Free essay on the most successful space mission of all time

Environment, Earth



- Introduction

Whilst there have been many space missions – the majority either under the auspices of the National Science and Aeronautics Administration (NASA), or the European Space Agency (ESA) or the Russian Aviation and Space Agency – famously including manned landings on the moon (NASA), the most successful mission of all time in terms of space travel must surely be the creation, construction and the successful continued existence and operation of the international Space Station (ISS). A key purpose of the ISS has been to evaluate the effects on humans of lengthy exposure to conditions in space – an essential step towards space exploration of more distant destinations such as Mars, or even further.

This essay provides details of this technological marvel, which is remarkable not just for its concept and execution, but also as an example of true international cooperation.

2. ISS History

As described in " About The International Space Station" (updated May 2013) – an article by ESA – the partner nations involved in the project are the U. S., Russia, Japan, Canada and Europe. The article reports that construction in space began with the launch of the first module (Zarya) by the Russians in November of 1998. There was some unexpected delay in assembly of the ISS due to the tragic disaster and loss of Space Shuttle Columbia, which also prompted NASA to decide to retire the space shuttle fleet once the ISS had been completed. The last major component of the ISS delivered by space shuttle was in May 2011. According to the article, one further ISS module is yet to be added – the Russian Nauka multipurpose laboratory – which will complete the total of pressurized environment for the human ISS crew of astronauts.

- Some ISS Facts

As detailed in " About The International Space Station" (updated May 2013), the ISS has a mass of circa 360 tonnes and contains circa 820 cubic metres of pressurized interior sufficient to house the usual crew complement of six people and all the various scientific instruments and other essential supplies and equipment. The picture below shows the ISS with space shuttle Endeavour and an Automated Transfer Vehicle (ATV) docked to it:

Extracted from: "About The International Space Station" (updated May 2013)

According to an ESA article entitled "Pushing the Boundaries of Science and Technology" (updated May 2013), their programme "ELIPS" (European Programme for Life and Physical Sciences in Space), which started in 2001 and involves research into microgravity, which ESA claims is "helping to improve our life on Earth and enable humankind's long term presence in space." The programme, which is tackling physiological and psychological problems that will need to be overcome before extended space exploration will be possible, is centered on the ISS and in particular the Columbus laboratory module, in which many hundreds of experiments are conducted at the behest of some 1500 scientists back on Earth, as well as various bodies involved in industrial research and development.

Since November 2000, the ISS has been host to a rotating crew of astronauts as it floats circa 240 miles (390 km) above the Earth (" International Space Station: Cosmic Laboratory", n. d.). Crews are ferried to the ISS either by space shuttle (formerly) or by the Russian Soyuz or Progress spacecraft, then typically spend about six months aboard the ISS while it orbits the Earth. They have learned to adapt to an environment where their sense of taste is reduced and in which they have to sleep attached to a fixed part of the ISS to avoid simply floating around. The astronauts have to exercise for two hours daily to compensate for the effects on their bodies of the low gravity environment within the ISS. The same National Geographic article describes the ISS as a series of cylindrical modules linked by a central truss. Huge solar arrays provide the source of power for the ISS, and docking ports facilitate linking by visiting spacecraft. A separate airlock allows crew members to exit in their spacesuits for maintenance activities.

O'Callaghan (March 2013) provides more interesting facts about the ISS, such as that the ISS overall is 109 meters long (357 feet), which is longer than a U. S. football field and has approximately the same " living space as a house with five bedrooms. He also notes that as it orbits the Earth in just 90 minutes, it is travelling at 17, 240 mph, and – since 1998 – has completed circa 60, 000 Earth orbits; the crews refreshed/exchanged through a total of 70 visits by either space shuttles or Russian spacecraft, plus there have been over 60 flights by unmanned vehicles to the ISS. O'Callaghan reminds us that \$100 billion, the ISS is the most expensive mankind has ever built.

Approximately half of that figure came from the U. S., with the other partner nations funding the rest.

According to "10 Things You Didn't Know About the International Space Station" (Feb 2011), those crew rotations which have kept the ISS continuously occupied have entailed no less than 196 individuals visiting it in the first 10 years of its existence. During that time there have been 150 spacewalks conducted for construction or maintenance purposes. It is the largest artificial satellite in Earth orbit and can be seen with the naked eye. And finally, here are a few interesting ISS details from "Fun Facts" (n. d.): The ISS solar panels cover an area of about one acre, supplying 110 kW of electrical power for the ISS. The ISS orbits cover over 90 percent of the populated areas of our planet and traverse the same area every three days. The ISS systems are controlled by no less than 52 onboard computers.

