

#### THE ECONOMIC IMPACT OF CLOUD COMPUTING IN EUROPE

#### A research report commissioned by the European Cloud Alliance

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#### 1. Types of Cloud Computing

Cloud computing has the potential to be one of the most transformative economic innovations of the twentyfirst century—allowing companies and government agencies to scale resources quickly, increase portability and accessibility, reduce costs, and increase security as well as productivity. Furthermore, it facilitates the market entry of new competitors, and thus enhances the competitiveness of companies.

Cloud computing offers a wide range of services. Basically, a distinction can be made between three different service models, namely Infrastructure as a Service ("IaaS"), Platform as a Service ("PaaS") and Software as a Service ("SaaS") (see also Figure 1) which can be briefly described as follows:

- laaS provides access to basic IT resources, such as computing power, storage or network capacities hosted by a cloud provider. For the user it is no longer necessary to build up own servers and storage capacities.
- PaaS is on-demand access to a complete, ready-to-use, cloud-hosted platform for developing, running, maintaining and managing applications. With PaaS, the cloud provider hosts all the needed elements in its data centre. These include servers, networks, storage, operating system software, middleware or databases.
- SaaS provides ready-to-use-applications that do not have to be installed on the end customer's system but is hosted in the cloud. This can, for example, be web-based applications, such as Microsoft Office 365, or video sharing platforms, such as YouTube. Thus, the consumer no longer buys software, but only pays for its use.<sup>1</sup>

SaaS, IaaS and PaaS are not mutually exclusive. Many medium-sized enterprises use more than one, and most large enterprises use all three. Moreover, it is also widespread among companies to use IaaS or PaaS to develop and host their own SaaS solutions. The services addressed can be made available via different cloud solutions, namely Private Cloud, Public Cloud, Community cloud or Hybrid Cloud.

Private cloud is a cloud environment in which the cloud infrastructure is provisioned for exclusive use by a single customer or organization. By contrast, the public cloud is offered by a freely accessible provider that makes its services openly available to anyone over the Internet. Community cloud is an extension of the private cloud. The cloud infrastructure is no longer provided for the exclusive use of one organisation, but for a specific community of organisations that have common concerns. A hybrid cloud is defined by its name alone. It is a

<sup>&</sup>lt;sup>1</sup>See <u>https://www.ibm.com/cloud/learn/cloud-computing#toc-cloud-comp-noOVC-kh</u>, accessed on April 28, 2022.



combination of two or more different cloud environments (i.e., private cloud, public cloud or community cloud).<sup>2</sup>

As with the cloud computing services models, the different solutions are not mutually exclusive. It is not atypical for companies to use more than one of these solutions. For example, it might be useful for companies to secure confidential data only via a private cloud, as the private cloud is not shared with others and therefore has greater security. Public clouds, on the other hand, are cheaper than private clouds and can be used for other applications.

#### Figure 1: Cloud Computing Service Models



Source: DICE Consult.

#### 2. The European Cloud Computing Market

The cloud computing market is a very fast-growing market. In Europe, the size of the cloud computing market was estimated at 53.9 billion euros for the year 2020. It is expected to grow to 135.9 billion euros by 2025.<sup>3</sup> PaaS services represent the smallest segment of cloud computing services in Europe at about 16.6 percent. This is followed by IaaS with a share of around 20.5 percent. With about 62.9 percent of all cloud computing services, SaaS services are the largest segment in Europe. The European cloud industry (IaaS and PaaS) is dominated by three major operators ("Hyperscalers"): Amazon Web Services ("Amazon"), Microsoft Azure ("Microsoft") and Google Cloud Platform ("Google"). At the end of 2020, they had a combined market share

<sup>&</sup>lt;sup>2</sup> See <u>https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf</u>, accessed on April 28, 2022.

