



COMMONWEALTH OF AUSTRALIA

Proof Committee Hansard

HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON INDUSTRY, INNOVATION, SCIENCE
AND RESOURCES

Developing Australia's space industry

(Public)

WEDNESDAY, 10 MARCH 2021

ADELAIDE

CONDITIONS OF DISTRIBUTION

This is an uncorrected proof of evidence taken before the committee.
It is made available under the condition that it is recognised as such.

BY AUTHORITY OF THE HOUSE OF REPRESENTATIVES

[PROOF COPY]

INTERNET

Hansard transcripts of public hearings are made available on the internet when authorised by the committee.

To search the parliamentary database, go to:

<http://parlinfo.aph.gov.au>

HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON INDUSTRY, INNOVATION, SCIENCE AND RESOURCES

Wednesday, 10 March 2021

Members in attendance: Dr Allen, Ms Bird, Mr Joyce, Mr Perrett, Ms Swanson.

Terms of Reference for the Inquiry:

To inquire into and report on:

The House of Representatives Standing Committee on Industry, Innovation, Science and Resources inquire into and report on developing Australia's space industry, including:

- Development of space satellites, technology and equipment;
- International collaboration, engagement and missions;
- Commercialisation of research and development, including flow on benefits to other industry sectors;
- Future research capacity, workforce development and job creation; and
- Other related matters.

The Committee will focus on how the Australian Government can support and encourage the space industry while preserving and protecting the space environment.

WITNESSES

DAMP, Mr Lloyd, Chief Executive Officer, Southern Launch	1
de Zwart, Professor Melissa, Dean of Law, University of Adelaide	29
DUNK, Mr Graeme, Head of Strategy, Shoal Group Pty Ltd [by audio link]	38
GILMOUR, Mr Adam, Gilmour Space Technologies	1
HUSSAIN, Dr Muhammad Akbar, Founder, Southern Cross Outreach Observatory Project	52
KERR, Mr Peter, Coordinator Defence and National Security, SmartSat CRC Ltd.....	44
KORONIOS, Professor Andy, Chief Executive Officer, SmartSat CRC Ltd.	44
LISK, Mr Joel, Director, Space Law Council of Australia and New Zealand Limited	29
OPIE, Mr Matthew, Director, Defence and Space, University of South Australia	23
PRICE, Mr Richard, Chief Executive Officer, South Australian Space Industry Centre	16
RAMSEY, Mr Mark, General Manager, Sitael Australia	9
ROGERS, Dr Derek, Engineering Lead, Defence and Space, Shoal Group Pty Ltd.....	38
SCHNEIDER, Mr Scott, Regulatory Lead, Southern Launch	1
SCOTT, Ms Carly, Chief Executive Officer, Equatorial Launch.....	1
TETLOW, Dr Matthew, Chief Executive Officer, Inovor Technologies	9
WOODGATE, Dr Peter, Chair of Board, SmartSat CRC Ltd.....	44

DAMP, Mr Lloyd, Chief Executive Officer, Southern Launch

GILMOUR, Mr Adam, Gilmour Space Technologies

SCHNEIDER, Mr Scott, Regulatory Lead, Southern Launch

SCOTT, Ms Carly, Chief Executive Officer, Equatorial Launch

Committee met at 09:07

ACTING CHAIR (Ms Bird): I declare open this public hearing of the House of Representatives Standing Committee on Industry, Innovation, Science and Resources for its inquiry into developing Australia's space industry. In accordance with the committee's resolution of 24 July 2019, this hearing will be broadcast on the parliament's website and the proof and official transcripts of the proceedings will be published on the parliament's website. Filming and recording by the media is permitted during this hearing, but I remind members of the media who may be present or listening on the web of the need to fairly and accurately report the proceedings of the committee.

I welcome representatives of Southern Launch, Gilmour Space and Equatorial Launch to give evidence today. This hearing is a legal proceeding of the parliament. The giving of false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. The evidence given today will be recorded by Hansard and attracts the parliamentary privilege. I invite each of you to make a brief opening statement. Members are always very keen to ask questions, so keep your opening statements fairly straight to the point and then we will engage in a more interactive process.

Mr Gilmour: We're based in Queensland. We have 63 employees. We've grown from three to 63 in the last five years. We are venture capital backed. We've raised \$26 million so far from venture capital investors. We're developing a launch vehicle to take small satellites into space. We're well on the way in the development of that. We're completing the critical design review, which is the final design review before we start manufacturing in earnest.

Our first scheduled launch date is March next year, so we have a very critical launch ahead of us. Launch site is a big risk for us—to have a launch site we can actually launch the rocket from. We're very optimistic. The market is very buoyant at the moment, from an investor point of view. In the last three months, more than \$3 billion has been raised by rocket companies around the world from investors. We're in the middle of doing our series C raise as well, and it's looking pretty good. I'm quite optimistic about the future. We want to grow jobs. Our forecast is to have at least 500 jobs in our company by 2025 and well over a thousand two or three years later.

ACTING CHAIR: Thank you, Mr Gilmour. Mr Damp?

Mr Damp: I'll give you a high-level word. As members of industry, it's very encouraging for us to be involved in this committee to carry out this inquiry into developing Australia's space industry. You've been introduced to the two other companies involved in this hearing. We three Australian launch companies are pleased to appear before the committee and demonstrate our commitment and competence in ensuring Australia is a reasonable and leading actor in the global space economy.

The global space economy is now much different than in the traditional days where space was all about government activity. As my colleague Mr Gilmour has pointed out, the modern space sector has evolved in a way today where it's led by private investment and private industry. It's creating a new market for launch services to provide these next generation technologies for Australians as well as, more broadly, the global world requirement. The market's dependence on next generation launch capability is driven by the demand for these new technologies to be safely, rapidly and reliably tested and placed in orbit. In space, these new technologies provide immense, if not immeasurable, value to everyday lives in Australia and around the world. The role of the launch industry is analogous to that of a middleman in business—that is, we launch-service suppliers make sure new technologies safely and reliably get to orbit so that customers and end users may access the benefits of these technologies. In this sense, without launch capability, there would be no GPS, no broadband internet and no effective way to monitor the environment or handle emergency situations. Launch provision is a necessary component for these services, and these new technologies, such as that being developed by Mr Gilmour and others, will provide these services with the dependence on next generation technologies.

Space technologies are also critical for national security, and a sustainable, industry-led sovereign launch capability for Australia will provide necessary support to the Australian Defence Force. In developing our sovereign capability, we harness Australian grown technologies, we create jobs and we support our service men and women on the front line.

We three wholly Australian owned companies before the committee today represent the next generation launch capability. We know Australia can be a global leader in this area. It's our shared ambition not only to ensure Australia is responsible in its launch activities but that Australia also becomes the market's first preference in getting this next generation technology into space. However, industry alone cannot bring Australia into this leading position. If the global market looks to Australia for long-term provision of next generation space services, it is vital that policy and regulation on the national level aligns with the same vision. Matters such as strategic direction, funding priorities and regulatory frameworks are the factors which can make or break Australia's opportunity.

In responding to the committee's questions today, the three of us before you seek to demonstrate the reality of Australia's opportunity in space and how this opportunity will be achieved with safe and reliable launch activity and to outline the challenges we face in becoming a globally preferred launch service provider, all of which are barriers that government can alleviate from industry, which will literally then allow Australia to be a global leader in the launch services market. With secure sovereign space launch capability, Australia not only benefits from the applications of the new space technologies but also benefits directly from the launch industry itself, which brings jobs, tourism and investment into Australia's economy. Thank you.

ACTING CHAIR: Thank you, Mr Damp. Mr Schneider, do you want to make some opening comments?

Mr Schneider: No, thank you; I've nothing to add.

ACTING CHAIR: Thank you for being available to answer questions. Ms Scott, do you want to make some opening comments?

Ms Scott: Equatorial Launch Australia is developing a commercial spaceport at about 12 degrees, which is really significant because one of the huge advantages that Australia has, in the growing global space market, is its geography. We have a contract to deliver NASA rocket-launchers from our site next year. This is a world first that demonstrates exactly what we're putting forward, that this industry and the opportunities are a reality now and will have a significant impact, positively, post-COVID on the national economy and national security. We're able to do that by unlocking some of these barriers and talking to the inquiry now about how we can do that to bring this reality forward for a safer, more reliable and more effective space economy. Thank you.

ACTING CHAIR: Excellent. Thank you, Ms Scott.

Ms SWANSON: Thank you, one and all, for being here with us this morning and virtually as well. In terms of Australia being a competitive participant in launching various pieces of equipment into orbit, I'm interested to hear about, firstly, what you think. You've said this morning that the regulatory framework is an issue. Are there any other impediments that you foresee into the future? I'll keep that question succinct, at this point. Can we talk about the impediments, and then I've got something to follow on from that.

Mr Gilmour: In our submission we talked about a number of things that we thought were impediments. We've got a list here but I'll go through a couple.

Ms SWANSON: Sure. It's just good to get it on the *Hansard*. That's the reason for the question.

Mr Gilmour: There's a concept called a 'suitably qualified expert' that's in the legislation. That's a person who has technical expertise to evaluate the flight safety risk of a launch. In the regulations, in Australia, that has to be an independent expert, that's probably going to be another company, that will do this on a commercial basis. One of the issues with that is there are not many of these companies that are suitably qualified. The second thing is that when we look into the other countries that launch rockets, this activity is done internally by either the space agency or the civil aviation authority.

I don't want to just talk about problems; I want to talk about solutions. I don't think it's that hard to say to the space agency, 'You should have a mandate before a certain time in the near future where you will conduct this activity, internally, in the space agency,' and then not have to have this suitably qualified expert involved in the process.

Ms SWANSON: That was the next phase of my question, what the impediments are and what you perceive the solutions to be. You've answered that in one instance.

Mr Damp: If I can add another impediment, the other one is cost recovery. Currently, the Australian Space Agency has indicated that it could charge up to \$189,000 per launch permit application. New Zealand charges a flat rate of \$60 and America charges zero dollars. The Northern Territory government has, in its submission collated 11 countries, I believe, that do not charge a fee, or if they do, it's somewhat minor, like NZ\$60. This is a very large impediment to Australia being competitive on a global scale, especially when the modern launch

vehicles are far smaller, far less complex and far cheaper to operate. So a potential cost recovery could be an insignificant amount of the overall launch vehicle cost.

ACTING CHAIR: Mr Schneider, is there anything you would like to add?

Mr Schneider: Not outside of the regulatory framework, beside what Mr Damp has already mentioned, but a solution to both of these issues that I've proposed—good old *Hansard* has that. The federal government, when it was devising these regulations, revisiting them from the old framework, did extensive consultations with industry both in the act itself and the delegated legislations. Both of these matters, which Adam and Lloyd mentioned, were raised by many members of the industry in the consultations and submissions that they made. A lot of the proposals are already there—they're already written—and the Commonwealth has them on hand. It's a matter of just going through them and processing them. That's a solution to some of the challenges that we've already mentioned, and more that we'll hopefully explain in the next half an hour.

ACTING CHAIR: Ms Scott, is there anything you would like to add?

Ms Scott: I have two points, if I may, on the regulatory front. The multination agreements that we're either signed to or not currently signed to can make a significant impact to market opportunities for Australia. One of those is the TSA, or Technology Safeguards Agreement, which would allow Australia to interact with the US market in a significant manner—we're currently excluded from that in many regards.

I'd also like to mention that there are some other funding considerations that Australia has available to it already, where we would be able to better recognise, preference and identify local launch opportunities within Defence procurement processes—that means the manufacture of vehicles and launching locally. We're talking about 70 per cent of direct spend from Defence on launch, which is a significant figure that's going to go offshore. It may be absorbed nationally to start to grow significantly capability and market in the local space.

We're also seeing that there are sovereign funds and established funding priorities that are able to have a shift in mandate to acknowledge the significant critical assets that are being established in Australia, to support those and support the launch industry and space industry more broadly. So on the regulatory front there are specific agreements internationally that can be entered into and existing funding programs that can be adjusted to see launch and space thrive.

ACTING CHAIR: Thank you.

Dr ALLEN: Just to summarise what I've read and what I've heard this morning in relation to the safety regulation and cost-recovery aspect: what you're saying is that at the moment the safety aspect is being outsourced to independent consultants, and you're suggesting to bring it into the ASA. Sometimes when you read this as a non-space person, you might think you're trying to cut corners as a for-profit company. But you're not asking for that, you're asking for it to be brought in-house and for some of the order of it to be changed so that the regulation is smoothed out. But you also want to build capability within the ASA to provide that oversight and that partnership with the commercial companies. With the cost-recovery aspect of it, do we know where that cost-recovery aspect is going? Is it going to general coffers or is it going to grow the ASA and therefore its own capabilities? Or is it cross-subsidising academic space initiatives to therefore balance out a market which has a commercial arm but also an academic aspect and a public arm as well?

Mr Gilmour: I'll confirm that, indeed, we are trying to just get the capability to do the qualification of the risk into the agency, and we embrace the actual process—it's just where it's done and the cost of getting that done. I don't have an answer for the second question. I'm not sure where the money is going—the \$190,000—if it's going back to the federal government or if it's staying with the Space Agency.

Dr ALLEN: Just to clarify, I read somewhere that the cost recovery scheme actually hasn't started.

Mr Gilmour: It hasn't.

Dr ALLEN: So we don't know where it would go. The cost recovery is for the future, presumably to build the space capability in Australia. Is that correct?

Ms Damp: The cost recovery is a Department of Finance mandated question, and it's something that the Australian Space Agency has now deferred twice from starting. It is ticketed to begin on 1 July 2021, and the Australian space launch industry has no clear guidance yet on what spectrum of costs could be associated with any launch, as such.

Dr ALLEN: So the question is that it could get deferred again and it could be deferred indefinitely, but, for business certainty, for commercial operations, you'd like to have some certainty around what that cost may or may not be. And you'd like to have it proportionate to the activities that a competitive commercial sector that's trying

to grow quickly would have. So it's probably not no cost, but just a cost that's proportionate and market competitive. Is that correct?

Mr Gilmour: Yes.

Ms Damp: Yes.

Mr Schneider: I have a response. I'm not sure if it's to the first or the second component of the question, but the purpose of cost recovery has not been made clear. It's to enhance the capabilities of the agency. It's to recover costs that are used in the assessment of the application, which could be staffing hours but also could be outsourcing those assessments to third parties—to contractors. That's the purpose of cost recovery under the current framework.

Ms Scott: I reiterate the importance of being competitive internationally. I think the rest has been covered well.

Dr ALLEN: I have a question about a technology safeguards agreement. To explain to a non-space-sector person listening to this, presumably such an agreement is to protect the IP of countries wanting agreements with Australia. If a country wants to invest in capabilities that are onshore in Australia, they want to know that Australia's not going to steal its IP and become a competitive market. That's my reading of what a TSA might be. Is that correct?

Ms Scott: I'm happy for Mr Schneider to add to the commentary. You're correct in talking to the fact that it provides some guidelines and boundaries in regard to the exchange of information that is sensitive, and not just on the commercial side. We're talking about highly capable equipment that is able to fly to space. So you're really looking at managing the flow of information and technologies in a controlled manner, and providing some guidelines around doing that. Allied nations, largely, have signed into a TSA. Australia is an outlier in not being signed to a technology safeguards agreement. Mr Schneider, I pass to you for any further commentary that enlightens the group on that.

Mr Schneider: I don't have a great deal more. Yes, it is more about the security and the control of where the information is going, for the governments of each nation—but particularly in terms of the US TSA, where the US government knows where the technology and information is going. But, as Ms Scott pointed out, other allied nations do have them, including the UK and New Zealand. The New Zealand TSA with the United States does facilitate conducting space launch activities.

Mr Damp: The other key reason to get a TSA in place is it allows Australian launch companies to partake in the US's satellite manufacturing capability. Research funded by the federal government in 2019 indicated that should Australia have a TSA place it would then be able to engage a full market potential under a gross value-add of up to \$2 billion in direct and induced value due to this TSA. So it's quite imperative that we as Australians capitalise on this launch opportunity before us and engage with the US in developing this TSA.

Dr ALLEN: As a representative of the taxpayer, obviously when you are trying to get capability onshore, there needs to be the balance. Of course, we want countries that are way ahead of us and have invested literally billions of dollars in being able to profit and protect their IP. The flip side of it is how does that feed on to growing our own domestic market and provide a competitive environment for Australian companies that may not just want to feed off the IP but grow their own IP and be competitive against those offshore companies coming onshore?

Mr Gilmore: Launch technology is not just available in the United States; it's available in all the companies that have launched. So the reality of the American ITAR system is that we buy products from other nations—Europe, Japan, et cetera. But having said that, the biggest space market in the world is the United States. So a TSA would enable us to trade more actively with American counterparts who actually do want to supply us products but are prohibited from doing so right now because of ITAR, which is what a TSA overcomes. In terms of development, it's an enabler for us in the short term but, in the long term, we are going to develop the technology ourselves.

Dr ALLEN: The TSA doesn't prevent that development?

Mr Gilmore: No.

Ms SWANSON: It might just be worthwhile, gentlemen, explaining what the ITAR system is very briefly so that members of the committee know what that means.

Mr Gilmore: We have a similar system in Australia called the Defence export controls. It's a list of munitions and weapons technology that the Americans are nervous about sharing with other countries. So things at the very top of that list are nuclear weapons and not far down the list are rockets and missiles. They restrict the transfer of

this information outside of the United States in terms of not just companies but citizens. So if you're an Australian citizen in America, you still can't get access to the information. It's really to safeguard what they consider to be dangerous technology or dual-use technology.

Mr PERRETT: I just wanted to get a rundown. We had evidence earlier that there's about \$270 billion annually of launch business. I just want to get an understanding of where that occurs in terms of who our competitors are right now. I'm sorry to go back to basics but, in terms of our competitiveness, we've had suggestions of the Northern Territory being 12 degrees from the equator. Woomera seems to be viable at 30 degrees south equator. Others have suggested the Aleutian Islands at 52 degrees north of the equator. So could we just get a bit of an understanding of who our competitors are and what we bring to the table in terms of government investing money in competitors.

ACTING CHAIR: Just to clarify, you're talking national players rather than businesses?

Mr PERRETT: I'm assuming that you can mention the companies, but if it be a US company that's launching out of Mongolia, so be it.

Mr Gilmore: In terms of actual launch vehicles, the market that we're looking at initially is to take small satellites up into low earth orbit. There are probably about eight competitors around the world that have either launched or will launch into space in the next two or three years. The majority of them are in the United States. There are probably two in Europe.

Mr PERRETT: Are there eight US companies launching from the US?

Mr Gilmore: There are eight in total around the world. I'm not talking about China. China is a bit of a restricted market. Not many people want to use China to launch into space. So outside of China—

Mr PERRETT: Does China commercially launch?

Mr Gilmore: Yes, it does.

Mr PERRETT: To nations outside of it?

Mr Gilmore: It wants to and it does in some cases.

Mr PERRETT: But not yet?

Mr Gilmore: No, it has. It has definitely launched foreign satellites into space commercially. But most of the Western world would rather launch on a on a vehicle from outside of China in the current environment. So I'm talking about outside of China. China has probably about four launch companies that are launching.

Mr PERRETT: They are closely connected to the government, one would imagine.

Mr Gilmore: Yes, they are. The launch market is not big. There are not that many competitors. I'll defer to Lloyd and Carly a bit more on the launch sites. There are probably around 12 or 15 commercial launch sites around the world. But from our perspective as a launch company with a vehicle, we very much like the locations in Australia that launch sites are getting built on. So Lloyd's site is a really good place to do sun synchronous and polar orbits. A lot of the small satellites that are going around—

Mr PERRETT: Is that Woomera?

Ms SWANSON: Could you clarify those terms?

ACTING CHAIR: Presume we're at the very entry level of space understanding, just explain.

Mr Gilmore: Lloyd's site is at Whalers Way down in South Australia.

Mr Damp: It's a 35-minute flight to our west at the tip of the Eyre Peninsula.

Mr PERRETT: So about 33 degrees?

Mr Damp: Yes, 34.9, same as Rocket Lab in New Zealand.

Dr ALLEN: Could you describe and explain what sun synchronous and polar orbits mean? And also, the other question I was going to ask is: what is specific about the Australian geography? I know you said it is because there's no flight paths and maritime; there is low-population density and less infrastructure for things to re-land; and it's close to water. But from the point of view of satellites going from our latitude, what is the advantage? Is it to do with the sun synchronous and polar orbits?

Mr Gilmore: We have a number of them. If you picture the earth, sun synchronous and polar orbits basically go over the poles or close to the poles. The reason why that's good is because they stay in that orbit as the earth spins. If you have enough of them in that orbit at any point in time over the earth, there is a satellite. If you've got 100 satellites in a polar or sun synchronous orbit then you can have global coverage. So, for example, the Iridium constellation, which is one of the first communication constellations that went up in the late nineties, they fully

run on a on a polar and sun synchronous orbit so they can cover the earth. I would say at least 50 percent of the customers that we've got slated to launch into space are looking at polar and sun sync. The reason why Lloyd's site is good for that is because you're quite south. Going south from there, there's nothing until you hit Antarctica, so it's incredibly safe. Sorry to be a little bit more technical but, when you're doing a sun synchronous orbit, you're actually going counter to the rotation of the earth. The closer you are to the poles, the less rotational speed you have to counteract, so it's a lot easier to go sun sync from a south or very north latitude.

Mr PERRETT: So then it is close to the equator to go to the moon and things like that?

Mr Gilmore: It is close to the equator for equatorial type orbits. If you want to go sun sync or retrograde—opposite of the earth's spin—the further south you go or the further north—but we are south—the better.

ACTING CHAIR: Geographically, which nations meet that?

Mr Damp: I forget if it was, Mr Perrett or Mrs Swanson, who asked the question: who are Australia's competitors? Our competitors are New Zealand with Rocket Lab, who are operational. New Zealand has a TSA in place. They charge NZ \$60. The UK has a brand new space agency. They have a TSA in place.

ACTING CHAIR: Mr Damp, can you just clarify for me, too, whether they've got an industry that's a manufacturing one or a launch one? I suspect they have slightly different location needs.

Mr Damp: Sure. New Zealand has Rocket Lab, amongst other manufacturing companies, as well as a launch capability. The UK has a number of launch and manufacturing companies, as well as, I believe, two or three spaceports under development.

ACTING CHAIR: In the UK?

Mr Damp: Yes, including Scotland. They have a TSA in place. Japan also has manufacturing, at both the national level and the commercial level. They have a TSA in place, I believe.

Dr ALLEN: But Japan doesn't have the geographical latitude we have. Isn't it more equatorial?

ACTING CHAIR: They're manufacturing, he's saying—not launching.

Dr ALLEN: Sorry, I thought Mr Perrett's question related to our competitors geographically.

Mr PERRETT: I'm happy to hear about all of them.

Mr Damp: And Japan does have a launch capability that it uses. It's more for the mid-inclination, so in between equatorial—

Mr PERRETT: Is it in Hokkaido?

Mr Gilmour: No, it's on the main island.

Mr PERRETT: Honshu?

