To stimulate the stimulating.

At the International Astronautical Congress held in Toronto in 2014 NASA´s chief administrator, Charles Bolden, stressed the need for entrepreneurs, politicians, and legislators to work in cooperation to stimulate and promote the space industry, and help it make further significant advances. The sector is attracting an ever-increasing number of highly-qualified engineers, technicians and scientists, but it is also necessary to create the favourable conditions needed for their work to flourish and grow, and so that society can recognise and appreciate all the many different benefits that the space industry brings to our daily lives. In short, it is necessary to stimulate activities which, *per se,* are stimulating.

We can start 2016 by looking back on a year which was a good one in the history of space exploration: the continuing exploration of Mars led to the discovery of liquid water on its surface; we finally reached Pluto and were able to see the face of was formerly considered the last planet in the solar system, before venturing into the Kuiper Belt; Rosetta continued to send back information about 67P/Churyumov–Gerasimenko; the Lisa Pathfinder mission lifted off to seek gravity waves; SpaceX´s Dragon and the Orbital Sciences Corporation´s Gygnus continued to deliver cargo to the ISS, while developing, as is Boeing, next-generation manned capsules, for which the astronauts have already been chosen; Blue Origin's New Shepard and SpaceX´s Falcon IX rockets landed vertically and; the rest of the orbital and suborbital spaceflight companies continued developing their space activities.

While NASA continues to develop its SLS and Orion spacecraft, Europe continues work on Galileo and Copernicus, is building its Ariane 6 launch vehicle, and is determined not to be left behind in planetary exploration. Meanwhile Latin American countries are engaged in a diverse range of projects, China is a burgeoning space power, and a record number of people attended the space weeks. Startups that specialise in space technology applications are proliferating, and provide an ever wider range of services to basic sectors. The new space economy is rapidly expanding, and numerous companies are developing projects and services based on space technologies, and the information we have obtained in and about space.

Any discussion of the space industry needs to examine the situation of the industry in Spain as well as in other countries. The space industry comprises technological companies, with the best professionals and highly-qualified teams, which are developing and commercialising a range of technologies. While it is true that these companies benefit from their activities, it is also true that they deliver much greater benefits to mankind as a whole (which can, in a way, be seen as fulfilling the first paragraph of Article 1 of the Outer Space Treaty of 1967).

Space activities can be classified into three main categories. The first is the physical exploration of space, including the space surrounding Earth, as well as

its resources and dynamics. Although some dissenting views have been expressed about the wisdom of space exploration, those voicing these opinions appear to forget that the history of mankind has been marked by constant expansion and that, even though this expansion has had both bright and dark moments, overall it has had a positive impact. Space should and must be the new arena for human exploration, where the goal will be to avoid past mistakes and to collaborate positively. One clear example of a successful collaboration of this type is the ISS, and I hope that a planned future manned mission to Mars will be another, where the keynote will be international collaboration, and all mankind will feel represented and joined in a common goal.

The second category is scientific knowledge; science in the sense of exploring and understanding the world we live in, the solar system and, by extension, the entire universe. It may true that some people believe that investing in scientific research, exploring our planet and what lies beyond, and trying to gain an understanding of how it all works is a waste of resources, but they would be mistaken. Throughout mankind´s history the pursuit of scientific knowledge has been one of the driving forces behind progress, and those who disparage it only reveal their own lack of understanding.

The third, and last, category is commercial access to space. This is a fast-growing area which probably produces the most immediate benefits in our daily lives, as dedicated entrepreneurs create and develop products and services which provide us with solutions in the fields of communications, data, security, information etc. When talking about the commercial use of space, it is useful to bear in mind how space activities have evolved since their beginnings. At the outset all space exploration was the preserve of states which sought to enhance their national prestige, but since then the focus has moved to private individuals whose goal is to improve the common good. If we look back at recent history, we see how the discovery missions financed by states have gradually given way to missions organised by private companies, which combine exploration with the obtaining of resources.

It is clear that all the above activities are stimulating and beneficial. However, it is also clear that private space companies need the support of public institutions and society. It is important that society understand the importance of private space activities, and appreciate all the many benefits it brings to our everyday lives, while public institutions need to promote these activities by providing the institutional support and legal framework required.

