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Mapping the cloud: Big Tech taking the sky by storm

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Mapping the Cloud: Big Tech Taking the Sky by Storm

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CITYPERC Working Paper No. 2023-05

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Mapping the Cloud: *Big Tech taking the sky by storm.*

Abstract

Here I map Big Tech clouds focusing on the making of asymmetric relations with the different type of involved organizations. Amazon, Microsoft, Google and Alibaba are cloud hegemons that control every inch of their clouds. The cloud is the main means of adoption of digital technologies. As such, developers and other firms offering their services on Big Tech clouds accept the rules of a game predefined by those few giants. They even need to get enabling credentials offered by another type of subordinate actor: the companies offering trainings to get mandatory certificates for joining the cloud as providers. At the other end, customers transition to the cloud often guided and hiring the services of outsourced sales forces. After presenting all these actors and their interplay, I focus on AI as a service to explain the negative effects of such a migration at the level of organizational learning and innovation. Customers' technological subordination and reduced learning by doing, using and interacting in the cloud has triggered mitigation strategies but only large players can afford them.

Keywords: Cloud computing; digital technologies; Big Tech; corporate power; digital learning; learning by doing.

1. Introduction: It is just someone else's computer

The cloud refers to computing services that you can consume but that are running on someone else's computer. More concretely, the cloud is software, hardware (infrastructure) and platforms offered through the Internet and running in datacentres -which ultimately are just interconnected computers- instead of locally in individual computers.

By 2025, 45% of the world's data storage will be on the cloud. We are constantly storing information and accessing online applications through the cloud. If you have access to the internet, it is almost impossible to escape the cloud. Video streaming runs on the cloud, your email is stored in the cloud and most of the software that we previously installed in our computers, from games to Microsoft Office, are no longer inside our devices but accessed as online cloud services. If, on top of all the latter, you store your files in Dropbox, Google Drive, Microsoft's OneDrive or any other similar provider, you have fully migrated to the cloud. ChatGPT is run on the cloud or embedded in services that are also based on the cloud. Individual users have outpaced organizations' adoption of the cloud.

Yet, increasingly more and more organizations are moving their computing operations to the cloud. While some keep at least part of their computing service in-house as a private cloud, most organizations are migrating to the so-called *public* cloud where computing services are offered by third-party providers. In an obvious misuse of the term public, the public cloud is a private and highly concentrated and profitable business.[1] Hereon, we use indistinctly public cloud and cloud to refer to

[1] Google justifies the use of the term by stating that, in the cloud, computing resources are "shared by organizations and individuals who want to use or purchase them." But organizations do not share but simply purchase -independently- access to the same lines of code. Sharing, by definition, implies doing something with others. When the same line of code is sold to many as black boxes, nothing is shared among those many, and certainly the cloud providers are not sharing anything with them. And, when it comes to storage, we simply do not share space in the cloud because two files cannot be stored

the former, but keep in mind that besides and before the business cloud, individuals were already surfing it. The cloud has not only changed the consumption or use of computing services but also developers' workspace. Developers barely write code inside their computer anymore but on online cloud interfaces, from developer platforms like GitHub to directly coding inside the interface provided by a Big Tech's cloud. And all these spaces are interconnected.

Amazon, Microsoft, Google and Alibaba, in that order, concentrate around 75% of this market globally. AWS leads with a stable share of 32 to 34%.[2] The three US Big Tech loom large as cloud provides around the world except in China, where Alibaba leads. Alibaba ranks 4th in other parts of Asia and is barely present in the rest of the world, even though the aim of the company is to keep internationalizing as my interviews confirmed.[3] Sometimes, a local company trails after the US Big Tech, like Fujitsu in Japan. This market dominance matters more than concentration elsewhere because, as I show here, it entrenches tech giants' control of digital technologies, which reinforces their global power and the value they capture from other businesses in the form of rents paid to use cloud services.

The public cloud is a global-scale computing outsourcing architecture used by all, from individuals storing pictures in Google drives or sharing a Google Doc, to multinational corporations and states. Outsourcing is not a new thing for multinational corporations (neither it is for states at least since neoliberal reforms). In fact, modern computing started as a service in the 1960s and large companies were already outsourcing part of their information technology (IT) before the arrival of the public cloud. In the beginnings of this industry, computer manufacturers leased equipment to customers. IBM included in this service "training, maintenance, and some level of systems engineering service to enable its customers to use the computers effectively" (Grad, 2002, p. 64). At that time, software was embedded in hardware, thus we may say that IBM and other computer manufacturers were offering hardware and software as a service already by the 1960s in a highly concentrated market.

In 1989, IBM and Kodak signed an agreement by which the former designed, built and managed a datacentre for the latter. The datacentre would be owned by IBM and almost 300 Kodak employees that worked in information processing were offered jobs at IBM.[4] I experience this type of corporate relation myself before becoming an academic. What has changed if we compare this form of IT outsourcing with the current public cloud owned by a selected group of Big Tech companies?

I see four main differences. In a nutshell, these are:

1) Digital technologies are nowadays at the core of the most diverse industries, while before information and communications technologies were only core for firms from that industry. After Kodak signed the datacentre agreement, the president of IBM's National Service Division clearly stated that it would allow Kodak "to focus on their core business, the things they're particularly good at, and allows us to focus on the things we're particularly good at."[5]

2) The public cloud is a marketplace. New players are involved, as sections 3.3 and 3.4 show. Developers, training and sales force companies comply to participate in the cloud business. Even

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simultaneously in the same place. It is true that one firm can purchase access to processing power in the morning and another one in the afternoon, but they are not sharing the resource, they only use it at a different moment in time but cannot use it at the same time without diminishing each other's use.