Dr Tetlow: Yes. They do the best they can from where they are, but our launch sites have significantly better capabilities.

Mr Damp: Brazil has just signed a TSA with the US. They have both domestic manufacturing and a launch capability that they are now starting to spool up. Then there are a lot of European nations—Norway, Sweden, Portugal—who are all developing both manufacturing and launch capabilities.

Mr PERRETT: Portugal?

Mr Damp: Portugal. Somalia have just recently announced that they are going to start looking at developing a launch capability. So Australia is, right now, at a fantastic point to take advantage of where we are, the companies we have and the advances that the launch sites have made in licensing our facilities. The time to act is now.

ACTING CHAIR: We've got about four minutes left. With the indulgence of my colleagues, I might just—look, there's one area of great interest to me, and I would like input from each of you. There are many reasons a government would encourage a particular industry in their nation, as opposed to leaving it to the market. One of those is jobs and employment. I'd be interested in hearing comments from each of you on how reliant you currently are on bringing talent and skills in from overseas, and where you see the opportunities in Australia for development. I'll put on the radar for you that we are particularly interested—the committee—in going beyond the traditional perspective: 'This is a boffins' industry.' When we've been going around, we're seeing a lot of technicians, a lot of people in this industry doing what we might consider the old apprenticeship-type jobs. There's going to be the broadest spectrum of work available for Australians if we can get this industry right. Mr Gilmour, I might start with you.

Mr Gilmour: As I said in my opening statement, we've got 63 employees now. On the mix of those employees, about 60 or 70 per cent are engineers. They can be mechanical, chemical, electrical or mechatronic—

we get them from all different types of engineering. Then we have a sizable team of technicians. These are welders, CNC machinists and electricians. As we build more launch vehicles, the ratio will go heavily towards the technicians, and we will get those technicians from industry. They're working either on cars or in oil and gas or—

ACTING CHAIR: Do you have to value-add to their existing skills.

Mr Gilmour: Absolutely. Yes, we do. You also asked about the ratio of foreign workers to locals. We hire about 10 to 15 per cent of our staff from overseas. They're super experienced rocket engineers that then teach Australians, so we want to keep that ratio for probably at least the next five years.

We're very optimistic about job growth. Space technology is inherently headcount heavy. It's people heavy. It's very hard to automate it or to get robots to do it. It's such a complicated system that we predict we're going to go through 500 people by 2025 and 1,000 people by 2027. If you look at some of our major competitors, they have thousands of people. SpaceX has 8,000 or 9,000 employees now. So it is a very, very good industry to grow jobs and diversify jobs—not just boffins but people from all over the industry. We also have people that do marketing, sales and financial control. So it's a broad spectrum.

ACTING CHAIR: That's a great overall picture. Thank you for that. Mr Damp, do you want to comment on that?

Mr Damp: Yes, thank you. I want to add some of the ancillary activities that are induced by Mr Gilmour's operations or by any launch activity and to give you an example of what occurred back in September, when Southern Launch undertook its first two launches of space-capable systems. During or prior to that launch campaign, we had 25 community members from Koonibba, a rural Aboriginal community, trained up by South Australia Police to be able to staff roadblocks. The goal was that they could be employed by us during the campaign. Lo and behold, fast-forward six months and the broader community has identified that there are now a large cohort of individuals in this Aboriginal community who can perform these other economic activities. With that, the community is now outsourcing these staff to gain additional income for the individuals. So it's not just the direct employment that our companies provide; it's the belief, the understanding, that our operations give the communities that they too can be masters of their own destiny, which I think is a real opportunity for the nation to get on board and run with.

ACTING CHAIR: It's interesting. I think we think of these sorts of longer-term employment opportunities. But, given that the operations of these sorts of businesses are often remote, you're saying that there are also opportunities for those regional and remote communities that you're in.

Mr Damp: Yes.

ACTING CHAIR: Of course, at the end of the day, that's good business practice, I would argue. But it's not required, is it?

Mr Damp: No, but it shows how space activities can be more than just what you see when you walk into an engineering office.

ACTING CHAIR: Yes. I think the interest for me is that so many new industries automatically pull towards cities, and you're probably one of the few that are actually looking to go out into more regional and remote areas. I know the chair, if he were here, would be jumping at that story.

Mr PERRETT: The Gold Coast isn't remote.

ACTING CHAIR: Yes. So it might be an unusual opportunity in and of itself by the nature of the industry. Mr Schneider, do you want to add anything on that issue about jobs and skills development?

Mr Schneider: Yes, thank you. I certainly echo what Adam Gilmour spoke about in terms of the trades having a role in the launch industry. Also, from my background and what I see, there's a huge demand for professional services. That includes legal services, because generally space law is quite new on the international level, and countries have to comply with what those international standards are, and they're largely untested standards. So it's a huge new platform, and it should be hugely interesting to new and aspiring lawyers. So there are huge opportunities there. General commercial matters and business advice, as well as insurance matters, are really interesting at the moment. So all this will be encouraged with a sovereign launch industry, as well as all the spin-offs that come from the end user applications and what the launch industry is putting into space. If there's manufacturing here, and if our domestic industry of satellite development and technology in Australia—it's a university industry—start bolstering up their capabilities because of this domestic industry, there will naturally be large job benefits from that as well.

ACTING CHAIR: Yes, good. I think we are giving evidence a bit later on about some new university courses generated by the space industry, so that's a great point. Thank you. Ms Scott, do you want to add something on that question?

Ms Scott: Thanks very much for the invitation. I would. Equatorial Launch Australia is another good example of that regional development story. We're located in East Arnhem Land, which is an area roughly the size of Belgium and which is going through a transition from mining and seeking new industries. The fact that we're developing a commercial space port there has seen close working relationships with the traditional owner community, with the rural community there, and direct jobs in land clearing, safety and recovery, bringing in those 60,000-year-old stories and Landcare practices and melding those with practices from NASA and other world leaders in the space community, to see that Australia has real and very diverse space jobs.

For myself, not having a space background at all, I like the comments you make around this being applicable to more than just boffins—although boffins are very important! My background also is in business, in running this company. We've seen, with this example, that we've got direct employment already, from land clearing to Landcare, and ongoing space capability at the Equatorial Launch site in a remote community where there has been significant change and transition as an industry seeking opportunities for Australia. It is a great example of how the space industry is igniting a range of diverse jobs, using everyday citizens who may not have considered space as an industry that they can participate in going forward.

As far as where we draw our skills from, it's probably pretty close to what Adam was saying. About 20 per cent of our workforce comes from overseas workers at the moment to supplement the local workforce. There is significant jobs growth on the ground directly, and flow-ons through our launch activity. We know that there are at least 100 people directly involved in the NASA launches.

Just on that touchpoint around how competitive we are: there are about 22 orbital launch sites around the world, but not all of those are accessible or able to do the launches that the market requires. Australia's unique geography and the fact that we have wide-open launch windows, and very-wide-open spaces with a very low risk profile, means we're a primary spot for launch both down south and up at the equator, where we're uniquely positioned globally to do GEO launches. These are launches that, in terms of market dollars, are the most dominant in the space market. Doing those close to the equator positions Australia uniquely to absorb a significant chunk of the international market in addition to the southern launches that we're doing. We're also able to cover using one tenth of the satellite.

So there are huge efficiencies by launching near the equator and in Australia that the global market is [inaudible] after. One: they can't get onto a site to start with. Two: they can't get onto one that has such great opportunities as what we're offering throughout Australia. Three: we see a growing demand for these launches. We've got three billion people in the middle class of South-East Asia and Asia generally that Australia is uniquely positioned to launch and provide services to. I just wanted to make those points. On the question of how we are positioned internationally: it is a unique opportunity that Australian launches provide, and there are very real opportunities for employment beyond and in addition to the very specific space and unique skills that are generally thought of.

ACTING CHAIR: Thank you, everyone. It seems to me that in terms of personnel in Australia, with our quite often groundbreaking researchers and practical researchers, our highly skilled tradespeople and, indeed, our innovative thinkers around regulation and law and all those other aspects, there are real opportunities there. I appreciate everybody's comments, and I love the examples of working with local Indigenous communities at the sites. That is tremendous.

Thank you for coming today. If you've been asked to provide any additional information, please forward it to the secretariat by Friday 26 March 2021. Can I ask for a written-up version of the story of your engagement with Indigenous communities? That would be wonderful for our report, as an opportunity to highlight those examples, if that's okay. You will be sent a copy of the transcript of your evidence and will have an opportunity to request corrections to transcription errors.

RAMSEY, Mr Mark, General Manager, Sitael Australia

TETLOW, Dr Matthew, Chief Executive Officer, Inovor Technologies

[09:57]

ACTING CHAIR: I now welcome representatives of Sitael Australia and Inovor Technologies to give evidence today. Is there anything you would like to add about the capacity in which you appear today?

Dr Tetlow: I am also the founder of Inovor Technologies.

ACTING CHAIR: This hearing is a legal proceeding of the parliament. The giving of false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. The evidence given today will be recorded by Hansard and attracts parliamentary privilege. I now invite you to make a brief opening statement before we proceed to members' questions. We usually find it's useful if it's a fairly brief opening statement as we have a more engaging exchange backwards and forwards. We're all very inquisitive, so we like to ask questions. Who would like to go first?

Mr Ramsey: I'll go first. Good morning, Chair, and committee members. Thank you very much for the opportunity to testify today. I'm personally very pleased to be here and delighted to see the standing committee's interest in developing Australia's space industry. I represent Sitael Australia, the Australian subsidiary of Italy's largest privately owned space company, Sitael. Sitael is a small satellite manufacturer and integrator of 50 kilogram to 300 kilogram satellites—in the Australian vernacular, from a large carton of beer up to refrigerator-sized spacecraft—and we have a strong heritage of building both in-space electric propulsion and spacecraft avionics. Our company has been set up in Australia to grow an Australian capability in space and has been motivated by the recent establishment of the Australian Space Agency and many exciting developments in the sector locally, particularly around growing a sovereign Australian space capability. We also view that, for all the recent excitement in Australia about space, the Australian space journey is still only at its beginning and that Australia is almost a textbook case as to why space technology can deliver national outcomes to a country. Thank you.

ACTING CHAIR: Thank you. Dr Tetlow, would you like to make some opening comments?

Dr Tetlow: Yes, thank you. I appreciate the opportunity to address this committee. My belief is that Australia should focus more on technology development in general. We should be aiming for the best rather than the cheapest, and we should not be afraid of doing things that are difficult and perhaps a little bit more risky. We have an expensive, well-educated workforce, so we should focus on high-barrier-to-entry technologies and services. Space is an ideal industry.

Inovor Technologies is one of only a few companies developing satellites and satellite technologies here in Australia, and we are probably leading the way in our use of an Australian supply chain to manufacture our space products. Our focus is clearly on the commercial and export markets. We don't want to be relying on the Australian government as a sole source of income to achieve this developing technology and know-how. Having the intellectual property owned in Australia and by Australians is key, as it provides unhindered access to global opportunities without parent companies or foreign government agendas getting in the way.

Most other countries have specific policies to ensure that space technology and know-how is locally owned and controlled, as they understand the commercial value of the space industry to their economies, not to mention the issue of sovereign priority access to technology when they need it. Australia, by comparison, does not mandate this federally or at the state level to support the Australian commercial space sector. Australian space tenders are usually open to all international companies and sometimes don't even consider Australian industry content as part of the evaluation criteria.

A useful change in thinking could be to restrict R&D projects to use only Australian suppliers. If lives don't depend on it, why would we spend our limited R&D funds to support other countries' space R&D programs, particularly countries that don't need support, like the US or many European countries? Where lives do depend on it, such as with defence capability acquisitions, clearly Australia is not in a position to mandate only local suppliers. But there should still be strict requirements to use Australian technologies wherever possible and ensure Australian industry has significant opportunities to upskill.

These are just two of my bugbears, but I strongly support all of the recommendations in the Space Industry Association of Australia submission. We're in the midst of an unprecedented Australian government investment in space and space systems, so it is a great opportunity to develop the Australian space ecosystem. If we do what we've always done, I fear we will be here in the same place in 20 years time. If, however, we are smart about this,

we could in fact triple the size of the sector to \$12 billion and create an additional 20,000 jobs over the next decade.

ACTING CHAIR: Thank you. I'm going to start on this session, basically where you just left off, Dr Tetlow. My area of interest is the jobs and skills and the ongoing development of that opportunity as an important reason for government to be really proactive in an industry sector. Can you give me a picture of your company—international talent you've had to bring in, development of homegrown talent and the mix of types of backgrounds and skills that you're looking at—and give us some feedback on what you think might be gaps that Australian education and training systems need to be looking at.

Dr Tetlow: If you start with entry-level or early-career engineers and scientists, I think we have an incredible talent pool and we are second to none in the world. It is the same with the technicians. The skilled technicians that we have have everything that we could possibly need. When you get up to the more senior management level or systems engineers that have worked on spacecraft for long periods of time, we're lacking that, and we're lacking the very senior people who have been in it for decades and have all the war wounds to basically educate the younger team members.

So I guess there's a mix. The vast majority of our team are Australian, and we've had a couple of people come in from overseas to bring skills. We've also been lucky enough to work with a couple of returned space systems engineering experts who basically support our team, one of whom is sitting next to us. I guess that sort of enables us to go forward just with the skill base that we have.

If you then look down at the manufacturing industry that we use, which sits underneath us—including machinists, metal machinists, electronic manufacturing capabilities and all those sorts of things—they're also available in Australia at a very high level. There is some upskilling that needs to be done or that is being done, I guess.

ACTING CHAIR: Could I just get you to comment on this: we have had some discussion in previous hearings about, I think, the German model, which has masters and apprentices, so people do base-level apprenticeships and then they can specialise in particular areas. I would imagine space would be a good example of that. So they value additional qualifications after they've been out of their apprenticeship for five years or whatever and can specialise. Have you come across that model and what would be your view on that?

Dr Tetlow: I certainly have come across that model. I'm well aware of the German ecosystem and how they grow it and I strongly support it. We don't have anything formal like that. We have an informal model where the younger technicians come and they learn from the more experienced people. So certainly I think that's a really good idea.

ACTING CHAIR: Mr Ramsey, did you want to comment on that?

Mr Ramsey: Just in addition to what Dr Tetlow said, what we've lacked in Australia is space experience. We've had a period of five or six decades of the space sector globally and Australia has really been hands off and out of the loop. The challenging area in expertise that we find is finding people with five, 10, 15 or 20 years of experience. That's probably a difficult workforce. There are a lot of Australians who've gone overseas. A lot of Australians are coming back at the moment. Matt Tetlow and I both went overseas to gain some experience. I employ staff who've done the same and have come back because they want to live in Australia but want a space career.

ACTING CHAIR: Is that as a result of the international COVID situation? Is it a result of age? Often people will go overseas for the first 10 years of their working life and, then, to have families come back. I would be interested in your experience.

Mr Ramsey: I'll tell you my experience. I moved over to live in France for a number of years. That was really trying to gain some experience in the space sector because in Australia it has been such a nebulous sector that to gain experience you would go overseas to gain three, five or 10 years of experience. Whether you end up living there long term is a question of the family dynamic. I moved back for family reasons and have been lucky enough to get a great job in the space sector. But that is certainly an area where we're seeing a lot of Australian expats who are interested in coming back. But a lot of the young, bright minds have literally gone offshore, working for international agencies, international companies, because they haven't been able to find jobs here.

CHAIR: Do you want to comment on that, Dr Tetlow?

Dr Tetlow: I would agree. There are a number of people that are interested in coming back because of the lifestyle in Australia. Often they've gone overseas, got their experience and now there is actually is an opportunity for them to come back. So I would say this pre-dates COVID. This is just about the industry being here. Now

there's an opportunity to come back and work in the space industry. That's basically what I think is bringing a number of them back.

ACTING CHAIR: It's an interesting opportunity, I think, because often when we talk about bringing international experience in we presume that will be non-Australians. But, in fact, many may have been doing 10, 15 or 20 years already internationally and are looking at maybe in the final years, even, of their working career to come back and work in Australia. The development of the industry is an opportunity for that.

Mr Ramsey: Space as an industry has a unique ability to inspire people and particularly to inspire people to take careers in science, technology, engineering and maths, STEM, which we've talked about. I was very pleased to have a sneak preview of the Australian Space Discovery Centre, which is nearly open, from the agency. It's a place children will go and really get excited about doing hard things. I went to university with a number of people who studied engineering because they were passionate about space. They've moved into oil and gas and mining and renewable energy and a number of other sectors, such as finance, using the skills they gained. But their inspiration was really born out of space.

ACTING CHAIR: We certainly saw that with a lot of school children engaged with the Mars landing the other work.

Dr ALLEN: Thank you very much for your submission. We've heard previously about the opportunities for the space sector in Australia. What you're describing is a catch-up concept. I come from a medical research background where Australians went overseas and there was a real brain drain. Then the Australian government actually encouraged people to come back, which brought with it all these sorts of IP that people had built up in expertise and training. So we could import medical research excellence. There's been a rapid growth in that. So you're right: we're at this critical point in time.

My question goes to your submission and about some of the things that the government can do besides changing policy so that it's simpler and more attractive to do business. Your point is the government can use its procurement power. Rather than giving out grants, it can procure things that are made here. But the question I have is: Sitael is an Australian standalone company with the parent company in Italy. So it's regarded as an Australian company, is it?

Mr Ramsey: It's a registered Australian company.

Dr ALLEN: So one model of bringing commercial activities here is to have a subsidiary company. The other model is to have a homegrown model, which is, I suppose, what Inovor is representing. Then the third model is international companies investing over here using the TSA—I can't remember the name of the term that we were talking about.

Mr Ramsey: Technology safeguards agreement.

Dr ALLEN: Yes. I was wondering if you could speak to us about that. Some of the other submissions we've received say it would be better to have these TSAs in place so that international companies will more readily want to invest in Australia. What would that do for the emerging local market with regard to you offering those two other models for growth in this particular area? It's a long question! The question I'm asking is: does the TSA hinder local development or subsidiaries of international companies, or is it going to support you to be competitive with international companies investing in Australia?

Dr Tetlow: I think it can be both. It depends how it's handled. First of all, you don't have to do anything to attract foreign companies here. They're spending \$10 billion on procurements in defence over the next 10 years, so they're all here waiting; they want it. I don't think there's any issue with trying to get them here. They're all here trying to get this work. Bringing them over here initially is good because it can upskill you quickly. But you have to be careful: if you don't structure it properly, it can basically limit the ability of whatever Australian technology is developed to be exported out of Australia. Say company X comes in from the United States and sets up here to meet a capability need. If they've set up a manufacturing or R&D facility or whatever, that's all fine and it works in the Australian context. But if an opportunity comes in, say, from Vietnam or something like that, that export opportunity comes out of the parent company, out of the US or wherever the company comes from. So you have to be careful. You're bringing them in, which upsills us quickly, but then it chops your head off because you then can't export. The reality is we have to export, because we can't rely on the Australian government to fund all our missions going forward. So we're very focused on the export market. That's why we want to own the technology, the IP, in Australia, and have only Australia's agenda in mind when we basically go after a foreign opportunity.

Mr Ramsey: As a European company, the TSA is a US-centric agreement so it probably doesn't have a significant impact on us. Most of our technology is civilian and commercial technology that's not intended for military uses. It comes out of European export control legislation rather than American.

Dr ALLEN: Can I just clarify that. My general understanding is that the technology safeguards agreement is for space IP that a foreign country might be investing in onshore, and it safeguards their IP so that it's not then undermined.

ACTING CHAIR: I think the earlier evidence was that it was for very specific types of technology that might have—

Dr ALLEN: It's only to do with defence; is that right?

Dr Tetlow: Probably rockets. I don't know either, but there are some technologies that are considered as serious weapon type stuff. Satellite that's doing remote sensing may not be.

Dr ALLEN: So satellites are outside the TSA?

Dr Tetlow: I don't know that for sure, just to be clear.

ACTING CHAIR: I think we can get more clarification on that. The examples that were given to us in the earlier section were for weapons type usage.

Ms SWANSON: I can clarify that. It's dual usage where there might be defence usage as well.

ACTING CHAIR: We'll explore that further ourselves.

Ms SWANSON: I want to focus on Inovor. Thank you for coming along, Dr Tetlow. At the moment your satellites and your IP are all Australian owned. Is the company also Australian owned? Have you raised funds for the company?

Dr Tetlow: It's 100 per cent Australian owned.

Ms SWANSON: Excellent; congratulations on that. Do you have growth projections for your company? Do you have an employee status?

Dr Tetlow: All I can look at is historical, I suppose. We've basically tripled in size in 18 months. We've basically just been ramping up. This industry is based on flight heritage. Typically agencies and defence departments pour money into companies—that's what they do in the US and Europe—to get them up to the stage where they demonstrate their capability in space, and then they're able to go after international opportunities. That was something that was missing in Australia, and there was nobody who was willing to take the risk. Fortunately, the CSIRO came to our rescue, I suppose you would call it, by giving us the first contract. That basically enabled us to really raise the level. That's basically, I guess, developed into four more satellites being procured, all by different Australian government departments—Defence and that kind of thing. So we've had this very rapid growth.

There is certainly a turning tide in the fact that Defence are now talking about a lot more sovereign industry involvement, and Geoscience Australia are looking at a study as to whether or not they should procure their own capability. So I'm pretty buoyant about where we're going, and I think there's going to be substantial growth. We're actually expanding and investing in clean facilities and all those sorts of things to basically take up on that going forward.

Those are all just the local type of opportunities. Once we've got our heritage and Australia is buying from us, the world will think, 'Okay, if Australia is buying from it then it's probably reasonable technology.' Then we can basically go after the international side of things, which would then see us scale more.

Ms SWANSON: How do you see your company interfacing with Defence locally and then Defence more broadly?

Dr Tetlow: We actually started as a defence company, so we're very embedded in Defence. We're a defence industry support program member and all sorts of things. So our relationship with Defence is very strong, particularly locally in the DST context, because there's a large presence here, but also, I guess, with Canberra or with more traditional defence, where we also have a lot of involvement. I see Defence and the federal government generally as the procurers of bespoke pieces of technology. They might want some funky sensor that was made up in another university or some piece of technology that comes out of DST. You develop these bespoke satellites, which you can then develop specifically for them. They're obviously more expensive. There's a lot of non-recurring development expense and all that kind of thing in it.

In parallel to that, you have what you might call cookie cutter type satellites. There are a number of commercial companies, some in Australia, that are looking at putting up constellations of tens or even hundreds of satellites. So it's about getting this down to a very low cost to be able to cookie-cutter them out, so you basically do the development once and then you just basically produce five or 10 of them at a time. That's kind of how I would see us engaging with the commercial industry, but with the defence industry I suspect that going

forward it'll be more of these bespoke missions demonstrating technology. Then, in the next generation, we might actually be the prime provider of a particular capability, whether it's earth observation or communications or something like that.

ACTING CHAIR: I might give Mr Ramsey a chance to comment on that issue too.

