



## Invited Paper

## Trends in space activities in 2014: The significance of the space activities of governments



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## ABSTRACT

This article addresses the principal events of 2014 in the field of space activities, and extrapolates from them the primary trends that can be identified in governmental space activities. In 2014, global space activities centered on two vectors. The first was geopolitical, and the second relates to the matrix between increasing commercial space activities and traditional governmental space activities. In light of these two vectors, the article outlines and analyzes trends of space exploration, human spaceflights, industry and technology, cooperation versus self-reliance, and space security and sustainability. It also reviews the space activities of the leading space-faring nations.

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## 1. Introduction

In 2014, global space activities centered on two vectors. The first vector was geopolitical, originating in the strategic tension that arose in the spring of 2014 between Russia on the one hand, and the U.S. and other nations on the other, over the Ukrainian crisis. This tension, although not directly related to governmental space activities, was manifested in various aspects of world activities in space. The other vector relates to the matrix between increasing commercial space activities and traditional governmental space activities. In this context, 2014 began in an optimistic spirit, with expectations of significant progress in fulfilling the dreams of private entrepreneurs, spearheaded by human commercial spaceflights. However, 2014 ended with the sense that there's still a long way to go to fulfill this vision.

This article addresses the principal events of 2014 in the field of space activities, and extrapolates from them

the primary trends that can be identified in governmental space activities. The first part of the article deals with the following subjects at the global level: space exploration, human spaceflights, industry and technology, cooperation versus self-reliance, space security and a sustainable space environment. The second part of the article reviews the space activities of the leading space-faring nations.

## 2. Space exploration

Observation of space exploration during the past year leads to the conclusion that the relationship between space exploration and political conflict around the globe is again intensifying. Manned and unmanned exploratory flights to areas far from the Earth: to the Moon and Mars; exploration of asteroids, comets and other celestial bodies; are synonymous in the world's experience with criteria for technological advancement. Such high technological achievements bestow high status in the international arena on the countries involved in this field. These achievements are proof of their overall abilities and power, not necessarily militarily. This prowess is expressed in new national exploration programs, in allocation of resources

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and in the statements of decision-makers and senior government and space agency officials in these nations. For example, in his speech after the Philae probe landed on comet 67P, the Director General of the European Space Agency [ESA], Jean-Jacques Dordain said, "We are the first to do this, and that will stay forever" [58]. Dordain's message was a clear indication that this scientific and technological achievement was not the sole objective. Rather, this successful mission also has political and strategic significance for the ESA and for all of Europe.

India's important achievement, attained when its Mars mission the Mangalayan (launched in December 2013) successfully entered Mars orbit in September 2014, is another example of the political and strategic significance of space exploration in world politics. The success of the mission proved that even with a modest budget, significant achievements can be accomplished [6]. Later, in December 2014, India succeeded in launching a capsule and have it return to earth, an important step in attaining human flights [88].

These events, and the way in which they were treated, point to the importance of these achievements, and are evidence of the developing trend amongst the leading space-faring nations to go further away from earth and deeper into space. In recent years, the U.S., Russia, China, India, Japan and the ESA have all announced their intentions to reach the Moon, Mars and even much more distant objectives in unmanned and human spaceflights. Some of these countries have already begun to make efforts to fulfill this vision.

What is intriguing is that in some of the cases, there is interest in carrying out these programs using the PPP (public-private partnership) model. For instance, NASA is entertaining the possibility of involving commercial satellites in its missions to the Moon and Mars. In January, 2014, NASA announced that it was seeking ways to increase its cooperation with commercial companies, in order to begin flights to the Moon. Specifically, NASA sought proposals from commercial companies to partner with it in developing small lunar landers, capable of delivering cargo to the Moon. NASA was willing to provide the infrastructure, facilities and computer programs, but not funding, as part of its Lunar Cargo Transportation and Landing by Soft Touchdown (Lunar CATALYST) [44] initiative. Last spring, NASA announced that it was involved in various projects to send people to Mars [1,54]. In July, 2014, NASA issued a Request for Information (RFI) to investigate the possibility of using commercial satellites to provide telecommunications capabilities for future robotic missions to Mars [77].

To achieve these goals, a need exists for strong, heavy launchers, capable of traveling far while carrying especially large and heavy cargo. The three leading space-faring countries, the U.S., Russia and China have begun to develop such launchers, capable of transporting more than 100 t.

### 3. Human spaceflights

Two principal aspects of human spaceflights should be addressed. One, as noted above, is the tension between

Russia and the U.S. over the Ukrainian crisis, which threatens to affect the functioning of the international space station and the lives of the astronauts and cosmonauts who live on the station. The other aspect is the future of private/commercial human spaceflights.

The crisis between Russia and the U.S. over Ukraine proves once again that human spaceflights are extremely important strategically to both countries. Such flights constitute a symbol of advanced technology and national capability, and thus serve as strategic cards in the conflict between them. The U.S. had been seeking an alternative to its dependency on Russia to launch American astronauts to the international space station, an effort made more intense by the crisis. Thus, NASA announced that it had extended its partnership with private American companies [46]. Beyond the strategic aspect, NASA's decision is a statement of trust in the ability of the private market to develop the necessary technology, at the level of security required, to carry out commercial human spaceflights. The statement also reflects NASA's belief that the venture can be profitable.

At the beginning of 2014, expectations for progress in this field were high. January saw a number of successes. Among them was Virgin Galactic's successful launch of a spacecraft in a test flight; it reached a height of 71,000 feet above earth [60]. Orbital Sciences successfully sent a Cygnus cargo ship to the international space station, its second successful unmanned mission to the station, that same month [59]. However, in October, the third Orbital Sciences' cargo ship to the international space station exploded upon its launch [98].

At the same time, China announced that it would send tourists and taikonauts into space by the end of 2014, through an agreement with the Space Expedition Corporation, a Dutch company [39]. Later, China announced that more than 300 Chinese citizens had purchased tickets for the spaceflights. Each ticket cost 100,000 USD [74]. In the end, none of the planned flights took place during 2014.

The investment in human spaceflights by the private market is still not a foregone conclusion. Doubts were further exacerbated by the fatal crash of Virgin Galactic's SpaceShipTwo at the end of October, 2014, in which the co-pilot was killed.

The accident renewed interest and discussion about the technological feasibility and economic profitability of space endeavors for the private market. Headlines proclaimed the end of the dream of space tourism and then calls to end space tourism activities, because of the high risks involved.<sup>1</sup> Quite probably, conclusions about the reasons for the accident will have an impact on the future of such initiatives. Nonetheless, the challenge of conducting human commercial spaceflights will not disappear. The nature of the social and technological processes that have begun is that they will continue and not simply end. Detailed, careful and precise investigations of the reasons leading to the failure will be conducted. It can be assumed that even though this accident might delay the process,

<sup>1</sup> For example: [96].

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