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History of space exploration

New Space Economy

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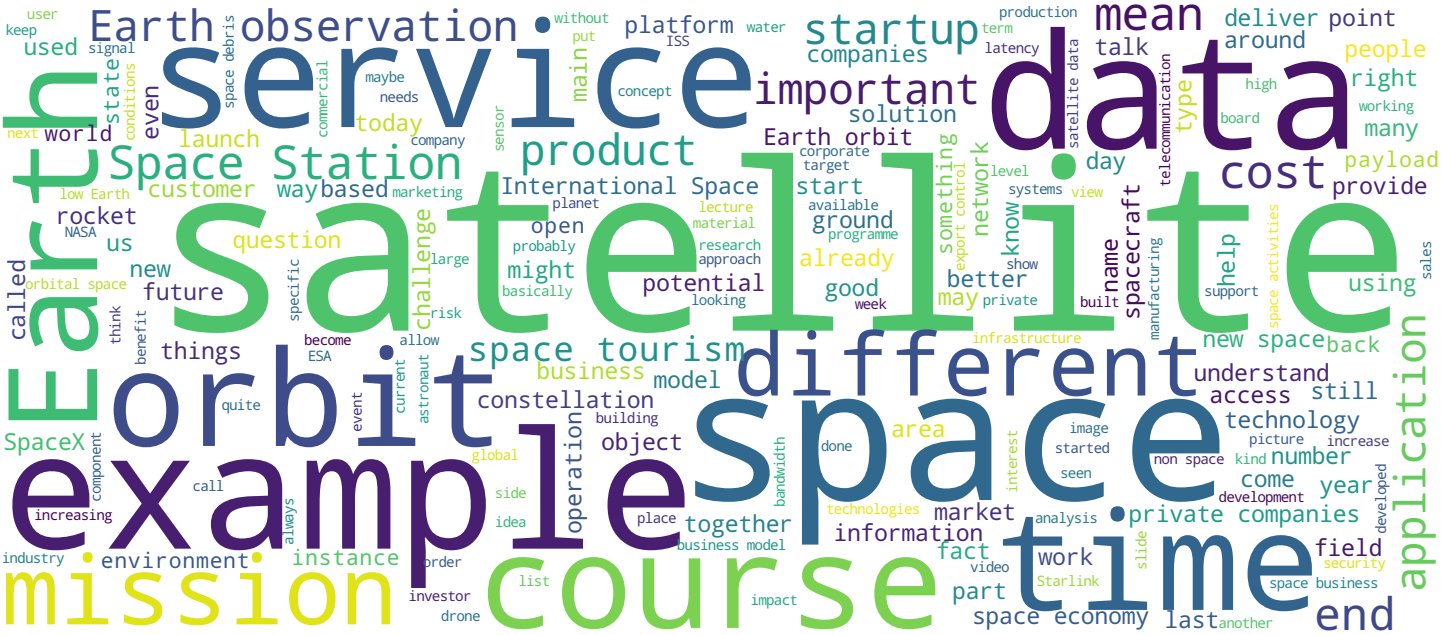

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Hello, everyone. My name is Claude Nicollier. I was an ESA Astronaut, and a crew member on four space shuttle missions. I'm presently affiliated with Space Innovation and still teaching at the Swiss Federal Institute of Technology in Lausanne, Switzerland. This course is about the new space economy. But the question is why new space economy? We had in fact, a deep involvement of private space companies since day one of space exploration and utilisation, which started more than 60 years ago. The Saturn V rocket was a NASA rocket but built by Boeing, McDonnell Douglas, and North American. The Apollo command module was built by Rockwell, the lunar module by Grumman. The ATV project of ESA involved dozens of companies and thousands of technicians and engineers from 10 European countries with Astrium as a prime contractor. So what is new? Well, the main feature that has boosted space business and space economy is the recently achieved significant reduction in the cost of access to space. You will get the numbers later in this course. Now, this reduction in launch cost in the US has been the result of the involvement of private companies in the launch business.

