

## **New actors in Technological Innovation in the Western World**

**Claudia Schatan.**

*Tech giants appear to be taking the lead in research and development (R&D) internationally, with Amazon and Google leading the way. What does this mean for innovation orientation?*

### **1. Relationship between the State and the private sector in R&D in the United States**

The United States was the undisputed global scientific and technological leader in the postwar period, during which time it financed about [70% of the world's R&D](#) (between 1950 and 1960). Much of this research activity was undertaken by the United States defense sector, because of the Cold War and by the race to conquer space against the Soviet Union. From there came the basis for the development in computers and electronics, satellite communications, aerospace advances and later included the pharmaceutical industry. The United States' contribution to R&D had [fallen to 28% of the world total in 2017](#) especially because other countries increased their spending on R&D considerably. In fact, financing for this activity grew at a rate of 4.3% per year in the United States between 2000 and 2017, while China did so at [17% per year in the same period](#).

The origin of expenditures on R&D in the United States has also been changing, with the private sector acquiring a growing presence. This sector contributed 70% of total R&D financing in 2018 compared to 50% at the end of the 1960s, while the public sector had a decreasing involvement comparatively ([Congressional Research Service, 2020](#)).

Despite its lower participation, the role of the United States Federal Government continues to be crucial, since in 2018 it financed 41.8% of basic research in that country, which is essential for the subsequent applied research and its development until it may usefully be absorbed by the productive sector ([Congressional Research Service, 2020](#)). However, a change has also been taking place here, as the participation of the business sector has also [increased its financial support for basic research](#) over the last two decades.

Within the US business sector, it is the largest companies – those with over 10,000 workers - that financed more than half of all R&D in that country in 2017 (according to Science & Engineering Indicators, National Science Board). And, within this perspective, the prominence the tech giants are acquiring in R&D is impressive. In 2018, the ten largest companies in the United States, led by Amazon and Alphabet (Google's “mother” company), invested [122 billion dollars in R&D](#), that is, 21% of all R&D carried out in the United States that year ([580 billion dollars](#)). Note that the ten largest North American companies - six of which are in the software, digital systems, electronics and computing sectors - contribute 85% of the total amount for R&D coming from the ten largest companies in the world.

In short, the large companies that have grown increasingly powerful in Western economies have also been expanding their role in R&D and, among them, the United States tech giants are the most outstanding, and this trend will deepen.

COVID-19 pandemic is generating the worst international economic depression since 1932 and, at the same time, large companies in the digital world have made huge profits in recent months, in addition to those they had already been accumulating previously. Services provided by these large digital platforms have become essential in the midst of quarantines, lockdowns and social distancing. Hence their role in the world, in many ways, but also regarding innovation will likely expand considerably, given the difficulty countries are facing to finance multiple areas, including the highly pressured health systems, unemployment insurance for millions and millions of newly unemployed, among others.

## **2. Direction, content and purpose of R&D under the new business leaders**

Technological giants have been deepening the world of knowledge by collecting huge and growing amounts of information and analyzing it, among other means, through Artificial Intelligence (AI), which has generated disruptive changes in technology.

**Amazon**, [currently leads the world in R&D activity](#) and its presence in this area has increased almost geometrically in recent years. Amazon develops experimentation throughout its company to “[help customers make purchase decisions](#)”.

Innovation driven from the consumer side has bolstered the development of the Internet, unleashing other innovations on the web. As [Jeff Bezos](#), Amazon's CEO, put it to his own company's executives in 2012: “Above all else, align with customers. Win when they win. Win only when they win.” In other words, consumption is the engine of the R&D of this company and the information about its clients is its gold mine. Amazon has invested substantially in extremely innovative areas such as Amazon Web Services (AWS) which is the most widely used and informative cloud platform in the world, enabling it to offer countless data hub services; the well-known Kindle, whose introduction was a watershed in how people read; Alexa (Amazon Echo), which answers any question from a user in an enormity of ways; and Amazon Go, which is the most advanced commerce concept, the technology that allows you to make purchases in the most innovative imaginable way.

It is inevitable to wonder if the R&D orientation inspired by consumers in various markets is the best guide to generate progress for human society, considering that this excludes a substantial part of the latter for being at the market margins due to their meager income and often cut off from digital world. If we look at **Google's** mission, it is not so different from Amazon's, but it has a more universal scope: “Organize the world's information and make it universally accessible and useful”, which requires permanent innovations in almost all disciplines of computer sciences. A [recent Google document](#) on its approach to research makes it clear that much of it is geared towards new ways of processing massive amounts of data, which means “understanding” the meaning of documents, translating between languages with ever greater precision, translate images into text, among a myriad of operations.