Mr Ramsey: Going to the point around Defence engagement, I think Australian Defence is a significant spender in the space sector. In their defence, they've never been able to purchase locally. There hasn't been a sector around them. So there's been this chicken and egg: we don't have an industry, so they can't buy from it, so they buy from overseas, which means that five years later we don't have an industry. That debate has really started to change, and they're really starting to get some capability locally they can rely upon.

Going to Matt's point, some of the cutting-edge technology development is kind of the sweet spot for smaller companies to grow capability and then deliver into their larger projects. So we see that discussion changing at the moment, but I would say it's still driven at a policy and political level around Australian content. As Matt suggested, even when they go to procure small things, they can choose to procure them locally or procure them internationally. For us, as an Australian subsidiary of an international company, the question comes down to this: is it better for us business wise to build in Australia or overseas? We'd love to be building in Australia, but if the government policy is, 'We want the cheapest thing,' we have a big factory overseas that may be able to produce it cheaper, so we're back to the chicken-and-egg scenario.

Ms SWANSON: Just very quickly, this is somewhat out of the space remit in terms of talking about development, but I'm really interested in your thoughts on space junk and litter. You're talking about launching lots of things into space. I know this is a long-range question, but I feel it would be remiss of this committee not to ask the question. Is this something that we need to play our part in? How much stuff is being put into orbit, and what happens? In 50 years, are they going to look back and say, 'Well, those were the Wild West days where everyone was just launching everything, and now we've got this big issue'? I know it's kind of a bit out there.

ACTING CHAIR: We've just completed a waste and recycling inquiry.

Ms SWANSON: We have.

ACTING CHAIR: So it is pertinently on our minds.

Ms SWANSON: Yes, it is. I have a friend who's a space lawyer, and she keeps asserting to me that this could be an issue that we should be thinking about now.

ACTING CHAIR: Who wants to start?

Dr Tetlow: To put it in context, there are what you might call 'self-cleaning orbits' below 600 kilometres that, within 25 years, will come back to earth, and that's exponential. So, if you get to 500 kilometres, it's only about five years. Anything you put up at 500 kilometres altitude will return in five years without your doing anything about it. Typically, all of these small satellites will go into orbits that are basically self-cleaning. Certainly, the ones that we've got planned are all going to these self-cleaning orbits.

Ms SWANSON: Do they burn up on re-entry?

Dr Tetlow: They burn up and they essentially evaporate; nothing comes back. It's a completely benign exercise. When you start going into the higher orbits, that's when there really needs to be strong international agreement that these things can't be left up there because there will be a problem. I think the Australian Space Agency has a part of the overseas launch certificate, where you've got to say how this thing gets back and what your plan is. If you have a really good reason why you don't have a plan, that's fine. They can't be stifling industry, because nobody else is doing it at the moment, but it needs to be something that everybody is considering, and we certainly do. We don't want to be putting things up into orbit that never come back. That was the Wild West of the seventies and eighties. That's what was happening and we have to get away from that, in my opinion.

Mr Ramsey: Yes, I agree with everything Dr Tetlow said. It is becoming an issue and everyone in the sector is becoming conscious of it. It's an international issue, so it's not something Australia can address by itself, but it is something Australia needs to be a part of diplomatically, legally and politically. We can choose to take a political position of leadership in the domain, or we can sit back and wait for the sector to evolve. But next decade is the time to start getting this right; otherwise, in a few years time, there will certainly be some orbits that become unusable to everyone and there are some inherent legal and insurance type issues that come with this. Who owns it when it bumps in and it's debris is really a interesting question. There are some liability implications for the Australian government. So it's a really hot topic that we need to get right in the next decade.

Mr PERRETT: I have a question for both of you. What is the role of government in terms of making sure that our space industry is better linked up? My understanding is you're using private equity, you're profit driven and you're looking after investors. How can the government—CSIRO, the Australian Space Agency, Defence—better collectivise and get the benefits of collectivisation? I'd be interested in your thoughts on, say, how the US did Silicon Valley, something that had incredible amounts of federal government investment but was also incredibly profit driven. It seemed to be the greatest combination of those two. How could we duplicate some of that here? Who should be the lead agencies? What are the traps? If you could do all of that in about two minutes that would be good! You could write our report!

ACTING CHAIR: Mr Ramsey looks like he's champing at the bit to answer that.

Mr Ramsey: It's just a smile for when questions like that come up. It's a really good question and it's one that's pertinent to Australia at the moment. We've really started our journey in space in the last couple of years. The Australian federal government in particular spends a lot of money in the space domain. A lot of that money goes overseas, so the impact of that spending on jobs and growth is not strong at this point. There are a lot of different agencies that are starting to coordinate at the national level, so further coordination between all of those agencies, even at the Prime Minister or cabinet level, would be warranted. The other thing I'd add here is that a lot of the government spending has a large impact on the Australian space sector—

Mr PERRETT: Seed money, so to speak.

Mr Ramsey: It's sort of seed money, but it helps get the leg up to get that in-orbit heritage. What we do see is that each project, each procurement, takes its own best interest and, across the board, none of that is in the national interest. When you aggregate all that spending, a lot of it goes overseas. Each little project is trying to do the best for its taxpayer value, but when you look at the pieces collectively you send most of it offshore.

There's probably some thinking in government policy around how we better address that. Certainly in Europe, where my parent company comes from, and America, most of the government spending is guaranteed locally in their sectors. I think NASA's annual budget is in the order of \$20 billion and Europe has an equivalent. We are well behind per capita and then we send a significant portion offshore. So there's a lot of thinking around policy and how each dollar can go further in the Australian economy.

Dr Tetlow: I agree. I think we need a much more coordinated approach, looking across government to say, 'We're going to spend all this money; how do we get the most value out of it?' Looking at the collective Australian industry content would be ideal. That's very difficult because you'd have to have Defence talking to GA and talking to CSIRO, and there are obviously hurdles around that. But if you have a look also at the structure of the funding schemes at the moment, companies are there to make profit and to grow with profit, and that's how you attract investment and all that kind of thing. But if you have a look at things like—

Mr PERRETT: I think you're stuck with capitalism as a model!

Dr Tetlow: That's right. But we've got to have a look at how some of the programs are structured, where you have this co-investment or you have these grant-type mechanisms that don't allow profit—and, in fact, oblige the company to make a loss—to try to find the in-kind support. 'In kind' is money, from a company's point of view. So there are a lot of programs out there, but they still seem to be a lean a little toward the university type; they're trying to grow the research and the university side of things. The ARC has a lot of money in it; what we need is industry to grow up and deliver contracts to say, 'We'll deliver this capability,' and learn to do that. If we just continue with these grants which don't necessarily have a concrete outcome and they are partially funded then industry is going to really struggle to make ends meet or basically justify going after them.

Mr PERRETT: Avoiding the dead hand of government, is it more opportunities for market exchanges, more regulations, more sharing of information and a louder voice to a lead agency like the Space Agency? Would you like to go on the public record and say how we might turn our gaze as a committee? We won't quote you on this, will we!

Dr Tetlow: It's on the public record! I smile because the reality is, I don't know. I run a small 45-person company and, from my point of view, it seems that space should have a big, loud voice. The Space Agency should be a standalone entity and be able to corral everybody together and have this cohesive path forward. But I'm—

Mr PERRETT: A guide or a shepherd?

Dr Tetlow: I think they need to set the agenda. They need to speak out internationally and say: 'What projects are we going to work on? Are we going to the moon or Jupiter?' or whatever they're going to do and come back to Australia and say: 'This is what we're doing. Australian industry: there are contracts. Bid for them and go.' That's what I think should be the case. Again, I'm no expert: I just want to clarify that. I'm not sure if that's the right—

Mr PERRETT: The Australian government's picking winners. We turned the Holden car out here in Adelaide with the Australian government picking a winner. That was very successful, but it's no longer here. But I would put it to you that Australian governments are not great at picking winners in the way private capital is. And we know Australians are risk averse when it comes to private equity. What else could you—

Dr Tetlow: I would agree with that, except in the context of this flight heritage thing. All of our competitors around the world have had their agencies or their defence departments invest in them so that they can get this flight heritage. Once you've got that then you're in a much better position to say, 'Okay, I can do this now.' So when we go out there and say, 'We haven't had this investment and our competitors have, how are we to attract investment?' particularly if even the government then says, 'Oh, well, these guys are lower risk because they've done it before.' Of course they've done it before, it's because their agencies invested in them. So it's difficult. I absolutely agree with this capital thing. Commercial driving is where the winners are. But the thing is, there is this thing in the space industry that you've got to get over the hurdle, because before you get over the hurdle—

Mr PERRETT: Someone has to make that first car, correct?

Dr Tetlow: That's exactly right. And that's funded by NASA and it's funded by their department of defence. That's exactly what they do in Europe and in the United States, and it's what they need to do here. Then we'll be on a level playing field, but you can't say the playing field is level because it isn't.

ACTING CHAIR: We've only got two minutes left, so I'll give Mr Ramsey an opportunity to comment on the issues that you've raised.

Mr Ramsey: I'll keep it brief, because I know that was a large question. We view the Australian Space Agency as central to the civilian space element in country. We believe that they should be further emboldened and funded as a statutory authority to really start to represent the leading voice in the civilian side of government. Obviously, Defence will remain the defence voice in Australia. There are many case studies around the world as to how everyone else does it. In Australia, we've picked a very unique model around grants, which we're not seeing globally as a model. I would look to support the Space Agency in delivering better outcomes for the nation going forward.

ACTING CHAIR: Thank you for coming today. If you've been asked to provide any additional information, please forward it to the secretariat by Friday 26 March this year. You'll be sent a copy of the transcript of your evidence and will have an opportunity to request corrections to transcription errors. I thank you both. We really found your evidence very useful.

Proceedings suspended from 10:31 to 10:48

PRICE, Mr Richard, Chief Executive Officer, South Australian Space Industry Centre

ACTING CHAIR: Welcome. This hearing is a legal proceeding of the parliament. The giving of false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. The evidence given today will be recorded by Hansard and attracts parliamentary privilege. I'm the acting chair, but I'll hand over to the chair once he's had an opportunity to have a look at the paperwork. Mr Price, I invite you to make an opening statement and then we'll go to questions.

Mr Price: Thank you, Deputy Chair. South Australia has been actively investing in the space ecosystem since 2016 and, as a consequence, the state has supported the establishment of a significant ecosystem for Australia's space industry. The Australian Space Agency, the SmartSat Collaborative Research Centre, the South Australian Space Industry Centre, the Space Discovery Centre and Mission Control are the centrepiece of a South Australian space ecosystem that is conducive to sustained growth. Despite the impact of the COVID-19 pandemic, South Australia's space sector growth target projects an average annual growth rate of 5.8 per cent across the next decade, equating to \$250 million in revenue per year for our companies. From this strong starting position in new space, the South Australian government will continue contributing to the growth of the national space industry through increasing the nation's share of the global space economy.

The South Australian *Growth State* space sector strategy articulates a vision to create a thriving and enduring South Australian ecosystem, supporting Australia's national space strategy and building on the opportunities of new space. At the heart of this is the vision to locally design, manufacture, launch and operate small satellites to deliver actionable space-derived data for sovereign Australian missions requiring disruptive approaches to design and technology. But, with the global space sector economy's upward growth trend now being led by the private sector, Australia must unlock private investment to drive domestic space sector growth.

Critical considerations for customers and investors include the burden and delay imposed by local and international regulation, proof of revenue earning and supply chain risk appetite, of which proof of space flight heritage is critical. South Australia's SASAT1 project, the launch of a locally manufactured small satellite to low earth orbit, is an example of how we can effectively address some of these issues for local companies. But despite the state's—and the nation's—rapidly growing startup sector, it is yet to make significant inroads into global supply chains or deliver space-related infrastructure to scale. Space is gaining broader recognition as critical infrastructure for our nation, so we need to collaborate nationally to scale domestic companies with the capability and capacity to contribute to our sovereignty and position them to compete on international markets.

With a focus firmly on the vision for small satellite manufacture, the South Australian government is actively working with local and international industry partners to deliver a new and scalable domestic space manufacturing base and stimulate growth in localised space manufacturing. The consequence is a need to absorb new technology from international partners and combine it with Australian innovation, making local workforce critical—South Australians working in the education sector to create an interdisciplinary future space workforce to sustain and increase local manufacturing capability. The good news is that, unlike many industries, space excites and inspires people of all ages in ways most other manufacturers can only dream of. Australia's interest in space requires a whole-of-government space strategy that combines defence and civil space, including national and state objectives to create an ecosystem that supports industry growth. It is incumbent on us all to collaborate to optimise scarce resources for success and unify efforts. South Australia will continue to work closely with other jurisdictions and space stakeholders to deliver on opportunities, enhance resilience and provide sovereign capability for the future.

CHAIR (Mr Joyce): Thank you, Mr Price. We'll go straight to questions. Ms Bird.

Ms BIRD: Thank you, Chair. Mr Price, my background is in education, so I'm interested in the points you said your centre is working on in terms of workforce development. And we've had some great evidence from different companies about the balance between imported and local expertise and the emerging skills that'll have demand. I'd be interested in your comments more broadly about that aspect of your work.

Mr Price: In my observation, we have great capacity in Australia in what we call the CubeSat space—small satellites that are designed for a short use period. But, as you scale up, it becomes increasingly harder from a technology perspective. Our ambition is to manufacture 500-kilogram satellites in South Australia in about 10 years time. In order to do that, there will be some skills and expertise that we need to bring from our international partners to make it happen; it is not as easy as plugging extra cubes together. Clearly we have the capacity to do that. But, if you want to do it quickly, we need to make sure we don't make the mistakes others have made. And that's where appropriate partnerships and the transfer of knowledge are critical.

Ms BIRD: And it's been quite interesting to hear a number of the companies talk about the fact that there are Australians overseas who may have been overseas for a number of years because they went overseas to get work in the space sector and might have an interest in returning to Australia as our space sector expands. Are you working to reach out to people internationally?

Mr Price: We are. In fact, in my other role, which is defence industry, we're going through that activity as well because we face similar challenges to scale up. What we're looking for is people with experience who can mentor and support the growth of Australians here. We're not looking necessarily to get a large number of people. It's important to get the right people, the right skill sets. Some of those will be expats. Anecdotally, there are Australians coming home to work in the industry in South Australia—not least Enrico of course. So there is a trend and, I think, an opportunity post COVID to bring back people who may be re-evaluating their situation.

Ms BIRD: As I said to some of the earlier presenters, there's often a misconception in the general community that the space industry is all about what we would generally call boffins—people doing high level research or high level design. There is not a good understanding of the broader range of jobs and employment in the sector, including in the trades and in allied areas such as legal and so forth. I'd be interested in your experience and advice about those issues in South Australia.

Mr Price: As the small companies have grown—three of our companies have gone from fewer than 15 people to well over 50 or 60 people—they're starting to need to actually understand manufacturing techniques. So what we're seeing is a shift from R&D type activity to how we produce these things at scale in an efficient manner, what our workforce looks like, what technicians we need and how we sell this stuff on the global market. So there clearly is opportunity for a broad range of skills. But we still have some technical challenges to resolve, where we will need some boffins.

Ms BIRD: So what role do you see for government? We have these small, innovative companies. They're moving to become bigger and they're needing a broader workforce. If we don't prepare well for that, they won't be able to grow. They won't be able to get the expertise they need locally. There's a danger that they'll be bought out, taken overseas or whatever.

Mr Price: We now have significant investment going on in a lot of different places in the space sector. We obviously have projects going on in the research community—CSIRO's SmartSat CRC and those sorts of areas. We have lots of projects going on in defence. We have other projects that are being considered as part of critical infrastructure for the country. We need to somehow bring them together to get some scale. We need to create a competitive environment that's not winner-take-all but at the same time doesn't become fragmented so that there are 15 companies all vying for the same cake. The policy position needs to recognise that, at some point, there'll need to be some consolidation or we won't achieve scale.

CHAIR: Dr Allen.

Dr ALLEN: Thank you, Chair. My question follows on nicely from that. It's always a balance between free market and critical scale, particularly in an economy like Australia's. It seems to me that real commercial opportunities are opening up, married to the fact that the federal government wants to invest in defence and space capability; they are kind of a partnered approach. Where does the state-federal divide come into this? Often federalism is our greatest strength, but also it can be our greatest weakness. Could you speak to the layers of regulation—the buy-in ownership and strategic direction of these different layers of government and how we can do something to actually facilitate that. Obviously the Australian Space Agency has a central role in that, but could you describe where you would see a best-practice outcome for the nation?

Mr Price: Let's take the example of what we're doing with Southern Launch, which I believe has given evidence already. Obviously a lot of the regulation fits within the national arena, but some of it is state based, particularly around environmental aspects. We were obviously all new to this; nobody had been on this journey before. So we stood up a small task force, within the state government, of all the interested departments. We declared Southern Launch as a major project, which allowed us to set very hard time lines for decision-making—maybe not as quick as Southern Launch would have liked, but at least we were able to set time lines on that and drive that process through. We probably could have had a closer working relationship with the Space Agency while they were doing the same thing, because from a regulatory perspective our two environments intersect. Now we're actually beginning to work more closely to fix those sorts of border issues, if that's the right term. But it is difficult because it's the first time any of us have done this. The natural tendency is to see everything as a major risk instead of being an opportunity. We obviously have our regulatory role. I look at my job as creating an environment in which business can succeed. What does that mean we do as a state government? It means we work on identifying opportunities, particularly for small businesses, on the international market. We look at where can

we contribute, not necessarily investing in individual companies, but in the infrastructure or in capability and capacity. By that I mean investing in research programs such as the SmartSat CRC or investing in workforce and skilling initiatives, [inaudible] vocational training or education. That's where I see the role. Again, that element of education is locally state based.

Dr ALLEN: They are the opportunities. What are the barriers?

Mr Price: The barrier is speed. We just need to do things more quickly. Every time somebody says to me, 'It's going to take a month', I say, 'Why does it take a month?' You just have to unpick that. This is an incredibly fast moving market. We have an opportunity with a greenfield here to get inside the decision-making cycles of other jurisdictions and create competitive advantage. If we want to overcome our cost base we're going to have to be smarter and nimbler than our traditional competitors in this area.

Dr ALLEN: Is there a political mechanism where that would sort of smooth through the space agency having more agency or national cabinet or COAG having some sort of streamlined approval process that's in the national interest or something?

Mr Price: I think the trick to this, in my view, is saying if we can agree on what the vision for the national space economy is going to look like at another level of detail than just the raw targets, and we can get all of the people they're funding to buy into that vision—and defence is a big player in that—then I think they do need to work together. We can't get a sovereign defence capability without a strong civil industry. We won't bootstrap a strong civil industry without some of the funding that comes out of defence.

Ms SWANSON: We've taken evidence this morning that the Australian Space Agency is somewhat slow. I understand it's new, but the regulatory environment is glacially slow, which was identified as an impediment. I'd like your opinion on that. And I'd like you to speak to the interface between state and federal bodies. What is the main takeaway? For us as federal legislators how can we do this better?

Mr Price: I think the main takeaway is to adopt the process. It's not a one-size-fits-all process. The risk profile depends very much on the context in which you're taking an activity.

Ms SWANSON: Risk profile has come up many times today.

Mr Price: One of the challenges, and we face it ourselves to be honest, is what happens if a fishing boat is downrange of a launch? How do we stop that happening? Is it acceptable? We haven't resolved this yet. Is it acceptable simply to warn people to stay out of the area at this certain time? Is that going to be enough or are we going to be told, no, we've got to positively sweep the area and make sure nobody is in there? These are the sorts of challenging questions that need to be solved. They are not easy and they take time to work through. But once that's happened then we need to be much quicker, in my view, in how we process these applications. I don't want to quite use the term pattern approach, but it kind of needs to be a pattern approach. If somebody is launching the same sort of rocket from the same location there's no reason why that shouldn't be an approval in days as opposed to an approval over weeks.

Ms SWANSON: We've heard months and years this morning. Again, I'd like your thoughts on the Space Agency.

Mr Price: I think the Space Agency has gone through that kind of 'Stormin' Norman' phase. They've come in and been created, and they've done an amazing job of getting the message out there. Now they've got the staffing, I think, to actually turn the regulatory process into a much quicker one. It's fair to recognise that when we started on this journey, probably three years ago, or close to three years ago now, launch wasn't at the centre of it. Launch is now very much at the centre of it. So there has been a change in emphasis, and that obviously changes the shape the Space Agency needs to adopt.

CHAIR: The member for Moreton has ducked out, but I'll make sure I leave him five minutes to ask questions as well. You mentioned 5.8 per cent growth over the next decade. I'm stating the bleeding obvious: you're talking about five per cent per annum, aren't you?

Mr Price: Yes.

CHAIR: I want to know what your view is of the person who starts in this industry. How do they start? What sort of size do they have to be to kick off?

Mr Price: This is a big pipeline. I can give you an example. We run something called the Space Infrastructure Fund—

CHAIR: Could you give us some details on that, please.

Mr Price: Yes. In our partnership with the University of South Australia, we can take somewhere between five and 10 new-idea companies every year through a program that basically tests their business viability. As an

example, we have an international company coming here from Canada. They are moving into our ecosystem because they can see what's around. They've got a business idea to manage surveillance using high-altitude balloons—I won't go into details. But we're getting those sorts of companies coming to SA now to set up and get into our ecosystem. They are very small. They are at a very, very early stage. Some of them have moved through into an acceleration program, and they're getting early-stage investment. If you look at some of the other activities that we've done with companies like DEWC, who've launched a sensor into space, all of them are at a very early stage. That's something that the state government could work closely with. Then they hit the valley of death: how do they then scale? We've got a few examples that we've managed to get investments into, such as Myriota and Gilmour, but is there going to be enough investment around for the next wave—and, to be honest, are they all going to be deserving of that investment?

But I come back to: it's all about proof. If we're going to get international investment into these companies, we need to get them to the point where they can prove they can do something in space. If they don't get to that proof point, they won't be able to secure any significant investment.

CHAIR: Do you offer them finance or merely a venue or a regulatory process?

Mr Price: We don't invest directly in the companies. We invest in infrastructure that helps companies grow. We invest in the education. We invest in them through supporting—I don't want to call them trade missions—their participation in international space events and those sorts of things. Those are the areas we support, and we support them with some co-investment in research and development in those areas of growth.

CHAIR: 'Investment' is a general term. What sort of investment do you support them with?

Mr Price: If you look at the space industry fund, that's four million bucks over four years. If you look at some of the other initiatives, they are much more significant than that. Our investment in mission control, which is enabling space infrastructure, with the federal government, was \$2½ million. Our investment in SASAT1, which is a lot of South Australian companies coming together to build a satellite, is over \$6 million.

CHAIR: That's interesting. Adelaide's got a history of international companies coming here and building motorcars—but not a French company coming in to assist in the building of submarines! Have you got any Australian companies, which are 100 per cent Australian, coming in?

Mr Price: Do you mean moving into South Australia?

CHAIR: Yes. I just want to know what the seedbed is like. Is it the case that you've got to be a millionaire or have a large capital base to even consider starting?

