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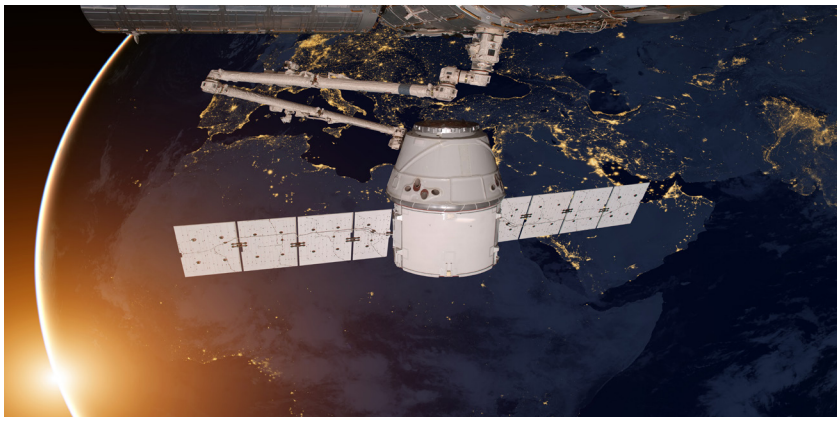
New Space: The Impact of the Digital Revolution on Space Actors and Policies in Europe



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Abstract

Like most “traditional” industries, for several years the space industry has been faced with the challenges of digital technology. So, the European space industry is dealing with new actors from digital technology, which are mainly American *start-ups* or Silicon Valley giants such as GAFA.[1] The latter use new methods such as increased use of private financing, faster production and decision-making cycles, and a rebalancing of priorities between the designer and client.

The digital revolution has additional characteristics with regard to the space industry. Indeed, it is not only the processes which have changed, but also the type of services which pass through the satellites. For example, telecommunications satellites (satcom) are moving away from the distribution of television channels to bandwidth distribution in order to broadcast digital content.

1. Acronym combining Google, Amazon, Facebook and Apple.

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Overview of the digital revolution

The digital revolution, which impacts various sectors of the European economy, is accompanied by a strengthening of the United States' economic domination over Europe. The digital economy is still largely dominated by the United States. Most of the companies, financial resources (venture-capital), and research, which are its spearhead, are concentrated in Silicon Valley in California.

Thus, 84% of global market capitalization in the digital sector is American, as opposed to only 2% for Europe. The world leaders in digital technology are unquestionably American. Google, Amazon and Facebook alone accounted for $ 1,516 billion of market capitalization at the start of 2015.[2] Each of these companies has a quasi-monopolistic position in Europe, with no major European competitor.

The United States dominates the software industry. In 2015, seven out of ten top global software publishers were based in the United States (only two in Europe). The French leader, Dassault Systèmes, comes in with approximately $ 22 billion of market capitalization and its most direct French competitor, Cegid Group, is weighted at less than $ 600 million. This size is obviously modest compared to the weighting of the Silicon Valley giants: the world leader, Microsoft, is weighted at more than $ 340 billion.

Europe is not even present in some digital sectors. The semi-conductor industry and hardware manufacturers, which have a strong presence in North America, are almost non-existent in Europe.

Foreseeing a dark future, Europe's delay compared to the United States seems difficult to catch up. Indeed, growth related to digital technology is exponential. Due to their greater financial power, the American digital giants are now systematically purchasing potential competitors, even when these are in their infancy. In so doing, Amazon, Apple, Google, Facebook and Microsoft are expanding quantitatively,

2. P. Fay, "Les 'Gafa', plus forts que le CAC 40", *Les Échos,* 22 February 2015.

safeguarding their financial supremacy, but also qualitatively, by integrating activities increasingly removed from their original core business. Thus, they are ensuring an even more dominant and encompassing place in the market. Google highlighted this process by investing nearly $ 200 million in the transport company Uber in 2013, and demonstrates, as Olivier Sichel explains, that the digital giants aim to build "ecosystems for their services".[3] This makes it very difficult for newcomers to develop in this sector.

So, it is a hegemony to which Europe – the EU and its Member States – does not yet know how to respond, to the point of appearing as a "colony" of American digital technology, in the words of Senator Catherine Morin-Desailly in an information report commissioned in 2013. Although some authoritarian regimes, in particular China and Russia, have managed to protect themselves from the American multi-nationals by building monopolistic national platforms (WeChat, VKontakte, Alibaba, Baidu, Yandex, etc.), Europe seems to be lagging in the area of industrial digital technology, due to a lack of political will to support European champions capable of breaking the status quo.

