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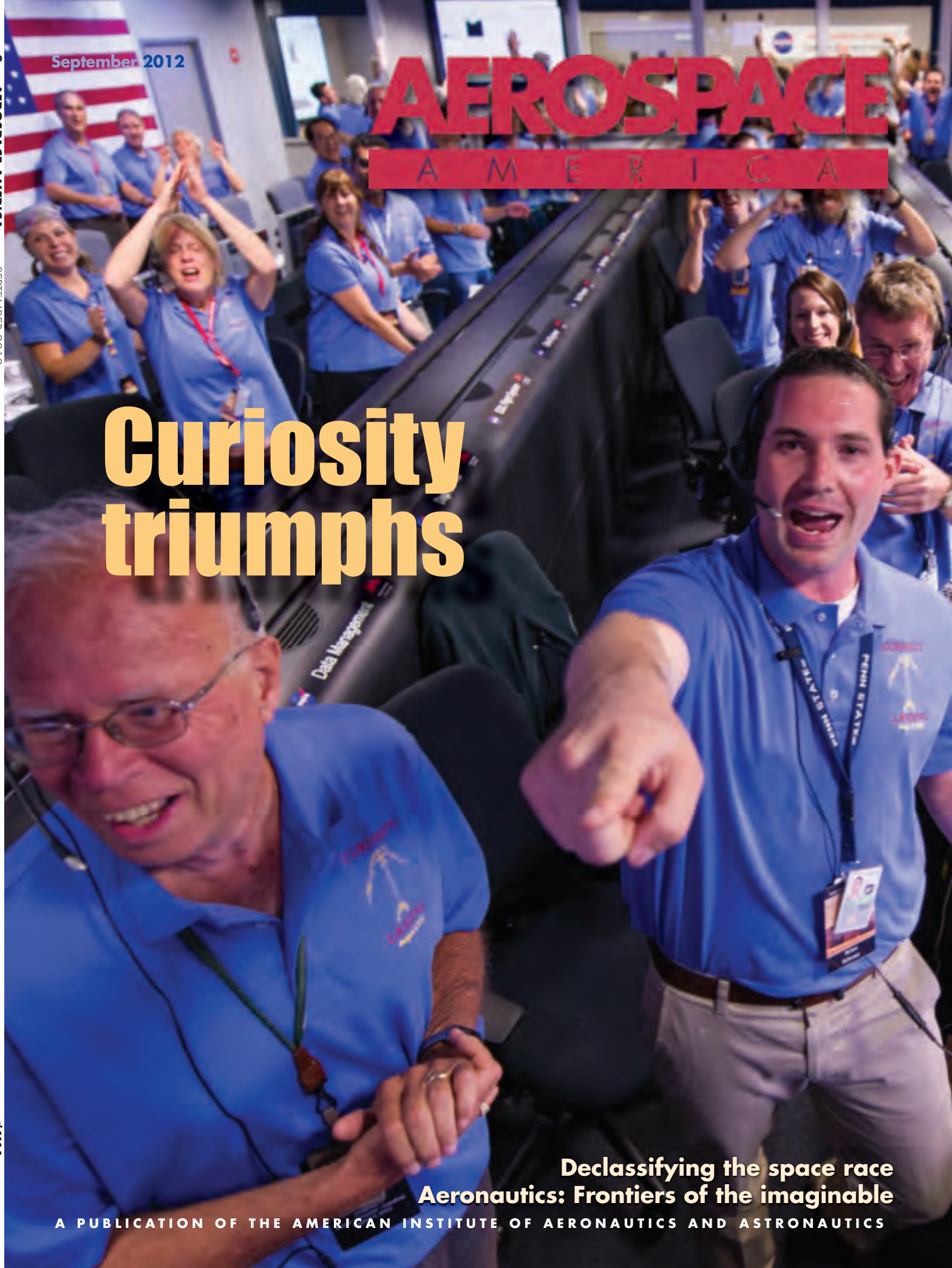

Curiosity triumphs

Declassifying the space race

Aeronautics: Frontiers of the imaginable

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Balance of space launches shifts

DURING THE SECOND HALF OF 2011 there have consistently been more orbital space launches attempted than during the first half. The last exceptions to this pattern were in 2002 and 2003. In both of those years, the number of attempted launches in January-June equaled the number for July-December: 66 launches in 2002 and 62 in 2003. Since then, except for 2011, the number of launches attempted in the first six months of each year has accounted for 42-48% of the total launches each year.

In 2011, the percentage noticeably dropped to 38, with 30 launches in the first half of the year and 49 in the second. The significant increase in activity during the second half was fueled largely by 14 Long March rocket missions and 11 Soyuz missions.