[2] https://www.srgresearch.com/articles/cloud-spending-growth-rate-slows-but-q4-still-up-by-10-billion-from-2021-microsoft-gains-market-share

[3] https://www.srgresearch.com/articles/aws-alibaba-and-microsoft-lead-the-apac-cloud-market-tencent-google-and-baidu-are-in-the-chasing-pack

[4] https://www.washingtonpost.com/archive/business/1989/07/26/ibm-to-take-over-kodaks-data-processing/fc22f559-b2b4-4dc7-a6a3-ffeb35b58c3b/

[5] https://www.washingtonpost.com/archive/business/1989/07/26/ibm-to-take-over-kodaks-data-processing/fc22f559-b2b4-4dc7-a6a3-ffeb35b58c3b/

price-setting is in the hands of Big Tech, as I show for the case of AWS. These other companies, misleadingly called "partners", profit by subordinating to cloud hegemons. Cloud developers live with the threat of being driven out the market if a Big Tech company decides to copy their services. Meanwhile, training and sales force companies often work for one cloud provider, further limiting their bargaining power.

3) Scale. While in the past users of IT outsourcing were big companies from core countries, nowadays computing is almost a basic need, spanning ubiquitously around the world, even penetrating, with mobile devices, the poorest countries and every firm size. Section 3.5 sketches three types of public cloud customers based on the examples of Open AI, the Santander Group and the US Deparment of Defense.

4) At the time of the Kodak-IBM agreement, managing a datacentre was like managing a huge bookshelf. Technologies to classify and store were quite stable and broadly known. The type of services that are currently sold on the public cloud include secretly kept advanced digital technologies offered in pieces as multiple services. These technologies, in particular processing big data with machine learning, change at an extremely accelerated, almost automatic pace. The cloud is the architecture that enables the adoption of digital technologies without accessing but only using purchased services. This difference between access and use, explained in section 3.6, overhauls the distribution of learning between innovation producers and users, further tilting the scale in favour of the former.

As I conclude in section 3.7, *clearing away the cloud*(s) of our understanding requires distinguishing between co-producing, using and accessing knowledge. In the public cloud, many co-produce knowledge and data, from developers and sales force consultants to even customers, but the cake is mostly eaten by Amazon, Microsoft, Google and Alibaba; they are the focus of the next section.

2. The cloud hegemons

Amazon, Microsoft, Google and Alibaba are the world's cloud hegemons. They offer every piece of the digital technologies' package as a service on their public clouds. Their clouds are engines of growth and profits. When announcing disappointing financial results to shareholders in 2022, Microsoft and Google kept referring to their clouds as their growth engine. The cloud was also responsible of Amazon's better than expected results during the same period. In fact, AWS is Amazon's most profitable business and Azure -Microsoft's cloud- is considered the engine without which Microsoft would be lost, as explained by a manager when I asked about Amazon and Google.

> "It seems to me that the competition with Google and Amazon is very deep and significant. Being a cloud provider is a lot, maybe I'm wrong, but I don't think we're going to partner with them and they're not looking for that either. Being a cloud provider is different.
>
> We can be frenemies with other companies that are also big, but it is different with them, they are in Azure, they have another path (...) With Amazon and in particular with Google we have many areas of competition from operating systems, Cloud and AI. These are areas that are very fundamental to the business, they are core to Microsoft. If we lose the Cloud business, we are lost. And the same with Amazon, which is Amazon for AWS" (Interview Microsoft manager).

This is an extremely lucrative business. The additional cost of selling software as a service (SaaS) to another customer -its marginal cost- is close to zero because the same lines of code are sold again and again. The price basically reflects an intellectual rent garnered by keeping code secret. Furthermore, the cloud hegemons offer growing sets of AI services in their clouds that assist AI field-specific applications' development. These services make AI adoption faster, easier and riskier. When

the SaaS are deep learning algorithms -including the frontier generative AI that underpins intelligence chatbots-, the more they are lent, the more they will learn and self-improve, thus reinforcing cloud giants' digital leadership (see section 3.6).

For those organizations without the internal capacities or that prefer to outsource the training process, cloud giants also offer pre-configured virtual machine templates and train the AI algorithms. They also offer data preparation tools that set the data in a format suitable for being processed by algorithms and "data as a service" (DaaS). The latter refers to access to standardized databases (for instance image datasets) to train algorithms. Here again the principle is selling the same dataset again and again, with a price that mainly reflects a rent.

The third leg of the cloud is the remaining piece of the digital technologies' package, i.e. digital infrastructure. Big Tech as rentiers not only capture value in the form of intellectual rents when selling SaaS and DaaS but have also enclosed digital spaces and capture a form of infrastructure rent that can be compared to those of urban and rural landowners (Srnicek, 2021). The public cloud offers infrastructure as a service. While it deconcentrates tangible capital for most, it results in higher tangible assets' concentration for Amazon, Microsoft, Google and Alibaba. According to Bloomberg data, the cloud capital expenditure of the former three was, by 2021, between 9 and 12% of their cloud revenues.[6]

Every interviewee acknowledged that the cloud was a settled market, with some interviews venturing to say that the main players will not change at least for the next few decades. Interviewees tended to identify the cloud first and for most with the US cloud hegemons and only sometimes refer to a Chinese giant. In relation to China, an interviewee from Alibaba argued that the required investment on infrastructure makes it really hard for others to catch-up, so that they thought that in the next two to three years no one would outperform AliCloud in China.

Cloud hegemons do compete against each other. Their rivalry is unfolded as a permanent technological race. Yet, the fact that these companies compete for technology is not translated into competitive markets in which entry is feasible and relations are set among equals. Precisely the opposite, their market shares' growth has been at the expense of other -smaller- players.[7] Cloud giants conform an established core. Turbulence is limited to peripheral firms that fuel their clouds with services and customers, as the two following sections explain.[8]

3. The third-party sellers

Amazon, Microsoft, Google and Alibaba's clouds also operate as marketplaces, which means that not only their own internally developed services will be sold but also computing services coded by other companies. In relation to AI, the cloud is the platform where producers and users of digital technologies meet. Cloud giants define the prices and conditions that each service needs to meet to

[6] https://www.economist.com/business/2022/08/29/the-cloud-computing-giants-are-vying-to-protect-fat-profits
[7] See for instance https://www.srgresearch.com/articles/cloud-spending-growth-rate-slows-but-q4-still-up-by-10-billion-from-2021-microsoft-gains-market-share
[8] In this mapping of the cloud, I will not include all the providers of datacentre infrastructure, from the companies setting the building to chip designers and manufacturers. For the purposes of this book, some relations that are particularly relevant to explore include Big Tech contracts with advanced GPU designers and manufacturers, like NVIDIA and TSMC. Given the centrality and fundamental relevance of processors in Big Tech business and the fact that NVIDIA and TSMC themselves can be considered as intellectual monopolies, their analysis corresponds to the type of links explored in the following two parts of this book. At the same time the fact that Google and Amazon design part of their own AI processors, may probably give them more bargaining power in comparison to Microsoft when buying NVIDIA designs (see for instance https://nvidianews.nvidia.com/news/nvidia-microsoft-accelerate-cloud-enterprise-ai).

be offered. They even decided to call "partners" the companies selling services in their cloud marketplaces, even though their relationship is all but a partnership of equals.