Mr Price: No. We're seeing two different sorts of company, actually. We've got some companies who are taking what I'll call a more traditional trajectory. What they're doing is they are winning contracts to do work for DST Group or the CSIRO, and they are slowly growing their businesses. We're getting some other businesses that are using more of a venture capital model, where they're basically pumping an idea, getting some proof points and then going through the various stages of investment raising. We are seeing both. Within South Australia now, there are about 80 organisations involved in space. There are probably about seven or eight Australian owned companies in the state who've grown from that 10- to 15-people level to over 50 people during the last three or four years.

CHAIR: So it's basically a venture capital arrangement, where you want to take a punt that this company might take off. You drop your money in. If it takes off, you're going to be rich; if not, let's hope that it's money that you didn't care about losing—which is generally how venture capital works.

Mr Price: That's about half of it, I would say, and half of it is the more traditional grant-winning, slow-growth model.

CHAIR: The credentials of the people in that space—what are we looking at? When we're up in Canberra taking evidence, we see that they're senior academics who've gone into the space industry.

Ms BIRD: And former Defence, too.

CHAIR: Yes. Correct, Madam Deputy Chair.

Mr Price: It's relatively similar here. Some people spin out from DST Group in particular here.

CHAIR: Could you expand the acronym, please.

Mr Price: Sorry. Defence Science and Technology Group. They spin out their businesses from that. We are seeing some academics, but we're also seeing a few people who are engineers, who haven't actually worked in those organisations, who have come straight out of university and are trying to create businesses.

CHAIR: I imagine you launch these things at Woomera or—where?

Mr Price: No, we don't have any launch at the moment, which is why we're working with Southern Launch and Equatorial Launch as well.

CHAIR: So it's basically—

Mr Price: Overseas launch.

CHAIR: theory that you're doing here, and overseas launch?

Mr Price: Yes. There are at least three South Australian companies who have launched satellites.

CHAIR: But they've launched them in equatorial Africa or—

Mr Price: They launch them overseas, either in India or the United States.

CHAIR: Why can't we launch them here?

Mr Price: We can launch them here, but we need to get to the point where the regulatory environment is sorted out and enough capital has been raised to establish those launch sites. We have some geographical advantages.

CHAIR: Could you give me a quick insight into what the regulatory imposts are.

Mr Price: There is a significant cost impost proposed at the moment on small companies to launch. The precise number escapes me, but it's several hundred thousand dollars per launch, which can be prohibitive.

CHAIR: That's regulatory cost?

Mr Price: Regulatory cost.

Ms BIRD: We did have evidence before that there's a proposed cost-recovery model.

Mr Price: Yes.

Ms BIRD: I think they calculated that it costs about \$189,000—and it costs \$60 in New Zealand.

Unidentified speaker: And nothing in America.

CHAIR: I'll ask the bleeding obvious question: why can't we get rid of that?

Mr Price: That's a question I'm not in a position to answer, I'm afraid. It's not a state cost.

CHAIR: Where does the money go when they pay their \$180,000? Who collects it?

Mr Price: I don't know whether it goes into general revenue or—

CHAIR: Where will it go?

Mr Price: I don't know.

Ms BIRD: It's a federal Treasury cost-recovery model.

CHAIR: So it's a federal cost?

Mr Price: Yes.

CHAIR: That's what I need to know, in case we want a recommendation to say we should reduce that. We can't say we want a space industry when New Zealand is charging \$60, America charges nothing and we charge \$180,000. There is a bit of a strategic advantage for New Zealand! I have a lot more questions, but I'll go to the member for Moreton.

Mr PERRETT: I was wondering what international partners you see the South Australian space industry linking up with. I'm particularly interested in perhaps the non-traditional space, such as Vietnam, Thailand, the ASEAN area, and also if there are any connections with the Pacific countries, in terms of opportunities that might be there, with Australia having such a lead in that area and with other countries trying to usurp that lead.

Mr Price: For some of our smaller companies that are starting up, or actually they're getting beyond small now—

Mr PERRETT: Are you speaking for the 80 in South Australia or more generally?

Mr Price: Yes, for South Australia. Then for the companies, like Myriota and Fleet, who already are offering services on the global market, there is tremendous opportunity in the region to provide those. They are all looking at establishing constellations of satellites that will enable them to provide global coverage, not just coverage for Australia. That is where they're putting most of their capital raising effort at the moment. That's clearly one area. And then, even though you said 'non-traditional', there are some traditional relationships, say with Japan, that I think we really should work very hard on. Japan has a very strong old space industry; they don't have a particularly strong new space industry at the moment. They're reaching out to look to opportunities to collaborate.

Bizarrely enough, in our strategy, we have actually been talking to Japan about food manufacturing on Mars. In the Moon to Mars mission, one of the strengths of Australia is the ability to grow crops in very trying conditions. Japan has been interested in providing habitation modules to the Moon to Mars mission. And so our universities are working with them to try and establish a Mars analogue where we can actually prove those technologies. Of course, the benefit for Australia is all of that technology has here-and-now applications on closed-cycle food production.

Ms BIRD: We've had quite a bit of evidence on this, so I'm interested to hear your perspective. We've got the Australian Space Agency. There were some conversations in earlier hearings we had around whether there's a role for Infrastructure Australia. You've said we moved from what was obviously a focus on developing and manufacturing what was in space—that is, satellites and so forth—towards launch capacity. There's a shifting push towards launch capacity. Normally when there's infrastructure, whether there's public good infrastructure or public private partnerships, there's a role for a body like Infrastructure Australia.

Mr Price: I think, given that we are looking at relatively small launches, the actual establishment of the infrastructure is relatively straightforward. The more challenging question is: what is the right business model for these launch sites to survive? I don't think anybody has the appetite for a government owned facility. Therefore, we kind of need some sort of model that recognises that the government is a stakeholder in this, but, at the same time, it needs to generate a significant amount of private revenue to sustain it. I suspect a lot of the challenges for these companies are actually going to be in establishing what is a viable operating model for this.

Ms BIRD: We do have models operating things like train transport for the mining industry and things like that, where we've identified this need for infrastructure and a role for government, but it's actually a business model operation.

Mr Price: I would argue, with my very parochial South Australian hat on here, that if we establish a polar launch site in South Australia and it gets up and running, really we need to say, 'That decision has been made and gone so the polar launch is going to be done from that launch site,' not allowing fragmentation. Fragmentation will be unsustainable. The same will happen with an equatorial launch. We can't afford to duplicate that kind of infrastructure unnecessarily.

The other point I'd make about infrastructure—and this is a very long thread to pull, so we probably won't have time—is about the role of space as critical infrastructure—that is, the satellites themselves. What do we need as a nation to regard it as critical infrastructure and what does that mean? What does it mean not only when things are working but when things don't work? I think that, in the current environment, that is a critical question for us to answer. I think that if we look at it narrowly as a defence problem we'll miss an opportunity and we'll also not deal with the real threats to that infrastructure.

Ms BIRD: Well, we have seen the impact of a major social media player deciding to impact on how a whole lot of Australians live their lives and organisations operate. So, as you say, we're so much more reliant to satellite-based information.

Dr ALLEN: I have a follow-up question with regard to our sovereign capability and our sovereign point of difference or competitive advantage. We heard from previous witnesses that the latitude where we are at—the southern part of the continent, quite close to a pole, so to speak—means that the sun sinking polar trajectories are growing very rapidly, particularly to have whole-of-planet coverage with regard to these new satellites that are going up. Could you speak to that competitive advantage and whether it's a faster growth opportunity than some of the other opportunities and whether that puts us in a better position? Obviously, the UK, New Zealand and Brazil were mentioned as other competitors, but other places closer to the equator are looking to different markets, potentially.

Mr Price: The reality is for the southern coast of Australia not only is the geography in our favour but so is the weather and the sparse population, which is relatively unique. Of course, being a stable country as well is incredibly important. Those are really major comparative advantages for us as a launch destination.

I'll be honest, I wasn't sold on launch when we first went on this journey, but I came to realise that, if we don't have a solid launch base, we're not going to have any business case that makes sense to manufacture satellites in volume. Why would anybody manufacture satellites thousands of kilometres away from their launch site? It doesn't make any sense whatsoever. So, if we want to unlock a manufacturing base here for satellites, we naturally need to launch them here, if we want to do it in volume. That connection is critical. For us as a state, we've been very clear: we need to have launch infrastructure. That will then unlock companies such as Fleet, such as Inovor being able to manufacture at scale. That will then make them sustainable and allow them to export. If we don't have that whole chain connected, we're not going to be able to stand up the industry.

Dr ALLEN: And the point about solar launch, is there better growth in that as well? Aside from the fact we need to link launch to manufacturing.

Mr Price: There are various missions where that is an incredible advantage. You can look at the same spot on the earth at the same time every day from the same angle, which means you can actually do comparative analysis that says: 'This is what this field looked like today. The next day it looks like this. The next day it looks like that.' So that particular orbit allows you to do things.

The other thing people are getting hooked on is they say the markets are gone because Amazon is launching 10,000 satellites or whatever the number is. To your point earlier, yes, that's not infrastructure we own, but those satellites will fail at different rates. The first time you deploy a big constellation, you can literally drive the bus through space and chuck satellites out. But what happens when one fails? If you need to replace it, you can't replace it with that approach. You need a precision launch to put a particular satellite in that position to replace it. So, when we get further downstream onto maintenance, some of the smaller launches will become more important.

CHAIR: Thank you for coming in today. If you have been asked to provide any additional information, please forward it to the secretariat by Friday 26 March 2021. You'll be sent a copy of the transcript of your evidence and will have the opportunity to request corrections to any transcriptional errors. Thank you very much, Mr Price.

Mr Price: A pleasure.

OPIE, Mr Matthew, Director, Defence and Space, University of South Australia

[11:24]

CHAIR: I now welcome the representative of the University of South Australia to give evidence today. This hearing is a legal proceeding of the parliament. The giving of false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. The evidence given today will be recorded by Hansard and attracts parliamentary privilege. I now invite you to make a brief opening statement, Mr Opie.

Mr Opie: Thank you, Chair. It is my and the University of South Australia's view that a successful space industry in Australia needs a broad ecosystem. That ecosystem would include a range of international companies and partners mixed with local industry, local and international funding mechanisms and an ecosystem to support the development of a sovereign industrial capability. This cannot be done by research funding or isolated funding alone. It needs to be a broad base.

I draw some comparisons with the defence industry, which enjoys significant acquisition projects and significant research funds, resulting in a sovereign industrial capability in certain areas for defence. We need support for start-ups so they can bridge their start-up profitability gap and commercialisation pathways to turn those smart ideas into product and profit. We need funded research, but that needs to be underpinned by those large acquisition and infrastructure projects. We need a resourcing, skills, training and jobs plan, including addressing difficulties with STEM skills and STEM training that have been historical. You can improve a STEM pipeline, but you need jobs at the end of that pipeline for those people to be employed within that industry and that needs to address things like gender imbalance. Females still make up as little as 10 to 15 per cent of STEM courses.

I referred to the defence industry, but I do highlight that they have quite different industries in Australia. Defence industry has perhaps five or 10 large primes or overseas companies present in Australia, a handful of medium companies, hundreds and hundreds of small companies and hundreds of start-ups and scale-ups, whereas the space sector is much more narrow. You're probably lucky if you can find one true prime in Australia. There are very, very few mediums and then thousands of start-ups and scale ups. There are different ways that I think the space industry needs to be developed but similar when comparing to the defence industry.

There are many things we can learn from the defence industry, things like Australian industry capability, developing that sovereign industrial capability so in 20 years we have a healthy and sizeable space industry in Australia. But you also need those large acquisition and research projects to underpin that and you need diversification. Very few small defence companies in Australia operate solely in the defence industry. Most of them have adjacent industries. My view is space would be very similar.

I also think the estimates of 20,000 jobs are optimistic. There have been estimates thrown around of about 20,000 jobs in the space sector. A simple comparison with defence: over a decade the current forecasts are the creation of about 5,000 jobs, but that's on the back of \$200 billion in acquisition and \$2 billion in research. So the 20,000 doesn't quite stack up because there isn't \$800 billion in acquisition and \$8 billion in research. Thank you.

CHAIR: Thank you very much, Mr Opie. Madam Deputy Chair?

Ms BIRD: Thank you, Chair. You made that point about the gap between 'we do good research and so forth', and then people spin-off with a great idea for a product or business or whatever. It's not only the space industry. That valley of death happens across many, many industries. What are the best models that you have seen that actually work to bridge that gap?

Mr Opie: One of the best models actually resides in uni SA. We have an Innovation and Collaboration Centre and within that centre we run space incubator programs. We take on start-ups and scale-ups. These are often one or two person companies with little or no income. We take them through—it's almost a graduate program or a training program that has a number of aims to support them in understanding the ecosystem. We've done this with some smaller defence companies as well. We aim to support them in understanding the ecosystem in Australia and give them some of those business skills that they might lack. Most of them have entrepreneurial skills, but some of them might lack basic project management or accounting or finance or legal or commercial skills. So we take them through a training program. We have a resident entrepreneur to support that and also resident experts that we use as mentors to bring those companies through the program.

Another model would be the Defence Teaming Centre—again, an analogy with the defence industry. I'm a former voluntary board member of the Defence Teaming Centre. They have about 300 member companies in Australia. Most of them would be small to medium enterprises, and they run a range of training and education programs for their member companies. That might be going to a trade show. It might be how to pitch your

product in a meeting. It might be defence industry for beginners. I think the Space Industry Association may run similar activities, but they're good examples of how we can grow those smaller companies.

Ms BIRD: I'm interested in that one because we did have some evidence at a previous hearing. And, Chair, I think you raised this issue with a number of people. How do we get our broader manufacturing base involved? There are people who may be manufacturing for other sectors across the board—electronic companies, specialist welders, all sorts of people. They may actually have opportunities in the space sector but have absolutely no idea how to connect into it and be involved.

Mr Opie: There's also the federal government's Centre for Defence Industry Capability. One of their roles is to do just that: educate companies in how to do business with Defence. Some current policies, like the Australian Industry Capability Policy, aim for a certain amount of Australian content on any Defence project. On a previous project, Land 400 Phase 2, which is the combat reconnaissance vehicles, which I was working for in industry at the time, we did a national roadshow to talk to companies about how they can be involved in our supply chain. That has many benefits. Of course, it meets the companies—

Ms BIRD: Just explain to me the reality. When you say 'national road show', how do you know who and where to go and see?

Mr Opie: We got support from Industry Division and the Department of Defence. They put out an open call. There probably could have been more vetting than there was; we got way too many companies who were not relevant to our purpose. I probably should say that this is my experience from working in industry rather than UniSA. But, because that was our job, we generally knew who was out there; it's a relatively small industry in Australia.

Ms BIRD: That is exactly the thing that struck me the last time we had this conversation: federal departments often do things from a very national perspective. They put a call out, and business in my area—and, I'm sure, businesses in my colleagues' areas—come out and say there's a whole existing network of manufacturing businesses who meet regularly and do all sorts of things. At the federal level, we're not very good at tapping into what already exists. In my area we have i3net, which is a manufacturing industry group. So when you say 'vetting', I imagine you would come and talk to them and give them information that would then allow local businesses who are connected to that to go, 'Actually, that would match us.'

Mr Opie: When I was in industry and in my current job at the university—we do engage with industry groups. I mentioned the Defence Teaming Centre. UniSA is a member. There is AI Group and the Advanced Manufacturing Growth Centre. We talk to a lot of those organisations. One of my roles is to coordinate defence research within the university. I keep saying that the ultimate aim there is to deliver capability to the Australian Defence Force. To do that, we need a couple of things. We need research, but we also need the small, smart ideas from small to medium companies. But then you also need the capacity from the primes in order to be able to produce something or commercialise it or understand a bit better how Defence is going to use it. So the dream team on a research project, if you like, is often a prime, a university and an SME—to bring those three capabilities to the team. So we engage with industry a lot to try to understand who we're talking to.

Dr ALLEN: Mr Opie, thank you very much for your submission. I'm interested in the global talent visa, and it's designed to support employees and not employers. As such early stage founders, we're not yet generating salary, which is the case for almost all founders; they are limited in how they can establish operations in Australia. This situation inhibits the ability of the Australian space industry to grow the space sector. From which particular nation do you think we should be importing new startup companies or employers, so to speak, and what can we do to facilitate that?

Mr Opie: My submission did not mention the talent visa.

Dr ALLEN: Am I looking at the wrong submission?

Mr Opie: That is my submission—with the blue cover.

Dr ALLEN: It says 'Matt Opie'; I'm reading directly above your name.

Mr Opie: I beg your pardon, you're correct. That data was provided by a colleague of mine. So, yes, it is part of my submission. I didn't write it, but I can talk to it. Are you talking about skills or education or research?

Dr ALLEN: I'm a university professor. When I was working in Manchester it was about to be rolled out—three or four years ago. There was a sort of race for some of the STEM capabilities in India in particular. So I was wondering whether you could speak to where the areas of expertise across the world for space are.

Mr Opie: It's the usual suspects. We've recently signed the UK-Australia Space Bridge. We've also recently signed an alliance with India. And I'm not sure what formally exists, but the Australian American Chamber of

Commerce has just created a space committee of a dozen national people to develop those links with the US. I think it'll happen on a couple of fronts. There are a couple of Indian defence companies represented in Australia but, to my knowledge, no Indian space companies. It'll come via companies. In the US example, that is companies like Lockheed Martin or Raytheon—typically the US defence primes that operate in the space sector. They will bid space work in Australia and they can resource that work in a couple of ways: recruit locally or perform some technology transfer from the US and bring some people out.

Another way will be through education. That's foreign students through a university and also postgraduate studies—bringing PhDs or postdocs out to Australia to perform relevant research. Of course, that would include countries like India and China, from which a lot of our current students come. We're already seeing, on the back of Naval Group and the submarine contract, small growth in French companies in South Australia. There have been a couple of small acquisitions. That's mainly in the defence sector. One, for example, was a mechanical engineering drafting company, a local company acquired by a French company. So there might be opportunities there, but, in the immediate term, they're focused on submarines rather than space thinking.

Dr ALLEN: My question pertains to the skills deficit. What I felt was being articulated was perhaps some entrepreneurial startup deficit. We've got big companies that are kind of government supported. We have a lot of tiny startup companies. We don't have many that have gone through that 'valley of debt' to the SME level. Often that entrepreneurial spirit can be inherited when there's a lot of skill sets in other countries. Because you didn't write that section, perhaps we could come back up the pipeline and go to the research and development aspect: is there a part of the university sector where we have a skills deficit academically? Where I come from, which is medical research, there's a real skills deficit in, for instance, health economics. We can never find health economists; they're as rare as hen's teeth. So where is the skills deficit in R&D in space, particularly in Australia?

Mr Opie: I will turn your question around, if you don't mind: we're typically focusing on our strengths. The SmartSat CRC is a good example of that. Member companies and UniSA are strong in satellite communications. We do work in artificial intelligence and data analytics. But then if you look at launch, for example, my university is not strong in launch or propulsion. I'm not familiar with those strengths elsewhere. So that could be a gap. But I'm not really aware of what other universities are good or bad at. Our strategy is to focus on our strengths rather than trying to fill gaps, because that's pretty hard. In propulsion, for example, it would be hard to develop a capability from scratch.

Dr ALLEN: Would it be worthwhile having a mapping exercise looking across our universities and higher education bodies to understand where the commercial opportunity is and where the R&D is—either at CSIRO or the higher education bodies—with regard to mapping our potential capability requirements as commercial opportunities arise?

Mr Opie: Definitely. And I'd expand that to include a jobs analysis as well, similar to what the Naval Shipbuilding College has done recently to look at what the demand is from industry and projects, what the jobs are and what the pipeline is doing.

Mr PERRETT: Mr Opie, could you tell me a bit more about the Southern Hemisphere Space Studies program?

Mr Opie: That's a program that we run in conjunction with the International Space University, which is based in Strasbourg, France. We run their Southern Hemisphere Space Studies Program. It's a residential program—or it normally is. It's run in January and February of each year. We get about 30 or 40 participants from about 20 countries around the world.

Mr PERRETT: Could you rewind. Why Strasbourg? Is that the European Space Agency—

Mr Opie: That's just where the International Space University has its home.

Mr PERRETT: It's not a Cape Canaveral or anything like that?

Mr Opie: I don't know its heritage. The program is about two months long. The students are typically professionals from the space industry, so they come with a base level of knowledge or expertise. It's not necessarily technical in nature. It's more a generalist course that looks at the whole breadth of space studies.

Mr PERRETT: What do we value add for those students and what do they value add to this nation, apart from buying a bit of South Australian wine and the like when they're down here?

Mr Opie: It's an export. There's a cost to doing the course. So there's value in that. It's good for profile. It gets UniSA and also South Australia and Australia on the ISU's map. We have a program director that runs it. He's come to us from University College London. He's now a resident and employee of UniSA.

Mr PERRETT: Are they undergraduates?

Mr Opie: No. It's postgraduate essentially.

Mr PERRETT: Is it an academic course?

Mr Opie: It's more along the lines of a workforce professional development course than an academic course.

Mr PERRETT: Is that in connection with the University of Adelaide?

Mr Opie: No. It's run by UniSA.

Mr PERRETT: Is there any educational collaboration with the other South Australian education providers, or are they the sworn enemy? They're coming next, so be careful!

Mr Opie: There's more collaboration than competition; the word's 'coopetition', I think! Our researchers collaborate with Adelaide University and Flinders University every day. In fact, the state government runs a really good program called Defence Innovation Partnership, which is partly funded by Defence Science Technology Group and partly funded by the universities, where a mandatory criterion to get research is that you must have a collaboration partner from one of the other universities.

Mr PERRETT: You were saying earlier that you don't know much about launch. So you stick to your own knitting and let someone else work in that area?

Mr Opie: Yes.

Ms SWANSON: I want to go to one of the questions in relation to legal frameworks and regulations. We've heard from other industry witnesses about that today. Do you have any additional comments you'd like to make on how we as legislators, and the recommendations of this committee, might move forward to make the ecosystem or the framework—whatever language you want to wrap around it—better?

Mr Opie: Yes. Given the complex nature of the space sector in terms of technology, there's a big barrier between being having a smart idea, being a startup and actually doing something—whether it be putting a payload on a satellite, running your software on a satellite, launch or recovery. They're all easy to do in a lab, but to do those somewhere out of a lab becomes technically and legally very difficult. So you might consider allowing a bit of a sandpit, a bit of an R&D skunkworks to enable companies to perform some of that more advanced research and prototyping, because without income it's very hard for them to do. They often need more capacity or a partner to help them get through some of those steps. I'd suggest perhaps we need an enabler to enable those companies to get to the next step.

Ms SWANSON: Do you think Defence has got a role to play in that?

Mr Opie: It's an interesting question. I sort of straddle both sectors, and it's an interesting dynamic, because the defence sector at large like to see themselves very closely linked to the space sector. Again, in my experience, the space sector doesn't quite share that keenness to be closely linked, often for philosophical reasons. But, given the high technology that we have in Australia, the fact that Defence Science Technology Group does have space as one as its so-called star shots that it wants to research, I think, yes, Defence does have a role to play. It's got the capacity, it's got the research funding and it's highly relevant to what Defence in space does.