Assuming that the increased launch activity in last year's second half was an anomaly, this year's total number of launches could surpass 80. With a total of 35 launches attempted during the first six months of this year, and given the launch trends we have observed over most of the past decade, it would be reasonable to project some 45 launches for July through December. On the other hand, if we were to assume last year was not an aberration, but rather the start of a new pattern, then it is entirely possible that this year's launch total could surpass 90. The last year there was anything close to this level of launch activity was in 2000, with a total of 87 launch attempts.

The difference between the kind of launch activity that occurred in 2000 versus today is that there was much less balance then in the distribution of missions by country. In 2000, for example, rockets belonging to the U.S. government or U.S. companies (Atlas II, Delta II, Delta III, Minotaur I, Pegasus XL, space shuttle, Taurus I, Titan 23G, Titan 4B, and Zenit 3SL) accounted for 36% of the launches; Russian/Ukrainian rockets (Cosmos, Dnepr, Proton K, Rockot, Soyuz, Start, Tsyklon 3, and Zenit 2), 41%; European rockets (Ariane 4 and Ariane 5), 18%; and Chinese launchers (Long March), 5%. Japan barely registered that year, with only one, unsuccessful, launch of its M-5.

Long March

If we look now at launches during January-June, U.S. rockets (Atlas V, Delta IV, Falcon 9, and Pegasus XL) accounted for 23% of the missions; Russian/Ukrainian rockets (Proton M, Soyuz, and Zenit 3SL), 29%; Chinese (Long March), 29%; European (Ariane 5 and Vega), 11%; with Japanese (H-2A), Indian (PSLV XL), Iranian (Safir 1B), and North Korean (Unha 3) rockets making up the remaining 8%.

A three-country race

The launch market—in terms of number of missions—is no longer dominated by the U.S. and Russia; it has definitely become a three-country race, with China picking up the pace over the past year to establish its preeminence. If we combine the number of Long March vehicles launched during the second half of 2011 and the first half of 2012, the Chinese have launched 24 rockets—an average of two missions per month over that period.

A shift is clearly occurring, and it is happening despite China's relative handicap when it comes to competing for commercial launch contracts around the world due to the U.S. government's ITAR (International Traffic in Arms Regulations) restrictions. These are measures that discourage Western satellite manufacturers from securing launch deals with the Chinese. However, this situation is gradually changing: Countries such as oil-rich Venezuela and Nigeria are moving to purchase Chinese-built satellites and paying to have them launched aboard Long March vehicles, while other countries are proceeding to buy 'ITAR-free' (carrying no U.S. content) satellites from European companies and simply thumbing their noses at the de-facto U.S. embargo against the Long March.

What China offers

The truth is that China's Long March program has an excellent launch record. Its rockets almost never fail and are priced extremely competitively. In addition, there is a wider degree of diversity in the variants of these vehicles than in perhaps any launch program—enabling the rocket's marketer, China Great Wall Industry, tremendous flexibility in promoting the vehicle for different size satellites and different orbital destinations.

While Western, Russian/Ukrainian, Japanese, and Indian launch programs tend to use no more than two or three variants of their rockets on a regular basis, the Chinese make a habit of using a much wider range of Long March models. For the 10 Long March missions conducted through June since the start of the year, seven different models were used: Long March CZ-2D, CZ-2F, CZ-3A, CZ-3B, CZ-3C, CZ-4B, and CZ-4C.

This was no fluke. If we look at the 14 Long March missions launched during the second half of 2011, we see that eight models were used: CZ-2C, CZ-2D, CZ-2F, CZ-3A, CZ-3B, CZ-3B/E, CZ-3C, and CZ-4B.

The point is that China is well positioned to dominate the international launch market eventually—unless, of course, the current launch services paradigm is changed by pioneers such as Space Exploration Technologies (SpaceX) and other startup companies seeking to offer newer low-cost launchers employing reusable technologies, stimulating new user applications and markets.

LAUNCH MISSIONS
by vehicle
January-June 2012

Long March, China	10
Proton, Russia	5
Soyuz, Russia	4
Atlas V, U.S.	3
Delta IV, U.S.	3
Ariane 5, Europe	2
Falcon 9, U.S.	1
H-2, Japan	1
Pegasus, U.S.	1
PSLV, India	1
Safir, Iran	1
Unha, North Korea	1
Vega, Europe	1
Zenit Sea Launch, Russia	1
Total	**35**

Payload trends

Along with the shift in the makeup and launch rates of the launch services providers, there has been a noticeable change since the turn of the century in terms of the types of payloads being launched.