In what is next, I focus on AWS, the comfortable market leader, while in the next section I will mostly refer to Google Cloud. AWS "partners" are classified as: 1) Software, defined as organizations that develop SaaS that is sold and runs of AWS, 2) Hardware, which are organizations that develop devices that work with AWS, 3) Services, which are basically consultancy companies, 4) Training, which are the organizations that sell the accreditations needed to use AWS as a "partner" and 5) Distribution, which are basically AWS sales force.[9] While the first three offer their services in AWS marketplace, the two latter operate as bridges. The training companies assure that partners' employees know how to develop computing services that can run on AWS. Trainings include explaining all the different AWS solutions, which is also a way to sell Amazon computing services to these "partners". The classification already blurs here because developers that offer cloud services use AWS cloud services too becoming "partners" and customers at the same time (see the case of OpenAI in section 3.5). Distribution companies attract customers to AWS. In this section I focus mostly on the first three types of "partners", while section 3.4 focuses on distribution companies.

Among the first three classes, by January 2023 AWS marketplace had 6783 registered AWS partners associated with 178 qualifications, which can be defined as classes of cloud services. These partners are not only small companies but also large multinationals like IBM and Hitachi and major consultancy companies like Accenture and Deloitte. Among the companies offering services in AWS marketplace there are many telecommunication giants, including China Mobile International. Table 3.1 presents a list of AWS's third parties that sell at least 15 products in that marketplace. Barracuda Networks, a cybersecurity software company, was the first to offer SaaS in AWS marketplace. Currently, it also offers services in Microsoft Azure and Google Cloud. At the other end of the spectrum, 2374 companies offer only one computing service on AWS.

Table 3.1. AWS third party seller offering 15 cloud services or more.

Company	Number of products
Barracuda Networks	49
Accenture	39
Deloitte	34
Infosys Ltd	34
Tata Consultancy Services (TCS)	33
IBM	31
Cognizant	29
Slalom	29
Onica by Rackspace Technology	28
LTIMindtree	25
Tech Mahindra	23
Virtusa Corporation	23
Rackspace Technology	21
ClearScale	20

[9] https://aws.amazon.com/partners/paths/?nc=sn&loc=2

Hitachi Vantara LLC	20
tecRacer	20
Wipro	20
NTT DATA Services	19
HCLTech	18
Ibexlabs	18
PEAK	18
Capgemini	17
AGILISIUM	16
CloudHesive	16
Logicworks	16
SoftServe Inc.	16
Trek10	16
AllCloud	15
Classmethod	15
PricewaterhouseCoopers	15
Quantiphi, Inc	15
Rapyder Cloud Solution Pvt Ltd	15
TensorIoT	15

Source: Author's analysis based on data scrapped from AWS by Dr. Facundo Lastra.

Every millimetre of AWS ecosystem is planned by Amazon. In countless websites developers are presented with the rules for offering AWS cloud services. Partners have no saying in the changes that directly affect how they conduct their business and probably their best strategy is to follow AWS suggestions. As an interviewee explained, Google, Amazon and Microsoft ask companies to comply with several prerequisites to list them as partners. They must provide annual business plans and have certifications, which are provided by the training partners to which I referred to above. Partner certifications are taken on an individual basis, which means that partner employees take the trainings.

As in Amazon's e-commerce marketplace, listing a product on AWS marketplace is free but there is a 30% transaction fee for each sale, and vendors can choose to offer their products on a pay-as-you-go basis or with subscription billing.[10] Amazon also defines rules to be followed for setting prices and sets maximum annual price increases. Price changes must be reviewed and approved by Amazon, a process that takes between one and three months. AWS also recommends developers how and when to charge for the use of a service. [11]

The pay as you go principle of the cloud is implemented with application programming interfaces (APIs). Charges are calculated and reported when an API is called. In simple terms, an API is an instruction -code- to connect at least two computer programmes. APIs connect AWS with the services sold in its marketplace and APIs also connect computing services sold on the cloud with the customer's computing system. Amazon's pricing recommendations include telling sellers to

[10] https://smallbusinessbonfire.com/what-partner-programs-are-available-with-aws-marketplaces/
[11] On AWS pricing see: https://docs.aws.amazon.com/marketplace/latest/userguide/pricing.html and https://docs.aws.amazon.com/marketplace/latest/userguide/saas-contracts.html

"configure the API to be called once per hour as a best practice, depending on their use case. All usage is calculated monthly and billed monthly using the same mechanism as existing AWS Marketplace software." AWS also defines when and how payments should be made for its "partners" services.[12]

AWS even provides standardized licensing contracts to be signed each time a customer purchases a product with contract pricing on its marketplace.[13] A contract pricing consists of upfront pricing to customers to buy the use of a service -a license- for a set amount of time, which AWS predefines as 1, 12, 24 or 36 months. The "partner" tracks its sold services from its "License Manager API". AWS also offers a program called Amazon DevPay. It is a turn-key solution for handling billing and payments. AWS charges a 20% fee per transaction for using this solution and third parties are responsible for the charges of their customers while using their applications on AWS.