CHAIR: Mr Opie, you said something there that I think is so pertinent. As we go through this inquiry, what I find is—it's the thing that frustrates me. You said 'to get it out of the lab'. I think that's the whole point. We know the Canadians are out of the lab. The United States have been out of the lab for a long while. The British are out of the lab, and the French are out of the lab, and the Russians are certainly out of the lab. But we sort of still seem to be in a majority sense in a theoretical position. I suppose one of the key markers for being out of the lab is when we have the hardware that is actually going into space from Australia. How far away are we from that? You talked about there being technical reasons and, I think, legal reasons. I'm asking you two questions. We also find there are regulatory reasons. We've got an inquiry into getting the space industry going. We need to know what those technical issues are that we need to address or remove. What are the legal issues? We've got all this theoretical stuff. Well, there's one place, and that's legislation, we've got to deal with. The regulatory issues just are a complete impose. So we start with: how do we actually get something from Australia out of the lab and into space so we can go, 'That's Australian,' rather than, 'That's Canadian'?

Mr Opie: In some ways we're already doing it, with companies like Myriota and their software, which is already on satellite platforms. But there are limited examples of that happening.

CHAIR: Myriota is part thereof; it's like, 'I've got a screw in that satellite, therefore it's an Australian satellite.' No, mate, it's a screw in someone else's satellite.

Mr Opie: One answer is we don't have to own the satellite or own everything in it, because that would take longer. So one answer is that we don't worry about that and we just collaborate with other countries and

companies, so it's a team effort. You have an Optus satellite that's owned by Singapore, in essence, with a defence transponder and some other technology and software on it that comes from Australian capability.

To answer your question more directly, it's one of capacity and funding to get those companies that are at that sort of profitability canyon, if you like, of: what next? To do 'what next?' they need to play with stuff, they need to trial, they need to prototype and they need to team with other Australian companies. I think that's the point where perhaps that challenge is.

CHAIR: It sounds like it's a long way down the track. Obviously that's a negative statement. What we need to know is how we bring it closer to where we are. Using the example, as you have of the Optus satellite, the rocket that took it into space certainly wasn't Australian; the ownership is Singaporean, and the actual construction of the satellite wasn't here. So that's a classic example of the problem we've got. We say, 'That's an Australian satellite,' but it's not really. It wasn't built here. It's not even owned by us.

Mr Opie: We lease a transponder.

CHAIR: We lease a transponder off it. That's something a real estate agent could do. How do we get this space industry in South Australia to a point where you say overwhelmingly that technology is Australian, even the rocket that gets it up into orbit, or is it just beyond our grasp? Is it like saying, 'Yeah, that's a dream, and it isn't going to happen'?

Mr Opie: I think it can happen. What would help, perhaps, is almost an industry cluster approach. The state government is doing some in this regard. Apart from, say, SmartSat CRC, which is based here, where companies are encouraged to collaborate, all of those companies—and we mentioned Myriota—everyday they're going to work to make stuff to sell it. So they'll have some collaborators. But there's no real imperative for them to collaborate with other Australian other companies to do something bigger and better. Then you've got another hundred like them.

CHAIR: Is the CRC thing one of the things that's addressing the technical issues that you brought up?

Mr Opie: Yes.

CHAIR: Can you now elaborate on the legal issues?

Mr Opie: That was more in terms of access to launch—the ability to launch something into the sky.

CHAIR: Are they international issues or Australian issues?

Mr Opie: I'm not quite sure. I think it's probably more Australian.

CHAIR: You said there were technical issues and legal issues when you're talking about out-of-the-lab issues. I'm just fleshing it out. We're politicians of some years, so, if you start talking about how legal issues are an inhibitor—what are they?

Mr Opie: The fact that it's illegal to take a rocket that you've made in your shed and trial it somewhere. I'm probably not advocating that, but, again, if it's a company that's done some proper prototyping and is ready to launch, it's just really hard for them. It's more legislatively than legal, I guess.

CHAIR: I get that. Obviously you can't just be flying planes, so you can't just be launching rockets. It's slightly dangerous! But are they excessive legal issues? Are we beyond where other nations are on legal issues?

Ms BIRD: We do have the law council coming up next.

CHAIR: Okay.

Mr Opie: I might leave that one for them, if that's okay.

CHAIR: Basically, in summary—correct me if I'm wrong, so I'm not verballing you—you'd say that the space industry in Australia is going to be one where we're sections of componentry of other people's satellites. That's basically where we're going to be.

Mr Opie: No, I'd characterise it a bit differently. We can be expert in certain areas without necessarily having full launch capabilities for every level or tier of satellite. I don't think that will happen.

Ms BIRD: I think we already have Australian made and built satellites in orbit that have been launched.

Mr Opie: I guess my view is we're never going to be as big as NASA. So, instead of having just a smaller version of NASA, let's be deep and expert in certain areas, like smart satellite technology, for example, or earth observation or data analytics, rather than necessarily launching satellites. They can run a million prototypes and see how it works and behaves. Then they can 3D print it. Then they can go and play with it. Then they can do it all over again. That sort of lab is a good example of how to generate that trial and error where the cost of that would be beyond a start-up.

Ms BIRD: It's a similar thing to when we went to the testing facility at ANU. ANU has a testing facility for satellites and so forth. Is that the sort of infrastructure you're talking about to support that getting out of the sandpit?

Mr Opie: Yes.

CHAIR: How far away do you think it is in Australia? What you're doing at the University of South Australia is great, but none of that has actually become the substantial part of what sits on top of the rocket. How far away do you think that is for Australia?

Mr Opie: You could do that within five years. You need the skills and the manufacturing. You could do that within fewer than five years.

CHAIR: The University of Queensland developed scram jets, which was incredible technology, world-leading technology. Do you think we would ever be developing the actual unit, the rocket unit itself or the thruster?

Mr Opie: Again, I'm not familiar enough with the research being done at the universities to answer that question with any knowledge, sorry.

CHAIR: Thank you for coming in today. If you've been asked to provide any additional information, please forward to the secretariat by Friday 26 of March 2021. You'll be sent a copy of the transcript of your evidence and will have the opportunity to request corrections to transcription errors. Thank you very much, Mr Opie. We really appreciate your attendance here today.

de Zwart, Professor Melissa, Dean of Law, University of Adelaide

LISK, Mr Joel, Director, Space Law Council of Australia and New Zealand Limited

[11:57]

CHAIR: Welcome. This hearing is a legal proceeding in the parliament. The giving a false or misleading evidence in a serious matter may be regarded as contempt of parliament. The evidence given today will be recorded by Hansard and attracts parliamentary privilege. Do you have any comments to make on the capacity in which you appear?

Prof. de Zwart: I'm also researcher and teacher of space law at the University of Adelaide. I am also the deputy chair of the Space Industry Association of Australia, although not appearing in that capacity today.

Mr Lisk: I'm also a PhD candidate and researcher in commercial space regulation at the Adelaide Law School.

CHAIR: I now invite you both to make a brief opening statement before we proceed to members' questions.

Prof. de Zwart: Thank you very much. My background is in commercialisation of technology. Prior to becoming an academic I was the manager of the in-house legal department at CSIRO so I have a very passionate commitment to commercialisation of Australian technology. My concern is that jobs and opportunities will go elsewhere unless we get the regulatory environment for the commercial space industry in Australia correct. I think that those jobs are ones that are highly desirable—ones in rural areas, skilled jobs for young people, STEM, but also in related industries such as my own.

I have three points I want to focus on today. Firstly, we need clarity and simplicity in the legal framework. Secondly, we need clarity and simplicity in the role and the activity of the regulator. Thirdly, we need recognition of the importance of sovereign capability in the space domain in Australia. On the first point, clear and simple regulation is required to encourage investment in our nascent space industry. When I say nascent, I do acknowledge the fact that we have been players in the space industry since the dawn of the space industry. We've been members of UN COPUOS since before it became a permanent committee of the UN. We had significant expertise at Woomera.

I note that one of the objects of the Space (Launches and Returns) Act is:

(b) to ensure that a reasonable balance is achieved between:

(i) the removal of barriers to participation in space activities and the encouragement of innovation and entrepreneurship in the space industry; and

(ii) the safety of space activities, and the risk of damage to persons or property as a result of space activities, regulated by this Act.

I'm concerned, however, that the balance in those objects has been distorted to one end of that spectrum. Put simply, my belief is that the regulation as it is currently drafted is too complex. My experience from my industry friends is that it is vastly expensive to comply with the requirements, such as the need for expert assessment. There are delays in getting launch licences, delays with the review process and loss of contracts offshore.

I am a strong supporter of the Australian Space Agency. As a member of the Space Industry Association of Australia and a participant in the IAC, in 2017 we lobbied hard for the establishment of a space agency, so I do strongly support it but I believe that it has not been sufficiently funded or supported with experts and with funding. At the moment it seems to be preoccupied with the promotion of space science and it really needs to dedicate greater resources to performing the role of industry supporter.

The regulation of industry really requires mature and well-resourced industry experts, which can lead onto, as I've said, skilled jobs. I also firmly believe that we should be a full spectrum space industry. I believe that we should have sovereign capability and we won't have sovereign capability without us becoming a full spectrum space industry, and that means from launch right through to cybersecurity of satellites. We've proven that we're capable of it previously and we need to maintain the wherewithal and the will to follow that through. I believe that this full spectrum space industry and sovereign capability can only be developed with effective and meaningful support from government and that means effective regulation. I think we are facing the risk of loss of expertise overseas. I think we can do things that can change the levers to bring that industry to a much more successful fulfilment here in Australia.

Mr Lisk: The Space Law Council of Australia and New Zealand is both the forum for those interested in space law and policy issues and a charitable entity dedicated to raising awareness and knowledge of space law issues here in Australia and New Zealand, while also advocating for the reform of laws related to outer space when such reform is necessary. At present the Space Law Council has approximately 150 participants across

Australia and New Zealand from a range of sectors including legal practitioners, academics, industry representatives and students.

In our written submission to this inquiry we made four principal submissions. Firstly, that there is a need for broader recognition, acceptance and promotion of the role of space industry related and space industry adjacent sectors such as the legal, finance and business advisory sectors. Secondly, that there should be continued focus and support for small to medium businesses in the space and research and development sectors. Thirdly, the Australian government should continue to further develop and refine and support the Australian Space Agency's role as the industry regulator and promoter. Finally, the Australian government should instigate the reform and continued evolution of the legal frameworks applicable to the space industry at both the domestic and the international level.

Without taking away from the remainder of our written submission, we wanted to take the opportunity to emphasise two of the principal submissions we had. Firstly, and as a number of other entities have submitted to this committee, there is a need for Australia to take an industry focused and comprehensive approach to regulating the space sector. The 2018 amendments to the Space Activities Act were far from the wholesale reform the industry was seeking. Between now and then our peers in the United States, New Zealand and the UK have all undertaken industry focused and substantial reviews of their legal frameworks to make them more future focused and sector friendly, while also retaining appropriate risk-based protections. With respect, without action, Australia's Space (Launches and Returns) Act risks not being reflective of the future requirements of the space sector and may stifle the development of a local space sector rather than support its growth.

Secondly, evidence shows the SMEs will drive Australia's incursion into the global space industry. The Australian government should be taking steps to ensure that these entities are supported with a low-cost environment to operate in and minimal regulatory burdens and barriers to enable rapid and efficient access to both Australian and global markets. This can be done with appropriately targeted regulatory reforms to ensure that laws are performance based and outcomes based as opposed to being prescriptive. We can also do this by providing tax incentives to both SMEs and their investors, delaying the imposition of launch licencing fees and removing barriers to the entry into government markets. The space law council looks forward to reading this committee's outcome and its work to further nurture the development of Australia's space sector, a sector that would benefit all Australians, either directly or indirectly, into the future.

CHAIR: Thank you. I might jump in first this time. With regard to the spectrum space industry, leading on from the previous witness, how do we go from here to that full spectrum space industry? Maybe my colleagues have a different view, but it seems that we are developing componentry parts of a satellite, creating the venue for other countries to come in and do some work in that space, but we're not actually building satellites or the rocket or other delivery that takes it into space.

Prof. de Zwart: I—

CHAIR: You'll get a chance to be a witness, if you want—just hold on. What do we need to do, Professor?

Prof. de Zwart: I think we are already doing a lot of those things. They're just not recognised or encouraged. Look at operations like Inovor, which is building the CubeSats; Gilmour Space, which is developing radical new launch technology; Southern Launch, which is developing launch sites; and Neumann Space, which is looking at new fuel and so much more. We do have a full spectrum of capability and talent, but it is dispersed and it's very difficult for them to move from the hobbyist angle to really ramping that right up. Gilmour Space are particularly keen to push the view that we do more than just build the components. They want to build the full thing. The regulatory environment has to make it possible for that to happen.

CHAIR: Right. This regulatory environment is obviously a bit of a carbuncle on it. Give me an example of one of those regulations, if you can. We have this regulation, which they don't have in New Zealand; or, we have that regulation, which they don't have in the United States. This becomes an impediment to getting those disparate groups to come together in such a form. They're actually completing the majority of the componentry of a satellite that goes into space. Have we created a problem for ourselves that we can actually fix ourselves? Has it got nothing to do with our capabilities but everything to do with the regulations that we've set up?

Prof. de Zwart: Absolutely.

CHAIR: Good. What are they?

Prof. de Zwart: I think we absolutely have the capabilities already there. I think the best model we can look at is the New Zealand example. They made a decision that they wanted to have a space industry. Now, of course, they partnered with a US based company to make that happen, but, once they made the decision that they were

going to do launches from New Zealand, it happened quickly. The legislation was put through. Agreements were put in place. We're still talking about putting in place appropriate ITAR type arrangements with the US.

CHAIR: Can you expand that acronym please?

Prof. de Zwart: The International Traffic in Arms Regulations. It's got to do with sensitive technology. Anything that is space technology can be weaponised. It's inherently dual use. A rocket is a weapon. So, in order to get access to do business with US companies, there are bands from the US on export of sensitive, confidential and potentially defence related technology, so New Zealand made sure that it went out and executed those agreements as quickly as it possibly could. That is a simple way in which we could move forward with enabling our businesses, like Inovor, to be able to do business with US space companies.

CHAIR: Can you give an example, just for the record?

Ms BIRD: Can I add to that? We've had a lot of people raise this issue with us. Why do you think we haven't moved more quickly on it?

Prof. de Zwart: Joel may talk more extensively about this. There was a significant inquiry into the space industry that was undertaken prior to the announcement of the formation of a space agency. At that point, we were essentially promised that we were going to get a completely rewritten piece of Australian legislation. The Space Activities Act was written in the nineties with the expectation that we would do what Australia usually does, which is provide our land to a major overseas launch provider.

CHAIR: When was it written? The 1970s?

Prof. de Zwart: The nineties. It was aimed at Kistler Aerospace, which was, at that point in time, going to build launch facilities from Woomera. We had a very narrow act that was aimed at that range of activities. There's a bit of cultural cringe happening here. One of the issues is that Australia is an incredibly good ground services provider. We are very fine at building things like the dish. CSIRO's ground stations are exceptional and world class, and we are located in a geography where we have quiet skies and those sorts of things. We kind of feel like we're good at those things and we should stay good at those things. That's what I get worried about: people say, 'We should only do this little bit and this little bit over here, because we're good at those bits.' The regulation was essentially written around our view of ourselves as not being a major space actor.

CHAIR: When people read this, they'll think 'Okay, there's excessive regulation,' but can you give an example? If I was to talk about environmental regulation, I would be able to say, well, look, the problem I've got is—

Ms SWANSON: Can I assist with this line of questioning? I think it will really help with what you're wanting to ask.

CHAIR: Okay.

Ms SWANSON: We spoke about it this morning. For example, the Technology Safeguards Agreement, which is a part of the ITAR stuff. That strikes me as a really good example. Basically, the new act is a lick of paint—that's how it was described. It hasn't really substantially changed. Is that your interpretation?

Prof. de Zwart: That is my interpretation, yes.

CHAIR: Give me an example. Drill down. Just give me one.

Prof. de Zwart: Say I want to get a launch licence—for example, as a university, say I want to send up a CubeSat, so I need a licence—I go to the licensor and I need to provide them with information of every employee of the organisation that is conducting the launch. That means the 15,000 employees of a university have to be named on that application, including their date of birth and place of residence.

Ms BIRD: Seriously?

Prof. de Zwart: Yes.

Ms BIRD: So under the auspice of a university, everybody who's an employee at that university has to be named?

Prof. de Zwart: And it would be the same for any of the primes. If I am the launcher, the detail that is required is excessive. I understand, from a security point of view, what you need to know for a launch licence, but, if I have used in there any commercial off-the-shelf equipment, I need to give the provenance of where I've bought that commercial off-the-shelf componentry of my satellite.

CHAIR: And other countries don't do that?

Prof. de Zwart: Not to that degree, but Mr Lisk would be best placed to answer that question.

CHAIR: Mr Lisk, give us an example, because there's nothing more annoying for me than New Zealand beating us, whether it's rugby or anything else. Give me an example of what you have to do in Australia—like, name every employee in the university—versus what happens in New Zealand. We need to know why. Give us an example of how they're more adroit than us, a real life example, so that the people who read the *Hansard* go, 'Oh, that's pretty crazy.'

Mr Lisk: Okay. For the example, it comes down to the nature of the New Zealand space industry. New Zealand created an act in 2017 purely in response to Rocket Lab expressing interest in launching from the South Island. Rocket Lab has a New Zealand subsidiary. They're very much happy to market that aspect. But at the core they are United States based company, so they require US based approvals for everything they do. New Zealand's legal framework enables them to go to the Federal Aviation Administration and the Office of Commercial Space Transportation in the US and ask for a licence which covers their launch vehicle that they have. They don't change it particularly often. They've reached the point now where it's mature. They go to them and receive a licence for the vehicle. They then lodge their applications and information about when they're going to conduct a launch but then take that particular licence and bring it along to New Zealand. New Zealand's regime is established in a way that you can bring a foreign licence and very minimal information that comes along with that to then get subsequent approval from the New Zealand Space Agency.

CHAIR: Basically, their licence is our licence. If they turn up with a licence from a reputable country, they've got a licence and off they go.

Mr Lisk: Yes. And what—

Dr ALLEN: Is there a definition of a 'reputable country'? If North Korea came to us—

Mr Lisk: My understanding of the regulations in New Zealand is that they'll bring it over along with information they submitted along with the application. New Zealand will assess it. In every instance we've seen so far, they're going to issue a launch licence based on the information they've provided the Federal Aviation Administration. The reason for that is, of course, the FAA in the US are quite a mature regulator. They've been doing it for the last thirty years. I know this is going to sound quite contrary to what we've been saying, but, whereas Australia's regulations are this pile here, the US's regulations are three binders worth. The problem we reach is that we have to have a mature US market with operators who are capable of powering through those regulations and are able to comply but also a regulator who's been doing it for a substantial period of time so they can say: 'We have this much guidance to provide you. We have previous examples we can work off of. We know what the safety standards are because they're publicly available. We use'—

Dr ALLEN: Does the regulator also monitor and remain accountable? So, if you take a product out of America and put it somewhere else, the regulator that's immature in New Zealand may not be able to monitor and keep accountable that ongoing safety issue.

Mr Lisk: I'm not entirely across the detail of how the interagency operations work. But, from an international perspective and purely on the face of the United States's regulations—

Dr ALLEN: As an example, if the US regulator approves something that's highly technical and then an immature regulator in another country—say, New Zealand—doesn't really understand what's been approved then it can't maintain that safety and accountability because it doesn't understand the technology behind it.

Mr Lisk: Yes, there's definitely that risk. That is, of course, a problem, especially for emerging or experimental technologies. In the US, we have different categories of licence. We have experimental permits which can cover those things, such as SpaceX's SN test they've been doing regularly, where they launch something to about 12 kilometres and then belly-flop it into the ground because they haven't managed to land it properly. Those are the kinds of things that they've set up, because the sector there is full spectrum. They do everything from the design phase through launch. The regulations have been set up over the last 30 to 40 years to do everything from design through to launch.

CHAIR: This is in New—

Mr Lisk: In the US. I can bring it back to New Zealand for you.

CHAIR: Yes.

Mr Lisk: There is the risk that New Zealand will take a licence from the US and not understand the content, but that's the risk with any intergovernmental licencing approval regime. The US is still responsible for the operations of that entity under international laws as well as their domestic space commercial launches act, which applies to any US company who wants to launch anywhere in the world.

CHAIR: Before I go to Madam Deputy Chair, the Australian Pesticides and Veterinary Medicines Authority is basically trying to get to a point where if it's licenced in England, it's licenced here; and if it's licenced in the United States, it's licenced here. They're actually setting up an international regulatory coordination process to try and stop duplication. If you believe that other people are competent in their country then they're competent in ours.

Ms BIRD: Further to that, we did have earlier evidence that our current model requires an applicant to have their risk assessed by contracting to some other private provider, and there was an argument presented to us that in-house expertise in the Australian Space Agency would be a better model. It's been a while since I looked at our air industry—people like CASA and that—but one of the great Australian strengths of our regulators in that sector has been in-house knowledge and expertise built over decades, which makes Australia a bit of a well-regarded world leader in air travel safety. I'd be interested in your views on that argument put to us about in-house versus contracted assessment.

Prof. de Zwart: I know you would have heard already the issues about the cost of getting the licence, and then the cost of getting a technical-expert review, which is significant. Certainly it would be preferable, more than preferable, to have that expertise in house at the Space Agency because that reduces the cost and, as you say, builds up expertise. That's why I feel that the Space Agency needs better funding, and it needs to really clarify what its role is as a regulator. Remembering that one of the objects of the act itself is to facilitate industry, that should be an object of the Space Agency, but its role as a regulator should be properly resourced with people with expertise. I think it is fair to say that, because of the particular niche areas of expertise that people in the Australian space industry have, it's almost impossible for them to find someone outside of their own startup who has expertise that's better than what they actually have in house anyway.

Ms BIRD: That was the frustration that was expressed to us.

Prof. de Zwart: It's self-defeating, rather than growing.

Ms BIRD: Mr Lisk, do you want to comment on that?

Mr Lisk: I don't have much more beyond what Melissa said there. There are interesting examples when we look to our international peers. The United Kingdom have recently announced, as part of a review of their act—they're moving from an act created in the eighties to something that was implemented in 2018, and they're working through the regulations now—that they've removed a substantial portion of the supervisory authority from the UK Space Agency and put it with their Civil Aviation Authority. They've recognised that their Civil Aviation Authority has that heritage. It has the capacity to regulate on safety. Because they want to start entering the launch market, and doing so from such a small island means navigating lots of different sensitivities around public health and safety, they've recognised that the Civil Aviation Authority has the capacity to manage that. They don't need to onboard and bring in a whole new capacity for the UK Space Agency in that regard.

Ms BIRD: That's interesting. When we look at what happens in the air travel industry, there's a lot of international cooperation. Not all countries repeat or copy each other's approvals, but they do regularly meet, talk and engage. So, for the industry sector, while there will be differences and nuances between countries, it's a pretty well-known process. If the Australian Space Agency doesn't have the in-house expertise on regulation, are we just relying on informal networks? How can we participate in those international forums and conversations?

