

Ascending to a whole new level

Obayashi Corporation, one of the world's leading construction companies, has plans to build an elevator that **EXTENDS INTO OUTER SPACE.**

Imagine an elevator extending from Earth to a quarter of the way to the Moon transporting cargo and people to stations in outer space. It sounds like the stuff of science fiction, but Obayashi intends to construct a space elevator capable of carrying materials almost 100,000 kilometres into space, possibly by 2050.

Founded more than 120 years ago, Obayashi is one of the world's leading construction companies. It has a proud record of tackling ambitious projects, such as the Colorado River Bridge in the United States — North America's longest concrete arch bridge — and the TOKYO SKYTREE®, the tallest free-standing broadcasting tower.

"TOKYO SKYTREE set a new standard in construction of large and complex structures," says Naoki Kajita, deputy general manager of Obayashi's technology division. "We will bring the expertise and know-how developed on it to the construction of the space elevator."

TAKING AN ELEVATOR RATHER THAN A ROCKET

But why build a space elevator? A permanent and reusable space elevator powered by solar

energy would revolutionize the space industry by providing a safe, low-cost and environmentally friendly alternative to rockets.

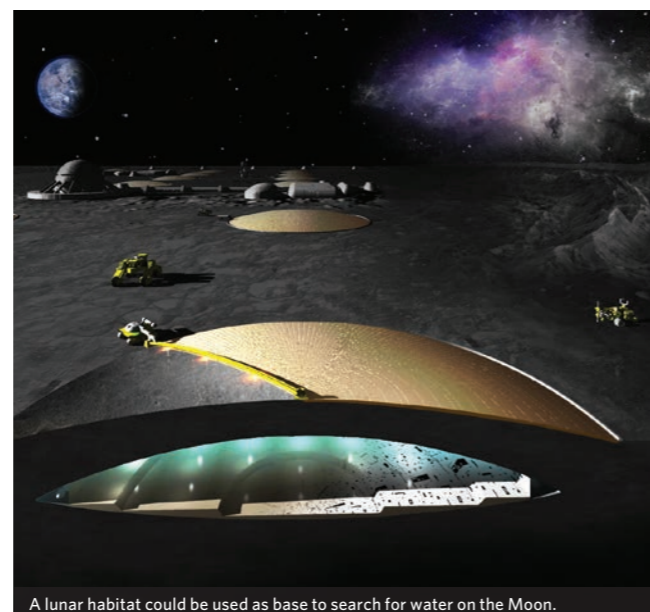
Rockets have changed very little since the 1960s, and space exploration and development is still expensive, dangerous and environmentally damaging. It costs as much as US\$20 million per ton to launch a payload into space, and the solid fuels used to propel rockets are highly explosive, producing substances that damage the ozone layer. A space elevator would be safer and cost a fraction of the price. Furthermore, it would generate little or no hazardous space debris, unlike spent rockets that remain in orbit around the Earth.

Obayashi's concept provides a comprehensive and detailed design for a complete elevator system, including cable, stations and climbers.

"The biggest challenge will be manufacturing a cable that is sufficiently strong, lightweight and flexible," says Yoji Ishikawa, manager of Obayashi's Space Elevator R&D team. To meet these criteria, Obayashi investigated the possibility of making a cable from carbon nanotubes. Discovered by



Members of Obayashi's team for the S-Booster 2017 competition



A lunar habitat could be used as base to search for water on the Moon.