Firstly, the fact that the digital sector is largely dominated by non-European actors raises economic issues. The digital revolution does not operate in a vacuum and it infiltrates all sectors of the economy. All companies in all sectors are witnessing the very nature of their activities (their *core business*) and their products change. The industrial sector, including the most traditional industries, must prepare for major *disruption*, i.e. a reversal in its production methods and its growth model.

The example of the plastics industry is very significant. The plastics industry, which manufactures countless objects for our everyday life from moulds which the molten plastic is poured into, does not seem *a priori* affected by digitalization. However, if the opportunities provided by 3D printers are considered, this industry could be at a critical turning point in its history. Indeed, companies in the plastics industry may be interested in carrying out part of their production remotely, for example at the client's premises, by means of 3D printers. Yet, the printers are operated by Windows (Microsoft) or Android (Google) operating systems (*software*).

3. O. Sichel, "L'échiquier numérique américain : quelle place pour l'Europe ?", *Potomac Paper*, No.20, Ifri, September 2014, available at: www.ifri.org.

These could enforce a right to be acquired for the licenses for the moulds used by the companies. So, value would be extracted from the activity by the *software* rather than the *hardware*. This is what happened for taxi services with Uber or hotel services with Airbnb: the value lies in the online reservation service and no longer in the actual service itself. The methods, growth model, production, and core business are considerably affected by this.

This prospect of transformation is very real. The Silicon Valley *venture capitalists* are constantly looking to create the next Uber, i.e. to extract value from the activity of traditional sectors of the economy *via* digital integration. The companies most likely to benefit from these *disruptions* are those which can provide the software: the American giants. The pervasiveness of digital technology thus extends into the most unexpected corners of the economy, which enables the market leaders to impose their dominance and prevent opportunities for emerging actors.

The issues associated with the dominance of the American digital giants are also political. While the European economy is at the mercy of major American groups, the latter are strengthening their control in a large number of areas. It is the sovereignty of the European countries which is challenged, in a context where the weakness of the EU's legal framework and disparities in the national legal frameworks grant the major players in digital technology significant room for maneuver.

Companies like Google, Apple, or Amazon do not hesitate to use these frameworks and to exploit their loopholes to serve their own interests. Thus, they enable barriers to competition and abuse their dominant position, like when Google imposed it navigator (Chrome) or its search engine on mobile phone manufacturers using Android. Other abuses are recorded with regard to the accumulation and use of users' personal data. Facebook in particular was given formal notice by the CNIL (the French data protection authority) in February 2016 for its breaches of the French law on the protection of personal data. At issue were targeted advertisements based on private data, the lack of transparency in the use of this data, or even the unlawful use of "Safe Harbour", i.e. the transfer of this data to the United States. Finally, the Californian giants are taking advantage of the lack of tax harmonization at European level to exempt themselves from tax *via* complex arrangements. A Greenwich study shows that for example in 2011, Google, Amazon, Facebook and Apple paid 22 times less corporate taxes in France than they should have. Similarly, the sanctions recently applied by the European Commission against

Apple – nearly € 13 billion – are related to illegal tax benefits which it took advantage of in Ireland.

This last example points to the need for co-ordinated action by the European states not only to stifle the power of these major American groups, but also to protect the common market in the hope of one day seeing European champions emerge, which are capable of playing a major role in the digital economy, and therefore in the economy as a whole.

The impact of the digital revolution on the space industry

The digital revolution also affects the space industry, resulting in a certain number of phenomena which are grouped under the heading of *"New Space."*

The space industry covers many distinct activities. Upstream, the production of large launcher and satellite systems and activities related to the launching and stationing of satellites; downstream, the production and processing of satellite data (images and scientific measurements) and telecommunications services. Firstly, *New Space* can be defined as a profound change in production methods in the upstream sector, but also as a development in some downstream services. The traditional satcom market, for example, has been transformed by innovations related to the increasing mobility of telephones and computers, as well as the fact that satellites, which mainly transmitted television channels, are devoting an increasingly greater part of their bandwidth to transmitting internet content.