Notes

Summary

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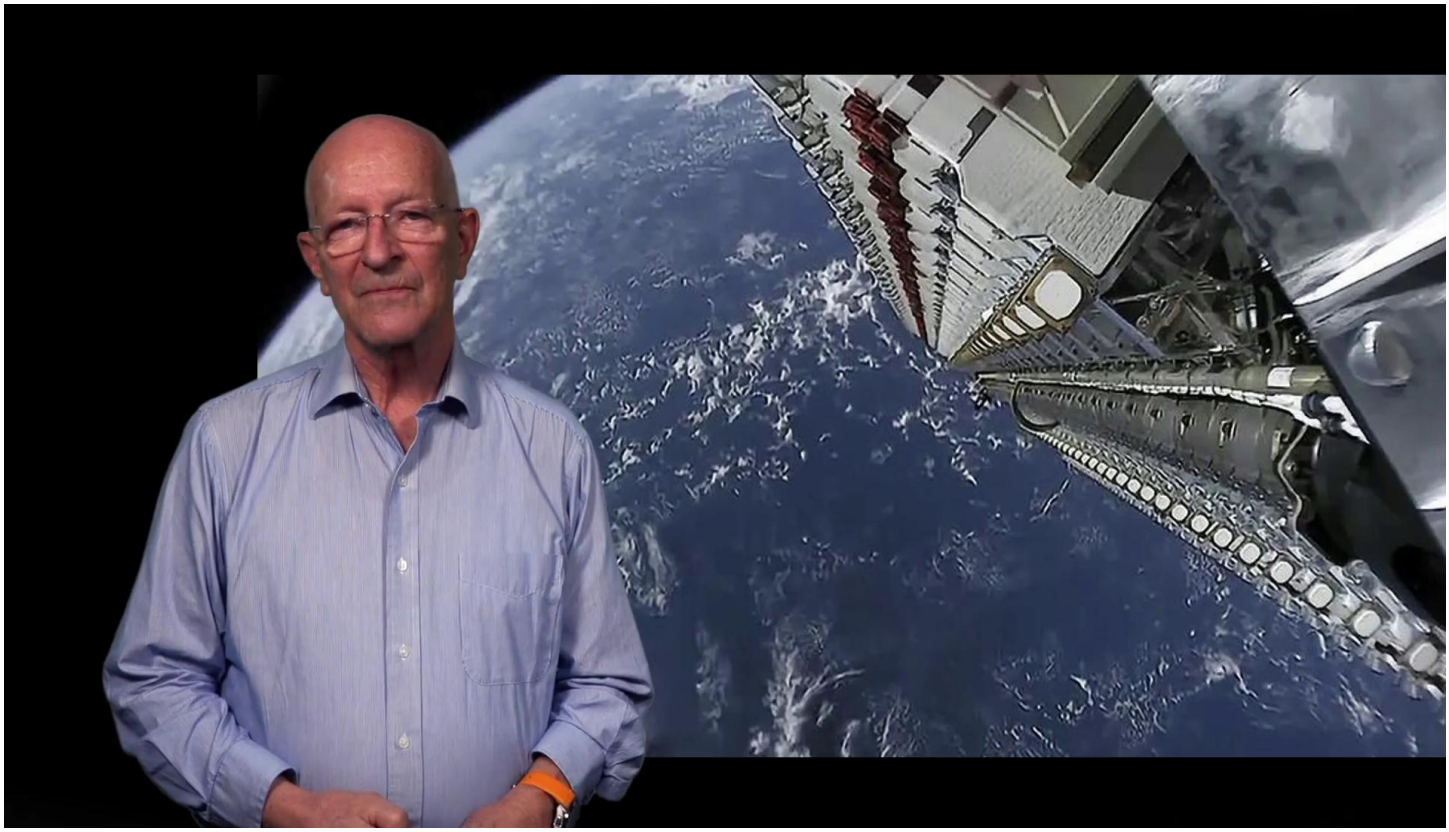

And this shift was promoted and sponsored by NASA after the retirement of the space shuttle in 2011. NASA, like the European Space Agency, is primarily an exploration agency and did not want to continue providing transportation of freight and astronauts from Earth to the International Space Station. A commercial orbital transportation system concept was put in place and companies that won the contract were SpaceX, Northrop Grumman, and Sierra Space for freight, and SpaceX again and Boeing for crew transportation. Now, what is interesting is that the engagement of private companies in space activities resulted and still results in a significant decrease of the cost of access to space. And this decrease in itself attracts more commercial companies into space business. And not only in the launcher segment, but in a lot of other space disciplines that I will list in a moment. Cheaper access to space, more private companies involved, which keeps the access to space cheap and even tends to reduce it further, bringing more companies into space business. Magic recipe, and it really works. But there is also a huge rise in the opportunities for the space private sector. Communications.

