encourage organizations to adopt cloud solutions while promoting the creation of new companies that can disrupt the status quo. Ideally, some of those new players could even become unicorns

at the global level. Polish policymakers, businesses, and individuals can help define Poland's future digital economy. The time to capture the potential of cloud technology is now.

The value proposition of cloud

Cloud has two complementary value propositions: It modernizes IT, and it accelerates digital innovation and pioneering. The first refers to its role in leveraging economies of scale and increasing operational agility by enabling companies to store, access, and process data and programs in a network of data centers rather than on a computer's hard drive. The second—perhaps more relevant for today's organizations—refers to its role as an accelerator of innovation and digital pioneering thanks to advanced tools such as artificial intelligence (AI), machine learning (ML), and the Internet of Things (IoT). In simple terms, cloud is not only a means to run databases or serve as a secure storage space. It is also the key to unlocking transformative opportunities and innovation when it comes to managing large volumes of data, making use of vast computing power from global infrastructures, and leveraging the latest digital technology.

Cloud provides its users with several layers of freedom, opening up the space that innovation needs in order to thrive: the freedom to experiment, the freedom to fail, and the freedom to be agile:

— **The freedom to experiment** is very important for innovation, as it rarely happens that the first idea leads to success. Cloud lowers the barriers to starting tests and experiments due to the lower capital commitment for each idea tried and the ability to quickly set up digital environments.

— **The freedom to fail** is relevant, for innovation flourishes when failure is embraced, accepted, and seen as an opportunity for growth. Cloud removes the organizational stigma associated with failure by reducing the pressure that comes from sunk costs and their long-term commitment. It creates the opportunity to quickly acknowledge failing ideas and step away from them before they become multiyear projects with too much inertia to close down.

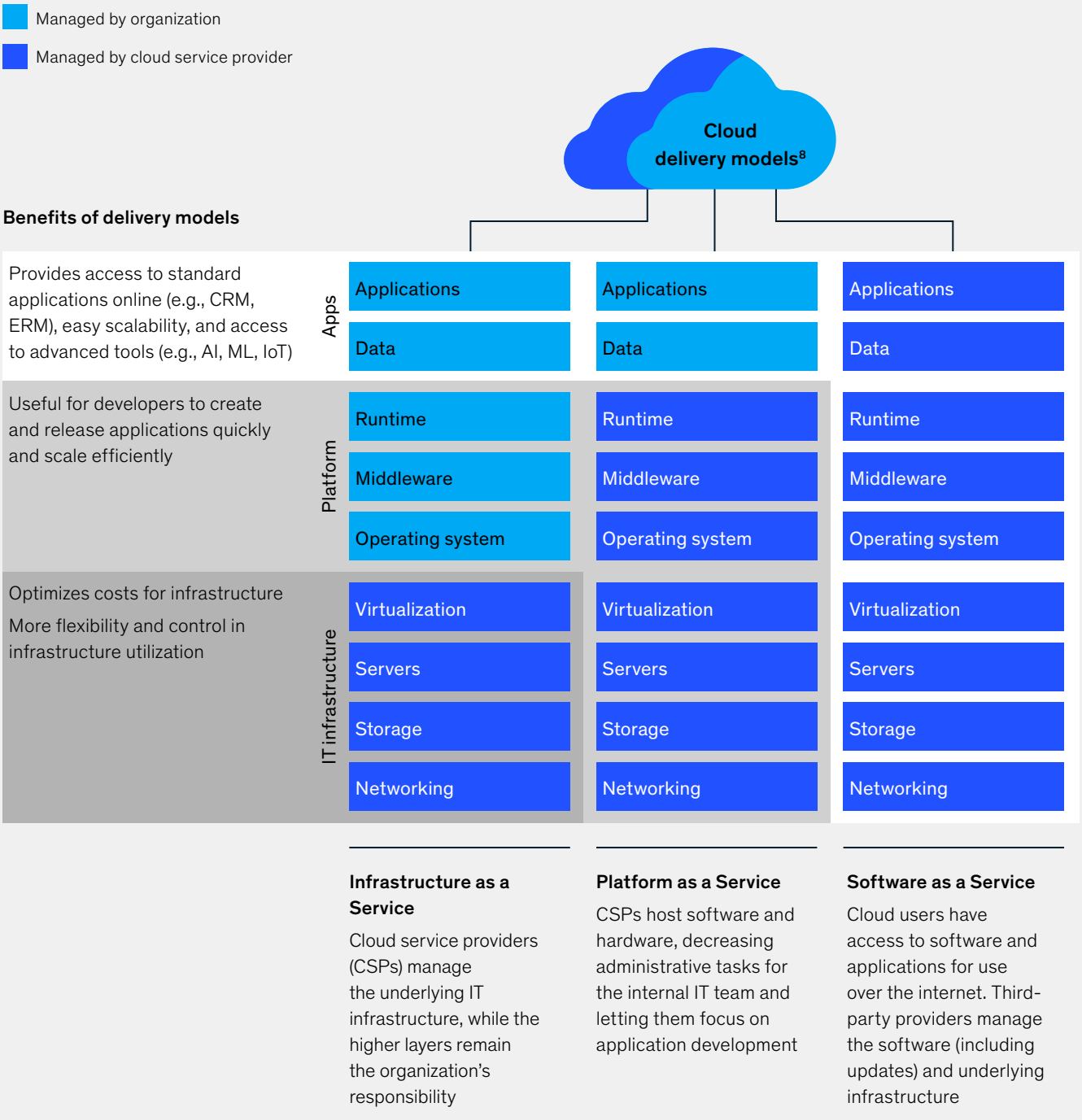
— **The freedom to be agile** applies to both SMEs (small and medium-size enterprises) and large organizations. Cloud provides the necessary tools for organizations to move faster and be more flexible during project execution, radically shortening the time to market and increasing the ROI of ideas. It does this by enabling offerings such as infrastructure as a service (or IaaS, on-demand infrastructure), platform as a service (PaaS, which can save months of configuration and planning), software as a service (SaaS, delivering ready-to-go solutions), or even business process as a service (BPaaS, removing reliance on hardware, software, and operations).

Cloud is the next paradigm shift in computing technology, following the internet in the 1990s and smartphones in the 2000s. For many users today, shopping online, catching a cab, sending emails, video chatting, streaming videos, and storing photos and files are activities "processed in the cloud." US software company Salesforce, founded in 1999, pioneered cloud-native application delivery by using the internet to provide software programs to end users. Since then, companies such as Netflix, Uber, and Airbnb, to name just a few, have leveraged cloud computing to speed up new ideas' time to market, increase organizational flexibility, and rapidly scale to global businesses.

Sidebar

Useful cloud concepts used throughout the report

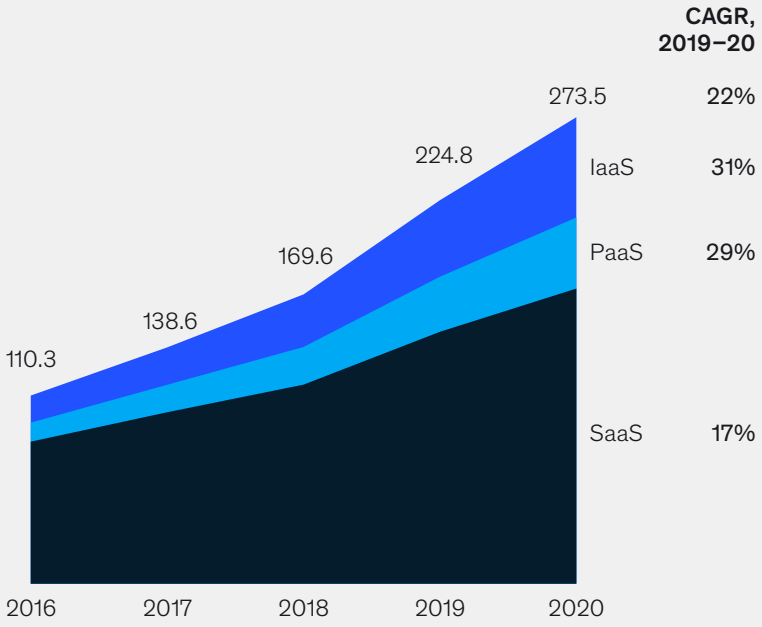
Depending on an organization's needs, three delivery models are possible for cloud-computing services. They vary by the amount of responsibility that the organization retains over its IT infrastructure, and whether or not it wants to leverage the benefits of predefined services from cloud providers.



Source: The NIST Definition of Cloud Computing, National Institute of Standards and Technology, September 2011; Cisco Global Cloud Index: Forecast and Methodology, 2016–2021

Public-cloud vendor revenue[1] per delivery model, 2016–20

€ billion total



[1] Public-cloud vendor revenue covers cloud software and cloud infrastructure (PaaS, SaaS applications and SaaS system infrastructure software, and IaaS) of incumbent players globally

Source: IDC Semiannual Public Cloud Services Tracker

SaaS is the largest market segment, growing at 17 percent per annum. However, infrastructure as a service (IaaS) and platform as a service (PaaS) have been growing faster in the past five years: IaaS at 31 percent and PaaS at 29 percent by delivery model.[9] The faster growth rate for IaaS could indicate that organizations are still not embracing the full potential that cloud offers, in that they are using it for computing and storage rather than for re-architecting applications. PaaS is driven by the increasing use of advanced solutions such as AI, analytics, and business-intelligence platforms. Driven by COVID-19, these solutions are becoming more easily available and gaining popularity among users as a key driver of innovation and competitiveness.

The trend in Poland is similar to the global trend, with SaaS products accounting for the largest share of public-cloud vendor revenue. SaaS was estimated to account for 69 percent of the public cloud market in 2020.[10]

Cloud deployment models

% of workloads in the public cloud

	Full private cloud	Hybrid	Full public cloud
Resources[1] hosted in…	In-house enterprise data centers, which are managed and supported internally but separate from already existing IT department	Across in-house data centers and public-cloud providers, managed in a unified manner	Servers provided and managed by third-party providers such as Google Cloud, AWS, or Microsoft
Pros	Uses existing infrastructure Full internal control, management, and security Customizable	Highly flexible and scalable (potential to optimize workloads between public and private) Cost effective	Easy scalability, increased automation and availability No geographical restrictions; easy to manage Cost effective
Cons	Harder to access data from remote locations High CAPEX—both upfront & maintenance Requires IT expertise Inability to scale resources on demand, resulting in slower deployment times	Simultaneous support for cloud and legacy infrastructure Communication and integration may be inefficient	Monthly pricing structure, which can result in higher OPEX costs High-quality reliable internet required
Suited for enterprises that are…	Constrained by regulations or in a region not serviced by a cloud provider	Transitioning from legacy on-premise infrastructure to public cloud Unable to go full public cloud due to data sovereignty or time-sensitive workloads	"Born in the cloud," with essential infrastructure and product/service delivery built in the public cloud

[1] Resources include data storage and computing power

With cloud computing becoming more widespread, there are new categories of the delivery models, including business process as a service (BPaaS), desktop as a service (DaaS), and AI as a service (AIaaS). In this report, we focus on the traditional models, which include these newer categories.

In addition to choosing the delivery model, organizations can also decide which environment to deploy the cloud in: private, public, or a hybrid of the two.

In 2020, the hybrid model was the most widespread globally, with 82 percent of organizations combining private and public environments to a certain extent, 17 percent opting for public cloud, and 7 percent choosing a single private deployment model. The overarching trend is for organizations to use multiple clouds rather than relying on a single CSP.[11]

The top-three global cloud service providers (CSP)—Amazon Web Services, Google Cloud Platform and Microsoft Azure—account for 50–60% percent of the global IaaS and PaaS market.[12,13]

These CSPs are also present in the SaaS market. However, the SaaS market is more fragmented, with all the major software providers—Salesforce, Adobe, SAP, Oracle, Cisco, IBM, and others—offering solutions.[14,15]

€537m

Estimate value of cloud for Poland in 2020, based on IDC reports

Current state of cloud globally, in Europe, and in Poland

The COVID-19 pandemic has further validated cloud's value proposition. According to Gartner, the proportion of IT spending that is shifting to cloud will accelerate in the aftermath of the COVID-19 crisis, with cloud projected to make up 14.2 percent of the total global enterprise IT spending market in 2024, up from 9.1 percent in 2020.[16]

The leader in cloud adoption is North America, with the United States being home to 81 percent of organizations already using cloud-computing infrastructure or having at least one application in the cloud in 2020.[17] Based on current adoption rates, the United States is forecasted to remain a global cloud frontrunner.[18] This position is further strengthened by it being the home of the top three global cloud service providers (CSPs), namely Amazon Web Services, Google Cloud Platform, and Microsoft Azure.

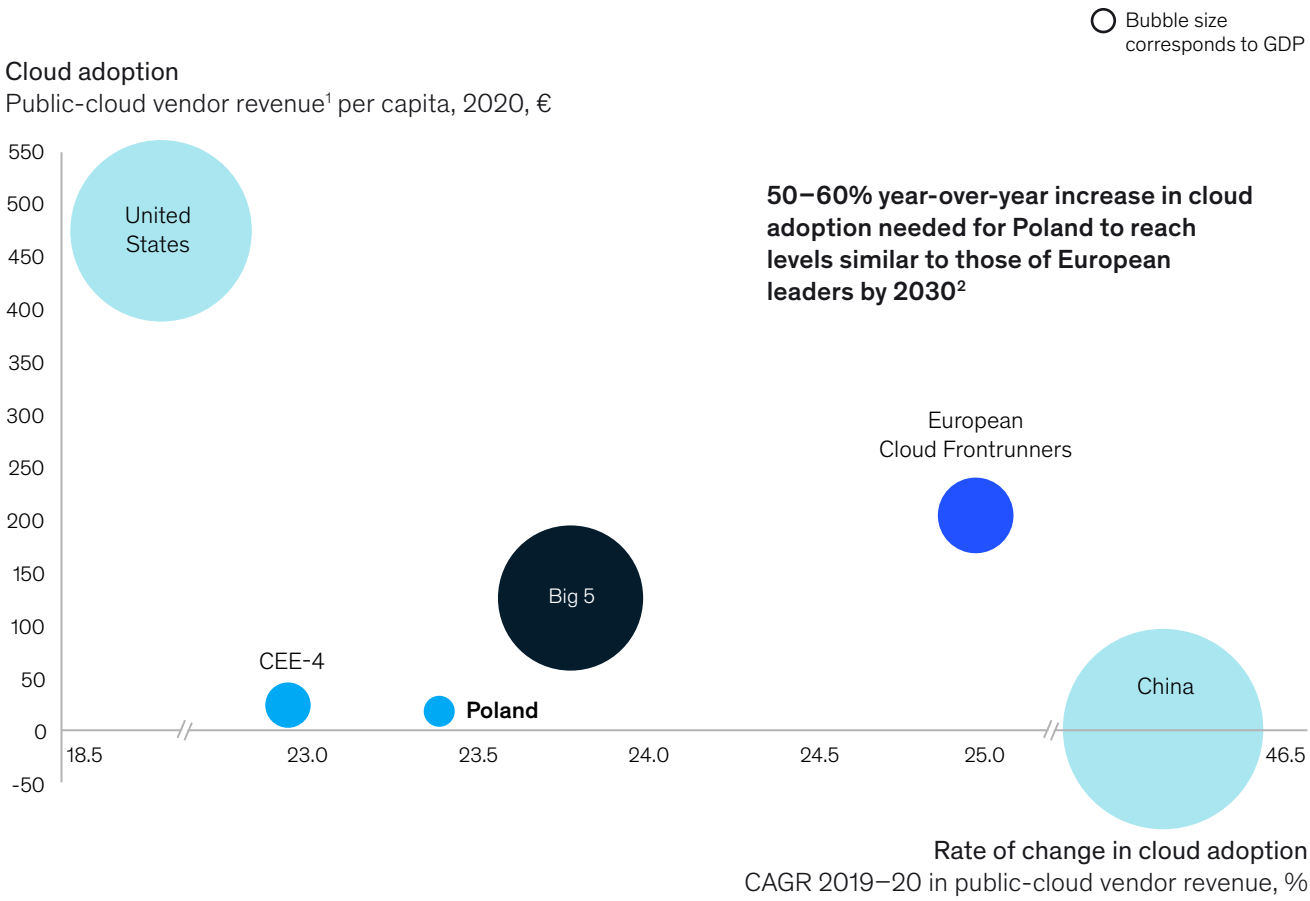
The Asia-Pacific region is showing the fastest acceleration in spending on public cloud, with 38 percent growth year on year in 2020. Contrary to the global trend, the largest part of this increase relates to infrastructure as a service (48 percent), driven primarily by China, the largest contributor in the region. SaaS follows, accounting for 40 percent of the revenue, and then PaaS, with 11 percent.[19] China was the biggest consumer of public-cloud computing services in the region, with year-on-year growth of 59 percent in the period 2017–20[20], followed by Japan, Australia, and India.[21,22]

One way to understand levels of cloud usage is to look at CSP revenue from the public cloud. As this is the most widespread deployment model among cloud users, it allows us to assess the value of the market with greater accuracy. We look separately at global economies (the United States, China, Japan, and Singapore) and Europe.

