

## Exploring the future of Cloud Computing



### **Introduction**

In the world of computer technology many feel the invention of the Internet (along with the World Wide Web) represents one of, if not the most important breakthroughs in human history. This seminal moment, which is now taken for granted, has completely changed lives, work, and habits. In fact, so much so that there is even a day named after it!<sup>1</sup>

What is less well known - or even documented - is the birth and growth of cloud computing, which some regard almost as significant as that of the Internet itself. Given that most users may use cloud computing without even realizing it, it is somewhat surprising to note this discrepancy. Perhaps a lack of clarity as to who coined the term (and when) plays a part in this. Some trace it back to 1996, where “inside the offices of Compaq Computer, a small group of technology executives was plotting the future of the Internet business and calling it *cloud computing*.”<sup>2</sup> Others suggest it was coined 10 years later, in 2006, where the then Google CEO, Eric Schmidt, used the term during a speech: “What’s interesting [now] is that there is an emergent new model, I don’t think people have really understood how big this opportunity is. It starts with the premise that the data services and architecture should be on servers. We call it cloud computing – they should be in a ‘cloud’ somewhere.”<sup>3</sup>

Nevertheless, what tech experts can agree on is, at its essence, cloud computing is “a metaphor [to describe] a remote network of computing resources which can be accessed on-demand. Consumers store their photos in the cloud, whilst workers around the world use cloud services every day at work and companies rely on remote servers to power their business.”<sup>4</sup>

Thus, even if some may not know or recognize it, cloud computing is used across email software (Gmail, Yahoo Mail, Outlook, etc.), or when uploading files, images or videos on Google Drive or Microsoft OneDrive. What this means is that the technology has provided a “geographical shift in the location of data from personal computers to a centralized server or *cloud*.”<sup>5</sup> Of course, this advancement is intrinsically linked to that of the Internet’s spread and its ability to access remote central servers over a networked connection with the ability to store and use software and tools in an online or virtual space.

Though many may assume cloud computing is a relatively new concept, its origins can be traced back close to 80 years ago, to the 1940s. To understand how computers worked back then one must comprehend how data was stored: in mainframes. At the time mainframes were “large and high computing platforms... managed in a separate large room or hall with all necessary power backup, cooling, and data backup maintenance. This was a huge investment for a company, so, not every company could afford this system.”<sup>6</sup>

These high costs encouraged businesses to pool their resources and collectively share mainframes and platforms. These platforms began to be known as data centers<sup>7</sup> and as technology evolved and became more accessible, more players entered the fray. This led to further investments in data storage and businesses began “selling space for [companies] to set up their hardware, such that this third party company was responsible for maintenance by providing enough power backup and maintaining the systems in cooling conditions.”<sup>8</sup>

Inevitably, the storage of data became a lucrative business and new entrants looked to leverage and provide newer and better service offerings as part of deals and bundles. However, with cheaper hardware and components entering the market many businesses were able to afford their own mainframes, which then “turned into the creation of ‘virtual’ private networks used by businesses.”<sup>9</sup> This led up to the 1990s with the development of a modern cloud computing infrastructure.

With the power and untapped potential of the cloud ever-present, large corporations (hyper-scalers) began to push further into the market. Tech giants like IBM, Microsoft, and later Google, jumped on the cloud bandwagon. However, it was only in 1999, when “Salesforce became the first company to offer applications over the internet, heralding the arrival of Software as a Service [SaaS],”<sup>10</sup> that the real power of cloud was visibly apparent. As mentioned, “three years later, the industry grew massively with video, music and other media being hosted and delivered online.”<sup>11</sup>

This opened the doors for more players – big and small – to launch their cloud-based applications. “Amazon was the first major company to offer cloud computing services... and launched Amazon Web Services and introduced its Elastic Compute Cloud (EC2) in August 2006. It was a pay-as-you-use subscription model that gained in popularity quickly”<sup>12</sup> and is still the most popular cloud service provider as of 2020.<sup>13</sup>

As more time and investments were made into cloud technology, five types of cloud services emerged: Public, Private, Hybrid, Community and Multi-cloud.

