

Is there something Australian manufacturers can put into space?

Alexandra Cooper speaks with the Australian Space Agency deputy head, Anthony Murfett, Titomic executive director and CTO, Jeff Lang, and Monash University's School of Physics and Astronomy associate professor, Michael Brown, to uncover where the opportunities lie for our investments in space technology.



ON 11 JULY, the world watched on as British billionaire Richard Branson flew 86km into suborbital space on his Virgin Galactic rocket plane, 17 years in the making.

"We're here to make space more accessible to all," Branson said, following the historic flight. "Welcome to the dawn of a new space age."

The space sector is one of Prime Minister Scott Morrison's Modern Manufacturing Strategy key priority areas. With the space sector now becoming more accessible for

Australian manufacturers, what does this mean for our future domestic capabilities?

Supporting the race to space

From the race to be the first on the moon to the first joy-ride to suborbital space, space-related technology has evolved dramatically over time. The recent commercial "space race" taking place in the US reflects this.

"I think there's an uptick in commercial space activities generally, and the number of launches that are happening across

the globe reflects that – a huge increase in activity by SpaceX in the US over the past few years," Monash University's School of Physics and Astronomy associate professor Michael Brown said.

"The SpaceX rockets can take un-crewed satellites anywhere in the solar system. The publicity stunt of launching a Tesla car into space, into orbit between Earth and Mars, was a demonstration from a couple of years ago.

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think, as always, it's the satellites and un-crewed commercial activities that are actually driving the space industry."

Since 2018, the Australian government has invested over \$700 million in the space industry, reinforcing that it is an emerging and important area that will create jobs and growth for the economy.

"One of the big programs we're delivering includes our \$150 million Moon to Mars program," Australian Space Agency deputy head Anthony Murfett said.

"It is designed to support

Australian manufacturers will support NASA's activities on the Moon and Mars.

to apply their technologies to space projects and determines the feasibility of how these technologies can function in space. The aim is for Australia to partner with NASA to support its activities on the Moon and Mars via these innovative technologies.

Another program facilitated by the Australian Space Agency is the Space Infrastructure Fund.

"Many of our space businesses, as well as those businesses that are thinking about space, require supporting infrastructure so they can show that their technologies work in space," Murfett said.

"So we've recently awarded a \$2.25 million grant to ANU (Australian National University), and its partners, to further enhance their payload qualification facilities. These facilities allow companies to test their products and technology in an environment that simulates aspects of space."

At the same time, the Modern Manufacturing Initiative (MMI), run by the broader Department of Industry, Science, Energy and Resources is gaining more traction.

"Space is one of the six manufacturing priority areas for a couple of reasons. This includes that we've got great capabilities in our manufacturing sector that can support the growing space sector, it grows a high-tech workforce and, excitingly, working in space is inspiring," Murfett said.

"The first rounds for two elements of the program have recently closed – the Translation and Integration Streams – where four space businesses received funding to support capabilities such as using titanium in satellite components and space vehicles; new sensors that can be used in space to look down on Earth; and looking at fluid and motion control products that can be used in space."

Putting the pieces together

Implementing these programs in Australia also aims to have a positive impact on global priorities, such as reducing our carbon footprint when launching spacecrafts into orbit. This is

reflected in the \$2.3 million in MMI funding provided to Titomic, which uses cold spray technology, or Kinetic Fusion, as an additive manufacturing process. This has been used in a variety of applications, however most recently in building space vehicles and components with green titanium.

So how does cold spray technology work?

"Ultimately, we were looking at advanced technologies that communalise titanium metal powder," Titomic executive director and CTO Jeff Lang said.

"What was interesting about this powder is it was a very cheap feedstock material and not quite the normal powder that's used in normal melting 3D printing, which is a nice round spherical powder. Cold spray technology is slightly different – it doesn't melt material, it actually accelerates metal particles at supersonic speed and as they collide, they fuse together."

to build a sovereign capability around that sector. Unfortunately, there's not exactly green processes on how titanium is traditionally produced.

"So what we've been able to do with green titanium is there's a company called Coogee Chemicals, and they have a feedstock material that cracks a poppy seed – basically where they extract the titanium out of those minerals," he said.

"The materials are mined in Australia, we process it to that first level, extract the metal out of the ore and then with that titanium poppy seed, we use hydrogen to embrittle the titanium. It breaks down into a fine powder and then we can use that feedstock. That feedstock is around 10 times less in cost than traditional metal powder used by 3D printing."

This process ensures that Titomic's end product can be delivered faster, on an industrial scale, using renewable energy. Lang



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On completing a project with CSIRO in 2014, Titomic developed a robust process for using cold spray in additive manufacturing. Then, they looked at applications for its end use.

"We worked with all the major defence aerospace primes in the world on demonstrator parts, but we also realised there was a loss of capability in the space industry around what we did in the Apollo missions – there was a lot of titanium used. That's why the SpaceX rockets are built out of stainless steel and not titanium, which is half the weight," Lang said.