Within Europe, we identify three distinct groups, which we refer to by name throughout this report. The first we call European Cloud Frontrunners, which comprise Belgium, Denmark, Finland, Ireland, the Netherlands, Norway, and Sweden. The economies of these countries have also been at the forefront of general digitization, leading the early adoption of technological advances. The second group we call the Big 5, which are the five biggest European economies: France, Germany, Italy, Spain, and the United Kingdom. These countries are relatively advanced in investing in cloud but lag behind the European Cloud Frontrunners. The third and final group we call the CEE-4: the Czech Republic, Hungary, Poland, and Romania. In this group, Poland has a slightly lower level of cloud adoption than the Czech Republic and Hungary, possibly for multiple reasons, including the overall digitization level of the CEE-4 countries: The Czech Republic ranked 17th of European countries in the Digital Economy and Society Index in 2020, Hungary ranked 21st, and Poland ranked 23rd.[23]

Exhibit 1

Poland has potential to grow its cloud adoption and improve its competitivenes vis-à-vis frontrunners



Note: European Cloud Frontrunners comprise Belgium, Denmark, Finland, Ireland, the Netherlands, Norway, and Sweden; the Big 5 comprise France, Germany, Italy, Spain, and the United Kingdom; the CEE-4 comprise the Czech Republic, Hungary, Poland, and Romania. Calculation of country clusters performed as a weighted average.
[1]Public-cloud vendor revenue covers cloud software and cloud infrastructure (IaaS, PaaS, and SaaS applications and SaaS system infrastructure software) of incumbent players per geography.
[2]Assuming other economies continue their current growth momentum.
Source: OECD 2015–2020, European Commission, IDC Semiannual Public Cloud Services Tracker

Poland may wish to pursue ambitious goals both in terms of cloud adoption (currently 1.5 times lower than the CEE average) and growth rate (currently, the compound annual growth rate, or CAGR, is 23 percent in Poland, compared with 25 percent on average for European Cloud Frontrunners). To accelerate cloud adoption and catch up with the European leaders by 2030, Poland would need to more than double its year-on-year cloud adoption rate. This would require a hypothetical 50 to 60 percent annual growth in cloud-vendor revenue, assuming the current growth momentum of other economics continues.

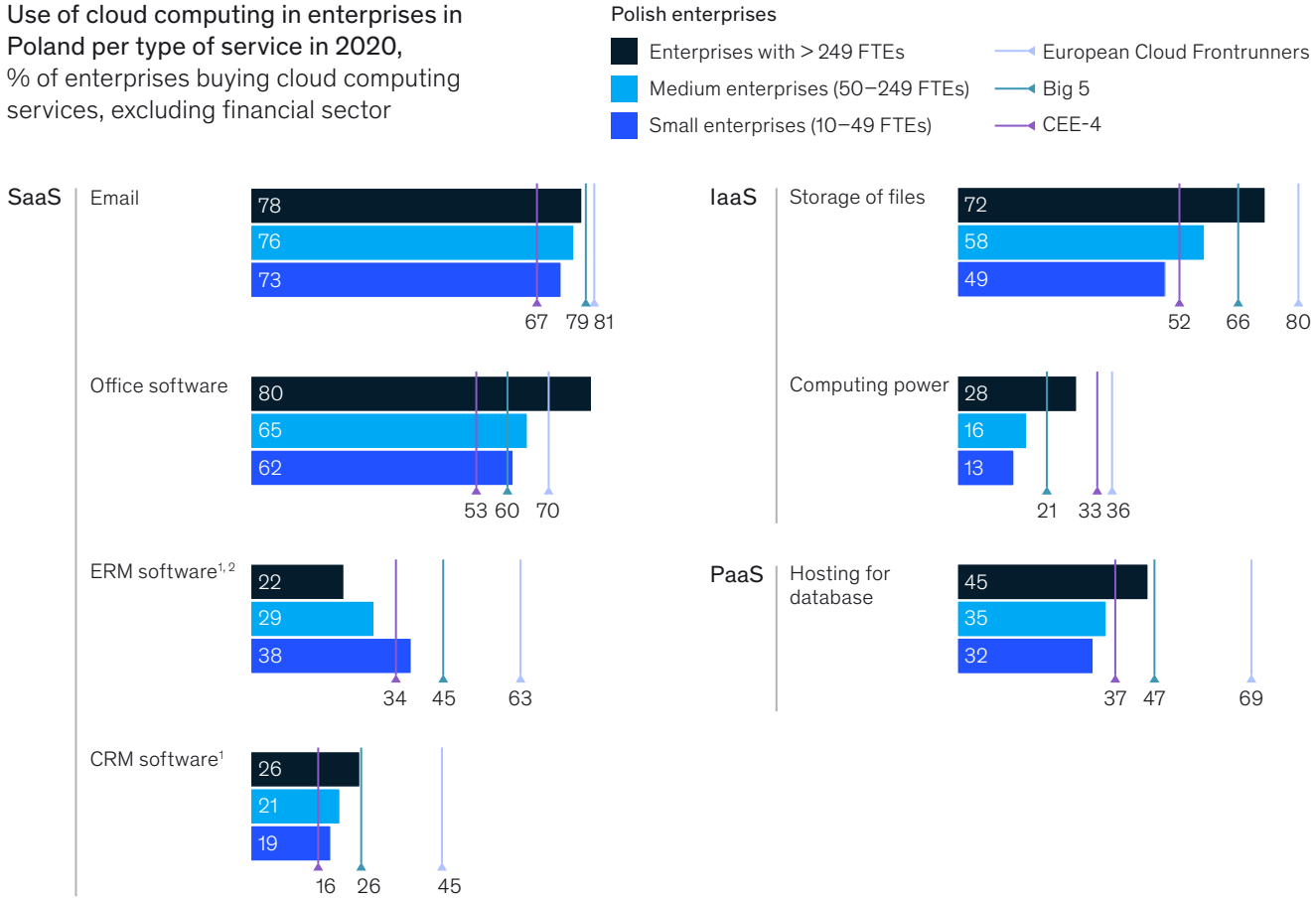
Office tools are the most common use case for enterprises already using cloud in Europe. Thus, 76 percent of enterprises host their email services on cloud, 69 percent use cloud for file storage, and 62 percent have office software managed in the cloud.[24]

In Poland, the trend toward using cloud for basic office tools is similar to that seen in other European countries, with cloud computing most often employed in collaborative applications such as email services, office software (for example, text editing), and file storage—all part of IaaS products.[25] Enterprises with more than 250 employees are more willing to use SaaS

Exhibit 2

Basic office tools are the most common use of cloud in Poland

Use of cloud computing in enterprises in Poland per type of service in 2020, % of enterprises buying cloud computing services, excluding financial sector



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[1] Collaborative applications
[2] Finance or accounting software applications.
Source: Eurostat 2014–2020

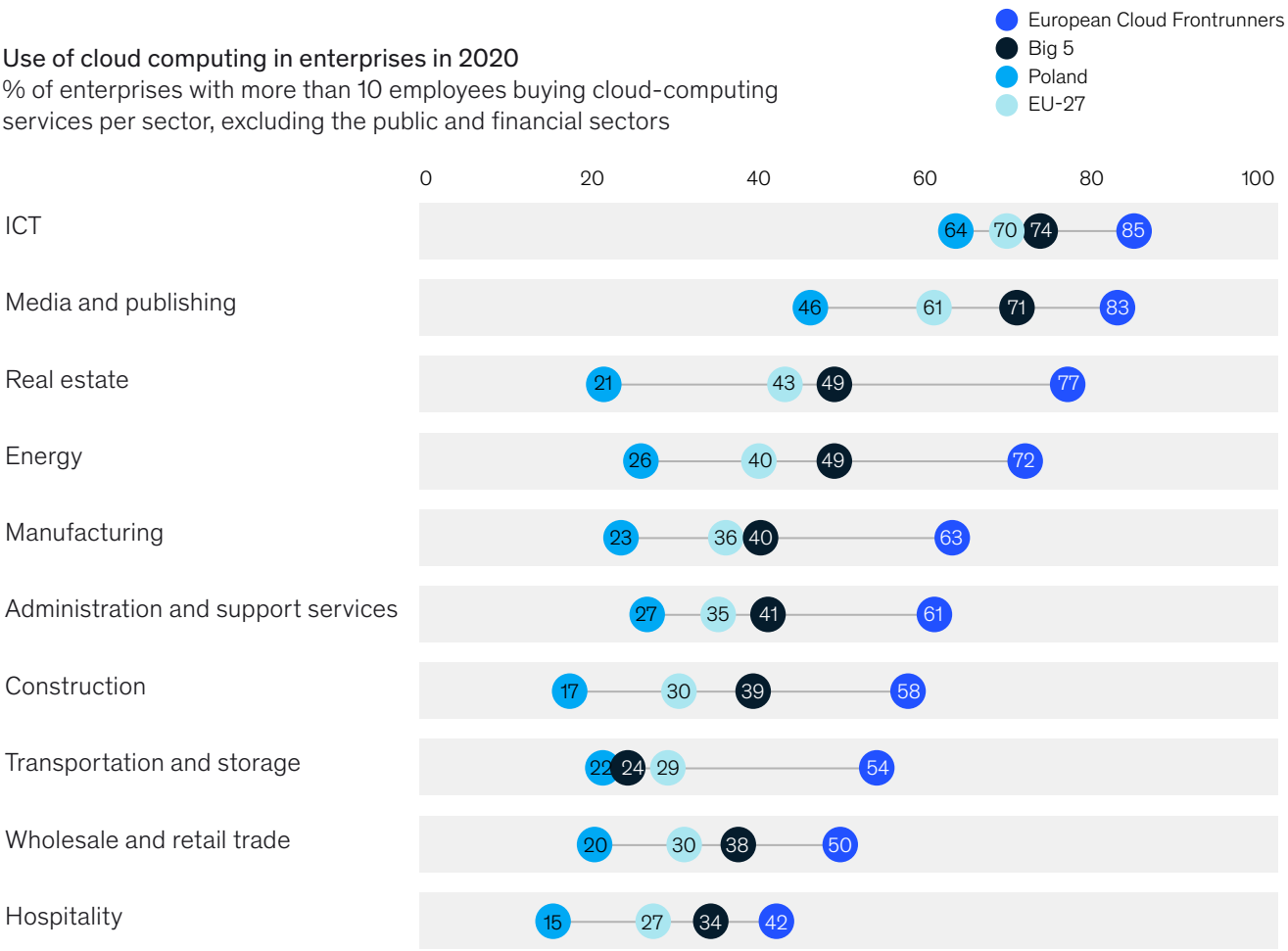
solutions than their smaller peers, except in the case of enterprise risk management (ERM) applications such as finance or accounting software, for which enterprises with fewer than 50 employees dominate usage. This could be due to the relatively low level of digitization among small enterprises in Poland, combined with the high level of outsourced services in this segment. For example, the infrastructure of accounting service providers could be in the cloud.

Looking more closely at spending categories worldwide, we see an increasing trend toward advanced technology tools, with advanced analytics (leveraging machine learning and AI engines) and business-intelligence tools showing the highest year-on-year growth across all regions. This may suggest that companies are trying to optimize and grow their businesses in more advanced ways using these sophisticated tools. However, potential remains for investment in advanced technologies, with China having the fastest growth in year-on-year spend in this category from 2017 to 2020.[26]

Differences in global levels of cloud adoption are also seen across industries, with “digitally native” sectors such as ICT or media and

Exhibit 3

Enterprises purchasing cloud computing services by sector for those with ten employees



Note: European Cloud Frontrunners comprise Belgium, Denmark, Finland, Ireland, the Netherlands, Norway, and Sweden; the Big 5 comprise France, Germany, Italy, Spain, and the United Kingdom. Calculation of country clusters performed as a weighted average of respondents per country
Source: Eurostat 2014–2020

publishing being home to enterprises that purchase cloud services more often.[27] The trend is similar in Poland, with some notable differences: The biggest gaps between Poland and the European Cloud Frontrunners are in the real estate sector (with 21 percent of Polish enterprises buying cloud services, compared with 77 percent for European Cloud Frontrunners); the energy sector (Poland, 26 percent, and European Cloud Frontrunners, 72 percent); and the manufacturing sector (Poland, 23 percent, and European Cloud Frontrunners, 63 percent). In terms of value, spending on public-cloud services in Poland is the highest in manufacturing (approximately 18 percent of total spending in 2019), professional services (16 percent), and retail and wholesale (15 percent).[28]

Cloud technology enables Poland's Digital Challenger journey

The main drivers of economic growth in CEE in the 1990s and 2000s were labor-cost advantages, dynamic exports, investments from abroad, and the expansion of traditional industries. As these drivers gradually power down, digitization is revealing itself as the new engine of sustained growth in the 2010s and 2020s, the key to increasing labor productivity and bridging the socioeconomic

development gap with Western Europe. Our previous published research found that Poland and nine other CEE countries—which we call the Digital Challengers—demonstrate strong growth potential in the digital economy. In our reports *Digital Challengers in the next normal* (2020)[29] and *The rise of Digital Challengers* (2018),[30] we show how they are trying to emulate the group of highly developed and digitized Northern European countries that we call the Digital Frontrunners, namely Belgium, Denmark, Estonia, Finland, Ireland, Luxembourg, the Netherlands, Norway, and Sweden.

Cloud can play a key role in Poland's digital journey. In fact, all seven key enablers for maximizing Poland's productivity gains from digital transformation listed in this and previous McKinsey reports are connected to cloud technology. Four of the enablers benefit directly from cloud adoption: three that relate to soft infrastructure (the adoption of digital tools and skills by Polish companies, institutions, and the general population) and one relating to innovation. The remaining three enablers (a large ICT labor pool, the development of digital capabilities, and a focus on the regulatory environment) are essential for increased cloud adoption in the Polish economy.