### **Public Cloud**

The cheapest cloud option, the public cloud is “a large pool of computing infrastructure available to the general public on a subscription basis.”<sup>14</sup> The most common examples include Google Drive and Dropbox and though there could be potential security concerns, its benefits include the ability to “be deployed faster and [be] infinitely scalable; lower costs, no maintenance and high reliability.”<sup>15</sup>

### Private Cloud

With a dedicated infrastructure provided, which is not shared by others, businesses can feel more secure within a private cloud. These are essentially “data centers within a controlled secure system,”<sup>16</sup> which provide users with “more concise needs when sensitive data needs to be stored and shared.”<sup>17</sup> However, the costs, which are much higher than that of a public cloud, as well as its management and maintenance, are completely borne by the business.

### Hybrid Cloud

As its name suggests, the hybrid cloud mixes both public and private cloud options, where required. The cost of a hybrid cloud model can vary depending on a number of factors as both the “service provider and [business] deal with [it] with each of them offering some hardware elements.”<sup>18</sup> Though many businesses have turned to this model, it requires specialist experts to manage and handle its intricacies. However, on the plus side, the hybrid cloud offers “more scalability and flexibility than completely private cloud apps without disturbing security.”<sup>19</sup>

### Community Cloud

According to Gartner, community cloud computing refers to “shared cloud computing service environment that is targeted to a limited set of organizations or employees. The organizing principle for the community will vary, but the members of the community generally share similar security, privacy, performance and compliance requirements.”<sup>20</sup> This helps share operating costs and resources and is a cheaper option to a private cloud.

### Multi-cloud

Another spin on the way cloud computing is being utilized is within multi-cloud. Not to be confused with hybrid cloud, this model demonstrates how “companies utilize a mix of various cloud providers for fulfilling business requirements.”<sup>21</sup> This ‘mix-and-match’ approach depends on businesses choosing the “best services from each cloud provider based on costs, technical requirements, geographic availability and other factors.”<sup>22</sup> Though this reduces the onus on having a sole cloud provider (in case of downtime or emergencies) the coordination efforts required in managing data across all providers can be challenging.

**Worldwide Public Cloud Service Revenue Forecast (Millions of U.S. Dollars)**

	2019	2020	2021	2022
Cloud Business Process Services (BPaaS)	45,212	43,438	46,287	49,509
Cloud Application Infrastructure Services (PaaS)	37,512	43,498	57,337	72,022
Cloud Application Services (SaaS)	1,02,064	1,04,672	1,20,990	1,40,629
Cloud Management and Security Services	12,836	14,663	16,089	18,387
Cloud System Infrastructure Services (IaaS)	44,457	50,393	64,294	80,980
Desktop as a Service (DaaS)	616	1,203	1,951	2,535
<b>Total Market</b>	<b>2,42,697</b>	<b>2,57,867</b>	<b>3,06,948</b>	<b>3,64,062</b>

BPaaS = Business Process as a Service; IaaS = Infrastructure as a Service; PaaS = Platform as a Service; SaaS = Software as a Service

Source: Gartner (July 2020) <https://www.gartner.com/en/newsroom/press-releases/2020-07-23-gartner-forecasts-worldwide-public-cloud-revenue-to-grow-6point3-percent-in-2020>

These various cloud options have led to the evolution and acceptance of the 'as-a-Service' model. With SaaS already prevalent, Infrastructure-as-a-Service (IaaS), (notably AWS and Microsoft Azure), became prevalent. This model provides users with the "infrastructure they need to run their apps, including virtual servers and storage disks."<sup>23</sup> There are a number of spin-offs from this including: PaaS (Platform as a Service) and Server-less Computing (usually used by web-based apps and software development businesses for multi-platform development)<sup>24</sup> as well as FaaS (Function as a Service), among others.