From the 1950s until recently, the European satellite and launcher programs have been subject to a certain number of characteristics. Considered by the government, particularly in France, as being of strategic importance, they were most often decided on, managed, and financed by the public authorities. The prototypes were designed by highly-qualified engineers with no consideration of price, time, or commercial interest – the national interest took precedence! The clients were mainly the Ministry of Defense, or other public entities such as Météo France (the French national meteorological service) and some large public companies. This approach was based on the development of the best possible technology, the "technology push", and on extremely long development cycles, often more than a decade.

The methods from the world of digital technology have upset this balance. A certain number of characteristics can be listed:

The cost and the risk

The *New Space* projects seek to reduce the cost for the manufacturer, but also for the client, by adopting a "low-cost" model as opposed to the traditional "high-cost" and "high-quality" model. The new programs seek to provide users with *cost-effective* solutions. For the satcom market, for example, a lower cost per "bit" must be offered.

One possibility is to mass manufacture small satellites with a limited lifetime, which would be launched in low-orbit constellation – a much less expensive solution than manufacturing large satellites launched for many years in geostationary orbit. Another way to reduce costs is to produce faster. The decision-making process and testing and development times are therefore shorter in an industry which traditionally took its time and precautions.

This latest development raises the question of the different relationship that Americans and Europeans have with risk. In American culture, failure is considered as an opportunity to learn and start over again, as the saying "Fail early, fail smart" demonstrates. In Europe, failure is not easily accepted and so it is more complicated to take risks. The field of launchers provides a good example: in Europe, a launcher prototype which experiences two consecutive failures during its development will doubtlessly be dropped. In the United States, the company SpaceX's Falcon rockets were able to move on from failures (the most recent in September 2016), but despite that these will make it possible to improve the following versions of the launcher. As a result, SpaceX can afford to provide shorter development times.

Software and applications: priority to service

The *New Space* designers' brilliant idea is that the end client is willing to pay dearly for a service which they really need or want. The activity is therefore *application-driven*, which goes back to focusing on the *software*. In order to develop the best "apps" possible, the software is customized while the hardware (launchers and satellites) can be mass-produced to be cheaper.

Therefore, *New Space* primarily thinks of the client's needs, which is a radical change of perspective in relation to the methods of the past, where the focus was on the system designer. In the first decades of the European space effort, the possibility of the applications' commercial success was only taken into account at the end of the process, sometimes with unpleasant surprises (see *below* for the example of Copernicus).

The key role of the United States

As is the case for the entire digital sector, the *New Space* phenomenon appeared in the United States for a certain number of reasons:

A favorable financial environment. In the private sector, the American economic framework has many "venture capitalist" investors and private capital flows ready to be invested. This funding is doubled by the presence of public actors, NASA and the Pentagon, who will be clients of *New Space* companies, which guarantees a planned workload for them.

Furthermore, the regulations, which are favorable to entrepreneurship and innovation, are largely unified across the country.

This environment is enhanced by the very personality of the *New Space* entrepreneurs who are from a new generation. Far from being NASA alumni, Silicon Valley's *high-tech* billionaires (Facebook, Google, etc.) are young and ambitious. Making their profit by selling advertising space on their pages does not quench their thirst for innovation and adventure. So, for many years, they have launched projects in amazing areas. Some are seeking to transform the human body to achieve immortality (this is called "transhumanism") and others want to develop space tourism.

Silicon Valley is obviously an extremely vibrant incubator for innovation. Compared to this, Europe is experiencing a specific constraint. Indeed, in order to ensure broad participation in the European space programs, the European Space Agency (ESA) set up a specific system from its foundation in 1975, called "just geographic return", which ensures distribution of industrial production between the countries. So, when a country funds a program, it must receive nearly as much to manufacture in its country. This system was adopted to ensure that all the European countries would have an interest in funding the space programs. This distribution is obviously a constraint that the United States does not have.

Finally, *New Space* has enabled a large number of newcomers to emerge, including in areas previously reserved for government actors, such as scientific research or space exploration. Here is a list of start-ups present

in the different areas of space operations for information only (NB: not all of them are American):