Nubiral is an example of a small to medium size "partner". The case is interesting because it shows that AWS's classification of partners is not clearcut. Nubiral is, at the same time, a hardware, consultancy and distribution partner. In fact, AWS's classification of partners does not operate as an ex-ante strict split but most likely guides (and ultimately rules over) so-called partners. The partner typology guides them in terms of what is allowed for them to do (thus to offer) in the cloud ecosystem.

Nubiral defines itself on AWS website as providing "personalized solutions and professional services focused on IT Consultancy, DevOps, Cloud and Data & Innovation." Nubiral specializes in data infrastructure projects that require to install and connect IoT to the public cloud so that its customers can store and analyse their data there. Nubiral does the engineering part and offers consultancy services including selling the benefits of the cloud to potential customers, among others, by estimating the infrastructure cost savings. As the company states in AWS "Our mission is to help companies to adopt technologies to increase agility, reduce costs, maximize performance, and overcome the challenges of the new digital age." In addition to providing digital infrastructure and selling the migration to the cloud, Nubiral manages the cloud billing of some of its customers.

Nubiral is an example of a "partner" that specializes in migration, which broadly refers to moving applications to the public cloud. Migration and specialization were two of the three suggestions given to "partners" by Jarrod Buckley, AWS Director of Global Partner Programs, at the 2018 re:Invent Conference. Since 2012, major changes, including new guidelines and business recommendations, are informed at this paid conference for "partners" (fees were USD 1,799 in 2022). Interestingly, when AWS and claims that those that specialized are thriving and suggests assistants to focus on a solution area like "data and analytics or a vertical like healthcare and life sciences"[14], the suggestion is not a pure disinterested idea to grow the business altogether. If partners specialize, they will never become a standalone cloud provider.

This extremely controlled environment is crucial for perpetuating Amazon's lead, which is further reinforced by spotting successful businesses. The cloud offers cloud hegemons a chance to sneak into (and copycat) thousands of organizations around the world. As so-called partner companies first fail or succeed, cloud hegemons reduce their investment risks while keeping long-term economic profits from successful third-party cloud services. It has been widely documented that Amazon frequently operates like this in its e-commerce marketplace (Khan, 2017; US Congress. Subcommittee on antitrust, commercial and administrative law, 2020). Less known is that the same practice takes place at its cloud. Elastic offered its products Elasticsearch and Kibana through AWS. As their popularity grew, AWS started offering its own version of these services, displacing Elastic from the market.[15]

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[12] https://docs.aws.amazon.com/marketplace/latest/userguide/pricing.html
[13] https://docs.aws.amazon.com/marketplace/latest/userguide/standardized-license-terms.html
[14] https://www.youtube.com/watch?v=LDRzckjVABM
[15] https://www.theregister.com/2021/01/22/aws_elastic_fork/

Microsoft's acquisition of Nuance for USD 19.7 billion gives further testament. Nuance offered as a service a cloud-based system for medical transcriptions on Microsoft's cloud marketplace. The acquisition expanded Microsoft's intellectual monopoly beyond healthcare, reinforcing its overall business, in particular its cloud because it gave Microsoft access to Nuance's more than 1,000 patents and secretly kept knowledge that had placed the latter at the frontier of speech recognition.[16]

Cloud computing is also a strategic industry. It allows to notice thriving businesses early by identifying growth in companies' consumption of data storage space and processing power as well as greater use of different AI services. Cloud giants identify and eventually fund existing businesses or start new promising ones on the basis of this information. Funding promising start-ups, orienting their business and getting privilege access to their developments is a regular practice of leading corporations in the tech sector as well as in the pharma industry. Table 3.2 lists the number of companies with 5 or less investors, one of which is a large tech company.

Table 3.2. Large technology companies among top investors of small firms with maximum five investors

Investor	Number of firms
Microsoft	392
Google	179
Tencent	175
Alibaba incl Ant	154
Samsung	116
Amazon	81
Meta	27
Nvidia	20

Source: Author's analysis based on data extracted from Crunchbase in June 2023.

Among the small firms funded by US and Chinese Big Tech there are several AI companies, many of which offer their services of Big Tech clouds (Rikap, n.d.). AWS also hosts start-up competitions and funds winners, among them Yieldex, whose Chief Strategy Officer gave account of that privilege access of information when he said that "it's great for Amazon to be able to see which ones are doing well -- to see things that aren't immediately obvious to the rest of the world." [17]

4. The sales force

What AWS calls distribution partners are companies that operate as sales department but remain legally independent. These companies effectively operate as subcontractors that sell and provide customer service, including technical service, to AWS and other cloud hegemon's customers.

Pure distribution partners do not usually develop their own solutions, but some may make minor adjustments to the services offered on the cloud, sell their own services to customers and optimize their consumption of web services, further blurring the classification of "partners". AWS offers business, technical, and marketing support to these "partners" to become Advanced Consulting

[16] https://www.forbes.com/sites/enriquedans/2021/04/13/theres-nothing-nuanced-about-microsofts-plans-for-voice-recognition-technology/?sh=1c43b96a43c9
[17] https://www.reuters.com/article/amazon-cloud-idUSN1E7A727Q20111109

Partners. The program, called AWS Partner Network, costed USD 2.500 per year in 2022. The Amazon Partner Network (APN) includes over 100,000 members in more than 150 countries.[18] Already by 2018, 60% of its APN partners had their headquarters outside the US.[19]

Big Tech focus as cloud hegemons is to profit from economies of scale and scope. Sell the same thing to all the organizations around the world but in pieces, so that each organization purchases the pieces that are of their convenience. However, most organizations lack the sufficient internal computing capabilities to migrate to and operate from the cloud. Cloud hegemons use third parties to solve this, thus outsourcing a mostly routinary and too specific or finetuned business. These specialized third parties bridge between cloud providers' more generic solutions and the tailored needs of diverse customers.

Google segments its sales force partners, with the smallest ones being those typically focused on selling a specific Google cloud service. Others specialize in a vertical, which refers to an industry or sector, such as retail or the financial sector, or a type of product containing many services, such as Google Maps, Google Analytics or Machine Learning. To reach the premium partner level they need to at least specialize in one vertical or type of product, have large clients and many past success stories. Premium partners receive Google support to further expand their business, which contributes to further stratifying third-party companies.