Promoting cloud adoption would help Poland achieve its ambition as a Digital Challenger. In the *Digital Challengers* reports, we identified Poland's Digital Challenger ambition to grow its digital economy from €32 billion in 2019 to €48 billion (9 percent of GDP) by 2025 in a business-as-usual scenario, or to as much as €90 billion (15 percent of GDP) in an aspirational scenario.[31]

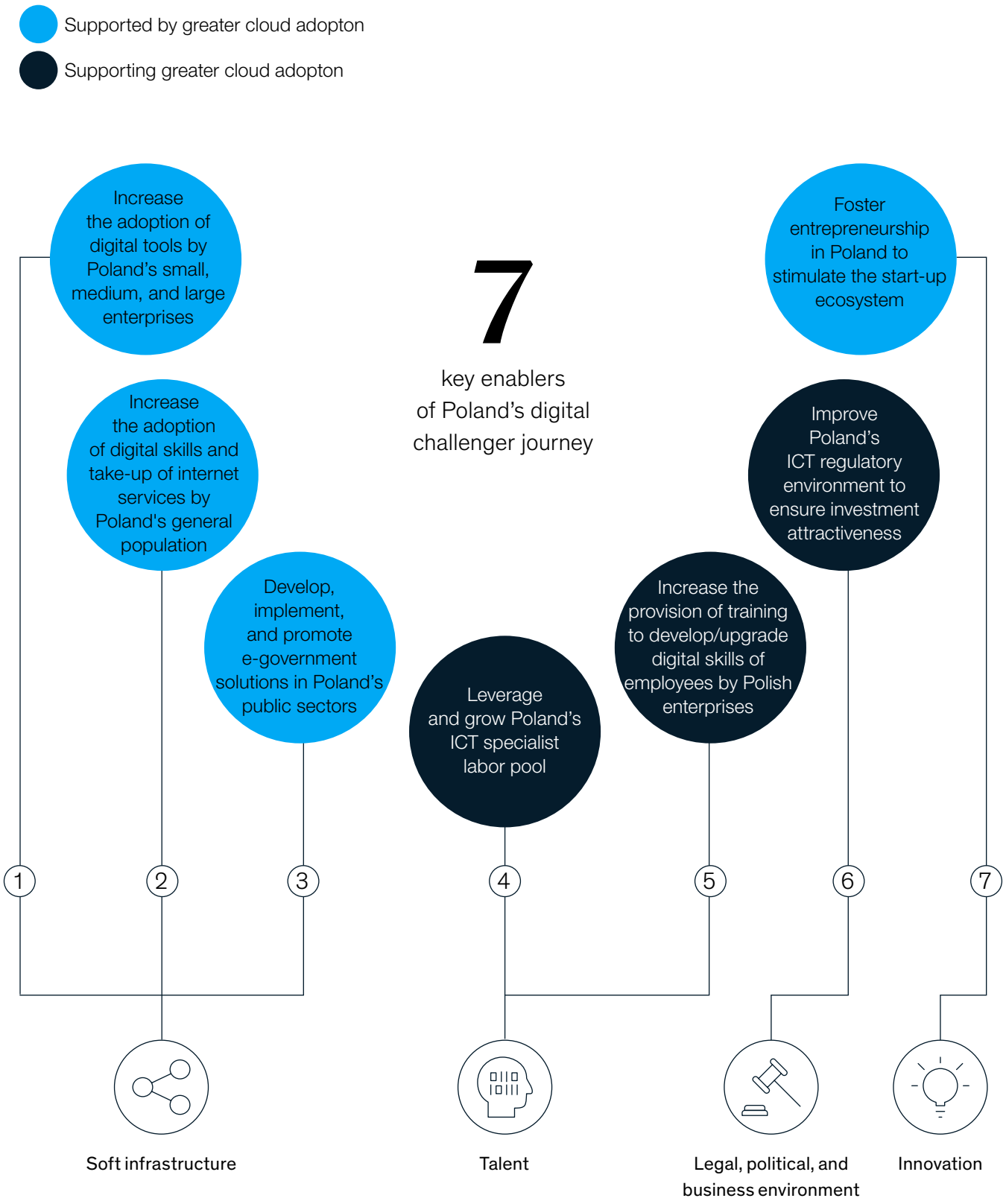
The COVID-19 pandemic has accelerated digital adoption both globally and in Poland. Faster digitization is in turn leading to the increased use of cloud; in fact, 90 percent of organizations say that, as a result of the pandemic, cloud usage is higher than they had initially planned.[32] A recent McKinsey pan-European Digital Sentiment Survey revealed a step change in digital adoption rates due to COVID-19, in terms of both the number of people using digital channels (up 9 percentage points) and the number of industries in which interaction is fully digital (it grew from 1.8 to 4.0 industries). As we settle into the next normal, this greater number of digital channels is expected to become ubiquitous across Europe, including in Poland.[33]

Perhaps unsurprisingly, while digital user bases in most European industries have increased, that growth may not be sustained after the pandemic. Users in sectors such as education, healthcare, the public sector, and retail said their postpandemic use of digital channels will be less frequent. In Poland, a reaction against digital channels is expected in the utilities and insurance sectors as well.[34] Nevertheless, industries such as banking and entertainment, which already have high levels of digital adoption, may follow the overarching trend and increase their use of cloud services after the pandemic.

90% of organizations say that their cloud usage is higher than they had initially planned, due to the pandemic

Exhibit 4

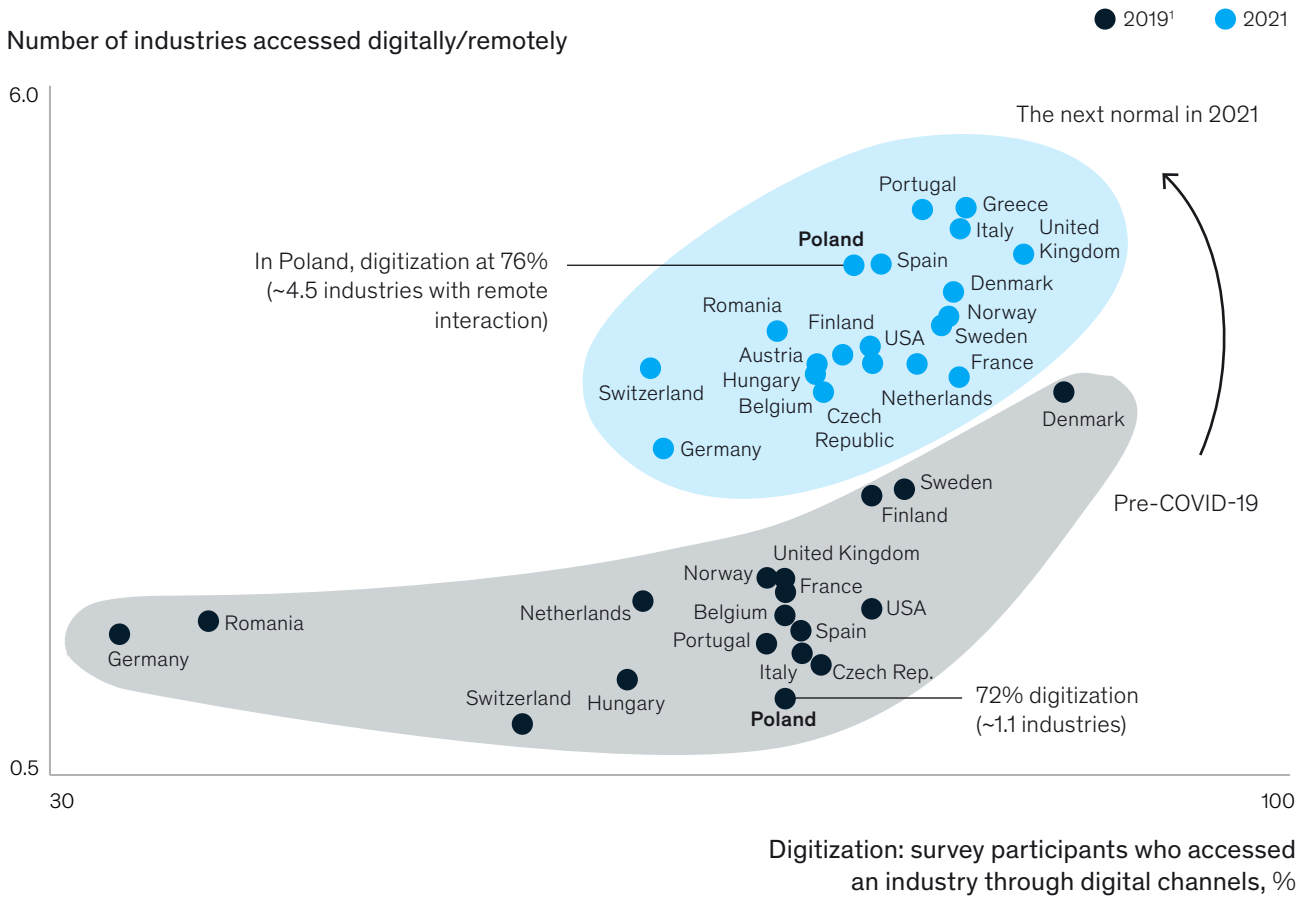
Digitization could be Poland's next growth engine, with cloud technology involved in each key enabler



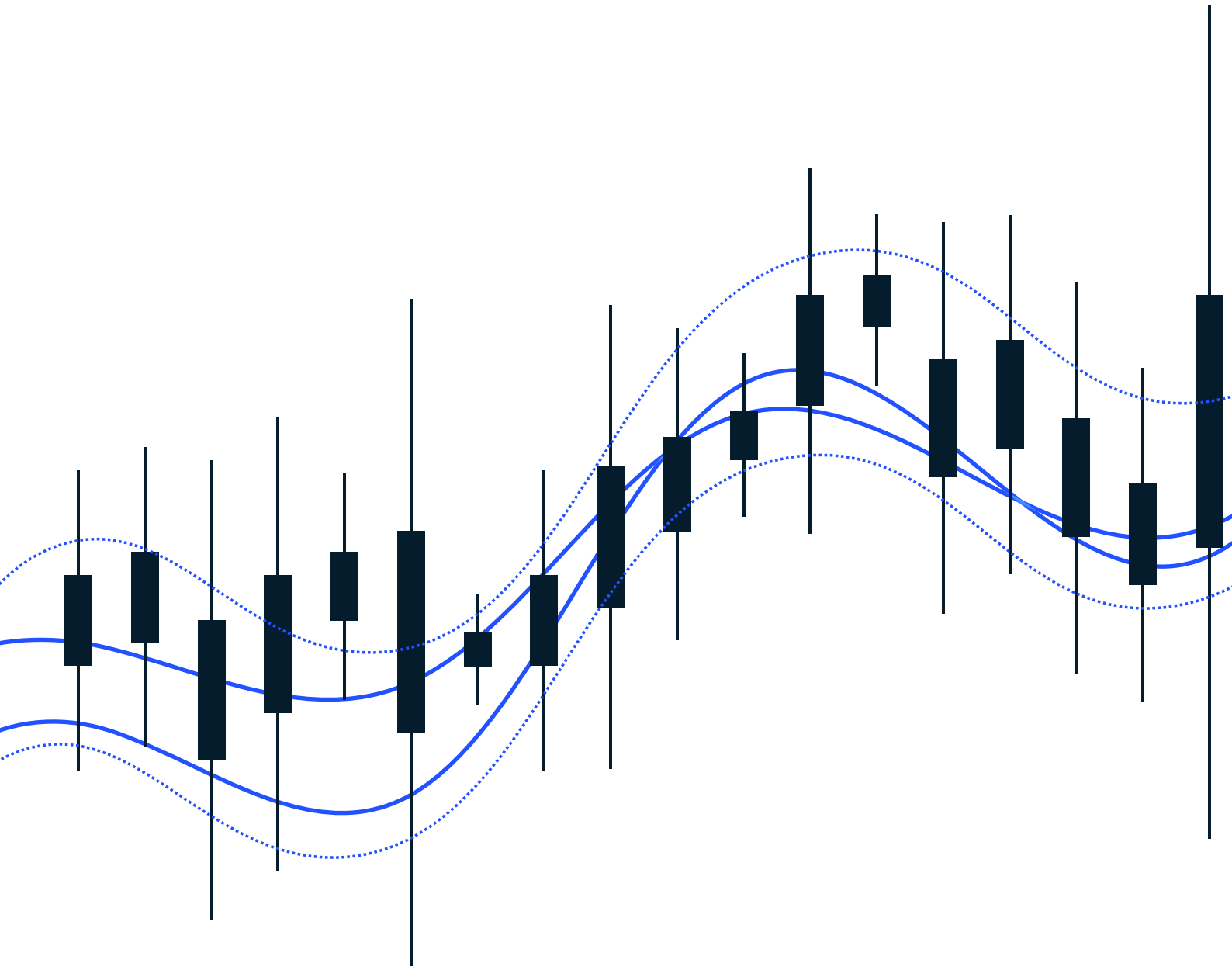
The introduction of remote working as the new standard could mean migration to the cloud for many organizations. The pressure to provide an at least partially remote work setup is expected to remain, with employees to continue to favor a flexible working model in the postpandemic era. Thus, 63 percent of respondents to a global McKinsey Employee Survey (conducted on a sample of more than 5,000 full-time corporate or government employees) said that post-COVID-19 they would prefer a hybrid (52 percent) or fully remote working model (11 percent). This would mean that around 40 percent of enterprises that had a physical presence prior to COVID-19 would have to shift to an alternative model.[35] A majority of employees also said that they would like to work from home at least three days a week.[36]

Exhibit 5

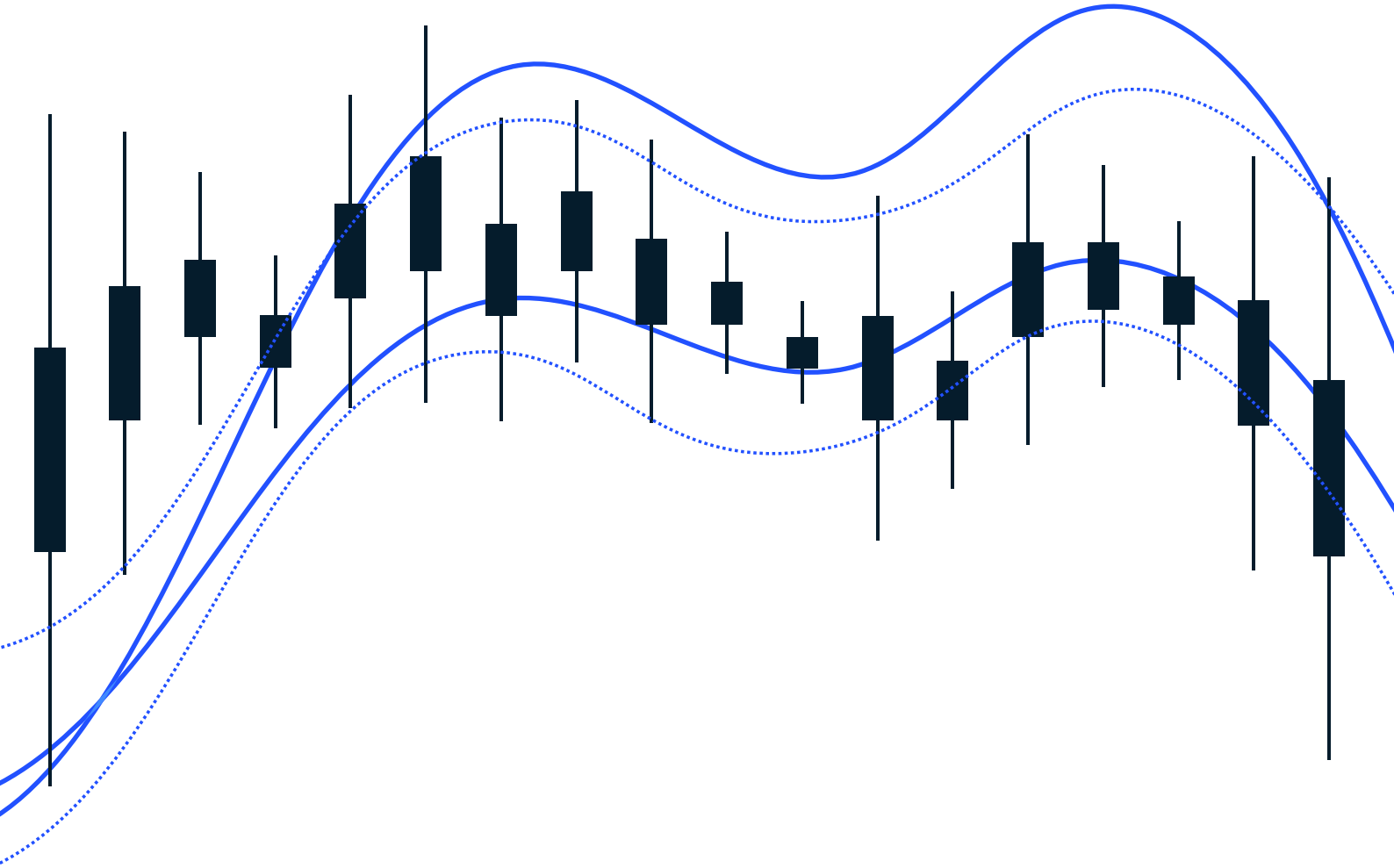
After COVID-19, digital acceleration, European markets appear to shift to the next normal with some returning to physical interactions