### **Cloud computing in practice**

Though cloud computing has helped reshape industries across the board, there have been discrepancies in its adoption levels. However, some of the ways in which it has benefitted specific industries are evident.

#### **Automotive**

With greater advancements in vehicle technology, "cloud plays a major role in connected cars, autonomous driving, shared mobility, deeper customer insights, and digital manufacturing."<sup>25</sup> This has benefitted all stakeholders, from OEMs, dealers, designers, and end users, across the automotive life-cycle. With smart factories and digital manufacturing plants powered by AI and robotics, processes are now faster, defects have reduced and operational efficiencies have increased.

By using cloud computing to store and access data, OEMs have the chance to "scale global vehicle services, including telematics, fleet management, over-the-air software updates and connected vehicles."<sup>26</sup>

In terms of safety which is paramount to the industry, "OEMs spend considerable chunks of time [in] testing. Cloud computing allows creating experimental test environments without the necessity to develop, maintain, and scale physical hardware. The on-demand nature of cloud technology frees OEM development teams from the necessity to build physical servers, which takes time for their automotive software solutions."<sup>27</sup>

Further, cloud infrastructure "facilitates better communication across suppliers, manufacturers, and dealers to enable a better customer experience. It can capture dealer feedback in real-time and thereby enable effective sales planning and forecasting. It can also help align manufacturing, part exports, and delivery to ensure optimum delivery lead time for customers."<sup>28</sup>

#### **Finance**

The financial services industry is embracing cloud computing at a rapid rate. "The promise of multiple monetary, innovation and performance benefits and promises of lower costs and enhanced scalability"<sup>29</sup> is helping to reshape the industry. For instance, "connecting with third-party apps promises to open the door to new customers and additional revenue streams."<sup>30</sup>

The cloud has also enabled financial services firms become more flexible in terms of adopting other technologies like AI and big data without having to commit to expensive capital investments. Thus, without building IT infrastructure or spending on more resources, the industry can now access historical data and information quickly and easily.

The arrival of so-called *fintech* (financial technology) players has also weighed in adopting cloud (and related technologies). By becoming agile and with the ability to quickly scale, such businesses have found the cloud to be a lifeline.

With so much data held by financial institutions the issue of data storage can become problematic businesses. Here, the cloud provides “easily scalable storage that can be increased or decreased in a matter of seconds through a cloud dashboard. In addition to its scalability, many cloud providers offer storage solutions for a fraction of the cost of purchasing, operating, and maintaining internal storage servers.”<sup>31</sup>

Further, the use of “Infrastructure as a Service (IAAS) by the industry helps reduce costs on deploying, testing, and running applications on in-house resources. In addition to [providing] businesses [with] a testing platform for new applications and projects, the cloud offers high-level computing and processing capabilities. [Thus] with the power of the cloud, credit risk simulations, which could take hours, can now be executed in approximately 20 minutes.”<sup>32</sup>

## **Manufacturing**

The ease of accessing services, apps, and data remotely has become a huge boon for the manufacturing industry. This means manufacturers can now “create a seamless product development environment, lower the cost of developing a product, and reduce the time it takes to get a product to market. Ultimately, cloud collaboration tools can improve manufacturing companies’ productivity and profits.”<sup>33</sup>

Cloud, also packaged with IoT platforms, can help manufacturers “receive data for specific machinery in real-time. By having instant access to crucial operational metrics like capacity utilization, inventory data, scheduling plans, job orders, and overall equipment effectiveness, [manufacturers] can monitor [their] machines’ performance and solve issues quickly and easily. [With this] the cloud enables manufacturers to avoid potential inaccuracies and delays in manufacturing processes.”<sup>34</sup>

The cloud has also benefitted the industry within production as well as in sales and marketing campaigns. Thus, “with the help of cloud computing applications deployed in a manufacturing plant, manufacturers can obtain data on production and sales and analyze it to make marketing [campaigns] more effective.”<sup>35</sup>