- Life Aboard the ISS

Chavis & Adcock (Ed.) (May 2011) describe life on the ISS for the crew on their usually six-month tour. Because of the orbital speed of the ISS, the crew experience 16 sunrises and sunsets in just one day, making work and sleep schedules challenging. Their day begins at 06: 00 (ISS local time) when they get up. Work time is from 8: 10 until 13: 05 when they break for one hour for lunch, then they continue working and exercising until the next sleep period which is at 21: 30 hours, when they each retire to tethered sleeping bags so that they don't float around in the weightless environment. Washing has to be without showers, using wet wipes, shampoo that needs no rinsing and teeth cleaning using edible toothpaste. Toilets operate by suction (effectively pulling the waste from the person. All waste materials are recycled which filters it to produce drinking water disposing the rest into the docked Russian Progress spacecraft, which removes the waste after resupplying the ISS. All solid foods consumed are either in cans or are frozen or refrigerated products, and all drinks are powdered and are mixed with water to drink. To keep their muscles in shape, the astronauts exercise regularly

using two treadmills and an exercise bicycle. The ISS onboard climate is controlled " just like your home or office" according to " Things you might not have known about space: Climate control" (Sep 2013). As described in a Boeing article: " Environmental Control and Life Support System" (n. d.), carefully and thoroughly designed systems not only provide the air to breathe and recycle waste, but also control the temperature and the humidity of the crew's environment. Most importantly, the systems include a fire detection and suppression subsystem which includes fire extinguishers and gas masks for each crew member.

- ISS Communications

The ISS Communication and Tracking system provides the vital two-way audio and video links between crew members, the crew and Mission Control, and between the crew and their scientist partners back on Earth, using a range of frequencies selected to be the most appropriate for specific purposes (" Communications and Tracking", n. d.).

- Benefits of the Microgravity Environment

Microgravity is the term used to describe the virtually weightless conditions experienced by the ISS crews. It literally means a gravitational pull of one millionth of that on the surface of Earth (" How Do We Know It's Really Microgravity?" June 2013).

Experiments conducted in that microgravity environment of the ISS have helped the advancement of cancer treatments here on Earth, according to " Cancer Treatment Delivery: International Space Station's Microgravity Platform" (May 5, 2012). Techniques developed on the ISS have since been found to be transferable to similar methods back here on Earth, facilitating

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much more effective application of cancer-treating drugs directly into tumors.

" Microgravity Science" (n. d.) published by Boeing mentions other advantages of conducting research experiments in that unique environment of the ISS. As the article reports, " phenomena usually masked by gravity" can be investigated and in some cases the experiments can be conducted remotely from Earth-based research centers. Even the culture and growing of crystals is more efficient and effective in microgravity, producing larger and more perfect crystals than be grown under normal gravity conditions.

- The Journey to the ISS

Sample (Oct 2010) describes the journey from Earth to join the ISS (travelling by space shuttle). The journey up to the ISS from Earth takes two days and consumes " 900 tonnes of solid rocket fuel and half a million gallons of liquid oxygen and liquid hydrogen to burn in the main engine." On the shuttle's final approach to the ISS from below, it executes a gentle somersault maneuver to allow the ISS crew to photograph the underbelly of the shuttle to check the heat shielding is intact. Docking of the shuttle and ISS is a careful operation that is followed by a 30-minute period of pressure equalization before the hatches are opened.

The fastest ever trip to the ISS was achieved in just six hours (Silcocks, March 2010) by astronauts ferried there in a Russian Soyuz spacecraft launched from Kazakhstan. The record-breaking journey time was facilitated by launching the spacecraft just after the ISS had passed overhead, and – with the help of better thrusters – had joined up with the ISS after just four Earth orbits instead of the more normal 30 orbits. - Life Expectancy of the ISS

David (Aug 2013) asks the rhetorical question: " Can the International Space Station Really Last Beyond 2020?" The issue was discussed at a July NASA meeting. Although the ISS itself is still fully functional and has endured better than was anticipated, concerns about ongoing costs versus future usefulness, plus increasing damage to the structure (especially the solar " sails") from micrometeoroid strikes are a concern. A NASA spokesman suggested that continuing ISS operations through to 2028 may mean that the U. S. – who are seen as more aware of all the research benefits of the ISS – may need to take the lead (i. e. in providing funding). It is likely that any mission to Mars may be dependent on the ISS still being in operation, in order to evaluate all the human issues involved in extended space travel. 6. Conclusions

There is no doubt the ISS deserves the title of "The Most Successful Space Mission." Not only is it the most costly object ever created by man, it has facilitated many years of scientific experiments that will be of long term benefit to mankind – in many fields including medicine – as well as being a key source of learning about the issues that may face space voyagers on future extended space missions, e. g. to Mars or beyond. It has also demonstrated unprecedented levels of truly international cooperation. This single space project has operated already for some 13 years and may well continue for as many years or more in the future.

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