"Australia has the largest mineral resource for this material in the world and the government's always felt there was an opportunity

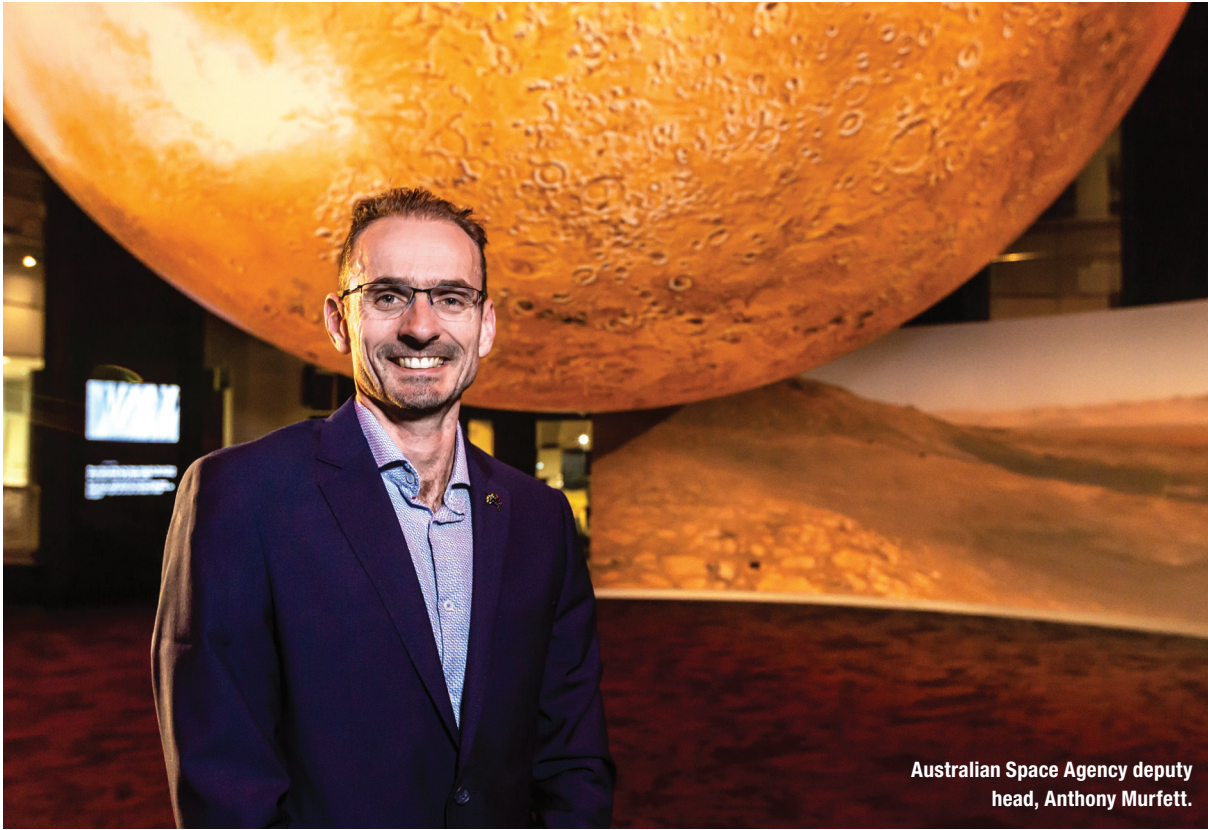
highlights the importance of using green technology to create change in the manufacturing industry in Australia.

"With the advent of climate crisis coming our way, we have to revisit how we look at manufacturing. We have to look at everything, from how we ship materials around the world to understanding the carbon footprint when we're manufacturing product," he said.

"The metals industry is the second largest polluter in the world – no one's doing anything about it. So, Titomic's working with the Australian government and we've decided to really look fundamentally at the resources we have in Australia and look at issues like: How do we maintain

Australian businesses to collaborate with international partners as part of NASA's ambitious mission to go forward to the Moon and onto Mars. It has three elements: firstly focusing on building supply chain capability, a second element supporting larger projects through a demonstrator program and the third element is a trailblazer program – where we invest in a significant project to support NASA's broader Moon to Mars activities."

Overall, the Moon to Mars Initiative gives advanced manufacturers the opportunity



sustainability around those resources? How do we control that in a better way and take responsibility in Australia? The answer is to grow the sustainability of our resource commodities, but also build some very advanced green technology industries around that capability as well.

"At Titomic, we like to see ourselves at the forefront, creating the gold standard around what we can do there. And we believe it gives the Australian space industry a unique value proposition that we can be the world leader in titanium space vehicles and other areas."

Other capabilities in space contribution

Other areas encompassing Australia's capabilities in the space industry include data integration and robotics, and research and development projects in rocket technologies, hybrid fuels, quantum technologies and optical communications.