Prof. de Zwart: This is the great advantage of having a space agency now. The problem that we had prior to the Space Agency was that it was almost impossible for another government, or even a NASA, to work out where the front door was for the Australian space industry. Having the Space Agency solves that problem. As we've seen, since the Space Agency was established, it's entered into a range of MOUs and agreements with other space agencies, such as NASA. Let's look at how that adds capacity building. If Australia is going to participate in the Artemis Project, which it has agreed to do, or to at least participate in the moon sector and possibly beyond the moon sector—for example, landing people on the moon—that is inevitably, in and of itself, an international activity. So you're exactly right; we should be working at that international level and lifting the capacity generally. Working in a silo just doesn't work in the space industry. It's got to be something that is multiagency focused. The agency gives us the platform to do that, and it needs to be supported to do that.

Ms BIRD: The agency isn't something very new—let's have that understanding—but it's been very well set up and well staffed to look at what Australia's role in space could be and engage at that level. But what we're hearing now, particularly from companies, is, 'We're here now, and we're trying to grow, and you actually don't have the expertise to make that a fairly seamless process.' It sounds a bit like the Space Agency is really good at the first part, but now we're hearing about lag times and problems with outsourcing, the assessments and those sorts of

things. What does the Space Agency need to do for its next development? What should we be saying to government?

Prof. de Zwart: I'm going to get Joel to talk in a minute about the potential splitting of the Space Agency and looking at its different actions. But I think one of the things that we need to recognise is that, for example, this is the regulatory environment that a space start-up has to deal with. There needs to be some ability to go to the Space Agency, for example, and say, 'How do we navigate this? Have you got people who are business development managers, contract managers, legal advisers who can walk us through what this is going to do?' A business development group in the space agency—

Ms BIRD: I like the term 'the navigator'.

Prof. de Zwart: Yes, that would be good. We've got the Space Discovery Centre, which is great for kids learning about space, which is really important, but why don't we build up the capacity in the agency to assist with business development? There are people across Australia now who have business qualifications, engineering qualifications, archaeology qualifications, law qualifications who can help them with that. So we're building up people who are what we call 'industry adjacent expertise'. From a simple point of view—not just about STEM education, which is great—how is the agency going to help you do business with NASA? How is the agency going to introduce you to working on the Canada arm with the Canadian Space Agency? What sorts of contracts should you expect? What are the hoops you're going to have to jump through?

Mr Lisk: I agree with many of the aspects around regulatory delays and lag times in processing applications. As we are probably all aware, SMEs operate on very condensed time frames. They move quickly. They move rapidly. They're trying to address a problem. During the initial consultations, in 2015-16, around the review of the Space Activities Act to make it what it is now there we're entities going, 'Let's copy the models that we see in the US where we have time frames, where if you don't have a licence within 90 days you've got your licence.' Of course here in Australia with a regulator that doesn't have the capacity to process that quickly that's unrealistic and it would present significant risks. But those sorts of models of making sure a regulator is appropriately resourced to deal with new issues and new concerns as they arise is the real kicker there. As I don't want to take away from my own profession, having guidance and documents provided by the regulator, as we see with ASIC and the ACCC—significant guidance on how to get an application—would save SMEs significant funds on legal, which is probably making my bosses in the law firm freak out, and is a nice way of providing industry that initial support so they can then reduce the overall cost they then have to bear at a later time.

Ms SWANSON: I'm looking at it from a slightly different angle or through a different prism, if you like. I can understand why we might need business development managers to help SMEs navigate the regulatory framework. I hear what you're saying about taking some of the frameworks from other countries and applying them here in Australia. But it seems to me, from what I've heard today, that at the bottom of this we have a clunky act. We have an act that is not fit for purpose. As legislators it would seem that we should be looking at that first and foremost and saying, 'Hang on a minute. The act was written in the nineties. It was given a lick of paint recently but it is not fit for purpose.' As a broad statement am I on the right track here?

Prof. de Zwart: Yes, you are.

Ms SWANSON: Thank you. In saying that, I want to give you a couple of examples from recommendations that we've had. One example is: 'That the Commonwealth amend the delegated legislation of the Space (Launches and Returns) Act 2018 by omitting the requirement that a suitably qualified expert who was approved by the minister must be a party not related to the applicant in order to perform risk hazard analysis on the applicant's launch vehicle and proposed launch activity.' That is one example of a recommendation that we have been given. I know we've been speaking about experts. I'm loath to use the phrase 'root and branch reform of the act', but it would seem to me that we actually need to throw out the act. But I'm concerned that if we do that it will again be a timely problem, because if we have to have a whole new act that will put all of these SMEs further back. Is there another jurisdiction across the world that we could look to for an act that we might be able to, not plug and play, but that—I'm worried. We have to reform the act. That could take a lot of time. We've got SME's saying it's already too long and complicated at the moment. Do you see the conundrum that I feel we have here? How do we solve that conundrum?

Mr PERRETT: I'll add to that—a leading question—particularly if there are academics that have written about the UK legislation and how that would seem to be the off-the-shelf one we could most copy.

Prof. de Zwart: I'm going to quickly answer one thing and then I'm going to throw to the legislation expert, Joel. We have to make some fundamental decisions before we get to that point. What you can see is there is a contentious issue between the innovators, the entrepreneurs and the space agency about who should bear the cost

of this stuff, right? This is a problem that we have to resolve even before we put that into legislation. Who is going to bear that cost? Take your launch licence as an example. Huge numbers of folders of information have to be provided to the agency who will then turn around and go, 'Well, this stuff is inaccessible to us. We can't process your application because you've just dumped all of this information on us and we need to go through and work out what it is.' Do you see what I'm saying?

Ms SWANSON: Absolutely I do.

Prof. de Zwart: On which end of the spectrum is the cost of all of that going to lie? You have to have an agency which will say, 'Okay. We will process this and this is what we want', to build that into the rules. It's one thing saying, 'We need this', but who's going to pay for the collection of that and then the assessment of that? Yes, certainly we need it rewritten, but we need to make some decisions, fundamental decisions [inaudible] about where the loss is going to lie, where the risk is going to be borne, and then we can work out how we're going to build that into our brand new legislation. There has been a lot of work done—there was a lot of work done prior to the reform of the act—that is still sitting there waiting to be built upon. I'm going to throw to Joel for the rest of that answer.

Mr Lisk: There's a lot of regulation. I think it's a really simple way of saying that. Globally there are thousands and thousands and thousands of pages of stuff that can be called upon when considering how to reform an act. The problem that comes about when looking to just transplant something from another nation is, of course, you aren't considering the nature of the Australian industry, the reasons for the particular development in a different country and the other factors that surround that. The UK is a good example. Their original Outer Space Act is from 1986. It was a total of about 12 pages long. It said, 'You'll get a licence and you'll comply with the requirements of the agency. End of story.' Of course, that provides you with no detail at all. It was then the agency's responsibility to develop that guidance and make the decisions from there. They determined that now, when they want to enter the launch industry, they want to have a fully evolved and full spectrum space industry. They needed to reform that. So now they have this—probably the equivalent length of our space industry act. They're still consulting on the regulations and what they look like.

When they commenced their consultation process they released not just the regulations themselves, but another 900 pages of documents on how to apply for a licence, what this part means and what this part means, as a way of consulting, not on the regulations, but on the process to get your licence. From them it wasn't just, 'We're going to issue what we want. We're going to tell you what we're looking for. We're also now going to discuss how you can achieve those goals,' and that provides a great model to work from.

Unfortunately, there aren't many academics who have written on the topic of the UK space act just yet. It's a little bit new for that to have happened. We see some commentary on generic online forums and more article and short-form based stuff so it's hard to provide anything seriously considered there. But it's definitely a step towards a new direction in terms of how we regulate and how we structure. The UK released their response paper, I believe, on Monday of this week or Friday last week. They've now just finished considering those consultations and they're about to move to that next step. Beyond that it is still quite difficult to bring foreign legislation into Australia. But we can look to those aspects that work and those aspects that industry say work to make them useful.

CHAIR: Thank you very much. I'll go to the member for Moreton. He's just told me breaking news, for those north, Cameron Smith has retired.

Mr PERRETT: All the best to Cameron Smith in his retirement. You didn't say whether there was any academic analysis—maybe written by you, Mr Lisk—in terms of the British legislation.

Mr Lisk: No, there's nothing comprehensive released yet. I do expect, from speaking to some people in the UK, that something will pop up in the next 12 months. But sometimes law academics can be a bit slow.

Mr PERRETT: I'm sure the secretariat will be keen to look at that. So my question is this: how can the space industry engage more readily with non-STEM sectors, and what specifically is needed to attract and retain people with relevant skills? I'm not sure if that particularly applies to you, but you'd have a broad sweep, Professor de Zwart?

Prof. de Zwart: Non-STEM?

ACTING CHAIR: The associated industries.

Mr PERRETT: Yes. I'm not sure if you were here for that earlier evidence in answer to questions from the deputy chair.

ACTING CHAIR: Obviously, an important reason for government to be engaged in the industry sector is jobs—employment.

Prof. de Zwart: Yes.

ACTING CHAIR: So there's the traditional view of boffins, as we describe them, who do exciting space research, but there are a whole lot of other opportunities too. I noticed your submission goes to that, so I think we'd be interested in hearing more.

Mr PERRETT: Yes.

Prof. de Zwart: Yes. I think that's absolutely vital, because, as I have learnt in my life, scientists and engineers are wonderful at coming up with great ideas, but, if they don't speak to a lawyer or a businessperson first, then they might find that it's illegal or unworkable or unauthorised. So it's very important to have those associated advisers built in right at the beginning.

There are a number of initiatives that the universities are engaged in. You heard about the International Space University, which is an interdisciplinary type of initiative. It does attract, largely, engineering students, but others as well. There are a number of people in Adelaide who get together regularly, and we engage in a lot of interdisciplinary work, such as with ethicists and with Alice Gorman at Flinders, who's the space archaeologist and is probably the world expert on space junk. We work with the scientists and engineers and space miners that we have at Adelaide.

Mr PERRETT: With industry as well?

Prof. de Zwart: Industry is linked in through them. Our industry engagement up until now has been quite direct. So Matt Tetlow from Inovor has been talking to us about the problem he's been having with getting licences since he started having problems with licences. Joel and I recently taught a postgraduate course called Commercial Space Law. We had a presentation from an engineer who's a space miner. We had a presentation from Southern Launch. We had—

Mr Lisk: SASIC.

Prof. de Zwart: SASIC, yes. We work also through organisations like SASIC. So we're very keen to engage in capacity building. Now, we have to be careful with the graduates. We can't say everybody who does Commercial Space Law is going to end up as a space lawyer, but at least they have an awareness of those particular industry issues that arise and, hopefully, will be astute enough to go, 'Actually, I've got a launch issue here, so I need to talk to someone who has expertise in launch.' I just think we need more of that. I think it would be useful to develop something like an MBA in space industry, something that brings together business, regulatory, economic, fundraising knowledge and also an understanding of the limitations of the technology itself. I think you have to know what a CubeSat is to give effective advice.

Mr PERRETT: In your earlier evidence, you were suggesting almost—not a market failure, but a market opportunity perhaps for a one-stop shop for those SMEs and the like, so that you're creating the people to plug the gap.

Prof. de Zwart: We are attempting to create the people to plug the gap, exactly right.

Mr PERRETT: To create the career and then plug the gap.

Prof. de Zwart: And to ensure that these businesses survive. There are wonderful startups who then get to the point where they think, 'How do I leverage myself up to the next level? I'm going to have to get venture capital or something like that.' And, for that, you need boring old legal advice and a strong regulatory environment.

Mr PERRETT: Yes. And you could say, 'There's a fast door over there, rather than knocking on that door over there.'

Prof. de Zwart: Yes, and it gets back to saying, 'Here's a template for the sorts of things that you need to consider. Here's a template for your risk points. Are you talking about launch or are you really just putting a small part on someone else's payload, in which case you don't have to open all those doors?'

Mr PERRETT: Okay. Thank you.

CHAIR: Currently, we do have to open all those doors. If I want to put a widget on a cube satellite, they'll say, 'Well, you've got to go through this regulatory process.'

Prof. de Zwart: Correct.

Ms BIRD: Don't blame everybody who's at the university who you're working with!

Prof. de Zwart: Yes. It has happened, and it is a real problem.

CHAIR: On notice, can you put your mind to what you'd recommend, if you were in our position, in regard to changing the actual act?

Prof. de Zwart: Yes.

CHAIR: Whether it says, 'Just throw the whole thing out and take the English act or the New Zealand act and put that in place' or 'Here is a list of erroneous sections of the act, which should be either deleted or amended'—I think that's really important. You'd be the most professional witness in this space, so I'd really appreciate that. I know that's a little bit of work. I can see that it's rather voluminous there—

Ms BIRD: Are there perhaps submissions that you've produced from when the act was being reconsidered that you could send through to us? You said there was a point at which people anticipated the act was going to be completely rewritten.

CHAIR: It was written for Kistler Aerospace. So it's not really written for Australia; it's written for a particular organisation at a particular point in time, and it's now completely and utterly out of date.

Ms BIRD: So rather than reinventing the wheel, if there's work that you did at that time that you think would be useful to us, we'd appreciate that.

CHAIR: Yes—whatever is required so that we can go back to the parliament not only saying the act is out of date but saying, 'Here are pertinent changes that you could actually make.' They will be very happy to hear from us. The other thing is, with the current regulatory environment, I imagine it's a bit like conveyancing. You say, 'I want to buy that,' and that person wants to sell it, and then I just go to the solicitors and say: 'At the end of the day, make sure I own that. That's all I'm really interested in.' Do people just come in to you and say, 'I want to put a satellite into space,' and it's, 'Come back to me when you've got all the paperwork done'? Is that it?

Unidentified speaker: Yes.

CHAIR: I say that because it's not really engagement with the proponents. It's engagement with a solicitor. That's fine, but that's also kind of superfluous. We've got a few minutes left. Are there any further questions from any of the panellists? No.

Ms BIRD: It's a good submission. We look forward to hearing your follow-up.

CHAIR: It's a good submission; I thank you very much. If you've been asked to provide any additional information that you have, please forward it to the secretary by—we'll give you longer than two weeks.

Secretary interjecting—

CHAIR: There will be negotiations with the secretariat. You'll be sent a copy of the transcript of your evidence and will have the opportunity to request corrections to transcript errors. I imagine the date is going to be somewhere around 9 April or something like that. That gives you two more weeks. Thank you very much for coming in today, Professor de Zwart and Mr Lisk.

Proceedings suspended from 12:43 to 13:30

DUNK, Mr Graeme, Head of Strategy, Shoal Group Pty Ltd [by audio link]

ROGERS, Dr Derek, Engineering Lead, Defence and Space, Shoal Group Pty Ltd

CHAIR: I welcome representatives of Shoal to give evidence today. This hearing is a legal proceeding of the Parliament. The giving of false or misleading evidence is a serious matter and may be regarded as contempt of parliament. The evidence given today will be recorded by Hansard and attracts parliamentary privilege. I now invite you to make a brief opening statement before we proceed to members' questions.

Dr Rogers: Thank you for the opportunity to be here. I appreciate it. Shoal is an Australian company that began about 20 years ago as Aerospace Concepts. It's specialised in digitised and data-driven system engineering, which was called out in the recent Modern Manufacturing Strategy. So system engineering is what we specialise in.

Shoal got its start in space, where we were involved in development of a project to provide broadband satellite communications for Australian bases in Antarctica. That was a long time ago. More recently, we've been involved in the return to earth of *Hayabusa2*, undertaking modelling and simulation of the descent of the space vehicle to verify that it would present no danger. We'd undertaken similar work for the Japanese capsule *Hayabusa 1* as well. For the Australian Space Agency, we're providing independent checks for the safety of launch returns, and we also play a key role in the SmartSat CRC, with other industry participants, in the development of combined or compact optical and hybrid communication systems, which are satellites. In the last year, we've grown from about 50 people to 80 people, with the desire to grow to about 120 soon. So there's certainly a lot of work that is occurring there, and that's in defence, space, transport and infrastructure, and medical devices as well.

We've made two separate submissions to the inquiry. The first, which I led, provides eight recommendations, and they're in the areas of development of sovereign capabilities; the adoption of appropriate technical standards; leverage of Commonwealth procurements; and helping with directions to us, which relates to professional indemnity insurance. Our second, supplementary submission, which Graeme, who's on the phone, led, set space in the context of work that he's been leading on national resilience and other related submissions to government. We felt that, whilst these are related topics, combining them could have reduced the clarity, so that's why we made two submissions.

In simple terms, Australia is heavily dependent on space, and that creates a vulnerability. The flip side of that is resilience, and that's really where our recommendations are. If we can better understand the dependencies of Australia on space and develop models to assist in evidence based policymaking, that can be really helpful.

I'm now happy to take questions from members of the committee.

CHAIR: Mr Dunk, do you have anything further to say?

Mr Dunk: No, Derek has summarised it quite well.

CHAIR: Thank you very much.

Ms BIRD: Thank you very much for both submissions. I will go firstly to the international competitiveness aspect, with the first submission. We've had quite a lot of evidence that, while Australia is not unique, the number of potential places in the world that offer the advantages that Australia does is relatively small. Could you give us your assessment of where that is at the moment? Obviously, we are in the Southern Hemisphere, and there is the clear land and sea capacity—those sorts of issues. Who else might be in our competitive space there, how do you see that we might be well positioned, and where are the challenges that we need to have a look at?

Dr Rogers: Australia is well positioned. The other submissions have talked about this. As you say, it's because of where we sit in relation to the globe and what we can see of the galaxy—the Milky Way. We're well positioned there. We're also a large, sparse country—that offers a number of advantages—and we're a very stable country that has a good industry and technology capability. So that gives us a distinct advantage.

The history of Australia has been very fraught in space. We've started, stopped, started and stopped, and that's been very frustrating. The current situation in space is different because it's more commercially driven. In the past, it was very much defence and government, with very large investments. Now, as we see with things like CubeSats, there's a lot more opportunity for smaller and developing enterprises. That, I think, is good for us in Australia.

The challenge we have, which is true of many of our emerging technologies, is access to capital and, I think, in some respects a desire and a culture to be the best in the world and to develop industries. It's often said we have great ideas but we don't follow through on those. Hopefully, we can change that. Certainly what I'm seeing in space is a lot of cooperation and a lot of collaboration. There is certainly a different feel to the industry, and I think that's really positive.

As for other competitive nations, it looks like New Zealand is doing well with Rocket Lab and the positioning there. You would have to say that in reality, while southern Africa is well positioned geographically, it's got a number of other challenges with the countries involved there. It's the same for South America, but Argentina, Chile et cetera have good observatories. So I think we have an opportunity, but we can leverage the rest of the world. It's not a zero-sum game. In some respects, we can play a key part because of where we sit. I think we can grow that opportunity for all of us in that regard.

Ms BIRD: Mr Dunk, do you want to comment on that?

Mr Dunk: No, not directly, other than to say that we do have an opportunity to grow the Australian space industry but I think we need to have at the back of our minds the reasons why we want to do it. I listened in to most of the testimony from this morning, and a lot of it was about growing the space industry basically for economic activity, which is good. I'm not saying that's not good, but at the end of the day the government only has a finite amount of money that it can invest, so we need to determine those things that will give the best return on investment for the national dollar that's invested into space. For that reason, we need to be quite clear about what we can do, where we can do it and particularly why we are doing it.

Ms BIRD: And you would go to the aspects of resilience that you talked about in your submission in answering your own question, would you?

Mr Dunk: Yes, pretty much. The submission that we wrote is consistent with some other submissions that we've written about COVID and what we need to do as a country to mitigate the effects of some other major strategic shocks, such as COVID was and other things might be in the future. Our submission basically highlighted what we would need as a resilient society and also highlighted the fact that space is an enabler for all those aspects of what we call being a resilient society.

Ms BIRD: We've also become more dependent on many of those things to simply function as a society—yes?

Mr Dunk: Yes, but we can't do everything. We can't be self-sufficient. So we need to be clear sighted, as I said before, as to what elements the government needs to invest in and what elements will give the greatest return on investment, not necessarily in dollars but in national capability. As Derek mentioned in his opening statement, any society, including a resilient society, is highly interconnected—there are lots of complex, interconnected parts—and, in order to understand where the best return on investment might be, we need to understand those relationships and how space, for example, impacts—or the lack of access to space impacts—on transport, on energy or on whatever it is that we're trying to do. Therefore, if we were to construct some sort of model based approach, that would be a way of illuminating the relationships and therefore where the key factors lie, which may not be obvious at the first glance.

Ms BIRD: Yes, okay. Dr Rogers, I'll go back to you. You've been operating for a couple of decades as a company across sectors, including in the space sector. One area of great interest to me is the people—not just the potential for jobs but who the jobs might be for. My colleagues will pardon me for repeating it, but I think there's a general understanding in the public that space industry people are all boffins, really clever people, in silos. In fact, a space industry provides not only university graduate type jobs but trades jobs and, we heard, associated types of work.

Dr Rogers: That's right, yes.

Ms BIRD: I'd be interested to hear from you where you think the gaps are, from your 20-odd years of experience in Australia. Where do we still have problems where we have to bring people in? Will we have to continue doing that? A number of people have said to us there is a great opportunity for training and education, but you also need to ensure there are jobs at the end of that. So I'm interested in your perspective on that human capital side of it.

Dr Rogers: Sure. To give you a little bit of background, I started in the commercial world. I worked for companies like Motorola. I worked overseas. I'm an electronics engineer by background. Then, when Motorola moved out of Australia, I moved into defence as a job so I could remain in Australia. I've worked in defence for I think it's about 13 or 15 years now. And then, in the last couple of years, as space has grown, I've expanded from defence to defence and space as an activity. So the skills in science, technology, engineering, and maths are transferable across industries. As you know, my original background is telecommunications. A lot of technologies that we see 15 or so years later come to fruition in that area.

As Melissa, who was here earlier, and Joel rightly pointed out, there is also a lot of opportunity in other sectors and industries. Insurance and the legal industries, social sciences as well, all contribute to the development of this. My first job was in a very small startup company, where we had economists, regulatory specialists, social scientists and engineers. That was really about looking at the way we could develop the mobile phone technology

in Australia, and it was the diversity of inputs that was really incredibly valuable. And the same applied when I worked in autonomous systems—drones, drone boats—as an area. I think that's also true in space. We can use that diversity of inputs to grow the country and to grow in very novel areas. It's really satisfying to me to see small companies in Australia growing in the provision of technology in the agricultural sector. Now, when we considered this about 20 years ago, the technology wasn't quite there, but the opportunities or the needs were potentially there. So I think there are a lot of opportunities there. Certainly, in defence—

Ms BIRD: You're talking about application industries—taking data and information that's come in and applying it?

Dr Rogers: Yes, that's right. Ultimately, there's an application and there's a whole chain of industry that supports that. But there needs to be a good end use for that.

Ms BIRD: Okay.