## **Retail**

The retail industry has experienced rapid transformation with the advent of cloud computing and its related technologies. One of the major advantages of cloud computing adoption within retail has been the “streamlining [of] operations across all departments. It enables interconnected point of sale (POS) systems as

[such] systems are moving from cash and cards to smartphones and tablets. Cloud POS systems are becoming a necessity for retailers due to the several benefits they offer such as the centralization of the customer, sales, and inventory information on central cloud storage.”<sup>36</sup>

Cloud computing has also helped with stock (as well as chain) visibility. “Cloud systems allow access to inventory information at any given time [to] help make decisions accordingly. It also builds predictive inventory forecasting that helps avoid issues such as stocks shortage.”<sup>37</sup> This has helped retailers with better planning, sales and marketing.

As is apparent in many other industries, retail has also directly benefitted from data visibility, analysis and insights, which are powered by cloud and other technologies. Thus, cloud computing “enables retailers with high-power computing resources and statistical models to analyze data. Based on this analysis, they can also develop their marketing, pricing or merchandising strategies to attract more customers. It also allows retailers to offer personalized recommendations, special membership offers coupon codes, etc., that add to the loyalty factor.”<sup>38</sup>

Within inventories, cloud-based tools have reshaped retailers’ operational models with “traditional methods of stock management now replaced by business automation. Rather than having separate inventories for each store, the cloud-based system synchronized multiple store inventories under one roof. This has enabled retailers to have quick access to real-time stock data across stores. The cloud’s timely inventory updates and real-time visibility of stock data have also made inventory management hassle-free.”<sup>39</sup>

Of course, cloud computing solutions have also helped retailer better understand their customers. With the support of big data and analytics, retailers have “better insights on the customer buyer journey and can also predict their buying behavior. The cloud’s ability to store, process, and analyze heaps of customer information is [clear] proof of its exceptional computing abilities.”<sup>40</sup>

Finally, retailers can research and determine the best cost structures for their business. By “moving to the cloud, retailers [can] save on their IT infrastructure costs, licensing fees, maintenance, and support costs. [In fact] Cloud’s diverse service models allow retail businesses to choose the best-suited operational model and pay only for what they use. By moving to the cloud, retail businesses can completely eliminate the need for any upfront capital costs.”<sup>41</sup>

## **Conclusion**

It is clearly apparent that cloud computing has reimagined the way businesses work. From making data-driven insights at speed and predictive analytics, to improving efficiencies and reducing costs, industries have been transformed by cloud computing.

However, there are still issues with such rapid technological advancement and some industries are still cautious about their approach to cloud computing.

High on the list is data security. With more remote work having taken place over the last year the room for security threats, hackers, and viruses has increased. Owing to this, businesses need to be “ensured about cloud management and security systems before migrating their data to a third party service provider.”<sup>42</sup> This is even truer when a multi-cloud infrastructure is in place as “the single data of the organization will be shared by multi-service providers [and] can create complexities in cloud implementation, especially when larger organizations are involved.”<sup>43</sup>

Further, there are questions to be debated with the ‘return-to-office’ scenario that many businesses and employees are experiencing. Some of these include, “If people move back to the office, what will happen to all the software tools and cloud service providers now in place? Additionally, “How will companies’ IT infrastructure change?”<sup>44</sup> There are no clear answers at present but such questions do throw up more talking points for businesses going forward.

For leaders who are trying to navigate the pandemic and restart their businesses, “a coordinated effort across the team at the top of an organization”<sup>45</sup> is required. As a recent McKinsey piece has stated, three ‘interventions’ are likely to emerge with regard to cloud adoption: “1) establishing a sustainable funding model to support the investments required to get business value from the cloud; 2) developing a new business-technology operating model that exploits cloud for speed, agility, and efficient scalability; 3) putting in place the HR, compensation, and location policies required to attract and retain the specialized engineering talent required to operate in the cloud.”<sup>46</sup>

Taken together these interventions can serve businesses in a post-pandemic world in terms of planning, resource allocation and IT infrastructure transformation. However, leaders will need to quickly become more familiar and flexible with cloud adoption and its advantages and determine where best it can add real value. Tactical or piece-meal inputs may serve a purpose in the short term but a strategic and visionary approach is required to approach cloud implementation within an uncertain business environment.