- Launchers: SpaceX, Generation Orbit, StratoLaunch Systems, RocketLab, Firefly, Swiss Space Systems, Reaction Engines;
- Earth observation: Skybox Imaging, Planet Labs, PlanettQ, OmniEarth, UrTheCast, Perseus;
- Suborbital flight for conducting tests and space tourism: Virgin Galactic, Blue Origin, XCOR Aerospace, Final Frontier Design, Master Space System, Zerogravity, Up Aerospace, Scaled Composite, Zero2Infinity, Copenhagen Suborbital;
- Telecommunications: OneWeb, Space X, Leasot, LaserLight, Kymeta, StratoBus, Zephyr, Phasor;
- Manufacturing in micro-gravity and use of space resources: Made in Space, Shackleton Energy, Planetary Ressources, Deep Space industries;
- Capture of space debris: Altius Space Machines, Nova Works, Clean-mE;
- Manned flight: Bigelow Aerospace, Paragin Space development, Golden Spike, Inspiration mars, Mars Foundation;
- Sciences and other: B612 Foundation, Digital Solid State, Moon Express, Exolance, TimeCapsule2Mars;
- Experiments in micro-gravity on the ISS: NanoRacks.

On first examination, *New Space* will have significant impacts on the development of product prices, both upstream and downstream, as well as on competition and co-operation, and on the possible consolidation of industrial and commercial entities. *New Space* leads to very different situations for the various types of actors in Europe. Some, like Airbus or Thales could benefit from the development, while others will have more difficulty.

The launcher market: Ariane 6, between a traditional model and *New Space* requirements

The area of launchers has been traditionally considered as an area of strategic importance, particularly by France, which saw it as a consequence of the development of missiles for its nuclear armament. From the 1960s, it convinced the other European countries to come together to form a consortium to develop an independent European rocket: it was the beginning of the Ariane line of rockets. Up until Ariane 5, the Ariane rockets were designed on traditional models in Europe, i.e. on an initiative, funding, and mainly by public actors, for often very long and cautious developments.

When the time came to start specifying the successor launcher for Ariane 5, the tightening of public funding and the example of the *New Space* actors changed the situation for Arianespace.

Hence, the company SpaceX, founded in 2002 by Elon Musk (a co-founder of PayPal and Tesla Motor), has the goal of reducing the launch price by using techniques from the private commercial sector. In December 2013, its Falcon rocket succeeded in putting a telecommunications satellite into orbit. Benefitting from its new very simplified production methods and orders from NASA, SpaceX offers a launch rate 30% cheaper than its competitors, at approximately $ 60 million.

The Ariane 6 program, which was launched in December 2014, reflects these developments. Its goal is to offer a halved cost compared to Ariane 5, and a greater launch rate, increasing from 7 Ariane 5 rockets per year to 11 Ariane 6 rockets per year.

To this end, major changes were made between 2014 and 2016 with regard to the governance of the Ariane 6 program. The industrial organization was reviewed. The public authorities, ESA and CNES (French space agency) are no more than the client.

The Airbus Safran Launcher (ASL) joint-venture was created between Airbus Defense and Space and Safran to serve as the prime contractor. This private joint-venture brings together the design of the new launcher and the propulsion and system integration aspects.

In August 2015, the ESA and ASL signed a contract providing € 2.4 billion for the rocket's development phase. So, this phase will mainly be financed by the public sector, but carried out by ASL. The operations phase will then be carried out without public support. This will make decision-making more effective within ASL. With regard to Arianespace, which is responsible for marketing the launcher, it is witnessing the shares of its capital held by the CNES transferred to ASL, thus becoming a private company.

Ariane 6, whose first flight is scheduled for 2020, will be operational in 2023. The rocket is designed as a modular launcher which is capable of adapting to launch different types of satellites. The A62 version, equipped with 2 thrusters, will have a payload capacity of 5 tones; the A64 version, equipped with 4 thrusters, will have a payload capacity of 10.5 tones. From a technical point of view, it is not a revolutionary change. For a company like Arianespace, caught up in the risk-aversion culture, it is not appropriate to jeopardise the reliability of a system already validated with previous versions of Ariane.

Seen from an external point of view, it seems that it is actually difficult for SpaceX to really learn from its failures. Due to the extreme simplification of the procedures, the monitoring of tests is not sufficiently thorough, which prevents a detailed review of the technical reasons for a failure. By comparison, Arianespace is proceeding with the "more haste less speed" method. The development of new components will therefore necessarily be slower for Ariane 6 than for SpaceX's Falcon.

In any event, the Ariane adventure reflects changing European attitudes with regard to access to space, originally based on the desire for strategic independence to nowadays incorporating a certain reorientation towards commercial attractiveness. Hence, the development of Ariane 6 was conducted as close as possible to its clients.

Space observation: undiscovered mass markets?