Notes

Summary

1m 32s

LEO, low Earth orbit up to 1,000 kilometres altitude, is a privileged location for the current boom in satellite networks. The main goal of these constellations is to provide a global coverage of broadband Internet to meet the need of consumers everywhere on the planet. Major players are Starlink of SpaceX and OneWeb. The number of satellites in LEO is increasing at a fast pace, and the total number could possibly reach close to 100,000 by the year 2030. This means, of course, that strict space traffic management rules will have to be applied. It is unknown today what a sustainable limit is in the total number of satellites in LEO, beyond which cascading collision effects could be catastrophic. Another problem with the massive LEO constellations is the sky coverage seen from the Earth, a significant concern for astronomers and for the public. Some constellations of relatively small size serve specific communication functions, like the Astrocast constellation, which eventually will serve a global Internet of Thing, IoT coverage with a set of about 100 high-tech satellites. The second major space discipline open for business is Earth and Earth atmosphere observation and analysis.

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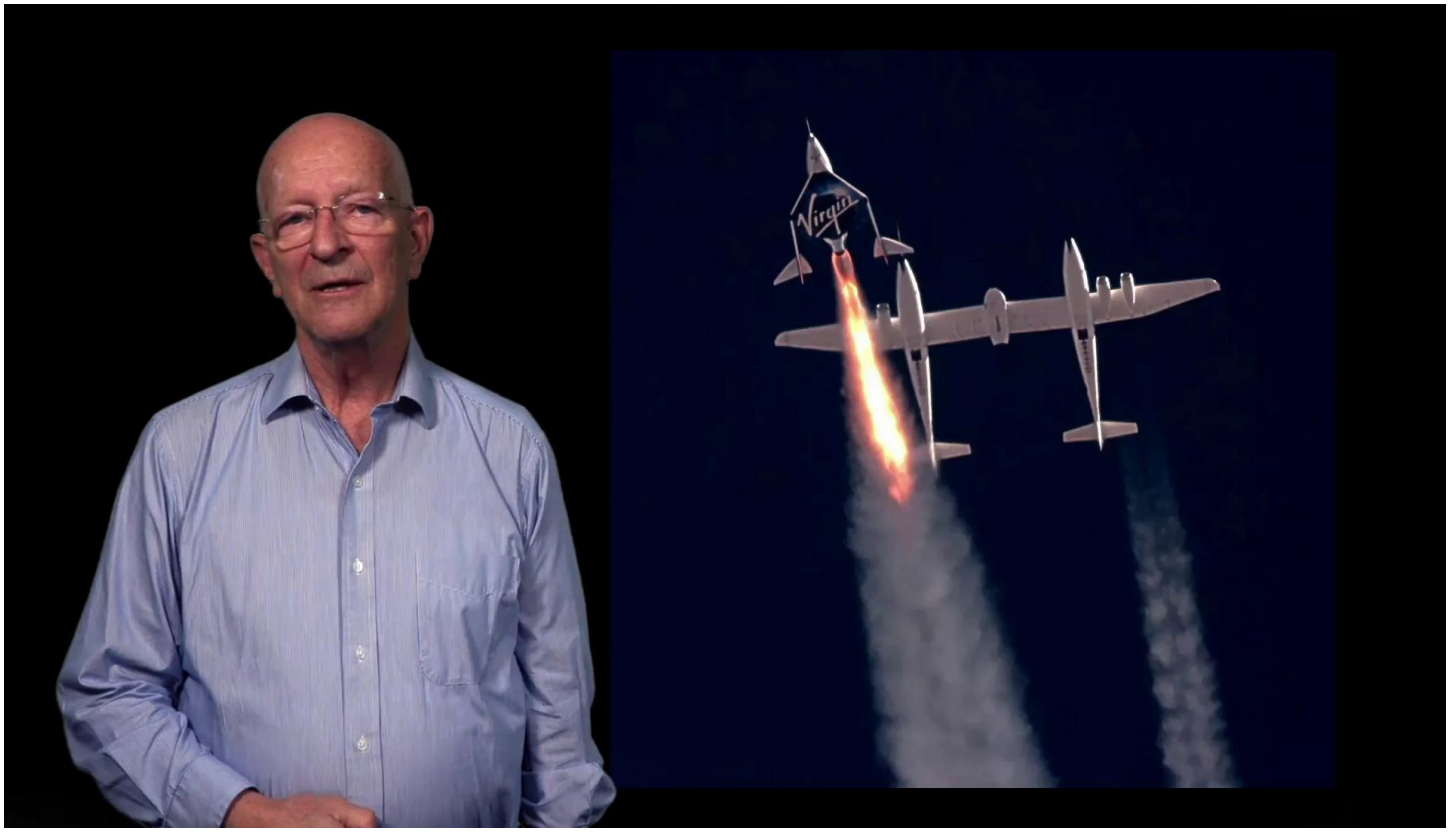
Summary