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- 1 <http://www.theinternetday.com/>
  - 2 <https://www.technologyreview.com/2011/10/31/257406/who-coined-cloud-computing/>
  - 3 <https://www.ficpa.org/publication/busting-top-seven-myths-about-cloud-computing>
  - 4 <https://technative.io/internet-day-2020-a-brief-history-of-cloud-computing/>
  - 5 <https://www.seasiainfotech.com/blog/history-and-evolution-cloud-computing/>
  - 6 <https://www.c-sharpcorner.com/article/history-and-evaluation-of-cloud-computing/>
  - 7 Ibid.
  - 8 Ibid.
  - 9 <https://www.dataversity.net/how-the-cloud-has-evolved-over-the-past-10-years/>
  - 10 <https://www.scality.com/solved/the-history-of-cloud-computing/>
  - 11 Ibid.
  - 12 <https://www.techaheadcorp.com/blog/brief-history-of-cloud-computing/>
  - 13 Ibid.
  - 14 [https://www.alibabacloud.com/blog/a-brief-look-into-the-evolution-of-cloud-computing\\_596404](https://www.alibabacloud.com/blog/a-brief-look-into-the-evolution-of-cloud-computing_596404)
  - 15 <https://sysgen.ca/understanding-the-different-types-of-cloud-computing/>
  - 16 <https://www.scality.com/solved/the-history-of-cloud-computing/>
  - 17 Ibid.
  - 18 <https://www.mindinventory.com/blog/types-of-cloud-computing/>
  - 19 Ibid.
  - 20 <https://www.gartner.com/en/information-technology/glossary/community-cloud>
  - 21 <https://www.mindinventory.com/blog/types-of-cloud-computing/>
  - 22 <https://www.factioninc.com/blog/what-is-multi-cloud/>
  - 23 <https://saasmetrics.co/iaas-paas-faas-saas-understanding-the-cloud-computing-pyramid/>
  - 24 Ibid.
  - 25 <https://www.embeddedcomputing.com/application/automotive/adas-autonomous-drive/how-cloud-drives-digital-transformation-across-the-automotive-industry>
  - 26 <https://www.automotivelogistics.media/digital-technology/a-cloud-with-a-silver-lining/41026.article>
  - 27 <https://www.intellias.com/devops-cloud-computing-automotive/>
  - 28 <https://www.techradar.com/in/news/why-hybrid-cloud-works-best-for-the-automotive-industry>
  - 29 <https://www.informationweek.com/cloud/why-the-financial-services-industry-is-embracing-the-cloud/a/d-id/1340050>
  - 30 Ibid.
  - 31 <https://www.privoit.com/resources/financial-services-industry-cloud-benefits>
  - 32 Ibid.
  - 33 <https://wire19.com/applications-of-cloud-computing-in-manufacturing-sector/>
  - 34 Ibid.
  - 35 <https://intonenetworks.com/importance-of-cloud-computing-in-manufacturing-industry/>
  - 36 <https://intonenetworks.com/impact-of-cloud-computing-in-the-retail-industry/>
  - 37 Ibid.
  - 38 <https://intonenetworks.com/impact-of-cloud-computing-in-the-retail-industry/>
  - 39 <https://www.preludesys.com/benefits-of-cloud-computing-in-the-retail-industry/>
  - 40 Ibid.
  - 41 Ibid.
  - 42 <https://itchronicles.com/cloud-computing/top-10-cloud-computing-challenges-to-face-in-2021/>
  - 43 Ibid.
  - 44 <https://www.itproportal.com/features/the-future-of-cloud-services-post-pandemic/>
  - 45 <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/three-actions-ceos-can-take-to-get-value-from-cloud-computing>
  - 46 Ibid.