Unlike the telecommunications market, the space imaging market has never really taken off. During the Cold War, satellite observation of the Earth was strictly reserved for military and intelligence uses, mainly American (Keyhole satellites) and Soviet (Kosmos). In the 1980s, European public systems were developed, mainly in France. The Spotimage [*sic:* Spot Image] satellites were intended for civilian use, such as meteorology. They were followed by the Helios military satellites.

During the 1990s, in the wake of the collapse of the USSR and the First Gulf War, a number of private companies tried to develop commercial systems for a mass retail market and other private users. Nevertheless, despite all these efforts, the manufacturers did not find their markets.

The difficulty that these companies had in making their satellites profitable was from the weakness of the market, but also from the fact that the few existing clients – military and meteorology services – were able to develop their own image analysis and processing software. Moreover, the added value is found in this software and applications. Therefore, spatial imaging providers cannot make a profit by developing software for their few clients.

A good example is Copernicus. Created by the EU and the ESA in 1998, the GMES project – for *Global Monitoring for Environment and Security* – was renamed Copernicus in 2012. It is an Earth Observation and Monitoring Program which should provide Europe with independent capability in this field. Hence, the National Centre for Space Studies (CNES) sets out Copernicus' aim: this system must "collect all data obtained from environmental satellites and on-site measuring instruments, in order to produce an overall and complete view of the state of our planet." The program's applications will be civilian and military. On the one hand, it will make it possible to carry out climate analyses, to monitor the state of the oceans, to help with crisis management in areas affected by natural disasters, etc.

The satcom market: a dynamic and profitable market, *New Space* initiatives for Africa

The telecommunication satellite (satcom) market has so far been the most profitable of all the space-related markets, since the demand for telecommunications is enormous in most countries in the world. This is why this sector has been able to quickly free itself from the public authorities to become a largely commercial market, whose main actors are companies in the upstream space sector (which build the satellites and the rockets to launch them); the satellite operators, mainly Eutelsat, SES, Intelsat, or Satcom Africa, which are responsible for their smooth operation and lease their bandwidth; and finally the *providers*, who lease this bandwidth to operators to transmit the content of television channels, radio stations, telephone communications, and internet content to private individuals, and the *end users*.

First and foremost, one aspect to take into account is that the satellite operators compete with companies offering the same telecommunications service from terrestrial or submarine cables. These are the "cable operators." In France, the telephone cable infrastructure was built in the post-war period in a very tight network, either on poles (called "telegraph poles"), or buried by the PTT, which became France Télécom and then the private company Orange. The latter's competitors are SFR or Bouygues. In partnership with the company Nexans, Orange is now rolling out fibre optic cables in France.

The advantage of space compared to terrestrial cables lies of course in the satellites' capability to easily cover geographical areas which are difficult to access. This is why space operators highlight the role that they can play in the fight against the *digital divide*, i.e., the fact that people living in rural areas far from major urban centers have more difficult access, or even no access, to telephone or internet services.

At a time when telephones and computers are becoming less static and increasingly mobile, satellite coverage is increasingly of interest.

This thriving sector is also impacted by *New Space*. An initial challenge is the change in the types of content transmitted by the telecommunications satellites. Before, it was mainly television channels. The world market had around 40 *providers* who offered these channels to television viewers. Nowadays, alongside these television channels, satellites are also transmitting internet content. The number of access providers on the market to offer these internet streams to the end users is much higher. The actors are still not consolidated in this relatively recent market. They are not yet clearly identified, which initially creates some confusion in the market, in any case from the satcom operators' point of view.

Additionally, several *New Space* projects in the upstream satcom system were initiated by a single person, an American entrepreneur, Greg Wyler. The latter made his fortune by inventing a new PC cooling system in the 1990s. Since then, he has been working on projects to reduce the digital divide in the world. In 2002, he founded the company, Terracom, which aims to provide telecommunication services in rural areas of Africa.

In 2007, he founded the company, O3b (for the "Other 3 Billion"), meaning the Africans without Internet access. The company launched a constellation of small low-orbiting telecommunications satellites to serve Africa. The market did not really work and O3b is nowadays mainly selling its services to tourist cruises on the world's seas – far from the initial philanthropic goal! It was purchased in August 2016 by the operator SES.