Q1: How have you interacted with these industries in the past 6 months (physically, remotely/digitally, mix)?
Q2: Which of these services did you start to use digitally during COVID-19?
[1]Prior to COVID-19
Source: McKinsey Global Digital Sentiment Survey



02 Potential of cloud in Poland



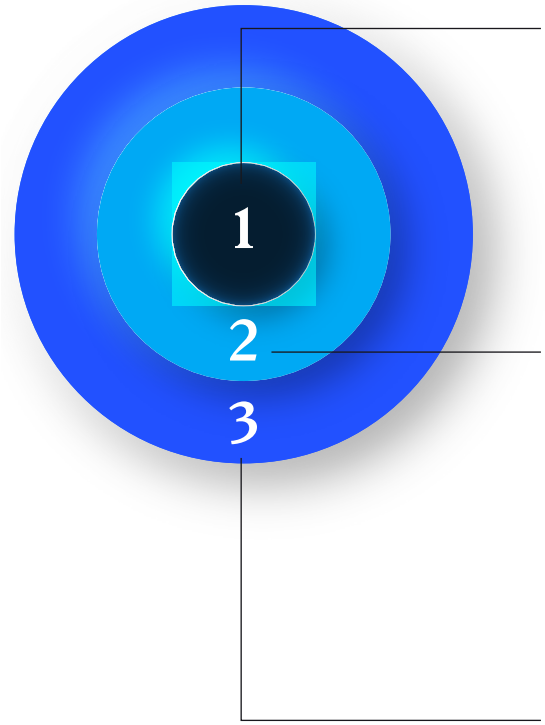
IT cost reduction is just one of the benefits of cloud technology. It also—and perhaps more importantly—acts as an accelerator of digital innovation by unlocking the three layers of freedom referred to in Chapter 1: the freedom to experiment, the freedom to fail, and the freedom to be agile. In this chapter, we calculate the potential overall economic impact of cloud on Poland, including both direct gains (cost optimization) and indirect gains (enabling or acceleration of innovative solutions in advanced analytics, IoT and automation). Our estimated potential corresponds to the economic value of public cloud, as opposed to private or hybrid cloud; we focus on public cloud, as it is the most common cloud deployment model, and reliable data on are available from CSPs.

Economic impact of cloud on Poland in 2030

According to our analysis, the widespread adoption of cloud technology across Polish companies and public institutions could generate an additional €27 billion in value each year by 2030, equivalent to 4 percent of GDP in 2030. Some 18 percent of that additional value is likely to come from direct gains, improving existing operations, or “rejuvenating,” including IT cost reductions, less downtime, and business automation. The remaining 82 percent is expected to be generated by new business and innovative digitization unlocked or accelerated by cloud architecture—in other words, innovating. An additional upside, not included in our total for additional value, could come from

Exhibit 6

By 2030, widespread cloud adoption could generate value equivalent to 4 percent of Poland's annual GDP (€27bn)



Rejuvenate
€5bn

IT cost optimization
Cost optimization of application development, maintenance, and IT infrastructure

Risk reduction
Improvement of business resilience of the organization and reduction in downtime

Core operations digitization
Implementation of latest technological achievements in core operations and back-office functions

Innovate
€22bn

Innovation driven growth
Business growth from new and enhanced use cases in advanced analytics (AI/ML), IoT, and automation

Accelerated product development
Enhancement of operating model agility, ease of cloud configuration, and democratized access to computational power

Hyperscalability
Access to instant on-demand elasticity in computing and storage capacity to scale across customer segments, geographies, channels

Pioneer
Additional opportunity (not measured)

Early adoption of cloud technology
Embracing culture of experimentation with low cost of failure and gaining experience in cloud technology, which is an enabler for early adoption of future tech such as quantum computing, AR/VR/MR (mixed reality), blockchain, 3D/4D printing, etc.

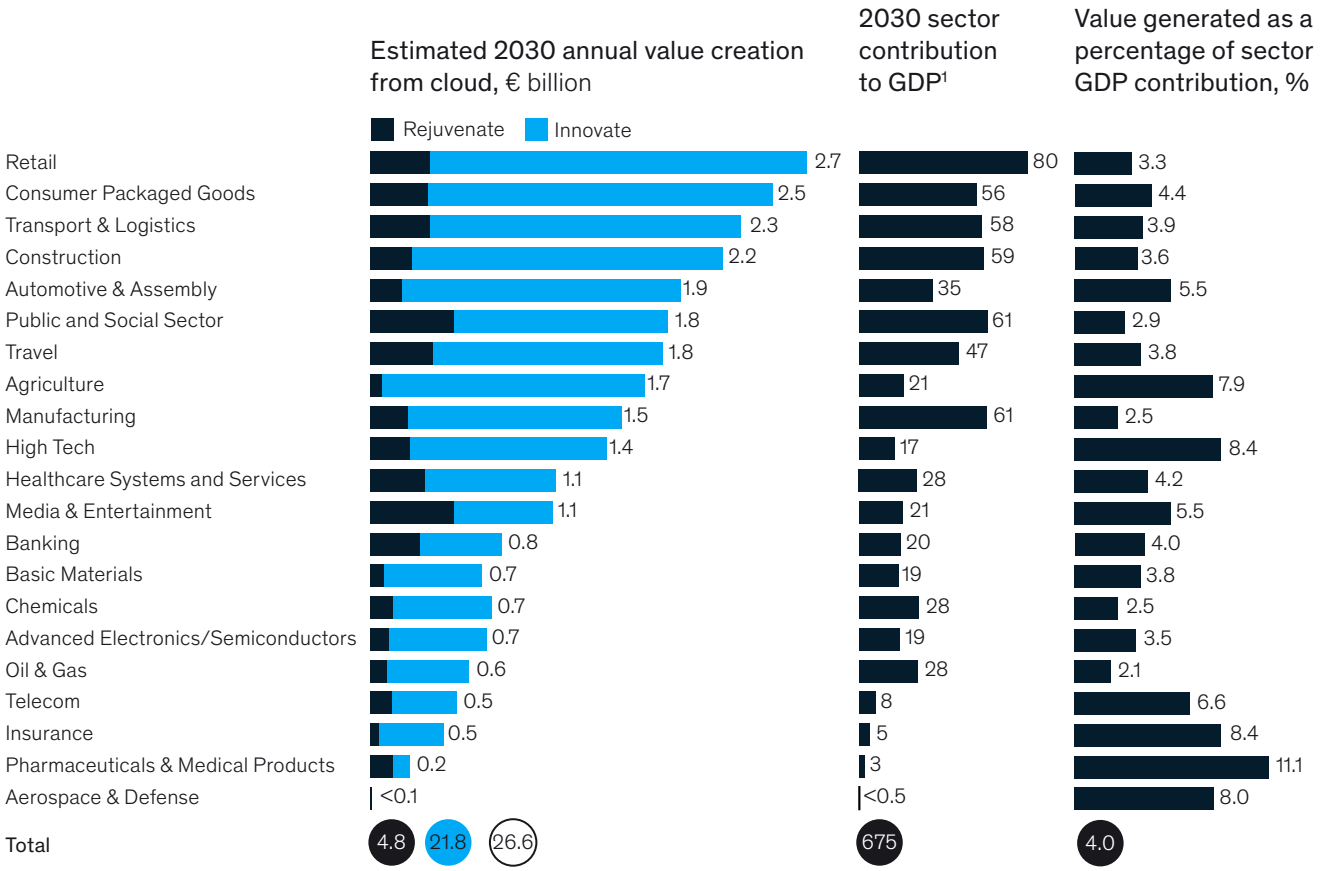
future technologies facilitated by cloud architecture, or "pioneering."

According to our analysis, the key beneficiaries of cloud adoption in Poland will be the retail, CPG, and transportation and logistics sectors, which together account for 28 percent of the total impact. Retail constitutes the largest sector in the Polish economy, accounting for €121 billion revenue in 2020.[37] Not only does it represent a large IT cost pool, which can be optimized, it is also a likely area for cloud-enabled innovation. For instance, cloud technology can accelerate the implementation of advanced analytics to measure consumer behavior, redesign shopping aisles, or maximize value from loyalty programs. Additionally, IoT can facilitate the creation of the future shopping experience, with cashierless checkouts and automatic payments. As e-commerce has grown, cloud has become essential in order to maintain a robust online shopping platform, quickly launch new platform features (such as similar product recommendations), and manage seasonal peaks in visitor traffic—just before Christmas or Valentine's Day, say. COVID-19 has further accelerated the trend, boosting the importance of online channels as e-commerce has captured sales volumes from bricks-and-mortar stores in many product categories.

The CPG sector, which covers the manufacture of all "daily use products," is a major industry in Poland,

Exhibit 7

Retail, CPG, and Transport & Logistics are expected to benefit most from cloud adoption, generating 28 percent of total impact



[1]Estimate based on real 2030 GDP forecast allocated to sectors by revenue; revenue extrapolated from 2020 according to forecast 2020–30 GDP growth (IHS Markit)

generating economic value of €85 billion in 2020.[38] Cloud-enabled value in this sector relates primarily to the automation of product manufacturing and the use of advanced analytics in marketing, sales, and operations, including predictive maintenance, inventory optimization, and smart promotion strategies.

Transportation and logistics is another pillar of the Polish economy, with €88 billion in revenues in 2020.[39] The sector includes all land, air, and water transportation, as well as postal and courier services, warehousing, and fulfillment. The potential in these areas is driven by advanced analytics and IoT use cases, which can be accelerated by cloud—for example, smart routing for logistics, autonomous vehicles in cities, predictive maintenance, and automation in warehouses.

A further 15 percent of the total impact could come from the construction sector and the automotive and assembly industry, with both on the verge of widespread automation and the IoT/robotics revolution. Cloud-based environments can improve yield, energy, and throughput on construction sites, improve the utilization, uptime, and life span of equipment, increase workforce productivity, and enable smart buildings, autonomous trucks, predictive servicing, and dynamic route optimization.

Large companies could capture 40 percent of the economic value, while companies with fewer than 500 employees could account for

Exhibit 8

Examples of cloud applications across industries

Retail

Poland
As online sales picked up, a clothing company struggled with keeping its website up during peak traffic days. Within six weeks it migrated one of its key brands to cloud—increasing uptime. which translated into incremental sales.

Australia
A fashion house decided to use cloud to revamp its product recommendation engine for a 10,000-product online catalog. The initial A/B testing identified double-digit % uplift in revenue per user session.

Switzerland
A leading country-wide retail network leveraged cloud data lakes and business-intelligence engines to get a 360-degree view of its customers offline-online behaviors. It reduced business-intelligence and CRM overhead costs by 60% and analyzed 4 TB of customer data per month.

United States
A major beverage producer had to quickly retrofit its soda fountain to a touchless, mobile version when COVID-19 began. Within 100 days, the team developed a low-latency "mobile pouring" feature and quickly rolled it out across thousands of machines.

An online bedsheet retailer ran spreadsheet-based sales forecasting and inventory management that led to excessive stockpiling. The team migrated its database to a cloud platform and through machine-learning tools managed to reduce inventory carryovers by 50 percent and gaining granular insights into individual SKUs' performance.

Italy
A traditional pasta manufacturer needed to digitize its pen-and-paper maintenance reports. Thanks to a cloud-based app with a photo posting feature, it managed to connect 2,700 employees at 18 factories, making the maintenance process faster and more efficient.

Consumer Packaged Goods

Transport & Logistics

Denmark
A large container shipping line used cloud to build out new capabilities at 50% of on-premise cost, and sole migration of 26 essential business applications reduced related OpEx by 10%.

United States
A parcel logistics giant used cloud-based data processing and AI/ML tools to optimize routing for dispatch drivers who make more than 120 pickups and drop-offs daily. The algorithm saves $400 million a year and reduces fuel consumption by 10 million gallons a year.

Poland
A national postal service decided to streamline and automate its back-office operations by moving its accounting system to the cloud. It is now used by 1,100 users, processes 10,000 monthly operations, and can absorb peaks of 100,000 transactions per hour, both saving administrative time and increasing operational accuracy.

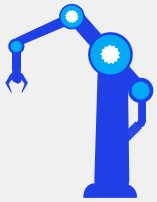
Russia
A leading residential developer switched to cloud-based collaboration tools for its 7,000 employees on construction sites and across 70 offices, enabling costing and work scheduling in shared spreadsheets. It increased staff efficiency by 20 percent.

Brazil
A major construction company streamlined its B2C sales by building a cloud-native app for channel partners. The result was a threefold increase in channel-partner sales and 24/7 access to relevant contractual information.

Australia
A rental marketplace wanted to enable its users to browse through facilities within a walkable radius of their desired property. Using a cloud-based geocoding engine, it quickly rolled out interactive maps with schools, gyms, shops, etc., to its 70,000 properties.

Construction

Automotive & Assembly



Poland
An automotive player leveraged advanced analytics across 1,000+ locations to improve customer engagement and employee support, optimize the operating model, and transform product offers with faster change implementation

Germany
A major auto manufacturer used cloud-enabled blockchain technology to verify and track a vehicle's history from manufacture to registration to maintenance to resale.

Norway
A Scandinavian telematics company leveraged the cloud environment for geocoding engines to track vehicles' location in real time and ensure they were not used for personal purposes—saving 20% in vehicle-related expenses (maintenance, insurance, fuel).