Dr ALLEN: Thanks for your submission, Dr Rogers. I've got three questions. The first one is regarding the Australian Space Agency. There have been a lot of submissions about the fact that it's fairly new; it's developing both a regulation and an investment kind of capability, and that the two are one under one authority; and whether that authority is considered to be intra-government or extra-government. My question pertains to your company and the fact that you've actually grown quite quickly—well, over a 20-year period—but you're not confined to space. You've also looked at the environmental and economic impacts of being in space. Certainly, when I got involved in this inquiry, I thought it was about putting people on the moon or on Mars and I was thinking, 'How's that relevant to the Australian public?' And it pertains because space is actually about how we deal with our data.

I just wondered, if we're going to invest the Space Agency with more authority—whether it's inside government or outside government—is it important that we continue just to use the concept of space or is it important that we think about it in a broader sense, about its data? It's almost more about data and communications that is about space. Now, space has traditionally been with defence. How do we bring that together strategically? Space has traditionally been about defence, and the moon, and now we're moving to everyday use and data—and communications, I suppose.

Dr Rogers: Yes. I think it's important to maintain the focus on space, simply because of the excitement and the enthusiasm that generates. You're right: it is about space and it is about communications; it's a mixture of different things. There are both defence elements and commercial civilian elements. But the excitement of space attracts people. If I put a sign at the door that said, 'Come and work for me in space' I would have a queue of 500 people that would turn up. It excites people in that and the industry in Australia—

Dr ALLEN: Can I be clear about whether they'd be lining up to hear about it or to work in it?

Dr Rogers: To work in it.

Dr ALLEN: And are they trained so that you can give them jobs and there are just no jobs there, or is it that they need to get the training?

Dr Rogers: There are a lot of engineers for whom it is a passion—it is a heart problem—and so the opportunity to work in that is intrinsic motivation. They would just come because they can, so they're trained in capabilities. For many of the emerging sectors, and particularly for younger generations of children, it is excitement: it can inspire them in where to pursue a path. So as we expand and develop the industry, it says you can pursue that as a path in your career and follow that path. I think there is a trained cadre. Admittedly, that trained cadre sits in defence and in other sectors as well. There's a lot of crossover, so I'm not so concerned there. But as the industry sector grows, what it really does is pull people through. Other submissions talk about space attracting a lot of younger girls. It is exciting; it attracts a lot of people to it. If you can get dinosaurs in there, it's fantastic.

Unidentified speaker: Dinosaurs in space!

Dr Rogers: Dinosaurs in space, yes, that's right. The deputy head loves that joke; he does that all the time. But it does attract people, and the skills, like I said, are transferable from different industries. So as industries go through their rises and falls or their cycles, if you like, people can transfer across.

I work in defence and we're active in defence. I also span space activities, and as it grows we can bring in more people for that. There are specialist skills that apply—the high end in complex geostationary large satellites and those sorts of things—but there are a lot of other things we can do. The CubeSats are one where 10 years ago you couldn't do that in capability, but now that's opened up a whole greater realm of possibilities for people because we don't need large clean rooms and we don't need massive investments. So it really does open up the potential for people to participate.

Dr ALLEN: The first part of my question is about platform capability, how an agency might enable that and what it stands for from a strategic point of view?

Mr Dunk: Can I make a short comment which I think might be relevant to your first question? I'm not an engineer and I'm certainly not a space engineer, but I have a simple way of looking at space and the space industry. One is that it exists in two parts: one is the in-space part, which is the rockets and the satellites and the comms; and the other one is the from-space part, which is the information and the data and all the stuff that goes with support: agriculture and transportation. That, to me, has been a useful way of simply looking at what is a complex environment.

Dr ALLEN: Thank you, that's extremely helpful. 'In-space and from-space' is exactly the way we need to think about it as the Australian public. I would say that we get excited about in-space, but in fact jobs growth might come in the from-space.

Dr Rogers: Absolutely.

Dr ALLEN: The second part of my question is: where do you think growth is in the from-space? Obviously, iPhones, but I noticed that you've developed into health—I've got a health background—and across transportation, infrastructure, agriculture and all sorts of things. Where do you think the growth potential is from hardware that is a point of difference for Australia?

Dr Rogers: Perhaps it's from hardware for data, because in data there's a lot of use. CSIRO has done some great work in data and observation which you can apply in agriculture for understanding crop yields and different elements there, and emergency management. There's a lot of value in data and there's a lot of value in the use of machine-learning techniques—REML et cetera—that take large volumes of data and turn it into useful information. There are good opportunities there and where it will come from, time will tell. Sometimes you have to get into the enabling elements, the technology, and then let society work out what to do with it. I think we'll see that.

There may well be opportunities in health. As we get more connected with networks and availability, perhaps there are distinct benefits we can pick up from that as well. To be honest I don't know, but my—

Dr ALLEN: So as a company, you're just open-minded and you take the opportunities as they come?

Dr Rogers: Yes.

Dr ALLEN: There's not some sort of growth area where you think there's an unmet need that you're growing into? You're responding—

Dr Rogers: That's right. Shoal is more in terms of the engineering design, capability development, design experience. So we're not so much a product development company; it's more the work in both above the line and below the line elements. In defence, for example, you would look at whether you choose ships or submarines or helicopters—those sort of decisions—and trade-offs will be made and then we'll get involved in the acquisition side of things, which is actually implementation and development and building of those systems. So, in space, there will be opportunities in capability, design and development. There will be opportunities in range safety as well, which is the returns, and certainly, over time, there will be opportunities in product development.

Dr ALLEN: Could you please describe the barriers to professional indemnity insurance for the space industry and what possible strategies there could be for reducing these costs?

Dr Rogers: The information we've had is that the premiums are looking to increase from about 20 percent to 48 percent. That's not so much the challenge as the fact that, really, the number of participants willing to provide insurance is dropping almost to zero. So, with the brokers that we deal with, we've had very little success in obtaining insurance in Australia. And then you go up to Lloyds, for instance, and they're also having that. It's driven by a number of factors. One is, of course, the COVID situation. Another is that the bushfires and the floods have had an effect there. But I also think the other factor is really an unfamiliarity with the sector. There's a view of space from the past.

When I worked in autonomous vessels, insurance companies didn't understand drones at all. There was one exception, which was a Queensland company, and that was because the person in there had a sufficient background and was involved in the industry association and they pursued support for that industry in terms of insurance. It was uninhabited aerial systems, and they really carved a new market for themselves. The same, I think, is true of space. When we say to people 'we're in defence and space, they'll shut up shop and go, 'Right, this is just all too risky.' They don't want to talk to you. There are many elements. Some elements are high risk, without doubt. There are other elements, where we provide engineering experience and design background, and, in truth, it's no more risky than other jobs that I've done over my career in other industries we work in, but there's

that lack of understanding of different fidelities or different elements of the sector, which I think is causing the blanket response: 'It's all too hard. We don't want to insure.' What can government do? Governments can perhaps look at the levels of insurance required in terms of government contracts. There can be a reduction there. In a perfect world, we stimulate the market and some people come in and say, 'You know what? Nobody else wants to play here. We'll have a look at this, and create a business out of this. That would be the perfect world. But it's a case of getting that maturity in the sector that, just because we say space, there are such a diversity of things that you can't just go, 'It's all too hard,' and walk away.'

Ms SWANSON: Thanks very much, Dr Rogers, for joining us this afternoon. First, I have a general question. One of the observations that's been made repeatedly today—I'll couch it in these terms—is that we need to decide where we want to go as a country in terms of space. And one of our witnesses earlier this morning said, in Australia, we have a relatively expensive workforce. We have great geographical, political, geopolitical things going for us. And he said we shouldn't shy away from the difficult things in space. I'm interested to hear your thoughts on that. I know this is an expansive question, but I think it's really getting to the nub of it. Then, earlier in evidence, when we were talking about legislative frameworks and how, as legislators, we should be thinking about the recommendations we're making, again, it was repeated: we need to work out where we want to go. I know this is really broad, and I'm asking you to find the needle in the haystack, but I'm after some direction and observation from you, given that you are in the rare situation where you've had a couple of decades of experience and, particularly, space experience.

Dr Rogers: I think the answer has to be: what's going to benefit Australia? I read many of the submissions, but I don't know if this is covered. It used to be that China knew more about Australia's agricultural sector and when to buy products and other commodities than we did. We have no direct earth observation. Now, there's been a lot of good work trying to address that. CSIRO is doing some fantastic work there. They are particularly good in data analytics. Focus in areas like that can give us an advantage as a country, so my personal view is that if we can leverage areas that give us that benefit, that's an area to focus on. It's the same in emergency management of bushfires, and the SmartSat CRC is doing great work in that area as well. So those are good things.

The Australian Space Agency and the government have been involved in supporting the Moon to Mars initiative. That is a large, complex, hard goal that's going to take decades and decades, but it is also an inspiration for people. I was born in 1969 and I sat in front of the TV as a four-month-old kid; I still have the newspaper. We need things that inspire us. We need things that provide a benefit to Australia and can support us here, but we also need things that push us and challenge us and get smart people to go: 'I want to do that. I don't know what I'm going to be doing, but I want to do it.' That's what I think we've got to do. So it's a mixture of both.

Ms SWANSON: You've answered the from space question with the ag piece and the in space. Can you just expand upon that Moon to Mars reference that you made—a couple of the committee members and I have been talking a little bit about that—in a shucked down, nutshell way?

Dr Rogers: My understanding is the Australian government has been involved with the activities of the United States government, which is bringing other countries into their Artemis program—I think that's the correct name for it—which is about sending exploration to Mars. Now, that's a very hard problem. There'll be a number of hops to that—return to the moon, which I think is 2024, and then on to Mars. That requires a number of challenges, such as whether you can extract water from the moon to assist in the development of fuel. There are a lot of challenges for robotics and a lot of challenges for communications. I understand the government has opened up opportunities for Australian companies to become involved in the supply chain for that program, to get in at the early stages of that program. I think that gives us a good opportunity. Australia played key roles in the moon landing. This is giving potential for our companies to get involved and, given the time frames, we can help pursue that. I think there are spinoff benefits; there's a lot of crossover with mining autonomous systems, autonomous transportation systems, et cetera. So whilst there's a lot of space, we've always seen the spin-outs of technology and other things from space activities over time. That's my understanding of the Australian government participating in the US government initiative.

Ms SWANSON: Thanks very much.

CHAIR: I have some questions, but we're over time, so I'll get you to take them on notice.

Dr Rogers: Certainly.

CHAIR: You mentioned sovereign capabilities. I just want to know what your view is currently of our sovereign capabilities. Can you just enlarge on what capabilities you believe we should be more attentive to and keeping? You cross that over with national resilience, and I imagine they're sort of one of the same thing, but it might be that resilience has a lesser level or broader scope. There's one thing I'm very interested in: you talked

about the stop-start industry. I want to know why the industry, in your view, stopped from time to time, because there lie the problems that we wish to avoid, if we can. Also, your view on the Space Activities Act 1998. I've been having a peruse of that since I heard about it. There seems to be an excessive amount of regulatory requirements between division 1 and division 2, and this is putting us at a strategic disadvantage to other countries that don't have that. If you could express your views in that space—if we waved the magic wand and made you the boss in Canberra, what would you do to fix it so it worked in a better way to keep us in a competitive environment?

The other thing is, Dr Rogers and Mr Dunk, if you could just express what you think is required to take the Australian space industry from an engagement with components into the construction, in a more fuller form and near totality, of satellites that we could launch from Australia. Take us through a holistic process of what are our impediments and what we need to do there? If you could take those notice I would be very much appreciative of that.

Ms BIRD: Dr Rogers, you'll get the transcript of the questions the chair asked.

Dr Rogers: Thank you. That would be helpful.

CHAIR: Yes, sorry about that but we're over time. Thank you for coming in today. If you've been asked, and you have, to provide any additional information please forward it to the secretariat by Friday 26 March 2021—or do you want a bit more time? We can extend it out to another two weeks, which takes us to 9 April. You'll be sent a copy of the transcript of your evidence and will have the opportunity to request corrections to transcription errors. Thank you very much, Dr Rogers and Mr Dunk.

KERR, Mr Peter, Coordinator Defence and National Security, SmartSat CRC Ltd.

KORONIOS, Professor Andy, Chief Executive Officer, SmartSat CRC Ltd.

WOODGATE, Dr Peter, Chair of Board, SmartSat CRC Ltd.

[14:06]

CHAIR: Welcome. This hearing is a legal proceeding of the parliament. The giving a false or misleading evidence in a serious matter and may be regarded as contempt of parliament. The evidence given today will be recorded by Hansard and attracts parliamentary privilege. I now offer you the opportunity to make a brief opening statement before we proceed to members' questions.

Dr Woodgate: Thank you, Chair. I'll do that. There are three key points we'd like to make. The first point is that the nation needs a national space plan. This needs to lay itself out, in an overarching set of priorities, a set of space missions looking forward over the next decade. We need the detail. We must also identify what we need to own as a nation. This should absolutely be a critical priority for us over the next couple of years. We need to control our own destiny and this is the way of doing it. The plan should build on the very good work of the Australian Space Agency on its national plan and all the roadmaps which are under development. That's the first point.

The second point is we need a sustained effort on investment with R&D. SmartSat has identified 27 key capabilities that will underpin a long-term national plan for us. We've done this with intensive consultation with 120 partners that we have: the 18 universities; CSIRO; 100 companies, including 80 start-ups that we've got; and the Department of Defence, who are our biggest single investor. These are a good start. They are considered to be essential by us, but we'd like to see them nested in an overarching national plan, this 'national space mission of missions' we might call it.

The third point is, and this is also essential, that the extensive R&D streams that are coming out of the SmartSat research activities need to translate across to Australian companies. This will build our national capability. They're focused on solving national challenges and we need to seize the opportunity to build an internationally competitive industry. This means space is seen as a critical component of the national fabric of science and industry. An innovative nation sells to the world and that's particularly so in space. To help us develop the detail on this we've formed end-user advisory boards: one in defence and national security, another one in agriculture and natural resources and a third one in mining and there will be more to come. These are led by and managed by industry. That's industry's peak voice guiding the research that we will undertake. This is an approach which we feel has merit as being translated upwards to a national approach to guiding the leadership that we need across all elements of space. SmartSat is only undertaking a component of that. The nation needs more than that but it needs to be industry led. Thank you, Chair.

CHAIR: Thank you very much. You probably heard the last questions that I asked of Shoal and I want to touch base with you on one. The previous evidence referred to a start and stop of the Australian space industry. I'm very much wanting you to sort of enlighten me why you think in the past it has stopped and why other countries just kept going. What has been our flaw? What've we learnt from that?

Dr Woodgate: I might start that one because I've been involved in a process that started here over 20 years ago, with Senator Grant Chapman, to identify what we needed as a nation to make ourselves a fully space faring nation. The senator identified the fact that we were nowhere near being a space faring nation, but that we were fundamentally reliant on the space assets and capabilities of other nations for our own critical needs. We had no—up until very recently—cohesive national space policy. We chose not to have one. It took us 15 years and at least one Senate inquiry to build the case to get an Australian Space Agency, which then created the environment for investment in R&D and, hence, SmartSat getting up as well. So from the very top the lack of political leadership in putting in place a national space policy was probably a significant impediment to us.

We have had instruments of government from time to time inside the public sector that've had a peak space role. We had an Australian space council that closed about eight years ago. It ran for quite a few years and then there was nothing. Now we've got the Space Agency again. The lesson out of this is that we need to take a long-range view of this as a critical national capability and not let go of the great gains that we've made over the last couple of years. We absolutely need to build on them. One of the ways we can do that is to send a very strong signal that we are here to stay with these developments in space.

CHAIR: I wanted to enlarge on that, because it seems that we had a partial fascination from time to time that happened and then waned. Without verballing you, it seems that we didn't have a vision that was sustainable over a long period of time. I suppose you'd have to quote Kennedy, 'We will take a man to the moon and return him

within the decade'. It gave people a long-term focus. This is what we need to achieve—and off we go running. They had sustainable programs. Obviously their budget was way in excess of ours. We're not pretending to become the United States of America and NASA. Is one of our things that we lack a sort of long-term, 'We want to achieve this'?

Dr Woodgate: Yes.

CHAIR: Not being held to it, what are the this's that you would suggest? You'd say, okay, if I'm going to set down a plan—and you talked about Senator Grant Chapman, who I knew, which starts to date me a bit, and worked with. Obviously it fell in. Tell me about the this's. Tell me about the things that we should be reaching out and saying, 'make this a goal' and, therefore, everybody's got a reason to coordinate, to collaborate, to come together and go off and do their other things as well. What are the this's?

Dr Woodgate: Let me sketch that out for you. This is something that we've given quite a deal of thought to. Let's view it as a supply chain, value chain picture. Right at the beginning are the ideas, the ideation, the ability for our critical thinkers to envisage what is needed for the next generation of space assets, systems and people. It's a people thing at the beginning. We then need the ability to develop sensors, design sensors, possibly even manufacture sensors. This is where the nation could well serve itself by identifying what's in the national need around sensors.

Once we've done that, we then need to identify whether we wish to be in the business of building spacecraft, launching spacecraft from sovereign territory, controlling those spacecraft—that is, we have the ability ourselves, without any fear of being usurped, to task those spacecraft to do the things that we need first and foremost. The key downward-looking aspects of that are telecommunications; positioning, navigation and timing—this is for the GPS type satellites; and earth observation. They're the three critical classes that we fundamentally rely on in most areas of the Australian economy. Having done that, the information flow at the other end is critical to us. Space is a means to an end, and usually it's a high-quality information product that you want. Whether you want to map agriculture—I know the Chinese gentleman who designed the Chinese system 15 years ago that now monitors all of the world's wheat crops. We still don't do that. We have the capability to do it. So, you need to know what the information product is that you want at the end of the day in each of the critical areas of the Australian economy and Australian society.

CHAIR: Okay, maybe I will verbal you. I'll try and bring it down. You brought up the sovereignty issue, and, prior to you, Dr Rogers brought up the sovereignty issue as well. If we were to lose access to critical data from the United States, because we just take for granted that we get it, and obviously the Russians' GLONASS aren't going to give it to us and the Chinese aren't going to give it to us, then we would be absolutely in a pickle because we couldn't operate. The next war will be won—we've received evidence on this—in space and on the internet before it's actually won anywhere else. What do we need to get into space to do that, to own our space sovereignty? What would we need to launch—what would that item be and what capabilities are we now lacking that we can't do that?

Dr Woodgate: I'll give you a thumbnail of that now, and then perhaps we could take it on notice and provide more detail to you.

CHAIR: Sure.

Dr Woodgate: There are three standard levels of space. There are low earth orbit satellites close to the earth, so 500 kilometres, there is mid earth orbit and there are geostationary satellites. They're constantly looking over Australia. We need an intelligent combination of all three across two of the three space asset classes that I mentioned, and they are earth observation and telecommunications. In the telecommunications area, the priority should be on really smart sensors for us. Not so much broadband, that is being catered for elsewhere—although that is important—but the big gap is in low earth orbit small satellites that will pick up the signals from what will be millions and millions of little sensors. We've got some leading companies in Australia building those. They're going to be—

Ms BIRD: Are you talking about the Internet of Things?

Dr Woodgate: This is the Internet of Things. This is exactly that. We're on the ground floor of the Internet of Things. We can become a global leader in that, so we need that as well.

CHAIR: I'm sorry to interrupt—it's fascinating—but it helps our recommendations when it starts to become succinct. So low earth orbit is 500 kilometres to 1,000 kilometres mid-range is whatever that is, and then geostationary—what's that, 36,000 kilometres?

Dr Woodgate: Yes.

CHAIR: So you're saying that we need to play in all those spaces, we need to have the capacity to launch into each one of those spaces, and we need to be able to cover the fields of communication and observation.

Dr Woodgate: Yes. And then we need trusted relationships on the third. There are six nations with global navigation satellite systems or regional systems, and some of those are very close allies of ours. Geoscience Australia has done a great job in building relationships with them. We need to maintain and work on those; because you don't get anywhere unless you've got precise positioning as an important data stream that is joining your earth observation. You can't get that high-quality information to anybody, unless you control your telecommunications.

CHAIR: And that would enforce collaboration and also spell out where we have a sovereignty gap—that is, we had to buy or borrow the technology to do it because we couldn't do it ourselves.

Dr Woodgate: Correct. You can ask the counterfactual; economists will do this. What if we turned off our access to the 25-odd key satellites that we're using at the moment for earth observation? Where would Australia be immediately? Where would we be?

CHAIR: Planet chaos.

Dr Woodgate: Yes. But have we asked that question? Well, we've asked it and we've actually started to do a risk management on that. I co-chair the national risk management committee under the Critical Infrastructure Advisory Council. So we're working through that at the moment. The outcome of that will be critical to determining which elements of it should be sovereign, and we can't afford to outsource.

CHAIR: Okay. I've been more than more than greedy with my time. Madam Deputy Chair?

Ms BIRD: We commented in an earlier session that we just had a very small taste of that, when a major social media player decided to intervene in what we could access, and people suddenly realised how significant that is to how we run our lives.

Dr Woodgate: This is correct.

Ms BIRD: So this is it is a very interesting area. My particular interest is in the human side of this—personnel more than personal. I notice that you've indicated that you've done some skills gap analysis work in terms of developing jobs and employment opportunities and in terms of the self-resilience factor so that we're part of international chains but also are able, if those chains are broken, to step up and at least survive. I'm interested in the work you've done there. There's been some evidence to us that one of the strategic gaps is actually: what have we already got in terms of people, skills development, education and research? What is your evidence on that?

Dr Woodgate: I'll invite our CEO to speak on that one.

Prof. Koronios: Yes, we have just completed a skills gap analysis, in partnership with the Space Agency. We have had a great relationship with the Space Agency all along, since their inception. That report is just about to be released, and we would be delighted to make that available to you, if you wish.

Ms BIRD: Absolutely.

Prof. Koronios: We have identified over 300, I believe, key skills that industry and all of the participants have identified as skills not only for the current demand for skills in this area of space but also for the future area, which is somewhat different. And it's somewhat broader as well, because it's not only about engineering; it's also about data analytics, communications and so on, and data science. We believe now that that this will form the basis for us to begin to influence the curriculum, to begin to develop work in partnership with our partners. We're not going to make the programs. We will work with the current universities and with our TAFE colleagues in areas such as microcredentialing, for instance, in areas where not only do we educate and train would-be space engineers and scientists but also we raise awareness about space for end users. Our farmers will actually be high tech—they are already high tech—and we have an opportunity in Australia to have the best ag tech capability in the world. The best friend for the farmer in the future will actually be data. Therefore, they need to be aware of how to use data, how to make sense of the insights and so on. We want to have an influence on the curriculum and education and training programs across the board.

Also Australia needs, in its vision to become a high-tech nation, which I think we are—well, we should be; we're an advanced nation, but probably not a very high-tech nation. We will then be able to flow the great knowledge that comes out of our R&D activities with our 20 universities, CSIRO and Defence and so on. That will form the basis for advanced knowledge in this area, for our undergraduate programs, for our TAFE system, and more importantly, of course, also for the PhD programs that will provide the next generation of space leaders in this area. Unlike in the past, I strongly believe, with the guidance and the leadership of the Space Agency and the government's commitment—very generous financial commitment to this area—that this will not be a false

start, that this time we will get it right, and we will become a space-faring nation, probably within the next decade.