<sup>&</sup>lt;sup>3</sup> See <u>https://www.statista.com/forecasts/1235161/europe-cloud-computing-market-size-by-segment</u>, accessed on April 1, 2022.

of 66 percent in Europe.<sup>4</sup> The SaaS market, on the other hand, is a very broad market with numerous providers. There are over 25,000 SaaS companies worldwide offering a wide range of different services. More than 15,000 of these companies are located in the USA, while only around 6,000 SaaS-companies are based in Europe.<sup>5</sup>

An increasing number of European companies are integrating cloud computing services into their business processes. While in 2014, just 18 percent of all European companies used cloud computing services, the share increased rapidly to 41 percent in 2021. The Corona pandemic, and the business challenges caused by it, were certainly a catalyst for many companies to accelerate their move to cloud. Nevertheless, the European economy also holds significant untapped growth potential in cloud services not only in sectors where penetration is low, such as manufacturing, transportation or aerospace-defence (European Commission, 2020), but also regarding the general adoption of cloud computing services across the different member states which still vary significantly (see Figure 2).

#### Figure 2: Cloud Computing Service usage across the EU



Source: DICE Consult, based on data from Eurostat.

As Figure 2 shows there are four broad clusters of cloud adoption: A north-south cluster of high adopters which includes the Scandinavian countries, the Netherlands and Italy. Over 60 percent of all companies in these

<sup>&</sup>lt;sup>4</sup> See <u>https://www.srgresearch.com/articles/european-cloud-providers-struggle-reverse-market-share-losses</u>, accessed on April 1, 2022.

<sup>&</sup>lt;sup>5</sup> See <u>https://www.crunchbase.com/hub/europe-saas-companies</u> and <u>https://ascendixtech.com/number-saas-companies-statistics/</u>, accessed on May 13, 2022.

countries use cloud computing services. In Finland and Sweden, the share is even more pronounced at over 70 percent. In addition, there is an Eastern European cluster of low adopters (Bulgaria, Romania, Greece, Hungary, Poland, Latvia; France has a similarly low cloud adoption rate. The share of companies using cloud computing services in these countries is below 30 percent in each case. A further cluster consists of higheradopters, namely Ireland, Estonia, Malta and Belgium, where at least half of all companies use cloud computing services. Finally, there is an average-cluster of countries, such as Germany, Spain, Portugal and Czechia in which between 31 and 49 percent of companies use cloud computing services. The EU average is 41 percent.

The adoption rate of cloud computing services differs not only between countries, but also in terms of company size. The share of companies that have integrated cloud computing services into their business processes increases with the size of the company. While only 38 percent of small enterprises in the EU use cloud computing services, more than half of all medium-sized enterprises, 58 percent, use cloud computing. With a share of 72 percent, the diffusion of cloud computing services is significantly higher among large companies than in small and medium-sized enterprises ("SMEs") which in total is just 40 percent.<sup>6</sup>

The reasons for the different adoption rates are manifold. France's adoption rate of only 29 percent is mainly due to the lack of adoption by SMEs.<sup>7</sup> According to the European SME survey 2019, 70 percent of French SME leaders do not consider the digital transformation of their companies as a top priority.<sup>8</sup> Moreover, certain company and market characteristics increase or decrease the likelihood of cloud adoption. For example, the probability of cloud adoption at the enterprise level is negatively related to enterprise age and positively related to enterprise size. In addition, the adoption of cloud computing is influenced by different market characteristics. Employment promotion laws and bankruptcy regulations are associated with a lower likelihood of cloud adoption. An additional factor is the availability of fast broadband or fibre access. Low levels of development of these technologies can be an obstacle for a company to adopt cloud computing (Andres et al., 2020).

#### RECAP

#### The Adoption of Cloud Computing in Europe

 $\rightarrow$  The adoption of cloud computing services differs significantly between different European countries, and in terms of company size.

 $\rightarrow$  There is still untapped growth potential, especially among SMEs, where the adoption rate is rather low.

<sup>7</sup> See <u>https://ec.europa.eu/eurostat/databrowser/view/ISOC\_CICCE\_USE\_\_custom\_2713366/default/table?lang=en</u>, accessed on May 13, 2022.

<sup>&</sup>lt;sup>6</sup> See <a href="https://ec.europa.eu/eurostat/databrowser/view/ISOC\_CICCE\_USE\_custom\_2622801/default/table?lang=en">https://ec.europa.eu/eurostat/databrowser/view/ISOC\_CICCE\_USE\_custom\_2622801/default/table?lang=en</a>, accessed on May 5, 2022.

<sup>&</sup>lt;sup>8</sup> See https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Studien-und-Materialien/PDF-Dateien-Paperand-Proceedings-(EN)/European-SME-Survey-2019.pdf, accessed on May 13, 2022.