In 2014, Greg Wyler started over and founded the company OneWeb, whose role is to make internet connection possible at all points of the globe. This time, it is a question of manufacturing a fleet of 900 microsatellites which will be launched in low orbit from 2018. The company announced a $ 700 million fund raising in 2015, backed by large groups like Coca-Cola and Airbus. In this case, European actors are rather the beneficiaries in this project, since it is envisaged that the satellites will be manufactured by Airbus Defense and Space (ADS) and they will be launched by Arianespace.

The OneWeb project remains fragile, however, since the funds raised are still insufficient to guarantee its start-up, and the technical issues related to the number of satellites that it would have to manage in low orbit are not resolved.

Marc Zuckerberg, the founder of Facebook, has developed a similar initiative. The "Internet.org" project was launched in 2013 with the participation of Facebook and 6 companies in the telecommunications sector to provide connection services in developing regions, particularly in sub-Saharan Africa. In October 2015, Eutelsat joined the scheme. Eutelsat

and Facebook planned to dedicate all of the AMOS 6 satellite's bandwidth to the use of African users, also providing them with the entire necessary downstream infrastructure. It was an "old-fashioned" heavy satellite launched into geostationary orbit, which would have allowed Eutelsat to prove its model in the eyes of the digital actors. Unfortunately, the Israeli-manufactured AMOS-6 satellite was lost in the failure of the Falcon 9 rocket launch in September 2016.

A new and fairly similar model can be deciphered in these different initiatives: a rich American entrepreneur pursuing a generous goal, based on a high-technology project and which remains viable from an economic point of view, providing opportunities for the European space actors.

Downstream space services: applications, software and programs to use satellite services better

The downstream space sector, which relates to the definition, retrieval and use of content provided by the satellites, has been connected to digital technology from the start, since the companies which deal with it, were created in the digital movement. The new challenge for *New Space* is therefore doubtlessly less impressive.

Nevertheless, the Booster project in France should be reported. It is another government initiative, this time led by Cospace (State Co-ordination Committee for the Space Industry) whose objective is to promote the creation of *start-ups* offering "digital services from space data."

The idea is to create a national network of "Boosters", which would be support structures to stimulate, catalyze, and accelerate innovation in France, at the intersection of the networks of the future which digital technology, the space industry, and all their areas of applications and potential markets are in the fields of town planning, agriculture, energy, environment, sea, risk management, industry, mobility, transport, sustainable regional development, leisure, etc.

The reboot of the British space program: a space program designed to integrate *New Space*

Historically, the United Kingdom developed its first space capabilities in the telecommunications field with the *Skynet* program of satellites for purely military use, whose first launch dates from 1969-1970. Vessels from the British fleet had to be able to communicate with London.

Otherwise, the lack of resources and ambition of the British government in the post-war years and the high demand for profitability of public investments impeded the development of space resources, whose objective would not have been profit, but prestige or scientific research, such as space exploration. In Thatcher's Great Britain, there was no "free lunch."

In 2010, the implementation of a plan to relaunch the British space program seemed like a small revolution, all the more so as the project was very ambitious. Indeed, space is now part of the eight priority technology areas for growth, prosperity, and employment in the United Kingdom – along with *Big Data*, robotics and energy. The bar is set very high: with £ 11.8 billion in turnover related to space operations today, the United Kingdom would like to exceed £ 19 billion in 2020 and £ 40 billion in 2030, or 10% of the global space market.

The target figures call for a comprehensive overhaul of the sector. It is a question of focusing on the markets and research capable of supporting space operations. The space industry must also be *out-looking* and cross the boundaries between sectors so that it stimulates demand in a wide range of areas.

Given the lack of immediate results, the British government relaunched the process with an "upgrade" in 2014. Five additional recommendations emerged:

(1) Develop high value-added priority markets and promote the benefit of the space industry to companies and public authorities;

(2) Make the United Kingdom the best place to develop *New Space* activities by building a business- and investment-friendly regulatory environment;

(3) Increase the British contribution to the ESA and increase the United Kingdom's influence in the European space programs;

(4) Increase British exports related to the space sector tenfold, by means of the implementation of a *National Space Growth Program*;

(5) Stimulate SMEs in the space industry – the "*space SMEs*" – with financial and industrial support, funding and training offers.

To this end, institutions which incorporate all the interests and areas relating to the space sector have been crated: The *Space Leadership Council*, *Regulatory Advisory Group*, *Spectrum Advisory Group*, *Export Advisory Group* and the *Defense Advisory Group*.