€2.7bn

estimated 2030 annual value creation from cloud in retail sector

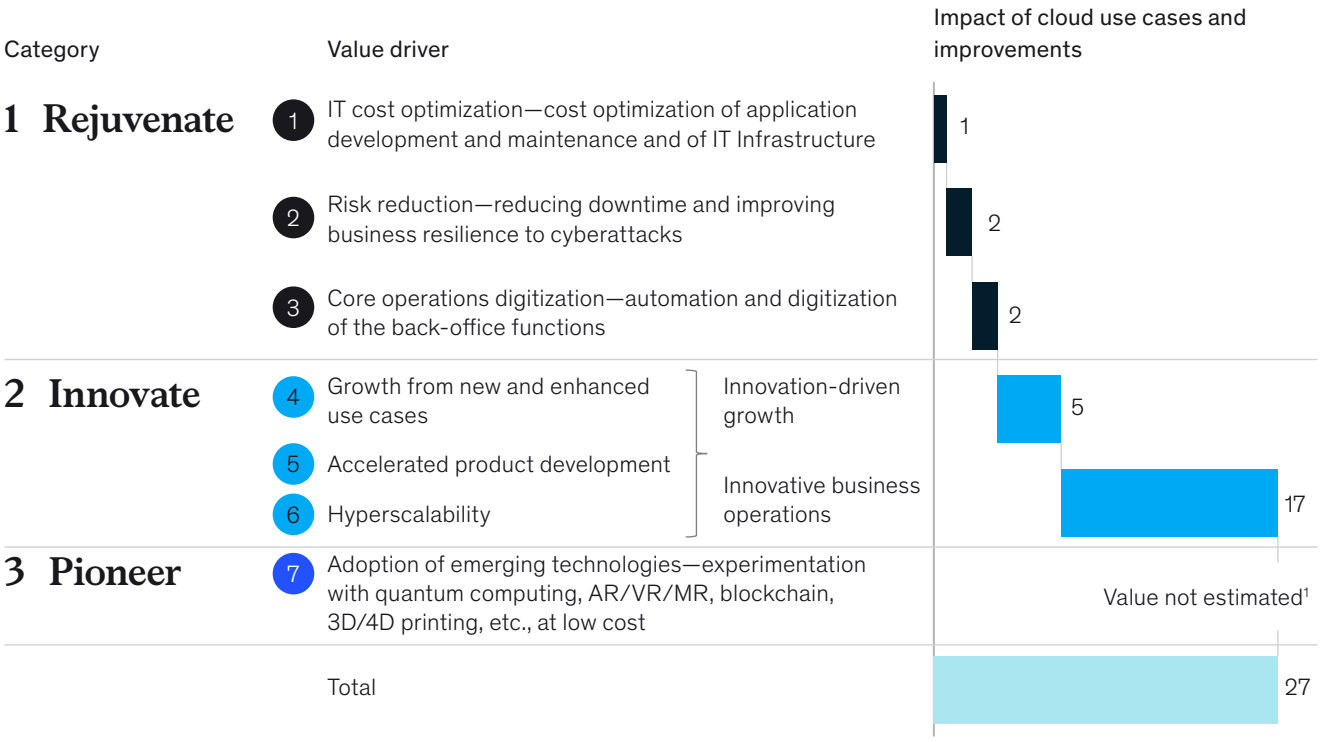
the remaining 60 percent, assuming that value capture is proportional to current spending on public cloud by Polish companies.[40] Today, around 23 percent of Polish SMEs (companies with ten to 250 employees) use at least one cloud-based service, compared with 60 percent of large enterprises (companies with more than 250 employees). This 37 percentage-point gap is much wider than in leading countries: European Cloud Frontrunners have a 26-point gap and the Big 5 a 30-point gap.[41] According to surveys, the reasons for less cloud adoption among smaller companies are: low awareness of cloud technology, difficulty calculating ROI for cloud migration, recent and only partially amortized investments in on-premise IT infrastructure, data security concerns, and lack of IT staff trained in cloud engineering. Large enterprises are naturally expected to reap greater benefits cloud, because their IT infrastructure footprint is bigger, their downtime is more costly, their risk of cyberattacks is higher, and their amount of internal data to be optimized with the help of advanced analytics is larger.[42]

Cloud can level the playing field for SMEs by providing three things: access to economies of scale, access to top solutions and talent, and the ability to embrace the potential of agile and fast innovation. Thus, cloud saves SMEs the upfront investment in local IT infrastructure, which can make a substantial difference to the cash flow of many small organizations by transforming capital expenditure into operating expenditure. It also enables quick scaling when necessary. Second, many sophisticated business applications are only available only in an SaaS model. Replicating those applications in-house can be prohibitively expensive and time-consuming for SMEs. Thanks to cloud, SMEs can access many off-the-shelf tools—SaaS CRM software, ERP software, AI/ML solutions, and so on—which can unlock innovation in both their core business operations and back-office functions. Preconfigured cloud resources also save the small and often overstretched teams at such companies the time they would otherwise spend on local configuration, allowing them to focus on growth and innovation initiatives instead. Additionally, CSPs consistently attract top IT talent, and SMEs can indirectly benefit from this talent pool by using cloud solutions. Third, thanks to the easily scaled, flexible solutions available with cloud, SMEs can make their product development teams more agile, quickly iterate on product features, and continuously tweak their value proposition in line with changing customer expectations.[43]

Exhibit 9

Seven value drivers are expected to generate annual value of €27bn in the Polish economy by 2030

Estimated 2030 annual value creation from cloud, € billion



[1]The value of these emerging technologies in Poland in 2030 cannot be estimated with any accuracy

As previously discussed, the economic value of cloud technology stems from three key areas: rejuvenating, innovating, and pioneering. Within these three areas we identify seven value levers.[44]

Rejuvenate

The rejuvenation category covers the immediate benefits of migration from traditional on-premise, local-server-based infrastructure to public cloud, including cost optimization of IT software, hardware, and labor.

Value driver 1: IT cost optimization

The traditional on-premise model for managing applications and infrastructure is not always efficient. It is highly manual and typically uses expensive technology equipment at less than full capacity. Cloud provides access to automated capabilities that enterprises could rarely afford to develop on premise, and CSPs leverage inverse correlations of workload usage patterns to run their assets at much higher utilization rates. Cloud also enables greater development productivity through new ways of working, such as agile and development, security, and operations (DevSecOps, the combined practice of software development, security, and IT operations). Efficiency improvements stem from application-program-interface (API)-based or self-service-based workflows and automation—for example, automated patching. Developers tend to spend measurably less time on infrastructure and production support and more on business requirements and

development when companies move to public cloud. Research also indicates that effective cloud usage can improve application development and maintenance productivity by 38 percent and infrastructure cost efficiency by 29 percent for migrated applications.[45]

Value driver 2: Risk reduction

Through more resilient architecture, cloud can reduce downtime by about 57 percent for migrated applications, as incidents within cloud infrastructure are less frequent and the average recovery time is shorter.[46] It can also reduce the cost of breaches by 26 percent[47]: Contrary to popular belief, cloud data storage can be safer than on-premise storage, as described in Chapter 3.[48] Cloud can also improve platform integrity through its automated, embedded security processes and controls (such as DevSecOps) and central security services provided by CSPs, including malicious-attack detection and escalation. These features reduce technological risks by providing a modernized, consistent technology stack across environments.

Value driver 3: Core operations digitization

Cloud can accelerate and, in some instances, unlock the implementation of the latest technological and digitization solutions in the back office, such as analytics-driven accounting and talent management. Organizations that shift to public cloud can unlock additional value by repurposing and reskilling their workforce to focus on higher-value tasks, such as developing products and services that address customer demand. Cloud enables a reduction in manual effort using API-based models, standardization, and automation (for example, infrastructure as code, or IaC), thereby increasing overall employee productivity.

Innovate

The innovation category relates to the power of public cloud to enable or accelerate innovation using technologies such as advanced analytics, IoT, and automation at scale. These technologies provide companies with ways to pursue innovation-driven growth and disrupt the manner in which they run their business operations. The range of potential value is wide, as not all organizations have the cloud maturity to achieve a similar degree of innovation.

To assess the potential of value drivers in the area of innovation, we analyzed more than 700 advanced analytics, IoT, and automation use cases. For each use case, we assessed the potential value of implementing it, along with its applicability to the Polish economy and the degree of value added by cloud technology (see sidebar, "Our methodology for calculating impact" for additional explanation).

Value driver 4: Growth from new and enhanced use cases

A fail-fast mentality—by which we mean an iterative process of experimentation and immediate market validation—is a hallmark of the most innovative companies. Cloud facilitates this mentality by providing access on demand to almost unlimited infrastructure capacity and computational power. It enables companies to experiment with applications and new business models at lower cost and greater speed. Executives who embrace cloud avoid large, up-front capital outlays when they launch or expand businesses. To support this shift, organizations can implement new operating models focused on areas such as managing consumption, gaining visibility into future demands and forming integrated financial operations (FinOps) teams to maintain fiscal control.

Value driver 5: Accelerated product development

Companies that adopt cloud generally enhance the agility of their operating model. This, in turn, accelerates the implementation of use cases, at the same time it reduces R&D investment. Companies can more easily configure solutions on cloud than they can on premise, enabling them to keep pace with the speed of business change and creating a flywheel, smoothing

out fluctuations in responsiveness. In addition, migrating to public cloud can provide organizations access to the innovative tools and capabilities offered by CSPs, such as containers, microservices, DevOps functions, continuous integration and continuous delivery (CI/CD), and advanced serverless architecture. This access enhances product development from the outset and dramatically speeds up design, build, and ramp-up, helping companies slash their time to market.

Value driver 6: Hyperscalability
Companies can harness the infrastructure and global presence of cloud providers to scale their products almost instantaneously, making them available to a broader set of customer segments, geographies, and channels via a flexible pay-as-you-consume cloud model. In addition, organizations can gain access to instant, on-demand elasticity in computing and storage capacity—critical for launching and building new businesses.

Pioneer
Pioneering relates to the extension of cloud's value once a company has achieved a certain level of cloud maturity. When they reach this stage, companies can harness the cloud to experiment with emerging technologies, such as blockchain, quantum computing, augmented and virtual reality, and 3D printing.

Value driver 7: Adoption of emerging technologies
With agile operating models, organizations can set up nimble "SWAT teams" to develop proofs of concept. This advanced level of cloud maturity has the additional benefit of attracting and retaining top talent to work on emerging technologies. This is critical as companies seek to incorporate transformative technologies that have not yet attained mass adoption. While the impact of nascent technologies is difficult to calculate, leaders need to account for potential applications and commit to understanding their potential value. Cloud can accelerate this process. Quantum computing is expected to provide significant performance improvement and thus potentially disrupt existing business models. By moving infrastructure to cloud and adapting the operating model, a company will be better positioned to benefit from cloud-based quantum computing when relevant use cases emerge. CSPs already offer these computing services, which allow organizations to run hybrid quantum and classical algorithms. Other emerging technologies, such as augmented and virtual reality and 3D printing, could also bring significant benefits.

60%

of the economic value of cloud could be captured by companies with fewer than 500 employees

Sidebar

One case study for each value driver

Value driver 1

IT cost optimization

Case study 1: Maersk, Denmark

As it recovered from serious cyberattack in 2017, Maersk—the largest container-shipping line and vessel operator in the world—used cloud to build new capabilities at 50 percent of the cost of doing so on premise. Within two years, the company had implemented a new IT operating model enabling user self-service and had put the responsibility for resource management in the hands of users. Maersk created a cloud-first organization that builds new on-premise software only as an exception. They created the tools and processes to allow visibility into cloud license management and better analytics to understand data and computational power consumption patterns, enabling potential cost savings. Just the migration of 26 essential business applications from mainframe to virtualized hardware reduced related operating expenditure by 10 percent, saving €4 million annually.[49]

Value driver 2

Risk reduction

Case study 2: LPP, Poland

LPP is a fashion industry player that owns five lifestyle clothing brands: Reserved, Cropp, House, Mohito, and Sinsay. It launched its first e-commerce platform, based on traditional local server infrastructure, in 2011. As online sales picked up, the company struggled to keep its website running during peak traffic days around Black Friday, Christmas, and the summer season. Excessive volume led to longer site loading times, which affected the customer experience. To alleviate this problem, LPP migrated its assets, brand by brand, to the cloud. Within six weeks, the company had migrated the first brand to cloud and started automatically scaling the cloud infrastructure up and down according to demand, thereby both reducing costs and maximizing uptime.[50]

Value driver 3

Core operations digitization

Case study 3: Ministry of Finance, Poland

One of the key roles of the public financial system is, naturally, tax collection. Poland's Ministry of Finance decided to make submitting tax returns easier for taxpayers by digitizing this process and migrating part of it to cloud. Production data remained on premise, while testing, development, and training environments were migrated to cloud. The process now includes multiple security features to meet the regulatory requirements. Taxpayers can submit prepopulated forms in less than five minutes, which both saves time and reduces errors. The migration has also had a positive indirect impact on the environment, with 18 percent fewer paper returns, resulting in 50 million sheets of paper saved in 2019.[51]

Value driver 4

Growth from new and enhanced use cases

Case study 4: UPS, United States

Logistics and shipping giant UPS used cloud-based data processing, AI, and machine-learning tools to design optimized routing software.[52] Delivering more than 20 million packages a day around the world, and even more during peak times, UPS drivers make an average of 120 to 125 pickups and drop-offs. The number of possible routes is nearly 200 digits long. Machine-learning models capable of processing one billion data points a day now examine package weight, shape, and size as well as facility capacity across the network. This saves UPS more than €300 million a year and reduces fuel consumption by almost 40 million liters a year.[53]

Value driver 5

Accelerated product development

Case study 5: Moderna, United States

American pharma company Moderna, the producer of an mRNA-technology-based COVID-19 vaccine, runs a proprietary Web application, Drug Design Studio, on cloud.[54] The company leverages cloud's scalable computing and storage infrastructure to analyze and quickly design mRNA sequences for protein targets. Scientists and engineers also make use of fully managed cloud data-warehousing services to integrate insights from multiple experiments running in parallel and quickly refine the design and production cycle. Moreover, the adoption of cloud principles, such as infrastructure as code (IaC) and security as code, have helped to automate good-practice (GxP) compliance processes, so the organization can move quickly while staying secure and compliant. Thanks in part to cloud, Moderna was able to deliver the first clinical batch of its vaccine candidate (mRNA-1273) to the US National Institutes of Health for phase 1 trials just 42 days after the initial sequencing of the virus.

Value driver 6

Hyperscalability

Case study 6: Brainly, Poland

Brainly is a Krakow-based, global, peer-to-peer online learning community with more than 350 million users. Managing a growing database became a serious issue for the small IT team at Brainly when the number of local servers exceeded 100. Brainly migrated the IT landscape to cloud using container orchestration in Kubernetes environments to make the platform more flexible and ready for continued growth. This enabled Brainly to grow its user base at an exponential pace, while simultaneously both increasing the website's uptime to 99.98 percent and reducing its operating costs by 50 percent.[55]

Case study 7: Ministry of Health, Poland

In December 2020, Centrum e-Zdrowia, a digital unit of the Polish Ministry of Health, asked Polish multicloud service provider Operator Chmury Krajowej (OChK) to design an online cloud-based system for the COVID-19 vaccine registration of more than 30 million Poles. The system needed to be integrated with the "trusted profile" system for citizens, serve thousands of vaccination sites, process thousands of requests per second, and manage both referrals and SMS notifications. Cloud architecture was essential to ensuring that the system could cope with registration peaks of up to 3,000 requests per second and remain reliable in the face of pandemic. Within just six weeks, OChK managed to launch a system that remains vital today for the COVID-19 vaccination campaign in Poland.[56]

Value driver 7

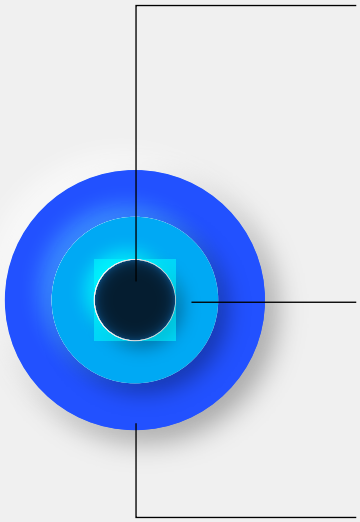
Additional opportunity

Case study 8: BMW, Germany; Nestlé, Switzerland; Axial3D, United Kingdom

Many companies are investing in emerging advanced technologies embedded in cloud infrastructure as a way of shifting their core business. BMW, for example, is testing blockchain technology to track a vehicle's history from manufacture to registration, maintenance, and resale. Nestlé is also experimenting with blockchain to improve the transparency of its supply chain. The company uses a cloud-native blockchain solution to store supply-chain transactions, thereby ensuring that they are immutable and verifiable. Another example is health-tech company Axial3D, which provides clinicians with patient-specific 3D anatomical models using a cloud-native, integrated development environment for machine learning.[57]

Sidebar

Our methodology for calculating impact



We sized the value of the rejuvenating category (IT cost optimization, risk reduction) by looking at macroeconomic baselines (such as estimated application data management, labor spend, and IT infrastructure cost in Poland) and typical cost-saving KPIs reported by major CSPs that help companies migrate to public cloud.

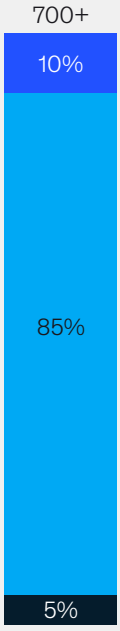
To calculate the value of the innovation category (and the digitization of core operations in the rejuvenation category), we drew on the McKinsey Global Institute library of 700+ advanced analytics, IoT, and automation use cases. We split these use cases into three categories based on their dependence on cloud infrastructure: (a) prerequisite (100 percent of the value is unlocked by cloud); (b) accelerate (30 percent of the value is unlocked by cloud); (c) not required (excluded from the data set). Next, we assessed each use case in terms of its applicability to the Polish economy and, using key macroeconomic metrics, scaled down the estimated worldwide impact to the Polish economy. Finally, we modeled the adoption curve for each use case in the period up to 2030.

