

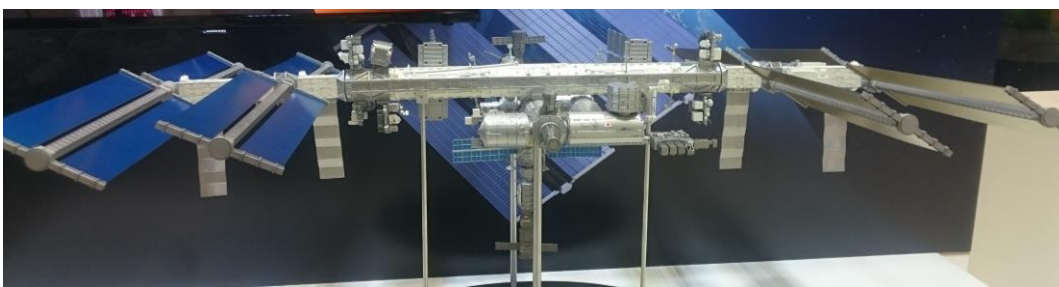
The International Astronautical Congress (IAC) 2017 was held in Adelaide, Australia this year where the conference was framed by Jean-Yves Le Gall, president of the International Astronautical Federation (IAF). Jean-Yves Le Gall opened the conference with a speech on the value of diversity in the space industry framed using the 3G's: geography, gender, and generation. He said utilisation of the 3Gs is an investment in the space industry that will yield a long-term return in the form of innovation, fascination and inspiration in the next generation.

The international space industry is tending towards greater collaboration on space projects including cross-agency collaboration much like the International Space Station, space agencies and small to medium sized enterprise (SME) collaboration, and stronger academic and commercial partnerships. This has been fostered in the context of advancing plans for lunar human space missions and Mars colonisation, in addition to the announcement of an Australian space agency by The Honourable Simon Birmingham, Minister for Education and Training on behalf of the Prime Minister, Malcolm Turnbull.

Roscosmos' and National Aeronautics and Space Administration (NASA) signed a joint statement on research and exploration for deep space missions. The Australian National University's (ANU) Research School of Astronomy of Astrophysics (RSAA) and University of New South Wales (UNSW) Canberra have signed a Memorandum of Understanding (MoU) to collaborate building and testing satellites and instrumentation. The intention is to enable end-to-end capability for mission and payload design, assembly and testing, as this is typically very difficult for space projects, due to their long duration. An additional MoU was signed between ANU and DLR, the German space agency, reinforcing space technology research internationally in the fields of optical instrumentation, laser physics and quantum technologies.

Although Australia's national space agency announcement may have been driven due to the New Zealand space agency being announced last year, it was still long awaited being in the works since 2005 when the first working group was formed. Australia already partook in the \$420 billion industry including the Deep Space Network in Tidbinbilla, Mount Stromlo Observatory, Parks Observatory and the Square Kilometre Array (SKA). All these projects involve the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and numerous international partners including NASA Jet Propulsion Laboratory (JPL).

With all these fragmented niche industries within space in which Australia partakes in a national coordinating body, such as the space agency, would be the ideal representation for Australia's space industry, whilst not restricting direct partnership such as the ANU and DLR MoU. This also means that Australia should continue to retain international partnerships with other countries in which we are reliant on and not replicate existing capabilities for the sole purpose of pretentiousness. By critically analysing existing capabilities nationally and internationally are we able to provide value to the global space market by enhancing other fields. Having taken so long to arrive at the conclusion of a national space agency the additional time should be taken to form an effective agency that can bring greater overflow effects downstream to industries such as academia, health, education and employment.