These outsourced sales force works on a commission basis depending on the consumption of Google technology by customers. Google has different commission schemes depending on the level of partnership, with the premium partner receiving the highest commission. Oni Group, an exclusive Google partner, is one of these companies and I interviewed one of its senior managers. Oni presents itself in its website as a "multi-award winning, Google Premier Partner and Specialist." All the awards were granted by Google. Oni is Google's biggest partner in the mobility sector. This means, among others, that they offer customers the opportunity to integrate Google Maps to their products, just like in Airbnb and Uber's respective platforms. Kenney and Zysman (2020) detail how Google Maps has become an indispensable technology for the most diverse firms. Here, I look at the other side of this story.

The story of Oni Group illustrates sales force strategic subordination. Selling cloud services is a profitable business for premium partners albeit becoming dependent on a cloud giant that captures part of the resulting profits and expand their technological and economic control as partners bring in new customers. My interviewee also referred to the role of premium partners providing non-paid feedback about Google new technologies.

> A partner is an extension of Google's sales team and technical team. Also, as a partner we get access to technology that is not released to the public, we review it and give feedback. (Oni Group interviewee).

Working only for Google is a company decision driven by the fact that, to be profitable and grow as Oni Group is growing, according to my interviewee, can only be achieved by specializing in one cloud. Once again, specialization among partners appears as a success driver (see section 3.3). Amon Google products, Oni Group specializes in Google Maps and some cloud services like Big Query, which is used for big data analysis.

Oni Group also provides technical support to its customers, with a team that has approximately the same size as the sales team, inferring that both sides of Oni's business are equally important. The technical team develops whatever is needed to integrate Google solutions into customer systems. Oni

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[18] https://aws.amazon.com/partners/programs/ https://aws.amazon.com/blogs/apn/make-the-most-of-your-aws-partner-network-apn-benefits/

[19] https://www.youtube.com/watch?v=LDRzckjVABM

develops technology to connect both systems internally. Everything is client-specific and based on Google technology.

> Our strength is not to create products as such but our consultative approach to understand the needs of an organization and bring a solution in the form of access to a Google technology and there may be certain developments, but it is not that we create products. If the Google product does not meet all the client's needs, then we adjust it (Oni Group interviewee).

The scalability of these solutions is low, which further explains why this is not a business for Google itself. According to my interviewee, partners like Oni Group exist precisely because these adaptations are kind of unique, need certain specific developments and it is not possible to directly automate them. As in the case of Nubiral discussed above, these bridging companies that sell and connect customers with the public cloud provide services that the cloud hegemons do not want to provide but that are required to expand their business. One wonders to what extent a solution like ChatGPT can eventually replace partners like Oni Group. For the moment, my interviewee did not seem concern about it.

Interestingly in relation to the fuzzy classifications of partners, Oni has developed and offers one cloud service just like developers selling in Google Cloud's marketplace. This is a product that does front and backend validation of addresses, which is somehow Oni's insignia product. It is generally offered associated with Google Maps and Big Query. Even if this is only one product, it shows that companies whose business is the cloud seek to diversify but their feasible options are those enabled by Big Tech.

As long as they are compliant "partners", their growth means more profits for cloud hegemons. A way to push further companies like Oni, that are also multinational firms seeking to enter more markets, is by funding their expansion. Oni regularly receives Google's funding to organize events for prospecting clients. What market or type of clients to prioritize must be agreed with Google. More generally, partners are closely monitored and controlled by Google, and this specially applies to premium partners like Oni Group. They meet once a week with multiple Google teams to align priorities and report results. Oni always defines its goals and key performance indicators connected to the Google products it wants to sell and the markets it wants to open. They always share these plans with Google, which sometimes suggest changes to better align them to its own goals.

Google also outsources analytics' consultancy to companies like Jellyfish -which manages most of Google's analytics market in Spain-, 1Strategy, 47Lining, and MightyHive, which is part of S4 Capital. The same principle applies here. These companies act as outsourced sales force departments and helpdesks. Big-data analytics consultants contribute to expanding Google's customer base, thus, profits.

5. The customers

At the other end of the cloud as a multi-tier marketplace, and often relying on companies like Oni Group, all sorts of organizations are migrating to and operate in the public cloud. In 2012, firms spent just USD 6.5b in cloud infrastructure services; by 2021, investments had jumped to USD 178b (representing an increase of 2,638 %).[20] Although the figure is impressive, this ongoing process in the Global North and China is quite incipient in the rest of the world. In China, most companies prefer AliCloud or, eventually, other Chinese clouds. As an interviewee from Alibaba explained, "Chinese companies only play with their own, you can't even use a lot of apps in China and of course Chinese only trust their own people."

[20] https://www.statista.com/statistics/1114926/enterprise-spending-cloud-and-data-centers/

Transitioning is costly and time consuming since organizations need to move all the computing on premise to the cloud and learn to operate there. It is only later that it becomes, with the sufficient knowledge on how to optimize consumption, a cheaper alternative.

> "The cloud, to the extent that you lock yourself in, is no longer financially attractive. (…) It's cheaper only when you are efficient in the use of data, which is called FinOps. If you don't have a team that looks at consumption in the cloud it becomes too expensive, because it's so easy to increase data, capacity, CPUs, it's easier to over-click than to make your application efficient." (Santander interview).

One of Amazon's interviewees explained to me that most firms migrate in steps, starting by storage and processing power, which -by the time of the interview in early 2023- made the most lucrative business for AWS. However, Amazon believes that the AI functionalities they offer on the cloud will become more and more in demand in the short run and they need to have them already available for those at the adoption frontier that want to go all in for a public cloud provider.

According to AWS website, AI and machine learning services are used by more than 100,000 AWS customers. Amazon claims that these technologies are used, among others, to remove friction from supply chains and personalized digital experiences. AWS also recently launched "Amazon Bedrock", a cloud service for building and scaling applications relying on ultra-large machine learning models developed by AWS and third parties like AI21, Anthropic (which was formed by people that worked for OpenAI until Microsoft stepped in), and Stability AI. These are the models that underpin generic AI chatbots.[21] Whenever software or data are sold as a cloud service, customers use them without accessing their code (see section 3.6).