Pioneering focuses on new technologies that rely on high computational power or cloud storage, such as quantum computing, AR/VR/MR, blockchain, and 3D/4D printing. It is difficult to forecast with any accuracy their development and broader adoption by the Polish economy at this stage, so we didn't quantify their upside potential.

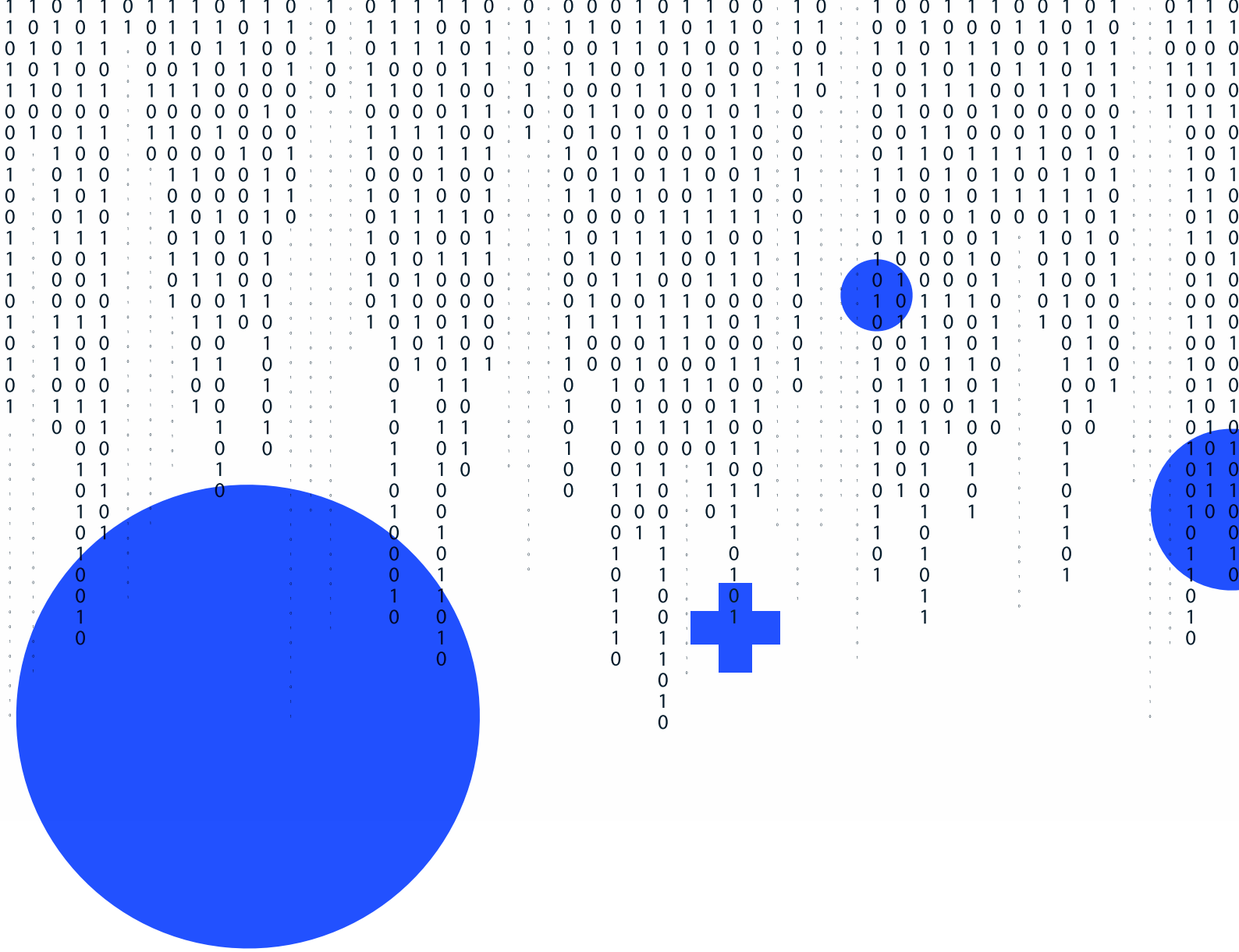
Exhibit 10

Innovate category – classification of use cases according to their dependence on cloud architecture

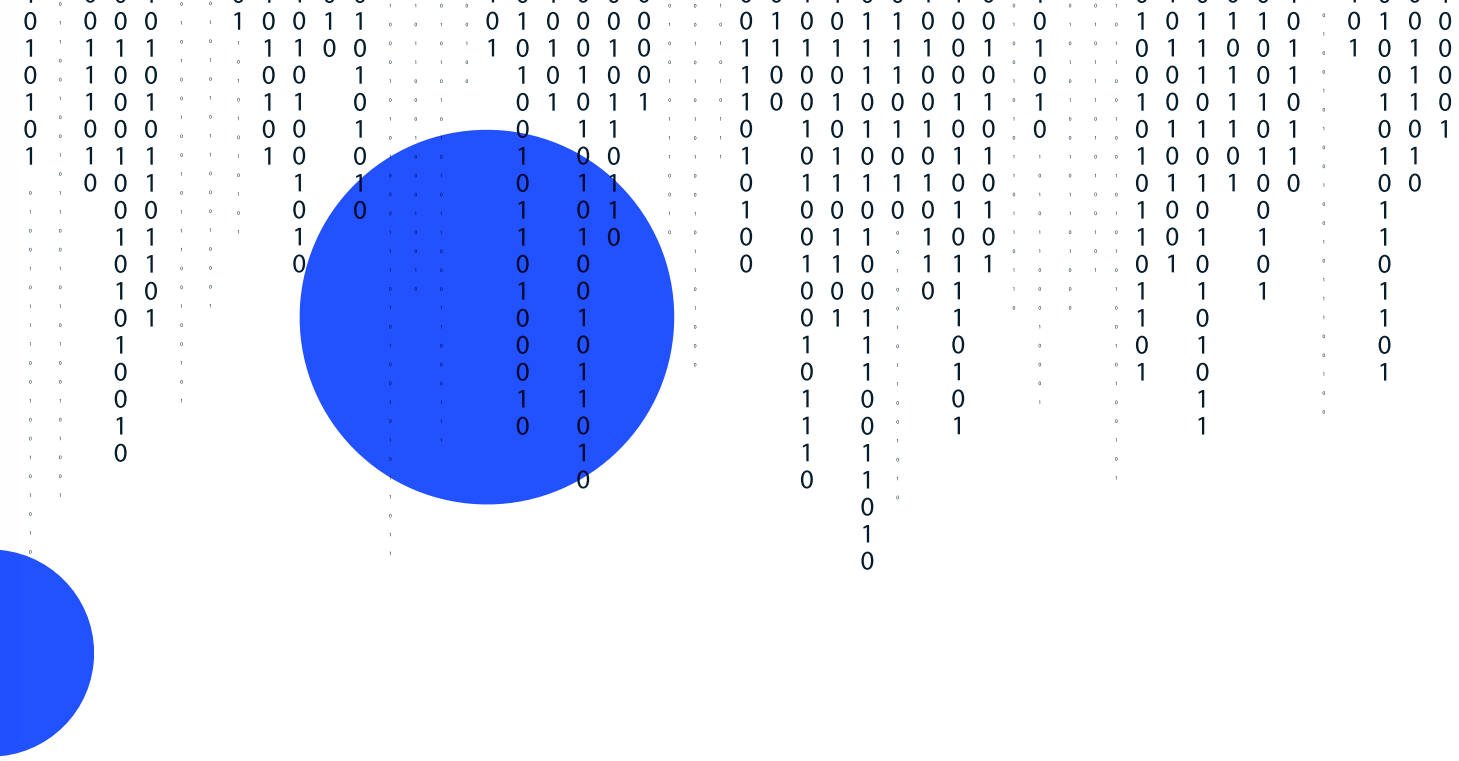
700+ use cases were split into 3 categories by their level of public-cloud dependence and then their respective share of value was attributed to the value of public cloud



Use cases per category, %	Definition	Use-case example	Public-cloud allocated value, %
Unlocked	Use cases that cannot be implemented without public cloud due to the complexity of the algorithm and data volumes	Design to value in retail: Using advanced analytics through sentiment analysis, trend modeling, and social listening to predict which products are likely to succeed in private labels	100% Full value allocated given scale of data volume and computing power; would be cost prohibitive to stand up on premises
Accelerated	Use cases that can be implemented on premise but will benefit from cloud capabilities, namely time to market and scalability	Predictive maintenance in advanced industries: Predicting defects by managing quality of products and analyzing what drives performance of vehicles	~30% Partial value allocated, given cloud will expand value via accelerated product development and scalability
On premise	Use cases that will not likely benefit incrementally from cloud capability and would most likely be implemented on premises; sensitive to regulation, privacy, bandwidth, and latency	Demand forecasting in healthcare: Forecasting demand for healthcare services and reducing readmissions through targeted discharge setting, due to strong regulations (e.g., HIPAA compliance) and relatively low data volume	0% None of the value of the use case is allocated to public cloud



03 Poland's cloud journey



A strong foundation consisting of scale, momentum, and a good digital starting point is a platform for the ability of organizations in Poland to capture the potential of cloud technology. In addition, Poland could focus on five key limiting factors—lack of awareness, regulatory concerns, security concerns, lack of required capabilities, and financial burden—that overcoming should unlock accelerated cloud adoption in Poland.

Current foundations for Poland's cloud adoption journey

Scale and position within CEE

Poland's GDP in 2019 reached €500 billion, making the Polish economy by far the largest in Central Eastern Europe, accounting for 36 percent of GDP of the region.[58] At the same time, the Polish population reached 38 million, which is 38 percent of CEE residents.[59] The growth of GDP averaged 4.2 percent over the past 25 years, and there wasn't a single annual economic contraction from 1991 to 2019.[60] Only Lithuania, with an economy 11 times smaller than Poland's, recorded a marginally higher growth rate over the same period.[61] This growth was driven by not only historically large, heavy industries such as mining and manufacturing but also by services, especially the surging business-services-outsourcing sector, which accounted for 5.2 percent of private-sector employment and more than 3 percent of Poland's GDP in 2019.[62] Increasing number of multinational companies are setting

up back-office accounting, finance, and customer care as well as R&D centers in Poland. Many of these service centers operate in cloud environments, both training their employees in cloud technology and stimulating demand for local IT companies to provide cloud managed services (for example, development, security, monitoring, and recovery services). In macroeconomic terms, Poland is a healthy and rapidly growing CEE market that stands a chance to be both a frontrunner and an exporter of the region's technological advances across the region.

Positive momentum

One orchestrated initiative to facilitate cloud migration of Polish companies is the Operator Chmury Krajowej (OChK). It was founded in 2019 as a 50:50 joint venture of the bank PKO Bank Polski and the Polish Development Fund. OChK operates as a multicloud storage and computing IaaS/PaaS/SaaS service provider as well as a channel partner for major CSPs. Its overarching mission is to increase cloud adoption by Polish enterprises in all industries, particularly in regulated sectors such as financial services, healthcare, and oil and gas.

OChK successfully attracted "hyperscalers" (leading global CSPs) to launch operations and build data centers in Poland. As a result, in Warsaw in April 2021, Google opened its seventh "data region" in Europe and the first in CEE, enabling low latency and high performance of cloud-based workloads and data for customers in Poland and across the region.[63] Along with data centers and enriched cloud service offerings, Google Cloud Platform is investing heavily in training ICT specialists and building an understanding of cloud solutions as well as nontechnical cloud skills at large enterprises, corporations, and SMEs. Microsoft announced in May 2020 plans to invest more than €800 million in Poland by building data centers and opening a CEE business region for its cloud product (Azure), collaboration suite (Microsoft 365), and additional services.[64] Microsoft also committed to raising digital competencies in the job market through trainings, hackathons, e-learning modules, and the like.

Additionally, to support its mission, OChK offers public-cloud services to the public via a Polish entity regulated by Polish law, supports on-premise-to-cloud migrations, provides managed services that are compliant with Polish regulations and security expectations, and builds tailored cloud-native solutions for public institutions (for example, the Polish vaccine e-registration system mentioned in Chapter 2).

OChK's mission also entails cooperating with Polish regulatory bodies to create legal frameworks that facilitate regulated sectors' transition to cloud. For instance, OChK worked closely with KNF (Polish Financial Supervision Authority) on its communication from January 2020 that liberalized the public and hybrid cloud computing services of financial institutions. Additionally, it helped ZBP (Polish Bank Association) in March 2020 create common guidelines, called Polish Cloud, for cloud migration at banks.[65]

Good digital starting point

Poland, a leading Digital Challenger, has a solid technological infrastructure to support a cloud transformation and a growing digital economy that can directly benefit from a cloud transformation. The Polish digital economy (understood as the sum of ICT, e-commerce, and offline electronics spend) was an estimated €32 billion in 2019 (35 percent of CEE) and has had a CAGR of 7 percent over the past three years.[66] Even though the share of ICT employees in Poland is less than the EU-27's average (3.4 percent in Poland, 4.3 percent in EU-27), with 550,000 specialists, Poland has the fourth-largest specialist population in the European Union (after Germany, France, and Italy). The share of ICT graduates among all graduates in Poland also increased, from 2.9 percent in 2014 to 3.8 percent in 2019.[67]

Digital entrepreneurship in Poland is also on the rise, with two domestic unicorns, Allegro and CD Projekt, serving as role models for the new generation of start-ups. Cumulative venture capital investments in Poland from 2013 to 2020 topped €850 million,[68] surpassed within CEE only by Romania (owing to a local software unicorn, UiPath). The Polish Development Fund (PFR), a state-owned development finance group, set aside more than €500 million for a fund of funds to invest in local venture capital funds in 2017—an unprecedented cash injection for the region. With more than 50 investment partners, it serves the purpose of stimulating the early-stage start-up investment ecosystem.[69]

Additionally, Polish residents have access to relatively reliable and fast broadband internet, a prerequisite for cloud technology. 57 percent of households already enjoy average broadband speed over 100 Mbps, and fiber penetration is expected to increase at a CAGR of 12 percent until 2025, especially in large agglomerations.[70] The next generation of mobile broadband technology, 5G, allowing download speeds up to 10 Gbps, is also likely to significantly improve connectivity in Poland. It is expected to cover 90 percent of the population and 58 percent of the territory in 2023, enabling IoT applications to become widespread.[71] A CAGR of 4.1 percent for the gross value of the Polish ICT sector over the past five years also reflects increasing adoption of a broad range of technologies.[72]

Current factors limiting greater cloud adoption in Poland

In addition to continuing to strengthen its foundation, Poland could focus on 5 areas—lack of awareness, regulatory ambiguity, security concerns, lack of required capabilities, and financial burden—in order to unlock accelerated cloud adoption in Poland. Although the relative importance of individual factors varies, these five dominate answers collected from businesses (potential cloud users) as part of data collection and studies conducted in 2018[73] and 2021[74] and from IT providers in 2019.[75] Some of the foregoing barriers are real, and overcoming them requires taking actionable steps (for example, improving awareness and regulatory clarity, as discussed in Chapter 4). Others are perceived barriers resulting from knowledge and awareness gaps about the technology itself. Regardless of whether the barriers are real or perceived, they all need to be taken into account to address any limiting factors that may be hindering the acceleration of cloud adoption.

Exhibit 11

Poland could focus on five areas that should unlock accelerated cloud adoption in Poland

Current factors limiting greater cloud adoption in Poland
(according to studies run by GUS and PMR)

Lack of awareness

Companies admit to having insufficient knowledge of cloud solutions and still predominantly (~42% of companies) see cost reduction as the primary reason to migrate to cloud. They have little familiarity with more advanced tools that could unlock cloud's large impact.

Regulatory ambiguity

About a third of Polish companies voice uncertainty about the location of data storage being a limiting factor for cloud adoption. This is particularly important in highly regulated sectors, in which complex legal requirements may keep companies from migrating to cloud.