"There are areas such as earth observation where Australia is really good at data integration, or

use of data," Murfett said.

"There's a big opportunity to use these observations to support bushfire disaster management and defence capabilities as well. These capabilities can also be used to understand the surface of the Moon or Mars.

"Robotics and automation is a significant area of opportunity. While we're an emerging space nation, the world is turning to Australia and seeing our robotics and automation capabilities – drawing from our mining and resources sectors," he said.

"We're currently developing technology road maps which outline where Australia could be in 10 years and the investments or opportunities for us to get there. We've released a technical road map on Australia's opportunities in advanced communication, which highlight opportunities using optical communication (which could be up to 100 times as fast compared to current technologies). Australia is world leading in some of these capabilities, which positions us well for the future.

"We're now doing the thinking to inform the industry, and manufacturers as well, where those opportunities could be."

For local manufacturers seeking to contribute their technologies to the space industry, the Moon to Mars Initiative could provide the opportunity to facilitate a global supply chain.

"In the space sector, there are particular requirements and quality standards that need to be met in international supply chains," Murfett said.

"So, we've got in place a program to support the development of these capabilities, should a business be considering operating in the space sector. We also have a program in our supply chain program to support around facilitation – what we really want to do is open these supply chains for Australian businesses to work internationally. We aim to have this element open later this year."

Murfett also said it is vitally important to work with the Australian community to promote an understanding of why investing

in space is essential.

"It's about jobs and growth and importantly, we use these space technologies every single day," he said.

"With the global space economy predicted to be worth \$1 trillion by 2040, being able to invest in and create that workforce, and importantly being able to develop technology to help other people here on earth is vitally important.

"Whether it's new robotics for agriculture using space technologies, new ways of communicating across air or land, or even using lessons from space medicine to support remote medicine capabilities and applying them to our rural and regional communities, the positive impacts here on Earth are immense. This reinforces why we're investing in space and how it helps people."

Space has a profound impact on our daily lives

"I think an interesting change that's happening now – it's sort of crept up on us – is how ubiquitous space is becoming in our daily lives," Brown said.

"We've all had GPS now on our phones for quite a while and got pretty well used to it. We could imagine that there will be similar things creeping in, perhaps with people using the Starlink satellite communications.

"There's definitely opportunities out there for Australian companies, certainly (perhaps unexpected) opportunities that could happen. With Rocket Lab's Electron launches happening out of New Zealand, 20 years ago the idea of satellites being launched from New Zealand might have seemed a little bit far-fetched – and now that's happening on a very regular basis."

Lang agrees, adding that the space industry has the potential to unify the globe.

"As we look toward the stars for the future, I think the billionaires are getting a lot of flack as far as their 'new little hobby playing space people.' But I would suggest otherwise," he said.

“I would suggest they’re pushing the boundaries that’s going to affect the human thinking at a collective level. The interconnectivity of everything, how it affects humanity, how we look at space for the next frontier, is really going to unify humanity on this planet.”

Looking to the future, Australia has the potential to play a major role in contributing to the space industry at large, such as with launch capabilities.

“Australia’s shown a record of being able to have a high level of pioneering spirit that evolved into innovation ingenuity to solve problems. And if you look at the space industry in Australia, we have probably one of the best geographic locations in the world to launch from,” Lang said.

“We’re looking at launching on the Yorke Peninsula in South Australia, and up in the Northern Territory - these are great geographic locations to launch from. If you’re going to launch vehicles

from Australia, would it not make sense to build those vehicles in Australia as well? The closer you can get your builder base to where the launch pad is, the greater that is.

“I grew up with books on the Moon, looking at structures on the Moon – all cartoons and animated. But it inspired me as a child to really look at this industry. And now I find myself years and years later and this opportunity has fallen in my lap. So I’m going to really be pushing for this, because I think it’s a great capability for humanity and Australia as well.”

This kind of inspiration is the driving force behind space innovations within Australia.

“As an astronomer, space still excites me, so I think there would be excitement about crewed space flights to the Moon,” Brown said.

“Who knows exactly when crewed space flight to Mars will happen – it’s fiendishly expensive, but at the same



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time, I’ll admit a certain childhood excitement about crewed missions to other parts of the solar system.

“I’m also very excited about the un-crewed space flights and what they’re going to achieve over the coming decade or so. I think there’s a lot to be excited about in terms of exploration and science in space.”

Inspiration for the future

The Australian Space Agency hopes that this excitement will inspire both manufacturers in the present and future generations to continue building an Australian

space heritage.

“We really want to show parents, teachers and kids that space is a reality for Australia, and is a growth area for Australia,” Murfett said.

“We want kids who are thinking about space to be able to look up to the sky and know there is now Australian technology there, supporting our way of life.

“We’re asking manufacturers – both those already in the space sector, and those thinking about it – to pause and think: is this something that I can put into space?” **M**



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