Customers sign long-term contracts with cloud giants and, as I mentioned above, usually pay as they use the services. Given the sunk cost of transitioning to a public cloud and the terms of the long-term agreements, high exiting fees lock customers in. Even Netflix recently stated in an annual report that it relies on services provided by AWS and that it could not easily switch to another provider. Leading multinational corporations from other industries are more prepared to bear those costs and tend to have more than one cloud provider. The above-mentioned Oni Group manager confirmed that the norm among large firms is to have more than one cloud provider and that Big Tech clouds were prepared to interoperate. In spite of this mitigation strategy, all my interviewees from customer companies agreed that their bargaining power with Big Tech remains low and that there was a trade-off between spending more in-house without losing grounds in the hand of cloud giants or accepting the latter and optimize costs.

In what follows, I describe three types of customers. OpenAI and the US Department of Defense move to the cloud are widely known. I found out about Santander Group's transition in an interview.

OpenAI

I told the story of OpenAI and Microsoft in another piece (Rikap, n.d.). Something that is worth mentioning again here is that the former is an Azure customer. Microsoft built special infrastructure to enable large training workloads as required by OpenAI. Microsoft used OpenAI requirements to advance Azure's training environments developing a standardized solution that they now offer to other customers as a service for training and using chatbots and other custom AI solutions.

According to Microsoft's executive vice president of the Cloud and AI, Scott Guthrie, Azure was the only one that could provide OpenAI with the necessary AI processing power ("GPUs, the InfiniBand

[21] https://www.aboutamazon.com/news/aws/aws-amazon-bedrock-generative-ai-service?utm_source=amazonnewsletter&utm_medium=email&utm_campaign=041523&utm_term=generativeai

networking and the unique AI infrastructure") to train and run its large language models.[22] Whether Azure was really the only one and AWS and Goggle Cloud could not provide a similar service is an open question. But what is clear is that it would have been impossible for OpenAI to train and run its models in-house; it required too many interconnected super-powerful cutting-edge processors. This entailed not only gigantic investments but also knowledge and large datasets monopolized by Big Tech companies.

Besides the fact that Microsoft partially owns and virtually controls OpenAI, profiting from its successes, this is an example of how cloud hegemons relate to frontier AI companies. The latter are obliged to rely on their clouds because without processing power, data and the engineering knowledge required to set those processors to train and run such models, the AI would not deliver. This is yet another case of specialization by firms operating under a Big Tech umbrella.

Santander Bank

In the banking sector, not only fintech companies run their businesses on the public cloud. In October 2022, Santander and Google released Dual Run, a cloud solution built on top of Santander's in-house developed software Gravity that allows parallel process in the mainframe and in the cloud. It operates as an intermediary step in the cloud transition, kind of when you are moving with your partner but still keeping both apartments. Using this middle ground solution is how Santander itself is transitioning to the public cloud. Dual Run press release claims that "Santander is one of the first major banks in the world to digitize its core banking, helping improve service for its 157 million customers and efficiency."

Dual Run exploits a specificity of the banking sector that slows its transition to the cloud. This is a highly regulated business. Hence, migrating to the public cloud is a very sensitive issue, as was pointed out by a senior manager working on the digital transition at Santander.

My interviewee confirmed that even though Santander partnered with Google Cloud for Dual Run, it mostly operates on AWS and Microsoft Azure, which are the providers originally chosen by the Santander Group globally. In 2018, they chose AWS to host Openbank, a 100% digital bank with 1.3 million customers in Spain. Its website, mobile application and core banking system run on AWS.[23] A year later, Santander signed a multi-year contract with Microsoft Azure that included the use of Azure's data and AI cloud services.[24] The agreement with Google Cloud as well as the decision to partner with Microsoft Azure when they were already operating with AWS can be seen as an attempt to cope with the risk of depending on Big Tech technologies.

For Santander, the relation with Big Tech cloud providers is not like their outsourcing of routine IT to cheaper subcontractors around the world. When I asked my interviewee about cloud hegemons, they replied:

> "You feel the pressure because you play by their rules, their timing and their processes, but we are also big and in general these issues are seen at the Group level, you have the power of the Santander Group behind you, and you do not deal with them locally. So, we have leeway, but they still have their processes and rules. We also have our own private cloud, which in the end I don't know if it means escaping from those companies, but it means having our own control. The concept is to virtualize, but we do have the margin to do it ourselves. What happens is that it ends

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[22] https://news.microsoft.com/source/features/ai/how-microsofts-bet-on-azure-unlocked-an-ai-revolution/?ocid=eml_pg394041_gdc_comm_mw&mkt_tok=MTU3LUdRRS0zODIAAAGKwmbrwlHO5mYvwKCSRwk2rcEO-79_q_J-nzO8jDiYkLCqxQDI3WXezvp1v-R1XS1chmfOLULFh7NnuL1mIejIT2WWNnZHWf1mc2zzg39WJ2aT7z8ppJQFXEi5

[23] https://press.aboutamazon.com/2018/11/santanders-openbank-goes-all-in-on-aws

[24] https://news.microsoft.com/es-es/2019/04/29/santander-partners-with-microsoft-as-a-preferred-strategic-cloud-provider-to-enable-the-banks-digital-transformation/

> up being more expensive. You have more control, but the price is higher, that's the risk and it depends on whether the Group wants to take it or how far it wants to take it." (Santander interviewee).

Anyway, Santander is moving to fully transition to Big Tech clouds, a process that the company expects to complete by 2025. When the agreement with Microsoft was announced, Santander's head of Technology & Operations, Dirk Marzluf, said: "Technology is a key enabler to the success of our business and Microsoft is a strong partner who will help us achieve our vision."[25] Along the same lines, my interviewee argued that the bank needs platforms to be very efficient because of their type of business and added: "The more we can take deposits, the more we can lend, so we are looking for zero back office and no friction". To what extent can one, thus, sustain that digital technologies are not part of the core of a company like Santander? Furthermore, to what extent a fast development and adoption -through the cloud- of digital technologies is responsible for the economic performance of the Santander Group?