#### 3. Cloud Computing as a Driver for Innovation and Economic Growth

The diffusion of cloud computing in EU enterprises is steadily increasing, but there is still untapped growth potential, especially in SMEs and in large European countries such as Germany, Spain, France and Poland. Cloud computing has the potential to create several benefits for enterprises resulting in increasing innovation as well as economic growth. Estimates for Poland, for instance, indicate that the widespread adoption of cloud computing services can generate an annual added value of 27 billion equivalent to four percent of Poland's annual GDP by 2030 (McKinsey & Company, 2021).

One key point for the adoption of cloud services is cost saving. Enterprises no longer must buy and maintain expensive infrastructure, but only pay for the services they use from the cloud provider. This also encourages the scalability of enterprises. Companies only pay for the infrastructure and services they need. Depending on demand, the required services can be scaled up or down. This creates efficiencies. Should a company be affected by seasonal or conjunctural fluctuations, there is no unused overcapacity and no need to buy additional expensive infrastructure during peak periods. Further efficiency advantages result from the fact that companies no longer have to worry about the investment, maintenance and updating of servers or applications. The cloud operator can take care of all this. Enterprises can use all their capacities for their core business. Furthermore, cloud computing offers a flexible access to resources. As data and applications are no longer stored on a device, but in the cloud, they can be accessed at any time, regardless of the location or device. This can increase employee efficiency, which ultimately benefits the entire company (Saini et al., 2019).

These findings are confirmed by a survey of the International Data Group (2020). 79 percent of the companies surveyed stated that they see three or more benefits from using cloud services. These mainly include cost savings, increased efficiency and access to new technologies. For example, 45 percent of companies report that they have lower infrastructure and storage costs, and 53 percent that operational efficiency has increased.

The use of cloud computing services not only leads to cost savings and efficiencies for businesses, but also promotes energy efficiency. Often, servers and storage capacities of classic IT-infrastructure remain unused by companies. Through cloud computing, companies only use the required amount of storage and computing capacity. Each company no longer has its own (often underutilised) servers, but the cloud provider's servers are shared. Lastly, this also means that the utility costs of the enterprises are reduced (Masanet et al., 2013).

Furthermore, the use of cloud computing services creates multi-dimensional network effects, as the cooperation of companies is considerably facilitated. For example, several cooperating companies can work simultaneously on the development of products and services via a platform hosted in the cloud. This makes the development of products and services more flexible, faster and efficient. Companies do not have to worry about compatibility problems, as the development takes place collectively on the platform of the cloud provider (Etro, 2009).

It is interesting to note that an increasing implementation of cloud computing services within a company leads to greater benefits. In fact, 44 percent of high adopters say they work more efficiently with the cloud which is ten percentage points more than those with low cloud adoption. 41 percent of high adapters have higher customer satisfaction. For low adopters, the proportion is just 33 percent. In addition, 53 percent of high

adopters say that they can use data more effectively through the cloud and generate profit as a result. In contrast, only 46 percent of low adopters state this (International Data Group, 2020).

One of the biggest opportunities of cloud computing is the encouragement of innovation. Lower costs for computer capacities or software applications allow companies to initiate and realise certain product or service developments in the first place. In addition, companies also take less risk when projects can be developed more cost-effectively through cloud computing. This applies to companies from all sectors of the European economy. Companies can use the cloud infrastructure to develop and offer their own innovative SaaS products. A prominent example of this is Netflix. Netflix needs great computing and storage requirements but does not have its own infrastructure. For almost all of its computing and storage needs, Netflix relies on Amazon's cloud offering.<sup>9</sup> Without cloud computing, Netflix would probably never have been able to revolutionise the international television market. Thus, cloud computing offers a completely new way to do business and promotes innovation (Yang et al., 2017).

According to the survey of the International Data Group (2020). 34 percent of companies stated that they were able to develop new innovative products and services through the use of cloud computing. 39 percent said they were able to test new products without high entry costs and 36 percent stated that the time to market of products has decreased.

Especially SMEs benefit from the described advantages of cloud computing due to cost-effective access to the latest technologies and applications created by professional developers around the world (Ross and Blumenstein, 2015). In the past, such applications or computing capacities were only available to large companies. Cloud computing not only reduces the costs of businesses but transforms fixed capital expenditure into operational costs. Companies rent the servers and computing capacity from the cloud provider and no hardware needs to be purchased for one-off or infrequent compute-intensive tasks. This lowers market entry barriers and promotes the emergence of new start-ups. The increasing number of companies as well as the increased competition can lead to new products and innovations, from which the entire economy benefits (Etro, 2009).