3m 08s



There are already a lot of platforms in space providing a massive amount of Earth observation data, often as an open source and only partially exploited. In a world with a rapidly changing climate and with a need for a smart utilisation of our planet's resources, this is an obvious area where commercial companies can make a significant difference for the benefit of our planet and of ourselves. A third area of interest for business is the use of the properties of space, mainly microgravity, for materials processing and for applied research or manufacture in the field of pharmaceutical products and medicine. This is a follow-on to research that has been done extensively on board the shuttle already using the ESA Space Lab Facility and later on board the International Space Station. Another obvious area where private companies started to be involved and will much more so in the future is space tourism. Giving the opportunity for non-space professionals to get the taste of space for a short time in suborbital flights or for a longer time on Earth orbit, or even beyond Earth orbit. The first space tourist was Dennis Tito on a short visit to International Space Station as a passenger on a Soyuz spacecraft in 2001.

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Summary

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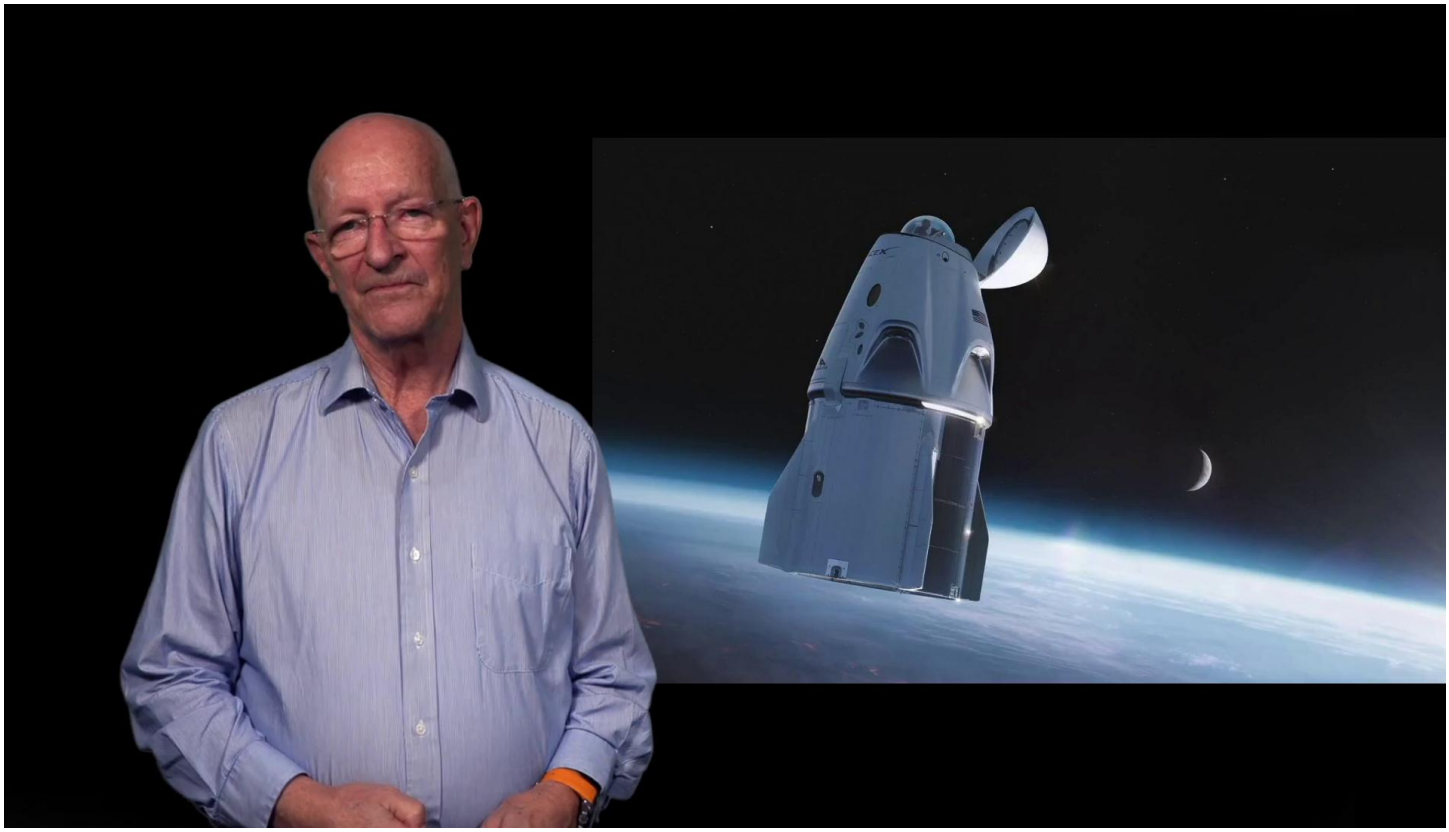