While there are still more than 100 payloads launched annually, a greater proportion of them are military satellites and tiny university spacecraft. Of the 134 payloads launched in 2000, 38% were civil (government nonmilitary), 34% commercial, 20% military, and 8% university. By comparison, of the 52 payloads launched during the first half of this year, 33% were civil, 25% military, 21% commercial, and 21% university.

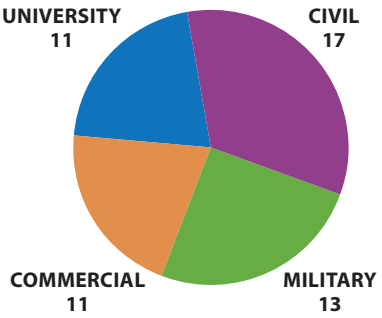
It is too soon to tell for certain if the relative drop in civil and commercial payloads versus the rise in military and university payloads is a changing trend. We will have a better sense of whether this shift will hold when we analyze the data for the full year.

But if we take into account the payloads launched in 2011, it does seem clear that, at the very least, military payloads have become more prominent, commercial ones less so. Of the 130 payloads launched last year, 41% were civil, 27% commercial, 25% military, and 8% university.

The 7% decline in commercial payloads and the 5% increase in military, as well as the 3% increase in civil, can be explained, in part, by the spike in Chinese launches—three-quarters of which were civil or military payloads. This preponderance of civil and military payloads by the Chinese has continued in 2012. Of the 13 payloads launched by Long Marches through June, 77% were civil or military.

China is launching very few commercial payloads, because it is still largely locked out of the commercial launch market as a result of ITAR, but also because it is very busy launching so many civil and military payloads. In other words, the country already has its hands full with its government space programs.

PAYLOADS LAUNCHED
by type, January-June 2012
Total: 52



Most of China's payloads from January 2011 through June 2012 have been satellites weighing less than 3,000 kg. Nearly two-thirds of these have been launched to LEO and the rest to geostationary orbit. But there are also a fair number of payloads with a mass of over 5,000 kg, including Apstar 7A, Chinasat 10, Eutelsat W3C, Nigcomsat-1R, Paksat 1 commercial communications satellites, Shenzhou manned capsules, and the 8,500-kg Tiangong-1 space module designed to test rendezvous and docking capabilities for a future space station.

The payloads under 3,000 kg have included a wide mix of data relay, navigation, scientific, meteorological, geological mapping, surveillance and reconnaissance, asset tracking, disaster monitoring, ocean resources, and technology development satellites. They have also come in a wide range of sizes, including the 9-kg Tiantuo-1; the 300-kg Chuangxin 1-3 and Tansuo 4; 1,040-kg Yaogan Weixing 15; 1,200-kg Shijian 3; 2,200-kg Beidous and Feng Yuns; and 2,630-kg Ziyuan 3.

The diversity of China's launch activity helps explain the use of so many

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different models of the Long March vehicle and different launch sites, including Jiuquan, Taiyuan, and Xichang.

New players and other factors

That relative drop in the number of commercial payloads being launched lately is related not only to China, but also to the fact that there are new players in the launch market, such as Iran, with its Safir rocket, and Arianespace with its Vega, as well as North Korea with its Unha. Initially, at least, none of these vehicles is going to be launching many, if any, commercial payloads.

The Iranians and North Koreans will stick to small scientific, imaging, and technology development satellites for their respective governments. Meanwhile, Vega will be used primarily to launch small satellites for ESA, European national space agencies, and universities. First launched on February 13, Vega is reportedly going to be priced at $40 million-$45 million per mission. Thus Vega would be much more expensive than Russian smaller launchers such as Dnepr and Start and the Russian/German Rockot, making it difficult for the Arianespace vehicle to compete for commercial payloads.

Judging from its maiden launch customers, however, Vega may end up fueling demand for launch services by universities and research institutes throughout Europe. The rocket carried a total of 10 satellites—seven were picosatellites (1 kg) for universities, including the Technical University of Budapest; Torino Polytechnic University; Universities of Bucharest, Montpellier II, Rome, and Vigo; and Warsaw University of Technology. One was a nanosatellite (12.5 kg) for the University of Bologna.


Safir

Vega

With the continuing demand for basic telecommunications and advanced broadband and direct TV broadcast communications around the world, we do not anticipate any significant decline in commercial payloads anytime soon. Replenishment spacecraft for LEO mobile communications satellite constellations such as Globalstar, Iridium, and Orbcomm will also keep the number of commercial payloads stable. But in relative terms, the commercial numbers may well continue to drop, for several reasons: the growing emphasis on other types of satellites because of the strength of China's national space program; evolving space programs such as that of Iran; and better access to space for dozens of universities as a result of new government-subsidized launch vehicles like Vega.

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