It becomes clear above all, that cloud computing increases the competitiveness of SMEs which is of particular interest since SMEs are the engine of growth for most economies, as they make a significant contribution to job creation, act as a source of innovation and account for a large share of enterprises. The growth of national economies is highly dependent on the growth of SMEs (Vajjhala and Ramollari, 2016). SMEs represent 99 percent of all businesses in the EU, employ about 100 million people and are responsible for over half of the GDP of the European Union. This makes them a key driver of European economic growth and the backbone of

<sup>&</sup>lt;sup>9</sup> See <u>https://aws.amazon.com/de/solutions/case-</u>

studies/netflix/#:~:text=Netflix%20verwendet%20AWS%20f%C3%BCr%20fast,Server%2DInstances%20auf%20AWS%20verwenden., accessed on May 23, 2022.

the European economy.<sup>10</sup> Bearing in mind that only 40 percent of all SMEs in the EU currently use cloud computing services, it becomes clear that there is still significant untapped growth potential.

Empirically, the previous arguments are verified by DeStefano et al. (2020) who find that the use of cloud services increases the number of employees and sales. These effects are higher for young companies than for incumbents. They also show that companies' fixed costs decrease. Another empirical work by Jin and McElheran (2017), which focuses on young companies, finds that the use of cloud computing is associated with significantly higher survival and growth rates among young companies. In contrast, investments in traditional IT capital increase the likelihood of failure.

The benefits of cloud computing are wide-ranging and apply to all businesses. However, different aspects of cloud computing apply to specific types of companies. This is illustrated in Figure 3. Start-ups don't have to make costly upfront investments in servers or computing power. They can rent this service as needed, making it easier to enter the market. SMEs benefit from the easy scalability, which creates efficiencies. In addition, they get access to large computing power and the latest applications, which makes the development of new and innovative products possible in the first place. Large established companies can outsource their entire IT. This saves resources and allows the company to fully focus on its core business. Furthermore, employees become more flexible and cooperation within a company as well as with other companies is facilitated.



#### Figure 3: Benefits of Cloud Computing for different Types of Companies

Source: DICE Consult.

For European companies and the entire European economy to benefit from the opportunities and advantages of the cloud, a large and robust cloud infrastructure is required. This requires a large investment volume in the

<sup>10</sup> See

https://ec.europa.eu/growth/smes\_de#:~:text=Small%20and%20medium%2Dsized%20enterprises%20(SMEs)%20are%20the%20backbone,ev ery%20sector%20of%20the%20economy, accessed on 10 May, 2022.

respective infrastructure. The three US-Hyperscalers Amazon, Microsoft and Google all have global operations — with dozens if not hundreds of data centers as well as a long chain of manufacturing suppliers. This enables them to further develop the existing infrastructure and make the necessary investments in its expansion. This is a win-win situation for the European economy which can be demonstrated using Google as an example.

Google has invested heavily in data centres and the related infrastructure in Europe in recent years. For example, huge hyperscale data centres have been built in Dublin in Ireland or in Eemshaven-Groningen in the Netherlands. In total, Google invested 6.9 billion euros between 2007 and 2018, from which the European economy has benefited enormously. During this period, Google's activities boosted economic activity in Europe by an average of 730 million euros per year, which amounts to a total of 8.8 billion euros for the entire period. In addition, on average 9,600 new jobs per year have been created across the value chain and across different sectors in European industry. This corresponds to a total of 115,200 newly created jobs for the entire period (Copenhagen Economics, 2019).

The economic benefits for Europe presented only refer to the direct effects. This includes the direct revenues and employees of the data centres, the expenditures and employees of the suppliers, as well as expenditures or consumption of the employees of the data centres in other sectors of the economy. However, estimates for Microsoft reveal that by 2025, Microsoft's ecosystem partners in Europe will generate eight dollars in revenue for every dollar generated by Microsoft itself.<sup>11</sup> Estimates for the European economy as a whole suggest that cloud computing created 1.6 million new jobs between 2008 and 2020 and enabled the creation of 303,000 start-ups between 2015 and 2020. In total, an additional 449 billion euros in revenue was expected in the EU over this period (European Commission, 2017).