A few others followed on similar missions. But the real space tourism business started in 2021 with the first suborbital flight of Virgin Galactic SpaceShipTwo with four tourists on board, including Richard Branson himself, and the first flight of Blue Origin's New Shepard rocket with Jeff Bezos and three other passengers. Whether in the future suborbital space tourism will have the huge success that the originators and investors anticipated, I do not know. It is certainly a great personal experience, but not without risk and still with a ticket price of a few hundred thousand dollars. In fact, to my opinion, you only get the wonderful taste of space when you stay for days, weeks, or month on orbit with a rapidly changing views of the Earth, the multiple sunrises and sunsets, and the time to fully enjoy the magic feeling of weightlessness. Orbital space tourism is coming alive in 2021 as well, with several tourist-dedicated flights with the Crew Dragon, with or without docking to the International Space Station. The missions are managed by the private company Axiom and with or without the participation of Axiom professional astronauts.

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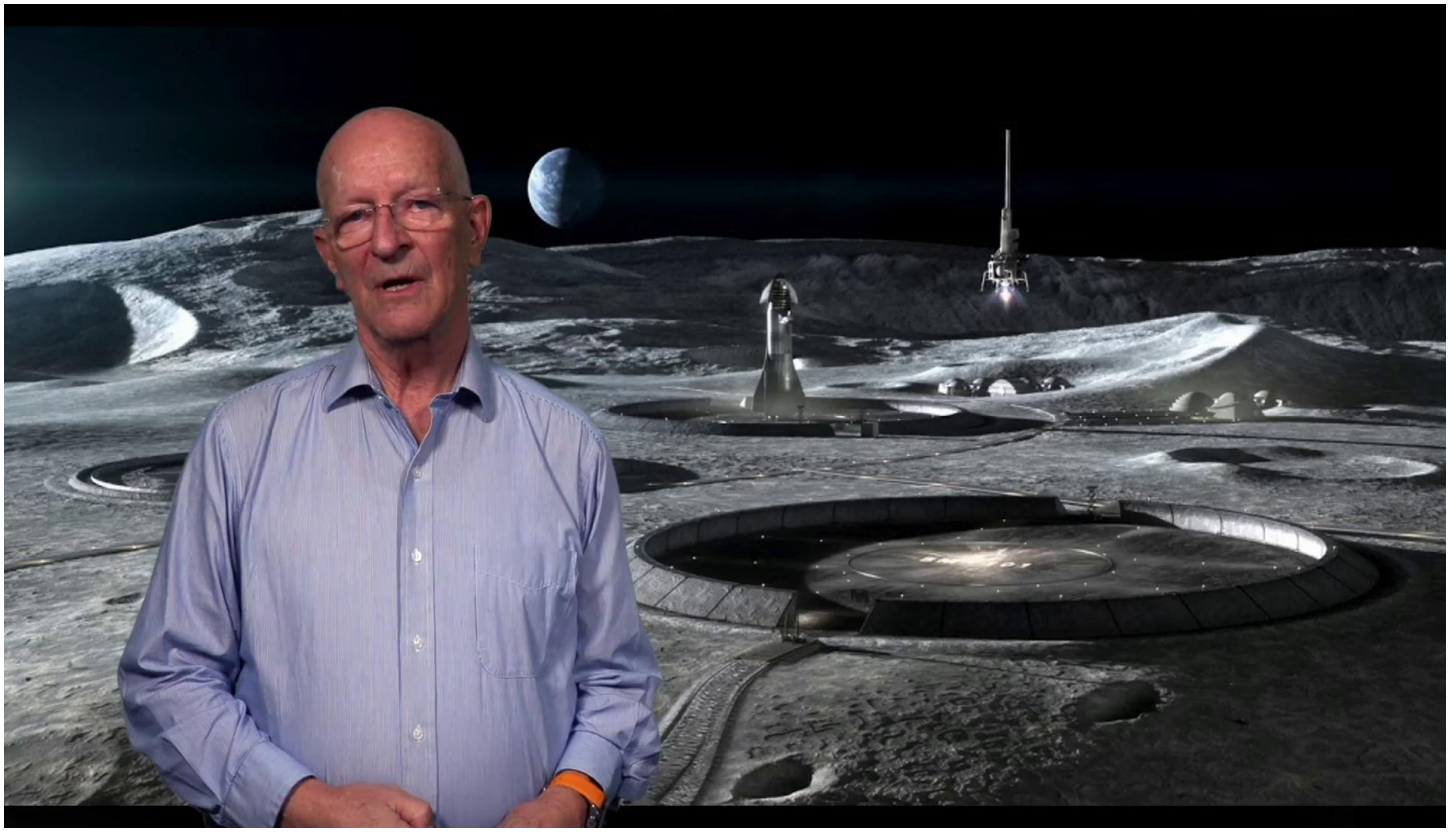
Summary

6m 15s



I personally believe that orbital space tourism will attract many customers and will be a good business. The price tag is quite a bit higher than for a suborbital experience, but it will mean a much deeper and emotional adventure for the participants. Eventually, the cost for a few days or weeks on orbit will go down and make orbital space tourism much more affordable. The International Space Station, ISS, is alive and well in 2021, but its days are counted. It will no longer be used like now around 2030 and will probably be deorbited. Before the end of the decade, however, Axiom, in coordination with the International Space Station partnership, will add modules to ISS for commercial and space