Australia's announcement also provoked the beginning of a wider range of potential SME blossoming and thus democratising the space industry. With the first incubator in Sydney, Delta V, launching in January 2016 they have and continue to

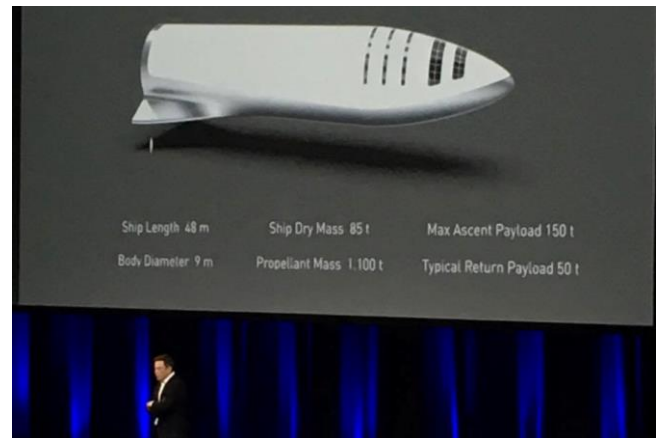
work with Fleet, Gilmour Space Technologies, Cuberider and more, enabling opportunities such as sending the first Australian payload to the ISS. Adelaide now have recently announced, ThinLab, enabling greater opportunities for space technology SME to test their ideas in a safe space. Whether this commercial technology will add to the commercialisation of Mars, or lunar exploration missions will be a test of their ability to play against the larger heavyweights in the industry such as space agencies and Space X.

Lockheed Martin announced their plans for a Deep Space Gateway (DSG) and Mars Base Camp Deep Space Transport (MBC) partnering with NASA. Orion is being built and tested at the moment, and will be placed on the

Space Launch System (SLS) rocket in which the Exploration Missions will take place slowly building the DSG as a space dock for science, lunar exploration and a platform to build MBC. MBC enables sample collection and analysis through the use of drones and rovers, extending to exploration of Mars' moons Phobos and Deimos. From there site selection for human landing will be enabled. First landings on Mars are planned to be by 2030.

Elon Musk announced SpaceX's plans stopping both NASA and Lockheed from monopolise on the lunar and Mars missions and Boeing's Dream Chaser vehicle. His bold vision to create competition against longstanding space companies begins with the new BFR rocket to replace all previous SpaceX rockets, including Falcon 9, Falcon Heavy and Dragon currently used to deliver cargo to the ISS. SpaceX's BFR will become the basis of the new age ISS cargo transportation method, modern day Earth and Mars air transportation method.

The basic concept of the BFR is that it is a 2-stage fully-reusable rocket that utilises SpaceX's propulsive landing capabilities through the use of deep cryogenic liquid oxygen tanks made of carbon fibre developed over the last few years. The idea is to remove landing-support fins used and solely depending on launch stands. The BFRs first stage will utilise 31 Raptor engines producing 5400 tons of thrust. Second stage will be eight stories high 48m in length with a 9m diameter, capable of carrying a maximum ascending payload of 150t and a return payload of 50t. With this technology Elon Musk sets the sights for the first Mars landing to be by 2022 and a colony by 2024, well ahead of NASA and Lockheed Martin's plans. Whilst also giving the heavyweights in the space industry a run for their money he also gave companies in the aviation industry a challenge to compete with: to travel anywhere on earth in under 1 hour.



Whilst, nanosatellites and propulsion technology were on display space isn't limited to the scientists, entrepreneurs and engineers, but also including the emerging field of space law. The International Institution of Space Law (IISL) ran their Manfred Lachs Space Law Moot Court Competition with world finalists from University of Mississippi and National Law School of India – Bangalore. Bangalore University won narrowly representing the fictitious state of Perovsk in the case written by Dr Michael Simpson (United States) and Chris Johnson, Esq. (United States).

The exhibition hall at IAC created a great snapshot of the international space industry, culture and environment. This industry internationally is diverse in all the national space agencies around the globe large and small, new and old. The SME enterprises at all stages of their development from Fleet, to Rocketlab, to Cuberider. Whether privately, or government funded capabilities aren't restricted to independent research institutions such as CSIRO, as academic institutions from Canada, Sydney, Adelaide, Canberra were on display. Education of the next generation of students were also incorporated into these stands, especially the International Space University, keeping in mind the value of reinvesting in the next generation thus creating a self-sustaining industry.