The fact that the three US-Hyperscalers are responsible for the majority of the European cloud infrastructure is no coincidence and completely plausible from an economic point of view. In addition to the necessary financial resources, these companies have years of experience in the development and operation of large data infrastructures. Moreover, they take advantage from network effects as they operate hundreds of data centres. Furthermore, they benefit from economies of scope, which occur when the production of one good lowers the cost of producing or providing another related good. This especially helped in the early days of building and growing cloud infrastructure. Microsoft, for example, needs large storage and computing capacity to offer its cloud software services to its customers, such as Office 365. According to information from Microsoft, economies of scope only play a subordinate role today. The provision of own software services via their infrastructure only represents a minor share.

<sup>&</sup>lt;sup>11</sup> See <u>https://blogs.microsoft.com/eupolicy/2022/05/18/microsoft-responds-to-european-cloud-provider-feedback-with-new-programs-and-principles/</u>, accessed on 25 May, 2022.



#### 4. Outlook

It has been shown that increasing use of clouds will strengthen the European economy's competitiveness, its innovation potential and accompanying economic growth. Companies can save costs, become more efficient, innovative and flexible. In addition, market entry barriers can be lowered, and the competitiveness of SMEs in particular can be increased. Especially the three big Hyperscalers operate a huge infrastructure, which they will continue to expand in the future. Microsoft<sup>12</sup>, Google<sup>13</sup> and Amazon<sup>14</sup> have already announced further investments and data centres in various regions of Europe.

The substitution of traditional ICT with cloud is taking place quite rapidly during the last several years, which is expected to be important for firm competitiveness and productivity growth. However, the rates of cloud adoption across EU member states are considerably different raising several issues regarding the appropriate policy to enable cloud use. A study by Andres et al. 2020 assesses whether current policy environments are appropriate for the emergence of cloud computing technology by using firm-level data for Germany and the UK. The design of many of these policies target investments in physical capital excluding digital services like the cloud. The results suggest that capital incentive policies are discouraging cloud adoption in the United Kingdom and in Germany.

Furthermore, the analysis of Andres et al. (2020) also suggests that the availability of fast broadband connections is an important determinant for cloud usage. These results are consistent with evidence on the importance of broadband for cloud but also for digital technologies in general (e. g. DeStefano, Kneller and Timmis, 2019). There are large differences in the availability of fast broadband between European countries, but also within European countries. For companies that have no access to a high-speed broadband connection,

<sup>&</sup>lt;sup>12</sup> See <u>https://news.microsoft.com/europe/2020/05/08/microsoft-announces-1-5-billion-investment-plan-to-accelerate-digital-transformation-in-italy-including-its-first-cloud-datacenter-region/</u>, accessed on 12 May, 2022.

<sup>&</sup>lt;sup>13</sup> See <u>https://cloud.google.com/blog/products/infrastructure/google-invests-1-billion-euros-in-germanys-digital-future</u>, accessed on 12 May, 2022.

<sup>&</sup>lt;sup>14</sup> See <u>https://www.reuters.com/technology/amazon-invest-3-billion-open-data-centres-spain-2022-2021-06-08/</u>, accessed on 12 May, 2022.



this presents a likely barrier to the adoption of cloud computing services. In Germany, for example, as the largest economic power in the EU, just half of all businesses have access to high-speed broadband internet<sup>15</sup> while the adoption of cloud computing services at 41 percent not very high. The nationwide expansion of broadband in Germany, but also in other European countries, would lead to improved framework conditions for the adoption of cloud computing and hence also contribute to European economic growth.

For the European economy to profit from all the benefits of cloud computing, a large infrastructure of data centres is needed. The three US-Hyperscalers Amazon, Microsoft and Google have been investing huge sums in this development in Europe for years. Europe's greatest challenge does not lie in building a cloud infrastructure, but in the widespread adoption of cloud computing services. There is a synergy between US-Hyperscalers and European companies that benefits the entire European economy.

<sup>&</sup>lt;sup>15</sup> See <u>https://stats.oecd.org/Index.aspx?DataSetCode=ICT\_BUS</u>, accessed on 13 May, 2022.



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