tourism utilisation, then install solar panels and an attitude control system on this new segment of the orbital complex. At some point, the cluster of Axiom module will be detached from the existing ISS and become a new autonomous space station. Commercial space activities do not have to end on Earth orbit. With the Artemis project targeting a moon landing at the South Pole as early as the end of 2024 and the establishment of a lunar base at the same location in 2028, numerous opportunities for commercial space will open up.

Notes

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7m 42s

There will be a lot of services that could be provided by private companies. Base construction and maintenance, logistics supply to the base, in-situ resource utilisation, power systems, and more. This will be a really exciting and challenging undertaking. One important thing that have to be kept in mind in any space or non-space activity, sustainability on the ground, in the atmosphere, during ascent, and while in space. In descent, reusability of components of a launch system like is done for the Falcon 9 and Falcon Heavy launches is a significant plus combining or lowering the launch costs with a definite sustainability advantage. Every possible action has to be taken to limit, if at all possible, down to zero, the production of space debris. Deorbiting the upper stage of the rocket, keeping manoeuvring capability at the end of life of a spacecraft for controlled deorbit, or the injection into a graveyard orbit. All of this requires technical ingenuity and costs money, but it is a must nowadays. Well, I come to the end of this short introduction. It has been a pleasure for me to share my views about the values in doing business in space. If you want to play a role in this effort, go for it and apply the lessons of this course, which will open the treasure chest for you. Good luck.

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Summary

9m 19s