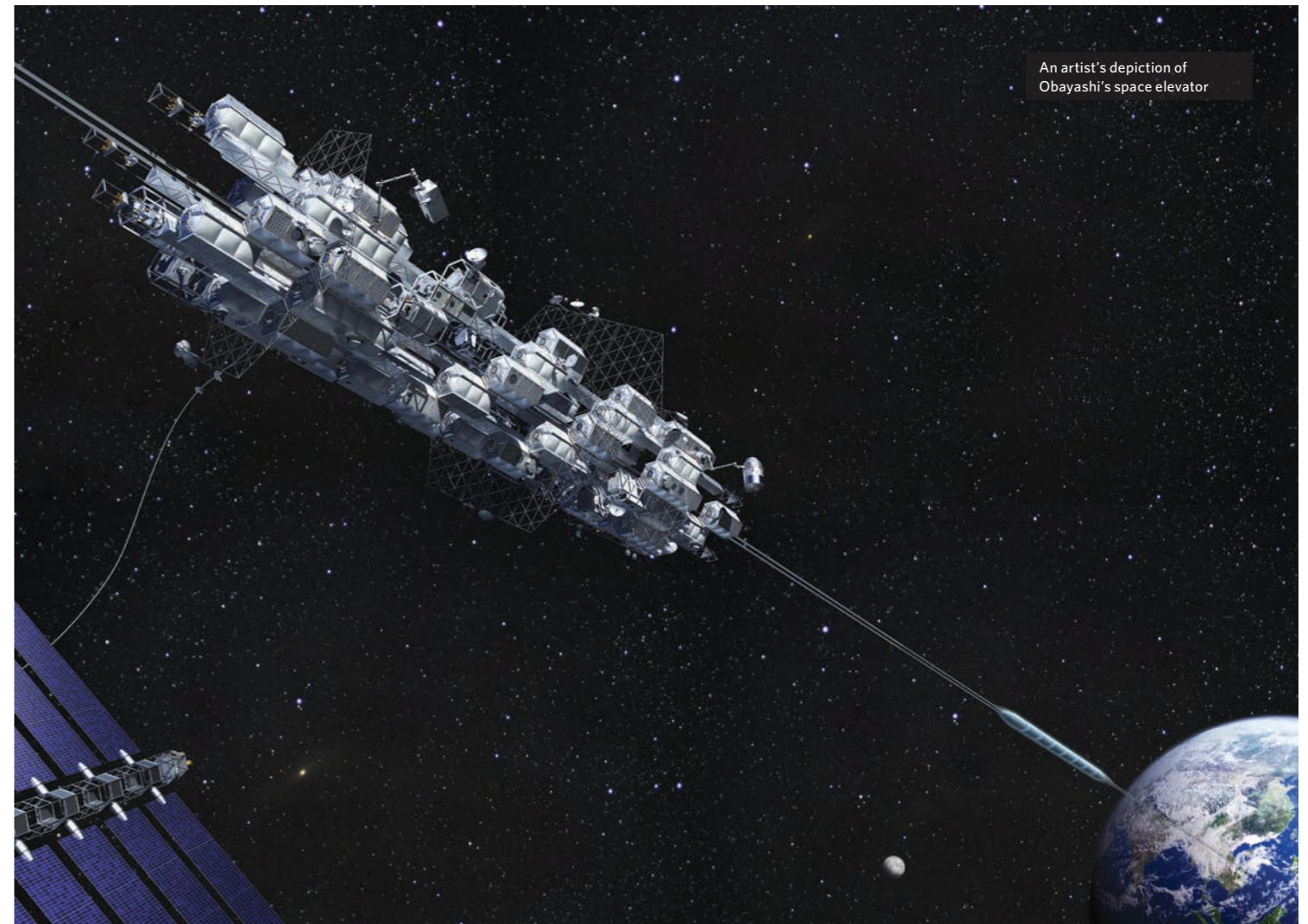
Japanese physicist Sumio Iijima in 1991, carbon nanotubes have a tensile strength 20 times greater than that of steel and are considerably lighter.

I BELIEVE OUR CONCEPT IS REALISTIC AND FEASIBLE

Another challenge is how to deploy the cable. For this, Obayashi turned to previous research on space elevators that proposed unfurling one end of the cable from a geostationary orbit 35,786

kilometres above Earth towards the Earth's surface, where one end will be tethered to a floating Earth port anchored to the sea floor. The spacecraft in orbit would simultaneously ascend to an altitude of 96,000 kilometres. The cable would then be reinforced and thickened and would eventually weigh around 7,000 tons.

Obayashi has estimated that, by balancing gravity and centrifugal forces, the cable should be sufficiently stable for climbers that can carry payloads of up to 70 tons and up to 30 people into space.



An artist's depiction of Obayashi's space elevator

"Significant advances in manufacturing technologies will be needed, especially for the cable," explains Ishikawa. "But I believe our concept is realistic and feasible."

AWARD-WINNING PROPOSALS

Obayashi is also furthering Japan's space industry in other ways. Together with representatives from the Japanese government, the Japan Aerospace Exploration Agency, and several other leading Japanese companies, Obayashi is supporting the

Space Business Idea Contest, S-Booster 2017, which aims to commercialize space-enabled products or services.

More than 300 proposals were submitted to S-Booster 2017, and Obayashi's Nuclear Facilities Division was one of only 15 finalists invited to present its idea. Obayashi's concept was for an inflatable, underground human habitat on the Moon. Such a habitat could be used as a base from which unmanned, remotely controlled explorers and excavators could search for water reserves on the Moon. If successful, this would

allow for lunar water to be split into oxygen and hydrogen by electrolysis to fuel spacecraft.

A team from Obayashi, in collaboration with researchers from the Faculty of Science and Technology and Haptic Research Center at Keio University, received the Special Jury Award for their high-precision robotic arms, which would enable more-demanding tasks to be undertaken safely and cheaply in space.

And the Obayashi Award was presented to Yoshio Aoki and his team from Nihon University for their tethered

satellites. Their work will investigate the deployment of tether and climber technologies in the harsh conditions of space, and could help to accelerate the construction of the space elevator.

Obayashi aims to be a major space industry player, and by working with governments, academia and industry, will be at the vanguard of an exciting new era in space science and exploration. ■

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