Some of the outstanding advances apply to health, which is invaluable to humanity. Google Health is an area of Google that provides extremely useful tools to improve the world's population health, at least for those with digital access. Through Google instruments you can gather information on the medical condition of people

(measurement of temperature, blood pressure, physical condition, etc ...). Google Health is also helping, through AI, to diagnose cancer and other diseases, as well as to monitor the recovery of patients.

Without a doubt, the platforms that embody the digital revolution are providing critical services in the current pandemic emergency. Thanks to them, there are instant communication channels to carry out an unprecedented cooperation between scientific researchers in the world who study the virus and seek its prevention or cure through a new vaccine, new or existing drugs. They also facilitate, through smartphones, the tracking of those affected by the coronavirus as well as people that may have been infected by close contact with the former (joint Google-Apple effort in the United States), and also help maintain social distancing through teleworking and study via Internet.

But, the aforementioned advances have not been achieved by the tech giants alone. It is important at this point to bring up the work of **Mazzucato** (2018), who carefully studied the case of **Apple iPhones** and the link between the technology used for their development and the technological contribution made by the company itself to achieve this great innovation (experience that is similar to that of other tech giants). The author shows how all the essential technologies for the iPhone came from the basic research that the United States government funded at the time, among others "... GPS, Internet, cellular communication, Siri, microchips, touch screens" ([Mazzucato, 2018](#) ) and attributes the true genius of **Steve Jobs**, creator of the iPhone, to the integration of these technologies - invented by others - and the very original design of their products. In other words, they could not have achieved these innovations by themselves.

Despite the impressive achievements of the knowledge society, which is currently helping us to face the pandemic, it is worth asking if science and technology and their application are really focusing on solving today's world biggest problems, that is, the problems that afflicted humanity before the pandemic, that persist or are currently worsening.

In this sense, it is important to ask whether there should not be, as **Mazzucato** suggests in a recent article (2018), public policies with specific purposes (“mission driven policies”) to overcome the great problems of our era. She proposes that “big science [should be] deployed to meet big problems”, which in her opinion are climate change and environmental quality, demographic changes, health and well-being, mobility problems, to which we should add poverty and inequality. The author believes that governments have the opportunity to influence the direction of growth and innovation by making strategic investments along the innovation chain and in multiple sectors. Entities such as the National Institute of Health in the United States aims to “seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability.” Here we have an institution that does not generate profits but deserves all the imaginable support.

In practice, as mentioned above, R&D is increasingly moving to the private sector and within it to large tech companies, and these are also taking greater responsibility for basic research. But will they be able to direct the advance of R&D towards what is needed? This deserves great concern.

Undoubtedly, technological giants are diversifying and increasing their R&D activities and their application. [Elon Musk](#), the fourth richest person in the world and CEO of several huge companies, has a big stake from the production of electric cars (**Tesla**) to space rockets (**SpaceX**). Between these extremes there is a series of other activities with disruptive innovations: in telecommunications (massive and inexpensive satellite Internet); solar energy; infrastructure for transportation, including new ways to build tunnels; artificial intelligence and robotics; medical treatments and prosthetics. He has extremely ambitious and almost far-fetching projects like the brain-machine interface that would connect the human brain directly to computers. **Musk's** presence in all of these spheres has come to be called the “Musk ecosystem.” Some of these innovations, in addition to being extremely profitable, will surely favor progress in the world, but probably many of them will leave intact some of the most pressing problems of our era, that threaten the very existence of the planet.

Some large companies, and specifically some CEOs, are more sensitive to these types of responsibilities than others, as has been the case with Bill Gates, co-founder and CEO of **Microsoft**. Gates left Microsoft's management in 2000 partly to focus on boosting the **Bill & Melinda Gates Foundation** with an asset of \$ 50 billion. This foundation supports programs that address global problems such as poverty, infant mortality, pandemics, and restrictions on access to health and education services. But people like **Gates** are very rare in the business world. Big businessmen normally seek unlimited profit margins and put technological innovations at this service, so their growing dominance over R&D is problematic. Without a sufficient definition and financing of public areas in R&D, these mostly respond to the market impulses.