In the end, this major reform of the space sector should provide some opportunities in a wide range of areas. Easier and cheaper access to space could, for example, transform public policies by optimizing the management, risk prevention, and regulation of rail, road, and air transport. The space industry could also be an important asset for national security with secure satellite communications, maritime surveillance, disaster management, etc.; and environmental protection, with better weather forecasts, climate science, agricultural and food safety policies, etc. Finally, access to space should create a crucial opportunity regarding the distribution of broadband internet: "*Broadband for everyone, everywhere.*"

Seen from the continent, the United Kingdom's assertive policy is interesting. Given its relative modesty so far, it seems relatively easy to organize things in an innovative and ambitious way. It remains to be seen what the results of these efforts will be and how they will be able to be deployed in the context of Brexit.

The development of European spatial and digital governance: more assurance and a better dialogue

In the space industry, Europe is already a major power, with four of the ten largest budgets in the sector – France, Germany, Italy and the United Kingdom. Combined, these budgets exceed that of Russia and equal that of China. And France is the third country in terms of space budget relative to GDP – behind Russia and the United States. Although the latter two remain the undisputed (and historical) leaders of the space industry, Europe is nevertheless a real space power, and its space agency, the ESA, is the third largest in the world.

Beyond successful scientific missions (Mars Express, Rosetta, Hubble, etc.), the ESA, together with the European Union, is currently conducting two flagship projects for civilian and military purposes: the Copernicus Earth observation system (see above) and Galileo. Galileo, which was launched in 2003, is a satellite positioning system, equivalent to the American GPS *(Global Positioning System)*. Unlike the latter, its use is restricted to civilian purposes. 14 of the 24 scheduled satellites are already in orbit, including the two last ones successfully launched in May 2016, and the full service is planned for 2018.

However, beyond the industrial resources and programs, the sustainability of the European space program is based on European governance, particularly at EU level. Despite a framework agreement in 2004 which formalized co-operation between the EU and the ESA, and the introduction *via* the Treaty of Lisbon (2009) of space in the "shared competences" between the EU and its Member States, this governance remains incomplete. For greater efficiency and competitiveness, the ESA must consolidate its complementarity with space actors, including the EU, as the conclusions of the Council of Ministers of the ESA Member States reaffirmed at Naples in 2012.

It also essential to ensure the stability of public procurement, which for the greater part comes from the EU, but also to establish long-term operational programs in order to effectively link space agencies, service

providers and users. Thus, the ESA could have a key role in the development of commercial opportunities for European space programs.

However, Europe and the EU lack the tools and resources of digital power to position themselves in *New Space*. As we have seen, Europe is a dwarf in the digital economy, especially compared to the United States and its Californian giants. To such an extent that digital technology seems to be a risk rather than an opportunity for the EU and its Member States, as things stand at any event. In order to reverse the trend and establish genuine digital governance at European level, the European Commission would have to assume its responsibilities for competition, particularly, where its prerogatives are critical. By effectively sanctioning the abuses of the dominant position by powerful Silicon Valley companies, it may provide potential European competitors with unprecedented commercial opportunities.

However, European digital governance is obviously not just a matter of practice. As it exists today, the European digital policy is handicapped, like other areas, by organizational institutional limits due to the lack of harmonization of the EU Member States' legal frameworks. It seems particularly necessary to fill this lack inherent in European integration that companies like Facebook, Apple, or Amazon have taken advantage of, by practicing excessive tax optimization. Common tax rules could also thus return control in the digital sector back to Europe.

Furthermore, strengthening the European framework, with regard to the protection of personal data would generate digital governance closer to the Member States' and European citizens' interests, particularly by defending this protection as a fundamental right, as opposed to a more liberal American view of consumers' rights; which gives free rein to the digital giants.

Another organizational limit lies in the competences, and therefore in the perpetual internal fight between supranationalism (delegation to a higher authority) and intergovernmentalism (the Member States deciding unanimously). A European digital sector capable of countering American power needs a common framework which is hardly conceivable outside the EU.

In order to see this framework emerge, it is necessary for Member States to delegate a part of their competences to European institutions, i.e. their sovereignty, which historically has always been a major obstacle to furthering European integration.

Finally, it is crucial that European institutions integrate the affected activities and sectors rationally. At Commission level, the Directorate-Generals responsible for the space sector (which historically have been the

DG Research and increasingly the DG Enterprise) and for digital technology (the DG Connect) should initiate regular and effective dialogue between themselves. It is through this that a European governance favorable to the development of *New Space* could develop.

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