The US Department of Defense

Finally, the US Department of Defense (DoD) provides another example of a big and powerful organization that ended up choosing multiple cloud providers, probably also attempting to gain bargaining power in its relationship with Big Tech companies.

The Joint Enterprise Defense Infrastructure (JEDI) project was a large US DoD cloud computing contract, which had been reported worth 10 billion USD. It was initially given to Microsoft and then subjected to a new bid where Amazon and Microsoft were expected to share the deal. By mid 2021, given concerns of the consequences of granting such a contract to only one provider, the US DoD replaced JEDI with the Joint Warfighting Cloud Capability, which has a multi-vendor approach. In a press release, the US DoD stated:

> "The Department intends to seek proposals from a limited number of sources, namely the Microsoft Corporation (Microsoft) and Amazon Web Services (AWS), as available market research indicates that these two vendors are the only Cloud Service Providers (CSPs) capable of meeting the Department's requirements. However, as noted in its Pre-Solicitation Notice, the Department will immediately engage with industry and continue its market research to determine whether any other U.S.-based hyperscale CSPs can also meet the DoD's requirements. If so, those Department will also negotiate with those companies." https://www.defense.gov/News/Releases/Release/Article/2682992/future-of-the-joint-enterprise-defense-infrastructure-cloud-contract/

This change in approach reflects at least two potential motivations: 1) dilute US cloud provider's power and 2) keep good relations with all of them. US Big Tech were simultaneously drafting recommendations for the US DoD from the National Security Commission on Artificial Intelligence (NSCAI), a congressionally mandated, independent federal commission led, among others, by Google's former chairman and CEO and by Amazon's current CEO. At that time, the commission was finishing a report for the US DoD on "the methods and means necessary to advance the development of artificial intelligence, machine learning and associated technologies by the United States to comprehensively address the national security and defense needs of the United States."[26] The last decade has also witnessed a sharp rise in US Big Tech contract with the US DoD.[27]

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[25] https://news.microsoft.com/es-es/2019/04/29/santander-partners-with-microsoft-as-a-preferred-strategic-cloud-provider-to-enable-the-banks-digital-transformation/

[26] https://www.nscai.gov/

[27] https://www.socialeurope.eu/war-in-the-time-of-digital-platforms

By December 2022, the US DoD awarded Joint Warfighting Cloud Capability contracts to AWS, Google, Microsoft and Oracle.[28] Among the cloud services provided, data analytics is included. In the next section, I explain how analysing data with machine learning cloud services diminishes learning by using while expanding Big Tech algorithms' digital learning, defined as the process by which deep neural networks self-improve, learn, by crunching data (Rikap & Lundvall, 2021).

6. Learning trade-offs: between digital learning and learning by doing, using and interacting

> "Me: My flight was cancelled, and I want to check if the refund claim I made yesterday is being correctly processed. I tried logging to customer services, but this pops up an error message.
>
> ChatBot: **Hmmm. Sorry, I didn't understand that. I'm a new ChatBot and still learning**. I'm better with simple, short questions. If you prefer to choose a topic from our menu, type "Help"" (March 31st, 2023 – Highlight is mine)

Outsourcing digital technologies to the cloud is not like the previous forms of subcontracting to IBM -or others like HP- IT services. In the latter, IBM or HP employees were based at the corporation that had outsourced that service and worked together, learning side-by-side, with that corporation's employees. Outsourcing IT was otherwise associated with subcontracting cheaper companies to do routinary or at least non-frontier developments, quite close to the practices observed in other industries that resulted in the structuring of global value chains (Milberg & Winkler, 2013). Unlike these cases, the public cloud represents the outsourcing of the most advanced, cutting-edge and general-purpose technology.

As frontier digital technologies are outsourced to the public cloud, there is no real access to purchased services but only the opportunity to rent their use; cloud services are sold as black boxes. Thus, customers using digital technologies on the cloud -which includes purchasing ChatGPT services and the like- are significantly deprived from learning by doing, using and interacting with the technology. Customers know what certain services can be used for, but they do not understand how the technology works and cannot learn from the rented code since they are prevented from accessing the services' algorithms. The same happens with all the so-called "partners". They access APIs, thus interfaces that call services without really reading the code. Even companies like Uber[29] and Siemens (Fernández Franco et al., 2022) made claims concerning their resulting technological dependence on big tech companies. APIs are key in this model because they enable communication between different lines of code. They are translators that integrate otherwise parcelled solutions while serving as gatekeepers.

Furthermore, when Big Tech sell deep neural network algorithms, the more data they crunch, the better they will get. Thus, digital learning is maximized at the expense of organizations and individuals' learning by doing, using and interacting. The learning subject is displaced as deep neural networks owned by Amazon, Microsoft, Google and Alibaba *learn*. It is also a novelty that, in this process and as learning by customers is curtailed, cloud hegemons outsource part of their R&D to their customers and so-called partners. Their use of services contributes to training, improving AI models.

The result is such a profitable and scalable business that cloud hegemons offer machine learning services for free during set periods of time; a strategy that also contributes to expanding adoption knowing that the time to learn how to use cloud services will afterwards be in their favour, lowering exit rates. Amazon offers 10 machine learning services for free for between 30 days to 12 months,

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[28] https://www.defense.gov/News/Releases/Release/Article/3239378/department-of-defense-announces-joint-warfighting-cloud-capability-procurement/

[29] https://www.cnbc.com/2019/04/11/uber-paid-google-58-million-over-three-years-for-map-services.html

depending on the service. They range from services that turn text to speech and the other way around to Amazon SageMaker, a service for building and deploying machine learning models.[30] AWS still offers Amazon Rekognition, a facial recognition tool that in 2019 was found to be racial and gender biased.[31]

ChatGPT gives testament of the outsourcing of R&D to customers. An Amazon corporate lawyer even told employees that they must not provide ChatGPT with "any Amazon confidential information (including Amazon code you are working on)"and added that this recommendation was "important because your inputs may be used as training data for a further iteration of ChatGPT, and we wouldn't want its output to include or resemble our confidential information (and I've already seen instances where its output closely matches existing material)".[32]

Big Tech have been outsourcing R&D in the most unexpected ways for years. The subject that contributes to the research is used sometimes even without knowing about it. An earlier precedent is Google's reCAPTCHA, the system used to validate that we are not robots that simultaneously outsources for free to individuals the mechanic job of classifying images that then will be used to train AI models. The labelling or classification of images and videos and other outsourced data tasks to micro-workers for training algorithms are another example (Tubaro et al., 2020). While in these cases precarious workers or society in general were doing the most routinary part of the R&D, the public cloud takes this arrangement to the next level as it expands the division between the producers and users of the cutting-edge technology of our time to a global scale.

