

### 12. Space exploration activities

Space exploration is a key driver for investments in innovation and science, and it constitutes an intensive activity for space agencies and industry. Space sciences and planetary missions have developed markedly over the years, with new actors joining in, although no country can today launch a major exploration mission alone, because of the costs involved and since the supply chains for systems and components have become so internationalised (see Chapter 1). Another factor for co-operation is the need for deep space monitoring systems, based on international arrays of giant radio antennas installed in different countries (e.g. Australia, Chile, United States, South Africa), to keep communication links with interplanetary spacecraft missions.

Out of the over 900 satellites orbiting the earth, a dozen are dedicated to space sciences, including large international space telescopes, and scientific missions searching for earth-like planets outside the solar system. Robotic spacecraft have been sent to all of the planets in the Solar System. As of spring 2014, three satellites are orbiting Mars (Europe, United States) and two more are on their way (US, India), two active rovers are on Mars' surface (US), two satellites are orbiting Venus (China, US) and at least ten probes are flying throughout the solar system, including one to reach and land on a comet for the first time by late 2014 (European mission with China, India, US). One of the more emblematic destinations for future missions is the planet Mars. Reaching Mars remains a challenge, as nearly two-thirds of all spacecraft destined for Mars have failed without completing their missions. Missions to Mars can be launched every two years or so (i.e. the alignment of earth and Mars in their orbits around the sun allows spacecraft to travel between the two planets with the least amount of

energy), and the voyage can take up to six months. The next missions to Mars could occur in 2016, 2018 and 2020.

Although scientific missions and joint space exploration strategic planning remain the remit of the public sector, new private actors aim to get engaged in innovative space exploration activities. Supported by successful information-technology entrepreneurs, the Google Lunar XPRIZE calls for privately-funded spaceflight teams to compete to launch by late 2015 a robotic spacecraft that can land and travel across the surface of the Moon. As of spring 2014, some 25 teams from around the world are engaged.

#### Methodological notes

Space agencies publish key statistics about their current and upcoming space exploration missions. A given space exploration mission can cumulate several tasks, such as a flyby, being an orbiter, carrying a lander or a rover.

#### Sources

European Space Agency (2014), Space Exploration Activities, [exploration.esa.int](http://exploration.esa.int).

NASA (2014), Solar System Exploration, [solarsystem.nasa.gov](http://solarsystem.nasa.gov).

Google Lunar XPRIZE (2014), [www.googlelunarxprize.org](http://www.googlelunarxprize.org).

#### Notes

12.1: 1. Include flyby missions.

### Chasing a comet for science

Comets are considered the primitive building blocks of the Solar System and likely helped to “seed” the earth with water, perhaps even the ingredients for life. Several missions have been sent over the years to observe comets from afar. Launched in 2004, the European Space Agency’s Rosetta probe has been travelling through the Solar System and arrived successfully at the Comet 67P/Churyumov-Gerasimenko in August 2014. It became the first space mission to rendezvous with a comet since the Giotto European probe’s close encounter with Comet Halley in 1986. It will also be the first attempt to land on a comet’s surface in Fall 2014.

### 12.1. Popular extra-planetary destinations

Number of missions, 1958-2013

	Asteroids and comets	Venus	Mars	Moon
Total number of missions <sup>1</sup>	29	45	46	116
Success rate	85%	55.5%	43.4%	50.8%
Successful orbiters	2	10	10	36
Successful landers/rovers	2/-	9/-	6/4	9/3
Successful crewed landing	-	-	-	6
En route missions	3	-	2	-
Operational	3	-	5	5
Planned (funded) missions	4	1	3	6
Comments	ESA’s Rosetta mission aims to orbit and deploy a lander on a comet for the first time (Nov. 2014).	Venera 3 (former USSR) was the first spacecraft to reach the surface of another planet in 1966.	NASA’s Mariner 9 made the 1st successful Mars orbit, while the USSR’s Mars 3 made the first landing the same year.	This is the only extra-terrestrial body visited by astronauts (last flight in 1972).

Source: OECD adapted from space agencies.



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