FIFTEEN YEARS OF INTERNATIONAL
SPACE STATION

The International Space Station (ISS) celebrated its 15th birthday in October 2013. The ISS is the largest spaceship ever built by humans and very important for research, to understand life and physics. However, the ISS is very expensive to maintain and therefore some people argue that the ISS program should stop. The US president has decided to support the extension of the operations of the ISS to at least 2020.

Since the arrival of Expedition 1, on November 2, 2000, the International Space Station has been continuously occupied for more than 13 years, the longest continuous human presence in space. The ISS programme is a joint project among five participating space agencies: NASA, Roscosmos, JAXA, ESA, and CSA. The station is serviced by a variety of visiting spacecraft: Soyuz, Progress, the Automated Transfer Vehicle, the H-II Transfer Vehicle, Dragon, and Cygnus. Astronauts and cosmonauts from fifteen different nations have visited the ISS. The ISS is arguably the most expensive single item ever constructed. The total estimated cost of the space station is 100 billion dollar.

CONSTRUCTION OF THE ISS
The ISS is a modular structure whose first component was launched in 1998. A Proton rocket launched the first ISS module, Zarya, on November 20, 1998. Zarya provided electrical power, propulsion, storage and guidance during the initial stages of assembly. The STS-88 shuttle mission followed two weeks after Zarya was launched, bringing Unity, the first of three node modules and connecting it to Zarya. At that moment, the station consisted of two modules. Human presence was not possible in these two modules so the station remained unmanned for one and a half years. In July 2000, the Russians added a third module: Zvezda. After connecting this module to the station, a crew of two astronauts or cosmonauts could stay on the ISS. It is still the structural and functional center of the Russian Orbital Segment (ROS). Building the entire space station required more than 115 flights, of which forty were assembly flights.

Russian elements were launched to space by proton rockets and NASA’s space shuttles brought other components into orbit. Also, more than 170 spacewalks were required to assemble and maintain the station. At this moment, the station consists of a set of communicating modules, in which the astronauts can live. These modules are connected to a truss onto which four large solar panels are attached to power the station.

RESEARCH
The ISS provides a unique platform on which scientific research can be conducted in microgravity. At the station, the crew conducts experiments in the fields of biology, human biology, physics, astronomy, meteorology and others. Small-unmanned spacecraft can provide platforms for zero gravity and exposure to space, but the ISS offers a long-term environment where research can be done, potentially for decades combined with ready access to human researchers over periods that exceed the capabilities of manned spacecraft.

NASA describes the importance of the ISS for research as follows: “The International Space Station is an unprecedented achievement in global human endeavors to conceive, plan, build, operate, and utilize a research platform in space. With the assembly of the space station at its completion and the support of a full-time crew of six, a new era of utilization for research has begun.”

One of the main research subjects is the human body. Research on the ISS improves knowledge about the effects of long-term space exposure on the human body. Subjects currently under study in-
include muscle atrophy, bone loss, and radiation. The collected data will be used to determine whether space colonization and long human spaceflight are feasible. Another widely-researched subject is physics. For example, the investigation of the physics of fluids in microgravity will allow researchers to model the behavior of fluids more accurately. At this moment, over 1,500 experiments have been performed with partners over 68 countries.

**FUTURE**

While there are currently discussions to extend the lifetime of the $100 billion International Space Station beyond 2020, there is concern about the station's overall usefulness and operational costs, such that the station might face a fiery demise in Earth's atmosphere at the end of this decade. The overall operational capabilities, utility, and longevity of the Earth-orbiting complex, as well as the willingness of nations to continue to take part in the program, were front-and-center topics during a meeting of the NASA Advisory Council's (NAC) Human Exploration and Operations Committee on July 29th, 2013. During this meeting, William Gerstenmaier, NASA's Associate Administrator for Human Exploration and Operations Mission Directorate, said space station component failure rates have been less than anticipated. "The hardware is looking pretty good overall," he said. But micrometeoroid and orbital debris hits to the station are still considered "a major risk", Gerstenmaier advised.

Concerning the attitude of the many space station partners about continuing operations through 2028, Gerstenmaier said: "I think this is probably an area where the US is going to have to lead." International partners "are still looking more for a positive, demonstrable return on investment," he added.

"For the United States, we're seeing some benefits from the station that the partners have not yet realized. The partners are doing more traditional kinds of research. They are not quite seeing that return on investment. They still see the cost side," Gerstenmaier added. "The cost side is very easy to measure. The benefit side is not so easy to measure.

The debate over how long the International Space Station should be maintained is something that has long loomed over the program, one expert said. "This is a little bit like smoker's cough. It's something that nobody wants to notice," said John Logsdon, Professor Emeritus of Political Science and International Affairs at George Washington University's Elliott School of International Affairs in Washington, D.C. An expert in space policy and history, Logsdon said his bottom line is that "the odds are heavily against the continuation of the ISS post 2020." Logsdon told SPACE.com that he does not think it likely that either Japan or Europe have any enthusiasm to pay for the ISS after 2020.

"That presumes that there's no major breakthrough," Logsdon said, referring to any potential discovery on the station with either great scientific or economic value.

Furthermore, according to Logsdon, there is some talk about Russia starting a second-generation space station on their own. The professor also pointed out that China has launched two crews to its first space laboratory module, Tiangong 1, and plans to construct a 60-ton space station by 2020.

**CONCLUSION**

The ISS provides a unique platform from which scientific research can be conducted in microgravity. Some countries mainly see the costs of maintaining the ISS and see little benefits. The US thinks that the other countries are performing traditional experiments, so they do not give themselves an opportunity to see the returns on investments. If the US wants to continue the operation through 2028, they have to convince the other partners about the benefits and returns on investment in the upcoming years till 2020.

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**SPACE DEPARTMENT**

The Space Department promotes astronauts among the students and employees of the faculty of Aerospace Engineering at Delft University of Technology by organizing lectures and excursions.