What is the space left for human learning from digital technologies when only usage is permitted and takes place under the conditions set by a few companies? Big Tech have attracted the most talented computer scientists and engineers who work full or part-time for the profit of these companies in secretly kept cutting-edge projects (Jurowetzki et al., 2021; Rikap, n.d.). Not only universities or small firms suffer from brain drain. My interviews confirmed that even large multinational corporations find it hard to find computer scientists and engineers to develop AI without having to rely so much on cloud services.

> "They (Big Tech) have lots of money and the best way to lead is to hire AI researchers and ask them to investigate stuff. Google is doing it. They collect all the good researchers so that opponents in the market cannot. So, AI research is less accessible to competition." (Bosch AI interviewee).

There are too many signs pointing to a consolidation of a sharper division of learning capabilities. What a paradox for the "learning and knowledge economy" to see that the more a reduced group of people and machines learn, the more all the rest -the overwhelming majority of the world- risk losing its capacity to learn. Besides the economic effects and the associated rise in inequalities, this process is expanding gaps between knowledge and ignorance, even potentially affecting the chances to envision and develop alternatives.

Also, the division of computing labour inside Big Tech companies contributes to compartmentalizing and fostering hyper-specialization among the most talented computing researchers and engineers. The politics of knowledge imposed inside these companies and in relation to the outside limit sharing information and knowledge to the point where probably nobody has a comprehensive or generalist

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[30] https://aws.amazon.com/free/machine-learning/?trk=ad887195-b4e9-42c0-9c4f-4748d77c4180&sc_channel=ps&ef_id=CjwKCAjwuqiiBhBtEiwATgvixPWNu5m-pywwdQgup2L51JtE8bbPdFgNLLmndYPtkUE_XKO-fYq0IxoCeT8QAvD_BwE:G:s&s_kwcid=AL!4422!3!645186206149!e!!g!!amazon%20web%20services%20artificial%20intelligence!19579892878!148952155367

[31] https://www.theverge.com/2019/1/25/18197137/amazon-rekognition-facial-recognition-bias-race-gender

[32] https://www.businessinsider.com/amazon-chatgpt-openai-warns-employees-not-share-confidential-information-microsoft-2023-1?r=US&IR=T

view of frontier AI. My interviewees doing AI research agreed that the edge in AI are small changes in configurations that most of the employees do not know about. Only the group that is programming those configurations will know about them. As the IBM AI researcher that I interviewed made it clear: "you are taught not to share the details of each project with those who don't have a 'need to know'; it's a basic IBM rule."

Braverman describes how deskilling took place inside the factory throughout most of the 20th century, as a process that reconfigured the relationship between the worker, on the one hand, and the machine and the manager, on the other. The machine replaced standardized tasks and it was that standardization, the process of turning tacit knowledge into explicit protocols what first diminished workers' local and experience-based knowledge, turning jobs into sequences of simple tasks. Managers monopolized the knowledge to oversee the whole production process, the "systematic pre-planning and pre-calculation of all elements of the labour process" and used that "monopoly over knowledge to control each step of the labor process and its mode of execution." (Braverman, 1998, p. 82).

The process at stake nowadays is more complex. This was a reorganization taking place inside each and every firm while the process we are witnessing now is a reorganization of labour and learning between firms. The machine not only "learns" at the expense of workers but also at the expense of most organizations' and societies' capacity to learn since the learning machines are controlled by a handful of companies. This is not the only possible way to develop and interact with digital technologies. This is the private, for-profit way in which the cloud serves as enabler for both further development and adoption.

7. Weaving a hierarchical network of corporate power

The cloud is the world's wholesaler of computing services in general and digital technologies in particular. Yet, as the different classification of Big Tech "partners" overviewed here made it clear, the cloud is not just another marketplace, it is a quite rigid organisation (division) of computing and related labour, thus of computing innovation. While there can be hybrids and frontiers are blurred between classes of partners, the cloud giants have a unique and quite determined role. They centralize and set the cloud as a network; they define and administer the integration among all players in what formally looks like a market but, at the same time, is an increasingly dictated, regulated and controlled sphere.

Cloud hegemons dominate and accumulate from the cloud. The different types of partners subordinate to them to profit from adjacent businesses (selling, providing technical services and working as helpdesks) or by offering computing services that can only run on Big Tech clouds. One could say that since there are at least four different cloud "ecosystems" that offer pretty much the same services, there is no serious risk of asymmetric relation with so-called partners and customers. Nonetheless, in contemporary capitalism market concentration is, more often than not, the outcome of knowledge and data concentration. When monopolized intangibles are crucial for another organization, the latter will have no better choice but to accept the terms of exchange of the intellectual monopoly. Relying on multiple cloud providers does not eliminate this asymmetry, it only lowers risks by providing bargaining space when purchasing a new service since the large customer can negotiate with more than one cloud provider.

The cloud is a discordant ecosystem also because a myriad of customers uses without accessing pieces of the digital technologies package. Yet, different realities are hidden under that label, as the cases of OpenAI, the Santander Group and the US DoD anticipate. In any case, as digital technologies

reconfigure every industry and aspect of our lives, the cloud will become an even more fundamental agent in the global hierarchy of intellectual monopoly power.

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