Up until now the government organisations responsible for overseeing space activities in Spain have delivered excellent results. The participation of Spain in the ESA has been extremely positive for the industry, since ESA´s policy of investing in each State an amount more or less equivalent to each country's contribution has acted as a driving force, and helped stimulate an industry which otherwise would probably have remained undeveloped, and certainly would not have grown as significantly as it has today.

However, although the ESA has played a very important role in the development of our space industry, and it is undoubtedly true that governments need to do more to encourage space activities, I believe that our private space companies have become so successful that they no longer have to depend solely on the European Space Agency. They have now developed the world-class space technologies and capabilities needed to enable them to compete in the international markets, where free competition prevails.

In my view private initiative will play a very important role in shaping the future of this industry, and I would like to give two examples to illustrate its *modus operandi*:

The first example is a new law brought in by the US known as The Space Resource Exploration and Utilization Act of 2015, commonly referred to as the Asteroids Act, which forms part of the Commercial Space Launch Competitiveness Act (H.R. 2262). To put it very briefly, the Act authorises its nationals to explore and utilise resources from celestial bodies on the basis of the "first in time" rule, and states that US courts shall have jurisdiction in any legal actions. The Act declares that any space activities should be carried out in a manner consistent with the existing international obligations of the US, although it does not specify how the frameworks needed to do this should be developed. The aim of the Act is to stimulate the activities which companies such as Deep Space, Planetary Resources, and the Shackleton Energy Company are engaged in, and provide them with legal certainty. While it is undoubtedly true that this Act is controversial, and many authoritative figures believe that it flouts the spirit of some provisions of the international treaties, in particular those referring to the non-appropriation of celestial bodies, it is equally true that other authoritative figures believe that it is fully compliant with international law (although, admittedly, further legislation is required), and that it creates a pro-growth environment which will favour the development of a space industry, and promote advances in propulsion, GNC, the locating of objects in space, and mining and processing activities, to name but a few. This will enable us to obtain valuable resources while at the same time fostering the creation of a new *modus operandi,* one which will help reduce the environmental burden imposed by mining on Earth.

The key point here is how ideas that, at first sight, appear to belong to the realms of science fiction have won the corporate and political support needed to have a law passed to promote them, within the framework of an Act regulating commercial access to space. It is also important to note how the institutions of a country such as the United States have taken the step of passing an Act to stimulate the commercial activities of its nationals before seeking to reconcile it, in a way that will not harm its interests, with the principles of international law. This situation has come about because, as we have seen countless times, legislation always lags behind the changes that take place in society.

My second example concerns a Spanish company called Payload Aerospace (PLD). This company is an ambitious private startup whose goal is to develop

space technologies, and it is building a liquid-fuel launch vehicle which will, if successful, be competitive in the international market and provide Spain with its own home-grown space rocket capability, something which the industry has previously lacked, as the other most important space technologies have been successfully developed by well-known Spanish companies.

It must be remembered that there have been earlier attempts to build a launch vehicle in Spain (the Capricorn Project) although, in the end, these projects had to be cancelled. PLD is currently developing Arion I and Arion II, the first stage of its launch vehicle project, whose payload capacities will rival those of the European Ariane, Soyuz, and Vega launchers and, if they are a success, the company wants to go further and create more versions. It should be noted that PLD´s structure, financing, and business philosophy are very similar to those of the companies that successfully developed the Falcon IX and New Shepard. The project has received widespread institutional support, and several governmental measures have been taken to promote Spain´s space industry, such as the preparation of a draft proposal for a Spanish Space Activities Act, which is currently being revised, and the creation of an agency to oversee all space-related issues ("The Agency"), which will be modelled on the Inter-ministerial Commission for Industrial Policy and Space Technology.

In this regard it may be useful to take other organisations, such as the UK Space Agency, as a model, as it was established without dismantling earlier government space organisations. The UK Space Agency coordinates and oversees the UK space programme, and one of its core objectives is to stimulate and encourage the UK´s space industry companies.

In conclusion we can say that private space companies have an important role to play as they have the knowledge, expertise, and willingness to undertake high-risk endeavours, and go beyond new frontiers. However, to achieve their objectives they need the support of both governments and society to provide the stimulus that I have discussed in this article. The stimulus that will take us to places we have never been to before. *I am sure you know what I mean.*