Security concerns

Security concerns are mentioned as a detractor from cloud services by a third of Polish companies, while 63% of IT providers indicate that security policies prevent wider cloud adoption in Poland.

Lack of required capabilities

Cloud-skills gaps exist along with a more general ICT talent scarcity. In 2019, 44% of Polish enterprises reported difficulties filling ICT vacancies. The gap could widen unless action is taken (e.g., more investment in on-the-job training).

Financial burden

Up-front investment costs of migration to cloud are cited as the main reason not to pursue the strategy. Too often, little analysis is done on highest-impact areas, and companies "lift and shift" existing solutions, resulting in unoptimized transformation costs.

Source: *Chmura Publiczna w Polsce 2019*, IDG, Oktawave; GUS; PMR

Lack of awareness

Around 40 percent of organizations still openly admit to having insufficient knowledge and awareness of cloud solutions.[76,77] In fact, the focus on cost reduction in IT suggests that businesses still have plenty of room to expand their cloud potential and could make full use of solutions generated by cloud computing.

According to Polish companies, the two most important business benefits from public cloud (each indicated by 42 percent of respondents) are reduced total cost of ownership of IT infrastructure and reduced payment based on actual use.[78]

While adoption of public cloud may lower IT spend (by improving labor efficiency with automation, using a pay-per-use model for applications, and so on), cost benefits are greatly outweighed by benefits such as operational efficiency, increased security, faster development, access to SaaS solutions, and access to modern tools (see Chapter 2 for a more comprehensive description).

Regulatory ambiguity

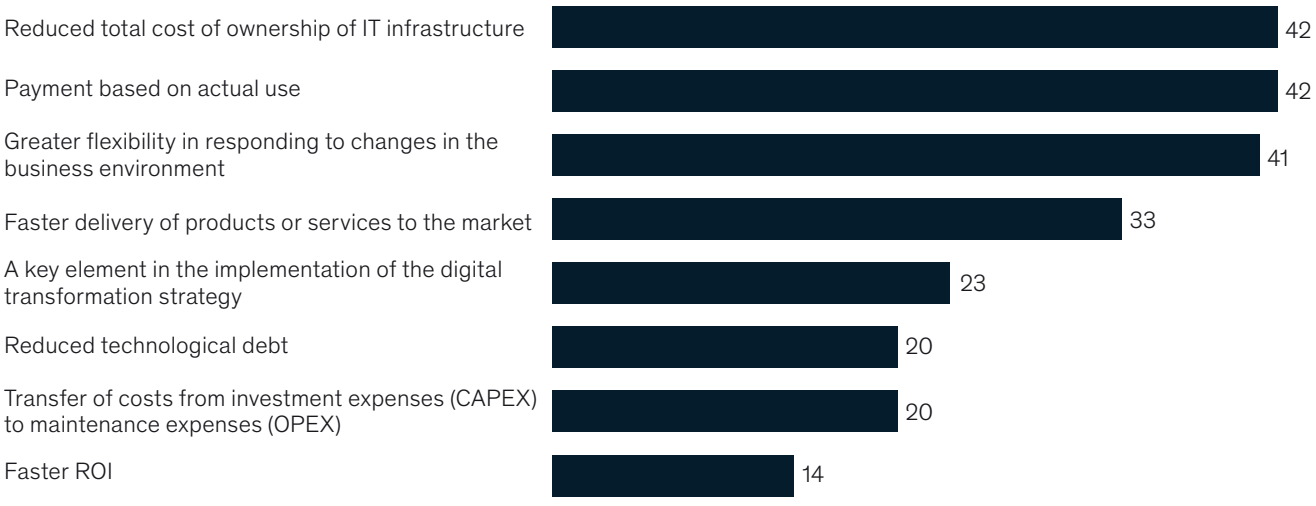
A third of Polish companies are concerned about meeting legal and compliance requirements when using cloud computing. A similar share cite uncertainty about the location of data storage as an inhibiting factor when it comes to cloud service purchase.[79] With all major CSPs operating at a global level and originating from outside of the European Union, there is potential for legal uncertainty.

In the European Union, personal data are protected by the General Data Protection Regulation (GDPR), which emphasizes the rights of EU data subjects to control who may access their data and restricts data flows out of the European Union. To satisfy local requirements, the largest cloud

Exhibit 12

Cost savings are perceived as the main business benefit

Key business benefits from public cloud, in the opinion of companies in Poland, 2019, %



Source: *Chmura Publiczna w Polsce 2019*, IDG, Oktawave

providers in Poland offer data regions, with data storage that's confined to EU territories. Uncertainties may still exist for isolated cases (for example, with respect to the complexities of applying the US Clarifying Lawful Overseas Use of Data (CLOUD) Act in Europe[80]), and organizations are able to err on the side of caution by using dedicated private-cloud environments within a broader hybrid model, partnering with EU-based providers (also as part of a multicloud system), or encrypting their data with self-managed private keys. As observed in Chapter 1, the double-digit year-on-year growth rate of cloud computing adoption indicates that organizations are able to identify solutions to meet regulatory requirements.

Regulated sectors such as finance, healthcare, pharmaceuticals, and energy operate under additional regulatory scrutiny and are subject to additional national regulations. These, on top of European law requirements, could make migration to the cloud more complex and resource consuming. For example, banks have to comply with the Banking Law and take into consideration guidelines from KNF. However, multiple layers of compliance do not stop institutions from using cloud computing. In fact, a recent KNF statement made its specific requirements clearer, and organizations were able to create compliance paths to meet them.[81] This could mean that the clarification of requirements could ease the path to adoption, especially in regulated sectors.

Security concerns

Security concerns are mentioned as a detractor to cloud services by a third of Polish companies,[82,83] while 63 percent of IT providers indicate that security policy impedes wider cloud adoption in Poland.[84] Organizations

Exhibit 13

Public cloud offers greater security and resilience, which are enabled by CSP scale, access to talent, and proprietary technologies

	Security operations failure	Regional failure	Data loss	Denial of service	Vulnerability exploits	Systematic concentration risk
Which solution has a higher risk level?	!	!	!	!	!	!
On-premise infrastructure and private cloud	Managed by small in-house team	Few data centers; limited geographical dispersion of data centers; data not always backed up	Data typically are not encrypted	Ability to buy or rent standard technologies to manage DDoS risks	Manual patching of systems, often leading to unpatched vulnerabilities	Lower levels of concentration risk
Public cloud	Advanced capabilities provided by CSP, including custom monitoring, threat intelligence tools, and automated incident response	Easier to configure, diversified data storage and multiple data centers boosting service ability. Lower likelihood of disruptions, e.g., from natural disasters	Data are typically encrypted at rest and in transit. Additional controls required to restrict CSPs from accessing data	Large-scale, innovative, out-of-the-box tools to protect against DDoS attacks	Automated CSP patching of systems, including with security updates that protect against internal technical failures and external security breaches	Concentration risk may increase exposure to single points of failure and market power of cloud service providers vs. firms. Multicloud strategies or hybrid models could potentially mitigate risk

Source: AWS, Microsoft Azure, and Google materials

may assume that data kept on premise are safer because the organization has more control over them. However, statistics from a sample of 3,950 data breaches (incidents that resulted in the confirmed disclosure of data to an unauthorized party) analyzed in 2020[85] indicate that cloud solutions performed better than companies' own infrastructure, with fewer security breaches. Cloud assets were involved in about 24 percent of breaches, while on-premise assets accounted for 70 percent.[86] Cloud solutions have the advantage of more sophisticated protections, but, being large targets with a high concentration of data, they present a more attractive target, and the consequences of a breach could be massive. Small targets such as SMEs are more likely to become victims of untargeted attacks such as those made via phishing email campaigns.

Furthermore, from a fundamentals perspective, public cloud, enabled by CSPs' scale, access to talent, and proprietary technologies, offers greater security and resilience. CSPs' business models depend on top-notch security, and they have invested substantially in cloud security and hiring top cyber experts. They have developed an array of new tools and methods to make cloud secure, in many cases requiring developer teams to take on responsibility for security (in a DevSecOps setup), rather than relying on a traditional security team.

This is particularly important because almost all public-cloud breaches have been the result of enterprise customers' insecure configurations.[87]

Lack of required capabilities

Although Poland has a large pool of ICT talent, as discussed in the

Exhibit 14

Specific areas of well-developed cloud competencies

Source: *Kompetencje chmurowe firm w Polsce 2020*, IDG, Oktawave; 7bulls.com

previous section, a cloud capability gap still exists: in 2019, 44 percent of Polish enterprises reported difficulty filling vacancies for ICT specialists. The top two impediments to finding candidates were “excessive financial expectations” and “lack of practical on-the-job experience," cited by 79 percent and 77 percent of respondents, respectively.[88] Moreover, when self-assessing existing internal competencies, more than 70 percent of medium enterprises and 80 percent of large ones still say that their level of cloud capabilities could be higher.

When it comes to a gap in cloud skills, both medium (with 80 to 249 employees) and large (with more than 250 employees) enterprises feel the shortage of capabilities, with the former most affected. The gap is having a negative impact on competitiveness, with more than half of Polish businesses already feeling or expecting to effect in the future.[89]

Looking more closely at the scarcest competencies, there is a strong perception that advanced capabilities are the least developed at both medium and large enterprises.

No imminent increase in the number of specialists is expected to fill the gap, but only 4 percent of 2019 graduates studied ICT,[90] and only 33 percent of companies offer on-the-job training for ICT specialists.[91] At the same time, there is 8 percent year-on-year growth in the number of ICT professionals employed in Poland,[92] an indication that the deficiency in professionals could continue increasing unless action is taken.

Furthermore, considering the fast pace of technological advancement, organizations that do not incorporate a lifelong learning culture, for both technical and nontechnical staff, run the risk of impairing their competitive position. This can be particularly felt with senior decision makers who find it hard to assess the benefits and risks of cloud as well as operational staff who are unprepared to leverage the potential of cloud technologies from both business and technical perspectives. Tailored sessions on cloud and emerging technologies could be a part of the professional learning curriculum for both senior decision makers and operations staff.

Finally, organizations that do not embrace the use of the latest technologies risk losing out on young and talented individuals who want to work with cloud technologies, acquire on-the-job experience, and have a long-term career of continuous learning.

Financial burden

Cloud costs should be broken down and considered separately into one-off migration costs and run costs.

In general, run costs are lower in the cloud (as shown in Chapter 2), with notable exceptions, such as cases that require a lot of customization (for example, high-performance computing) and those that require little variability in processing or storage capacity (for example, file storage offerings).

On the other hand, the high cost of cloud migration is cited as one of the main factors that discourage Polish companies from cloud computing. This includes the cost of adapting software and covering sunk costs of existing systems (cited in several surveys as companies' preference to invest in their own IT infrastructure[93,94]). Organizations that have recently gone system modernization or large entities that have already achieved on-premise economies of scale might prefer to stick to their current strategy, to avoid double investment.[95]

Verifying the profitability of migrating solutions to the crowd requires careful analysis and positive business cases. On the other hand, setting up new solutions in the cloud involves only maintenance costs, which simplifies the decision (see Chapter 4 for a decision guide for cloud strategy).

40%

of organizations still openly admit to having insufficient knowledge and awareness of cloud solutions

04 Realizing the opportunity for cloud in Poland

Polish policymakers, organizations, and individuals should act now or risk losing their competitiveness with European and global peers. As in other CEE countries, growth in Poland during the 1990s and 2000s was driven by traditional industries, exports, investments from abroad, an expanding workforce, a labor-cost advantage, and funding from the European Union. But those growth engines are now losing power. Their place could be taken by the digital economy, which has the potential to become up to 15 percent of Poland's GDP by 2025.[96]

Cloud adoption is already underway in Poland, with year-on-year growth in the use of cloud computing services and spending on cloud. However, significant room for improvement remains, both with respect to the adoption level and its growth rate. Poland and Polish companies can use this potential to enhance their competitiveness. Indeed, cloud adoption alone could deliver growth worth 4 percent of Polish GDP in 2030, as described in Chapter 2, 82 percent of which relates to future-looking, innovation-driven use cases.

Poland has a strong foundation on which to build. In particular, its size and position as a leading Digital Challenger make it an attractive market for investment by the major cloud providers. Indeed, we see major investments in cloud infrastructure, awareness campaigns, and help with developing new talent, such as the introduction of government incentives for businesses that take part in cloud learning courses.[97,98,99]

However, the window for catching up to the cloud adoption level of global economies is closing. In this chapter, we present possible approaches for Polish policymakers, businesses, and individuals to seizing the opportunity while it is still available. In particular, they involve speeding up cloud adoption, which will have the dual effect of boosting competitiveness and creating a new level of efficiency for organizations.

Journey to cloud: Policymakers and public administration

Four areas in which policy makers can support the adoption of cloud computing in Poland, namely promoting digital/cloud talent, raising awareness, ensuring digital infrastructure, and leading by example.

Promoting digital/cloud talent

Similar to other CEE countries, Poland suffers from a talent gap in the ICT sector and a cloud-talent shortage. Some 44 percent of organizations reported difficulty filling openings in 2019.[100] Government could promote digital and cloud capabilities by taking various steps, from introducing cloud into ICT curricula at schools and universities to helping businesses develop cloud talent.

First, government could consider revising ICT curricula to include clouse, which would both emphasize the importance of cloud skills and help prepare students for working in cloud environments.

Second, government could promote specialization in science, technology, engineering, and math (STEM) subjects. This would help Poland continue building its ICT talent base. Some programs already exist in the country—for example, the IT for SHE program and Dziewczyny na Politechniki, which both aim to encourage women to study technology subjects.

A third step would be more public-private collaboration with cloud providers and other private-sector organizations. For example, in collaboration with universities and business partners, McKinsey organizes a Data Science in Practice course, in which students solve a business or societal issue and gain practical knowledge and skills that prepare them for the labor market. Similar initiatives, jointly developed by academia, CSPs, and other private-sector organizations, could also aim to develop cloud skills.

A fourth step for the public sector would be to encourage businesses to develop cloud talent. This could be done, for example, by creating dedicated programs or by sponsoring part of employees' participation in training courses.

Finally, government could set up a dedicated investment fund for training programs. Ideally, it would include specific targets, such as a particular percentage increase in cloud certification or percentage decrease in vacant cloud positions.

Raising awareness

As discussed in Chapter 3, there is currently a low level of awareness about cloud computing services in Poland, which may be a factor in the slow rate of cloud adoption. To some extent, this is being improved by promotional campaigns that followed the arrival of major CSPs on the Polish market. However, policymakers could support these efforts by addressing current concerns, such as the fear of potential barriers, and drawing up clear guidelines for the use of cloud computing across sectors, not just in regulated industries. They could potentially create a private-public forum where industry representatives, cloud providers, and relevant policymakers could discuss current topics in cloud computing. The UK's Artificial Intelligence Public Private Forum, launched by the Bank of England and the Financial Conduct Authority, is an example of one such platform. It aims to foster dialogue between the public and private sectors in order "to better understand the use and impact of AI in financial services… [and promote] the safe adoption of this new technology." Quarterly meetings

and workshops are held on the topics of data, model risk management, and governance.[101]

Policymakers may decide to direct resources to encouraging cloud adoption and raising awareness about the technology in the economy. Several initiatives have already been launched in Poland—for example, the GovTech Poland Program, a competition for projects that contribute to the value chain of cloud infrastructure and services.[102] Additional initiatives could be tailored to specific industries.

Cloud technology can be an enabler of more widespread technological development. To help raise awareness about cloud and other technologies, policymakers could initiate partnerships with academia and the private sector to support research on digital topics, such as AI, machine learning, and IoT.

Ensuring digital infrastructure

Online access is a key requirement for cloud. Organizations need a certain level of speed and network capacity to use the cloud efficiently. Ensuring good connectivity has been the focus of policymakers for some time, with visible results: Poland has high-quality infrastructure, and the fiber-optic network is forecast to grow at 12 percent a year through 2025.[103] It will be important for Poland to continue improving connectivity with the development of 5G, which enables even faster connection speeds, as discussed in Chapter 3.

Leading by example

Governmental and administrative agencies in Poland have already started to embrace cloud technology across the value chain, as discussed in Chapters 2 and 3. Sustaining the momentum would have a positive spillover effect that could address common concerns about cloud migration.

Several countries around the globe, including the United States, the United Kingdom, Estonia, and Belgium, have implemented "cloud first" policies or government cloud policies. These policies are based on the idea that that migrating to cloud-based models offers advantages such as enhanced agility, reliability, security, and innovation. Typically, specific cloud services are established to serve government authorities, and departments and associated bodies in a secure, cost-effective, and efficient way. The United Kingdom, for example, published its Cloud First Policy as early as 2013.[104] It stated that public-sector organizations should consider potential public-cloud solutions first, before other options. This policy was mandatory for central government and strongly recommended for the wider public sector. The United Kingdom also created G-Cloud, a series of framework agreements with suppliers to showcase their services in a marketplace that public bodies can browse according to their needs.[105]

The public sector in Poland also has a number of programs promoting the use of cloud services. For example, the common IT infrastructure project *Wspólna Infrastruktura Informatyczna Państwa* (WIIP) aims to increase public service efficiency and security. It includes the following elements:

1. Public-cloud services (*Publiczne Chmury Obliczeniowe*, PChO), offered by private providers
2. Government cloud services (*Rządowa Chmura Obliczeniowa*, RChO), using secure government IT infrastructure
3. An integrated cloud provisioning system (*System Zapewniania Usług Chmurowych*, ZUCH) for public administration that simplifies purchasing and payment and includes a catalog of available services

Going forward, it will be important to encourage public entities to implement their cloud strategies at scale. Governments are advised to take a systematic, structured approach to cloud in order to unlock the full value of the technology. Indeed, it would be useful for public-sector institutions to follow the same approach as businesses.

44%

of organizations reported difficulty filling openings in 2019

Journey to cloud: Businesses

To understand the value that cloud can bring them—from increasing IT productivity to driving innovation—businesses need to put in place a cloud transformation program that covers three broad areas: Strategy and management, Business domain adoption and Foundational capabilities.

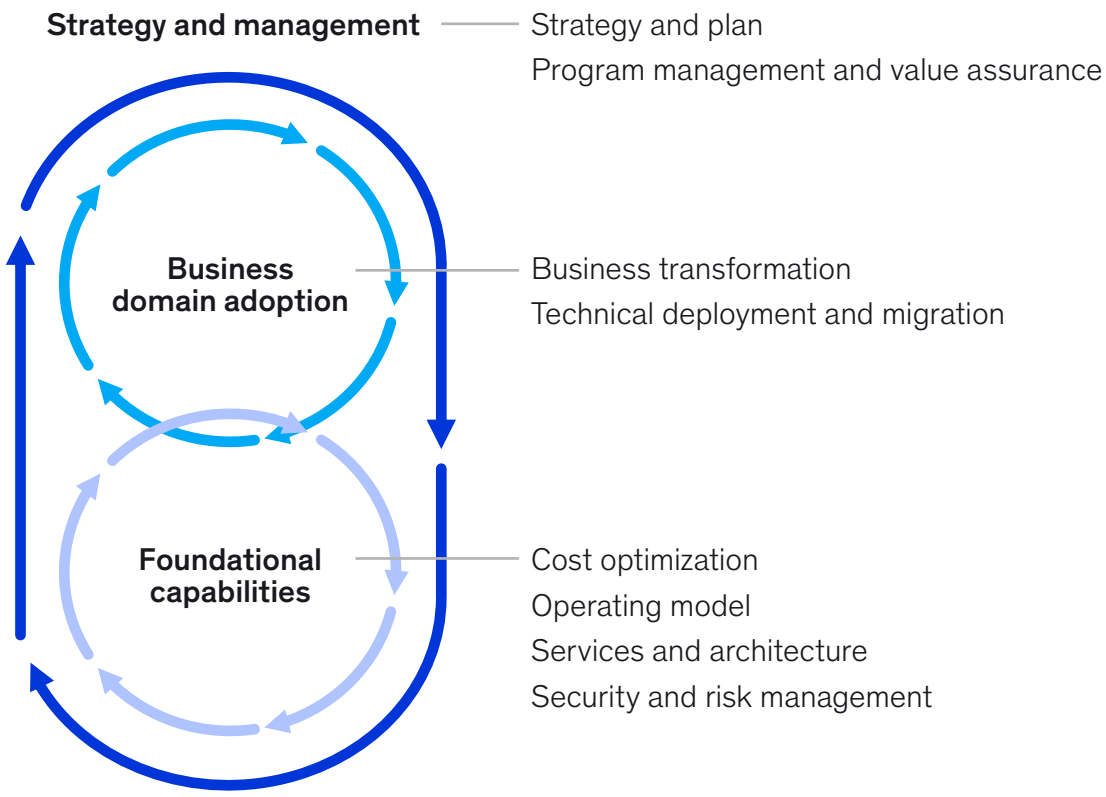
Strategy and management

Strategy and plan

Those who have succeeded, think of cloud in terms of business transformation not as an opportunity for next-gen hosting. They are relentless in identifying the value, assessing the drivers of that value, and prioritizing business domains (e.g., finance or supply chain) that can generate significant value from cloud. Some sources of value from cloud include:

- Faster development: Cloud providers usually offer solutions that do not require profound knowledge of AI, machine-learning theory or a team of data scientists. They can thus help organizations experiment with the technology despite a lack of internal resources.[106]
- Access to a wider range of tools, including cloud-native options: More and more application providers are releasing updated versions of their products as cloud-native options. As a result, users are switching to cloud solutions by default when they upgrade to the latest offering. For example, the leaders in multichannel marketing currently all offer cloud-based solutions.[107]
- Some solutions have always been cloud-native: For example, a major customer relationship management platform has only ever been offered as a SaaS-based cloud offering.
- Some solutions can only be accessed via cloud: IoT, for

Exhibit 15
Cloud Transformation Engine



example, cannot function efficiently without cloud computing.

— Cloud facilitates real-time delivery of computing capacity: This makes it possible to process the vast amounts of data generated from hundreds of IoT devices, databases, storage, and applications.

— Organizations also examine how and to what extent cloud computing can support them in achieving their vision. The output is a clear strategy that forms the starting point for conscious action.

Program management and value assurance

Driving cloud value is a cross-functional program, requiring active change and participation from business leaders, developers, infrastructure managers, security, compliance and other enabling functions over two to three years. Success requires breaking everything into a series of three- to four-month sprints, with initial sprints focused on minimum viable products (MVPs).

Organizations should carry out a detailed assessment of their application portfolio (their HR system, customer relationship management application, and so on). In doing so, they would be advised to look carefully at stakeholders and the current features of their applications, such as their architecture and hosting. They also need to examine their existing infrastructure, understanding the current footprint and environment. Building on this, they could then identify any ongoing modernization initiatives, as this provides important input for any decisions regarding transformation. It is important to also consider any regulatory, contractual, physical, or technological factors that could impact their modernization efforts.

Companies should also develop their approach to cloud, which involves reviewing the different options available, namely public cloud, private cloud, and hybrid cloud (see Chapter 1 for the advantages and disadvantages of each of these). They will also need to decide between single-cloud and multicloud solutions, which involve a trade-off between simplicity and risk of vendor lock-in. Organizations should perform a case-by-case analysis, looking at five strategic options for each application: retire, repurchase, move to cloud, optimize on premise, or implement a new solution on premise.

The output is an implementation roadmap with specific out-oriented KPIs. Each phase of the roadmap will include the potential impact, the effort needed to achieve it, how long it will take, and details of what changes need

		Decision regarding application (assessed case by case)		
		Remove from portfolio	**Keep existing application**	**Change application**
End-state environment	**Cloud**	Retire Accelerate application retirement and focus on taking cost out (e.g., for applications providing duplicate functionality or not used anymore)	Move to cloud Move to public-cloud IaaS or PaaS and modernize application architecture	Repurchase Move services hosted on premise to an SaaS solution where viable replacements exist
	On premise		Optimize on premise Implement architectural quick wins and consolidate data center footprint	New solution on premise In cases with constraints (e.g., regulatory restriction in the financial sector), consider new solutions fully on premise or in hybrid configurations

to be undertaken.[108] The initial vision should drive the prioritization effort and timeline for implementation.

Business domain adoption

Business transformation
Just moving an application to the cloud by itself does not necessarily create value. It has to be combined with business perspectives on how to leverage agility, innovation, or scalability for competitive advantage or operational efficiency. This requires tight integration with business leadership to ensure cloud-transition efforts drive business value. The CEO and relevant business-unit heads must mandate people in their organizations to be product owners and provide them with decision-making authority.

It's important to think about transitioning domains (a complete product, service, or function), not applications. Start with migrating one business domain and build a repeatable approach, with supporting skills, that can be rolled out domain by domain across the institution.

Technical deployment and migration
In the rush to move apps to the cloud, most companies have already started to accumulate technical debt. Many systems in the cloud are unstandardized, manually configured, hard to manage, and insecure. Any technical transition plan needs to account for this technical debt and take aggressive steps to reduce it.

For existing applications, the level of remediation drives both investment and value. Transition costs to "lift and shift" an application, for example, may be only 10 percent of the application's total cost of ownership (TCO), but costs may go up and agility may not improve at all. In contrast, containerizing an application as you move it to cloud may cost 20 to 60 percent of the original application's TCO but can improve productivity by 20 to 30 percent and enable weekly releases. Companies that invest in automation and repeatable transition processes, for example, can reduce one-time transition costs by 20 to 30 percent.[109]

Foundational capabilities

Cost optimization
A major driver of value capture is transforming the approach to sourcing and consuming cloud. Choices about level of automation and types of cloud services to consume have large impacts on investments required and future-state run rate. Enterprises estimate that around 30 percent of their cloud spend is wasted. Furthermore, around 80 percent of enterprises consider managing cloud spend a challenge. A governing model is needed to continuously evaluate performance, forecast demand, and optimize costs through an IT governance structure that implements FinOps processes.

Cloud operating model
Cloud goes hand in hand with agile, speeding up innovation cycles by improving time to market. Furthermore, adjusting to more flexible, agile ways of working can unlock new opportunities for the organization. This approach supports an environment of experimentation, including testing various proofs of concept.

Companies need to adjust their operating model to be more agile to take advantage of cloud's benefits. This involves areas such as governance mechanisms, leadership alignment, talent development, and upskilling to successfully deliver the technology roadmap.

Companies should make everything a product, with a stable product-funding model. Products provide business capabilities such as order capture or billing. Automated as-a-service platforms can provide underlying technology services such as data management or web hosting. This approach focuses teams on delivering a finished working product rather than isolated elements of a product.

Organizations also need the right talent in order to manage new technologies and use them to their full potential, as discussed in Chapter 3. It is important for businesses to build up a core of cloud engineers, and close other skills gap by means of

targeted upskilling programs, helping employees acquire knowledge about new technologies and agile ways of working, including cloud skills.

Cloud services and architecture
There are a massive number of offerings from cloud service providers (CSPs) and configuration choices, which can overwhelm developers. To counter this issue, companies must create standardized cloud products that developers can consume in order to avoid unmanageable complexity and technical debt in the cloud. Given how critical developer acceptance and developer productivity will be to the overall business case—in many respects, they are the customers for cloud—it's crucial to design the service model around developer experience.

Cloud risk and security management
Managing "policy as code" (or "security as code") is the only way to reconcile the imperatives for security and risk management and the imperative for speed in the cloud. Security as code defines cybersecurity policies and standards programmatically, so they can be referenced automatically in the configuration scripts used to provision cloud systems and so that systems running in the cloud can be compared to security policies.

Journey to cloud: Individuals

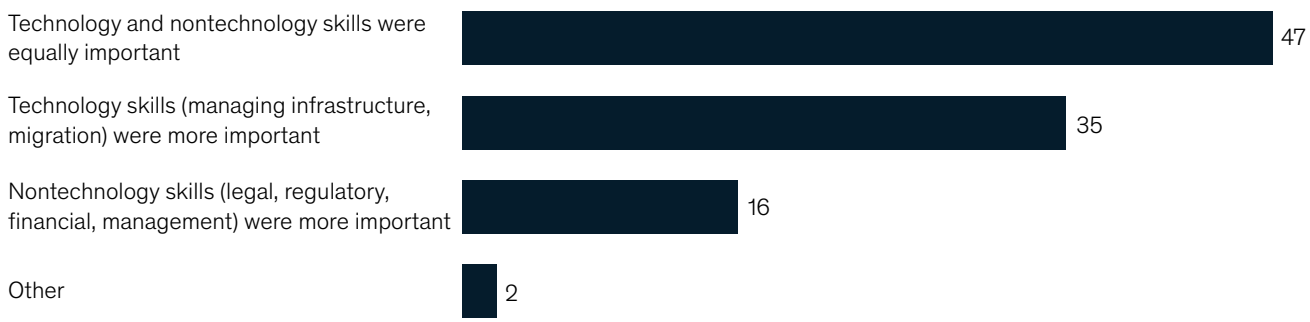
Cloud is a part of both our professional lives and day-to-day existence. The COVID-19 pandemic has shown that it's possible to perform online most everyday activities—working or studying, signing up for vaccines, talking to the doctor, grocery shopping, and many more. As discussed throughout this report, these activities could be and often are done in the cloud. Learning about cloud technology will make everyone more aware of what such changes mean.

As discussed in the report *Digital Challengers in the next normal*, lifelong learning is key for individuals. To remain competitive in the labor market, people need both general digital skills and cloud skills. As discussed in Chapter 1, new technology paradigms appear every five to ten years. Individuals need to keep up with the changes through self-development and learning.

Demand for both technical and business skills in the cloud-computing world is likely to grow, giving individuals the opportunity to choose which

Exhibit 16
Technology and nontechnology competencies are crucial to successful cloud strategies

Which set of competencies contributed most to the success of cloud transformation in your company? 2019, %



Source: *Kompetencje chmurowe firm w Polsce 2020*, IDG, Oktawave; 7bulls.com

50%

of organizations consider business and technical skillsets equally important when it comes to successful cloud transformation

skills to develop. Nearly half of the organizations surveyed consider business and technical skills equally important for successful cloud transformation.[110] Demand will also likely increase for less technical roles, such as cloud-conscious project managers, UI/UX designers, testers, product owners, and administrative roles. Furthermore, senior decision makers should ensure that they have at least a basic knowledge of cloud so that they can make informed decisions about how their organization's technical landscape should evolve.

CSPs and education-focused websites that provide online training courses dedicated to cloud skills are a good starting point for both individuals who want to build basic skills and those who wish to expand their existing technical knowledge. For the purposes of education and training, cloud skills can be broken down into the following categories:

1. Cloud infrastructure and DevOps, including skills such as creating and managing cloud resources
2. Data engineering, machine learning, and AI in the cloud
3. Applications—for example, building applications, websites, and interfaces in the cloud
4. Cybersecurity—for example, managing workloads and services

Closing remarks

The COVID-19 pandemic has demonstrated clearly that organizations, indeed entire economies, need to be ready for unpredictable circumstances and prepared to adapt their ways of working accordingly. Cloud computing has been an important enabler in the mass shift to remote working that was spurred by the pandemic. Speeding up cloud adoption can also unlock innovation and help Poland to keep moving along its journey as a Digital Challenger.

It is our hope that this report will raise awareness about the potential that can be realized by speeding up the adoption of cloud across the Polish economy. With this in mind, we have laid out the facts concerning the current state of cloud technology, the potential that it could unlock for the economy, Poland's favorable starting point, and the real and perceived barriers that will need to be overcome. We have also presented the implications of cloud adoption for policymakers, businesses, and individuals.

Technology changes fast, and the time to act on cloud is now. With the help of our analyses, stakeholders can make the right decisions and seize the opportunity while it is still available.

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