Ms BIRD: I'm pleased you mentioned TAFE along with the university—

Prof. Koronios: Absolutely.

Ms BIRD: because that's the other conversation we've had—people think the nature of jobs in the space industry are very post-graduate experts. That's not actually for me—

Prof. Koronios: Exactly! It's a pyramid, actually.

Ms BIRD: High-quality welders, electricians and so forth are there.

Prof. Koronios: That's right.

Ms BIRD: In terms of programs that run—I'm from Wollongong, so the University of Wollongong is in my area.

CHAIR: Everything's about Wollongong!

Ms BIRD: Everything's about Wollongong, as it should be.

Prof. Koronios: It's a great place.

Ms BIRD: It does have an expansive Internet of Things driven by our SMART Infrastructure Facility operating there. But one of the things I'm really conscious of is that there's an international solar competition—the name escapes me at the moment—that they have twice entered. You design a house that's self-sustaining. It's actually a project that brings the university students together with the TAFE students to complete a project. And I think of it like those house-building programs you watch where you've got the architect and the builder and the great interaction that happens there between concept and reality of delivery. Is there anything we do in that sort of area, do you think, or should we be looking at a program around that sort of thing?

Prof. Koronios: There is. In the CRC, although we have very generous investment by the federal government—thank you, \$55 million; overall, we have \$245 million CRC—we still have limited funds and we want to use it wisely. So, whatever we do, we don't want to duplicate things. We don't want to reinvent wheels. Deloitte and the South Australian government—it's actually a nice national program now—have devised a challenge called the Gravity Challenge, and we participate. We're actually supporting that. Through that, we'll be able to replicate the type of work that you've mentioned. There are other challenges. There are international challenges like ActInSpace from Airbus and ESA, and there is also an American one, a NASA one, as well. So we will tap into those, rather than create our own.

Ms BIRD: So would you be able to follow up by sending us some information on that particular one?

Prof. Koronios: Absolutely. I'd be very glad to do so.

Ms BIRD: That'd be great. Thank you.

Dr ALLEN: Thank you for your submission. I want to ask you about the Smart Sat CRC. You've spoken a lot about building capability and what you think the strategy for the future would be. Could you give us some sort of case study of what you've generated yourself as a CRC? I was the director of a CRE, or centre of research excellence. Could you give us your vision for the funding that you have—obviously collaborating with industry, enabling research and development, but specifically for space? What is your specific strategy and what have you achieved in the period of time that you've been given your CRC?

Dr Woodgate: So I'll start and then I'll invite Andy to make a few comments as well. We've just celebrated our 12-month anniversary—

Dr ALLEN: Early days! Perhaps tell us what you hope to achieve.

Dr Woodgate: We've got a series of fundamental projects underway at the moment, some of which are demonstrator projects. They're designed to illustrate how this complex and very impressive combination of organisations from the research sector, publicly funded, private sector and defence can come together to really leverage outcomes which are greater than the sum of the parts. That's the CRC objective. A classic example of this is our Aquawatch program. The Aquawatch program is looking to prove up home grown Internet of Things technology—little \$50 sensors that can go out to remote water bodies, talk directly to low earth orbit satellites and then come straight back in near real time to end users to tell them what's happening at that remote water body. And we've got to test a few things with that. We've got to test whether these home-grown sensors are capable of surviving in a rough, remote environment with all the stresses that are on it, that the stream of data that they produce is reliably received by the satellite and reliably transmitted back to earth, and that we've got the back-end capability of analysing that very quickly, bundling that up with what other information the local farmer wants or

the water resource managers want and then provisioning it back out to them in the time that they want it. We've got about a hundred of these sensors being tested at the moment through remote South Australia. We're confident they're going to work, and, then, with CSIRO, who are a key partner with us, we would like to scale that right across the whole of Australia where we need water. For example, in the Murray-Darling Basin there are 100,000 static water bodies or more. There is no reason, in time, why they couldn't each be being monitored for water level, usage, salinity content, quality and so on via this mechanism. So that's one example of one that's already underway.

Dr ALLEN: Having been on CRE panels, often the question is: you've describe something that could just be a company working on its own, so what has the CRC done as the value-add? That company came in under your auspice when you came together as a cooperative research centre, so you're championing it. It's got its own funding, and what you're doing is bringing it into line partners such as CSIRO, so you're the marriage broker, or did you take the research and develop it? Where are you sitting as a CRC? With all these component parts, what's the value-add of the CRC? Where are you centring yourself for what you want to be able to achieve and, in five years time, to be able to say you are a successful CRC?

Prof. Koronios: We are the partners. We are a consortium of more than 100 partners—universities, industry and startups ecosystem—so we work through our partners. We are an agent, facilitator and a matchmaker, bringing the ideas together. The ideas come from the end users, as we've said before. We have an end user advisory board that actually feeds us needs for agriculture, natural resources, mining as well as defence. We bring those together to develop projects that are SmartSat projects, guided by SmartSat, funded by SmartSat and developed by what might be in the first instance owned by SmartSat, but actually it's pushed to the partner most appropriate to commercialise that. So it's commercialised by our industry partners, and we guide the whole process until we finalise the project, develop the IP, test it, validate it and bring it to commercial outcomes.

Dr ALLEN: So you act as a funder for seed funding, or do you act as a partner link? I'm just wondering where the \$55 million federal government investment goes.

Prof. Koronios: We fully fund the projects. Typically, the end users bring the problems to us. An agricultural company might bring the problems to us. The industry partners will actually work with our researchers, like the universities and so on. We will be funding the universities out of that \$110 million cash that we have, together with the in kind that they present. We will be funding the project, guiding the project and reviewing the project until its completion. We're not just the funding body like many funding bodies are.

Dr ALLEN: We've heard from earlier witnesses that the Australian Space Agency shouldn't just give out funding for grants, a bit like NHMRC giving out funding. Do you think the model you use is a model the ASA should take on board?

Prof. Koronios: We work very closely with the Space Agency, as we actually share almost the same floor—I think some of you might visit us tomorrow. But it is a model where we can hold the people that are doing the R&D accountable and the people that are working to commercialise accountable, all the way from the inception of the project to the IP actually becoming a business. Whether that's the model for the space agency, that is really something that can be considered, and the Space Agency may and the government may choose to have that.

Dr ALLEN: Would it be fair to say that for a CRC after five years the number of companies you've spun out would be seen as an outcome that would be—

Prof. Koronios: It could be. With some CRCs it is. For us, we would love to say it's not so much how many spin-out companies we have but how many of our partner companies are thriving and are globally competitive rather than just local companies that joined the journey.

Mr PERRETT: Further to Dr Allen's question, before I go to mine, in terms of the return to the CRC for that commercialisation of the IP, do you keep track of that or do you get a cut of it?

Prof. Koronios: Both.

Mr PERRETT: As Dr Allen was indicating, it's a pretty good KPI for the taxpayer dollar. So could you give us a bit more data on that?

Dr Woodgate: The CRC program obligates us, before we even put a bid up, to have a very detailed economic impact analysis undertaken. It's got to be independently undertaken and it forms part of the decision-making criteria to get your CRC going. In our case, we calculated ours was a bit over three to one, based on the anticipated investments that we're going to make.

Mr PERRETT: Three to one?

Dr Woodgate: Three-to-one return in terms of the economic analysis. So you look at the value that's going to be created for Australia by this investment over a 15-year period, and it's discounted back. You do that analysis and build up a very detailed report which runs to hundreds of pages of analytics.

Mr PERRETT: Just give me the short *Reader's Digest* version of it. You must have some straight KPI.

Dr Woodgate: It's three to one.

Mr PERRETT: And you're tracking on that?

Prof. Koronios: We're tracking on that, about a billion dollars.

Mr PERRETT: I'm just trying to get my arts and law degree head around the economics of this industry. We had earlier evidence about the space industry in terms of the costs and how limited share is. I just want to get an idea of the costs of preparing the payloads, whatever the payload is. Is getting the payload to the launch site a significant cost or is it negligible? We're 16,000 kilometres from Paris. We're a long way from a lot of things, as is New Zealand. I just wanted to get an idea of how much that transportation cost would be for the types of payloads that people want to send into space.

Prof. Koronios: From my perspective, it's not so much the weight but about the ability—that is, if the supply chain of the world is limiting the ability for us to launch in New Zealand or in Paris or in North America. Is what you're asking?

Mr PERRETT: The premise seems to be, 'If you build it, they will come.' I just wanted to find out whether we'll have this perfect baseball field in the middle of a cornfield and no one will come.

Ms BIRD: If we're launching, is there enough domestic demand to make launch a viable business?

Mr PERRETT: And others.

Ms BIRD: And if you have international coming here, is that realistic?

Mr PERRETT: You must have an indication as to how much that is a cost.

Mr Kerr: Much has been written about the mega constellations like Starlink. But if you look at the trends for launch—and we have done this—there is a major shift in the last few years in terms of the volume of spacecraft being launched. It's not just the Starlink satellites being launched; it is a range of smaller satellites doing much more useful stuff, and they have done historically. The projections are that this will continue on. So if Australia had the capacity to launch from here, there would be enough supply, potentially, to meet that.

Mr PERRETT: So the distance we are from the 500 million people in Europe is negligible in terms of the costs?

Mr Kerr: Historically, the Optus C1 satellite from Defence, which I was involved with, and the two NBN satellites were launched from South America.

Mr PERRETT: So you can say it's negligible?

Prof. Koronios: It's small.

Mr PERRETT: We're not talking 50 armoured trucks sending the payload here; do you just put it in a post pack and send it here?

Prof. Koronios: Just about. Not quite.

Mr PERRETT: Not quite, but it's not significant. Okay. You made the point about the 2030 Space and Spatial Industry Growth Roadmap. I just want to be the devil's advocate here in terms of the road map idea. You're saying that we need a road map. I wanted to put an alternative proposal. We can't choose a road map because we don't know where we're going. It might actually be more useful to send every worker bee out to find the plants that are useful, and that will be the new beeline that we make, rather than saying, 'Let's all head for that bush; it looks good to us.' Government traditionally is not good at choosing the right plant to head to, if I can mix my metaphors of bees and road maps. That's my arts degree for you! Would you like to counter that idea?

CHAIR: Everybody's being polite. I haven't got a clue what you're talking about!

Mr PERRETT: Hopefully these guys are smart enough to understand what I was trying to say.

Dr Woodgate: I think we understand that question. The first thing is if the people who are guiding the development of this road map are doing it with three critical things in mind. First of all they're going to develop a discussion paper, which is just about there, which has identified around 20 key issues. It will go out probably to about 2,000 individuals across all of the relevant sectors in Australia. Feedback will come back, and that feedback is explicitly asking for the gap: what is it that we're not doing that we need, and where do we need to be as a nation in 10 years time? So it's user driven and asking where we need to be.

Mr PERRETT: So there's no point trying to invent the thing that we can buy off the shelf that someone has already built, that someone does very well?

Dr Woodgate: Exactly, yes.

Mr Kerr: Precisely.

Mr PERRETT: Okay, so you're looking for the gaps?

Dr Woodgate: We're looking for the gaps.

Mr PERRETT: And that off-the-shelf technology involves price, friends, national interests—all those sorts of things?

Dr Woodgate: Exactly: national interests, defence, security and commercial. So it's looking at all of those. Defence are a big player in this, and their view will be balanced by what we get from the other sectors. This road map, critically, is asking the question around the gap between the space assets and the information that space assets are going to produce. That's the spatial component, the mapping that needs to be done.

Mr PERRETT: Well, that was my question. If you'd sent NASA to invent velcro, they wouldn't have—or Tang or whatever the example you want to give. If you'd sent the CSIRO to invent wi-fi they wouldn't have. That's why I thought it was about sending the bees everywhere and then having them come back and say, 'This is what we can do well.' So my metaphors do collide with your meaning?

Dr Woodgate: They do. You're painting a nice word picture there.

Mr PERRETT: I do write in my spare time.

Dr Woodgate: So that degree was well used! You asked of Dr Rogers a question about agriculture and the fact that over the last decade or more the Chinese have put up a series of satellites that monitor all of the world's grain crops. They publish that. It's called CropWatch. That system enables the Chinese to give continuous reporting back up to the top levels of government on where all the grains are around the world and how they're faring. So they do know more about us than we know about ourselves.

Mr PERRETT: They want to feed 1.2 billion people.

Dr Woodgate: They do, and they want to get ahead of themselves on the futures trading as well—they've got a whole range of reasons for doing it.

Ms SWANSON: And they want to plant—

Dr Woodgate: Yes. So they've taken a long-range view.

Mr PERRETT: When they starve, they tend to get rid of governments in China.

Dr Woodgate: They do. I think that's certainly an issue which motivates them. I've spent a bit of time in China over the last 15 years, so I'm aware that their rural constituents are vitally important to the thinking of government over there and have been for a long while.

CHAIR: Member for Morton, I might give the member for Paterson a run.

Dr Woodgate: The last observation, Mr Chair, was: should we have a system like that or are we just happy to keep going the way we are?

CHAIR: I was just thinking: if we're buying something off the shelf, it's only off the shelf if someone who owns the shelf wants to sell it to us.

Dr Woodgate: Yes, no doubt.

Ms SWANSON: I want to go back to the idea of low-orbit satellites and data. We had a witness this morning who is in the business of low-orbit satellites. Again, they were saying how difficult the regulatory framework is and how at this point the agency aren't set up to help navigate their own frameworks. I guess also I'm looking for us to be able to make some recommendations. I think the high-level recommendations have been excellent, but, at a more practical level, how do we make some recommendations in relation to not only the legislation but also perhaps the agency and how it might improve? I'm asking for your opinion, in your experience thus far. We know that it's a fledgling agency. We know that there's a lot of work to be done, but we also have fledgling innovators who are on the precipice of success or failure. They want to succeed, they need the agency to succeed, but they need it to be more responsive. Given that you are a cooperative research centre, I am really interested in what recommendations you would make to us about that agency.

Dr Woodgate: I might tackle this first, Andy. Let me correct something for the record, Chair: I said 80 startups; it's 60 startups, and the rest are SMEs and multinationals. With 100 companies in our CRC as formal members, we've organised them into very cohesive groups. There are two groups. We've got a startup company

which has got a board over it that the startups have chosen. They've got a peak body and they've got a mechanism for systematically providing their thoughts to that board. That board relates directly to an industry advisory board that we've also established—and the chair of the board is sitting behind me—which brings in all the other companies. So we've given the startups a particular and focused voice, and they therefore have equal footing with respect to the SMEs and the multinationals, which is a big issue.

The critical thing is we now have the ability to get an answer to your question by systematically asking them what they need for launch. So, rather than us guessing or talking to a few of them, we will ask them that question and come back with a considered answer. That's one of the real benefits of having them organised in this way. We know, because they've joined us, that they are there for the innovation; they are there for the translation of research and development into practical commercial outcomes. So they relate to the thinking which is inherent in the mission of the CRC. They're a great group for us to poll and use systematically in this way.

CHAIR: Professor Koronios, did you want to add to that?

Prof. Koronios: I want to make a comment, if I may, on this question that you're asking. I think the Space Agency is one year old—

Ms SWANSON: 'Fledgling' was the word I used, yes.

Prof. Koronios: It's also a fledgling industry globally, not just the Australian industry. It's a fledgling global industry when it comes to CubeSats and LEO. It's also a very risky business because, as we all know, if there is a collision up there—and it's starting to get very crowded—then there are significant consequences for the whole system. Who is responsible for that? The Australian government is, if we cause the problem. Therefore, I am sympathetic to the space agencies taking a very steady and deliberate look at how they will actually have that regulatory environment.

CHAIR: Thank you very much, Professor Koronios. It sounds like we have a vital and enthusiastic industry, but it is a disparate and probably disconnected industry. I think, if there's a role for government, it's got to create some sort of vision that people can be part of and contribute to, or not. If they do, it will force a lot of the problems out; things will start to resolve themselves because they have a target to hit.

Thank you very much for coming in today. If you have been asked to provide any additional information—I think you yourself may have offered to do so—please forward it to the secretariat by 26 March 2021. You will be sent a copy of the transcript of your evidence and will have the opportunity to request corrections to transcription errors. Mr Kerr, Dr Woodgate and Professor Koronios, thank you very much for your attendance. We appreciate it.

HUSSAIN, Dr Muhammad Akbar, Founder, Southern Cross Outreach Observatory Project

[14:49]

CHAIR: I now welcome the representative of the Southern Cross Outreach Observatory Project to give evidence today. This hearing is a legal proceeding of the parliament. The giving of false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. The evidence given today will be recorded by Hansard and attracts parliamentary privilege. Dr Hussain, I invite you to give a brief opening statement before the members ask questions.

Dr Hussain: I thank the honourable chair, deputy chair and members of the House Standing Committee on Industry, Innovation, Science and Resources for giving me an opportunity to comment on the inquiry into and report on developing Australia's space industry.

On behalf of Southern Cross Outreach Observatory Project, a not-for-profit community science initiative for promotion of astronomy in remote Australian communities, I would like to propose establishment of a network of mobile observatories for the purpose of detecting and tracking of space debris. This will enable creation of a highly accurate database of their parameters and trajectories. Nearly five years ago we designed, constructed and executed the operation of Australia's first purpose-built mobile astronomical observatory for astronomy outreach in remote communities. Today we see the immense potential of this concept for the space industry, not just as an educational tool but also in its application in space situational awareness for tracking and cataloguing space debris with high accuracy.

We aim to harness the untapped potential of the vast Australian landscapes and its pristine, dark and clear skies to establish a network of mobile observatories that can rapidly deploy in remote locations with clear skies to observe space debris and create a database of highest precision. This will lead to the development of comprehensive algorithms to execute de-orbiting measures of space debris to ensure safety of modern space infrastructure and human space missions. Such a network of mobile observatories will bring a sense of participation in Australia's emerging space industry to remote communities. It will also make Australia a global leader in the effort of salvaging the earth's orbit to make it safe for our future generations. It will enhance Australia's role in global efforts in mitigating the space debris issue and will bring the world together to tackle a problem that affects us all equally. This will also create a sense and understanding in the world to reduce the militarisation of space. Space is big and common, and the only frontier that needs to be defended in space is the earth's orbit itself to make it safe for our future generations. Thank you.

CHAIR: Thank you very much, Dr Hussain. It was just today that the Hewitt camera, which was used for tracking satellites, was installed at Tamworth in a facility that was partially funded by the Commonwealth, so it's an interesting thing. I'm fascinated by this coming from a place called Danglemah, which is in a completely dark hilly area. It has a very good view of the sky because all the interrupting light is cut out. You can go out and watch stars; just the other night I was watching a big orange streak of light go across, which I imagine was space junk falling because it was obviously a different colour. When you say there's a lot of it out there, can you enlarge on that for the purposes of *Hansard* and for the fascination of others? What exactly do you mean? How much do we need up there before there's a possibility that pieces start running into one another?

Dr Hussain: At this moment I think we don't know yet. But as more and more countries and companies are getting into the space industry, with every launch and deployment of satellites there's going to be more junk in space, naturally, as part of the deployment. Secondly, as more junk is there, the likelihood of collisions increases. It's estimated that the space debris of greater than 10 centimetres in size numbers over 50,000 or 60,000, maybe even more, and that space debris between one and 10 centimetres in size is close to a million. Now, that is debris which cannot be detected or tracked easily and can still destroy a functioning satellite or even a human space mission, if it comes across it. This is the type of debris that cannot be tracked easily, so it's always a constant threat. We don't know yet if we have reached that tipping point, but the Kessler syndrome, as the name for this phenomenon of cascading—

CHAIR: What's it called?

Dr Hussain: Kessler syndrome.

CHAIR: Can you spell that?

Dr Hussain: K-e-double-s-l-e-r. It's named after a NASA engineer, Donald Kessler, who first proposed this idea back in the seventies. That process is going to start very slowly but, as more and more debris will continue to form in Earth's orbit, it will exponentially escalate.

CHAIR: This is a tangential question. Why is there space junk up there that's one centimetre and two centimetres wide? Has it already run into something and stayed in orbit?

Dr Hussain: We sometimes hear news of a small chunk of paint or small debris hitting and punching holes in the International Space Station. That is a common problem.

CHAIR: So it's already doing it.

Dr Hussain: Yes, they already do it. But that came to the surface and got world attention in recent years when two communication satellites ran into each other. They just had a collision course that wasn't predicted and that created a huge debris field, every single piece of which is capable of hitting another satellite.

CHAIR: So they are already running into one another.

Dr Hussain: I think that was the Iridium company.

CHAIR: How many years before they naturally come to earth?

Dr Hussain: It is estimated that, in low earth orbit, it may take up to 25 years, or at least 25 years, before they can deorbit. It also depends upon the solar activity, because, as the sun gets hotter and more active, the atmosphere expands, and that is our only hope that the small junk can then deorbit. But the space debris which is higher than that can take hundreds, even thousands, of years before it gets out of orbit.

CHAIR: I've got a lot more questions but I shouldn't be asking them.

Ms BIRD: I have one, if that helps. This is fascinating stuff. Should what you're describing be a private sector activity? It has the potential to be a business opportunity and, indeed, an exporting business opportunity. Or should it be something government is involved in? Why would the government be involved in it? What do you see as the relationship there for government?

Dr Hussain: There are a couple of reasons that I can think of. First, Australia is perhaps the largest piece of land with flat topography, clear skies and low light pollution where such a network of mobile observatories could be established. That could make Australia a global leader in space situational awareness and in mitigating of the debris problem. Second, the amount of extremely precise data that we can get through this network of mobile observatories can be used by our partners globally—space agencies and companies—at a cost that could sustain the operation of running such a network of mobile observatories. These mobile observatories, of course, will be connected to each other in real time, actually turning the entire continent of Australia into a single giant instrument.

Ms BIRD: I might clarify, just because I want my colleagues to have an opportunity. I don't doubt the benefits and the strategic advantage of Australia. What is the government's role in this? What exactly are you saying? Do you want government investment? Do you want government regulation to make it happen? If all that's true, business could set up and operate and do it. Yes, it would be a strategic advantage for Australia, but where, in your view, is the government in that?

Dr Hussain: In my view, the government can implement this idea as part of the initiatives for the Australian Space Agency and put some funding into it. The experts in the Space Agency can then work out a way to establish such a network of observatories. Part of the funding can come from investment, from the private sector, with incentives given to them as well for their participation.

Ms BIRD: So have it as an identified strategic component of the overall space story?

Dr Hussain: Yes.

Ms BIRD: Okay, that makes sense. Thank you, Chair.

Dr ALLEN: I think that even the members of the committee can see the excitement about such a level of engagement with regard to the public's imagination. What engagement have you done with the public and have you found a lot of receptivity to your wandering telescope?

And the second thing is: when it comes to the issue of funding such a mobile network, there's obviously the infrastructure, which is the telescope on wheels. But there's also paying for people to man it. I suspect that you managed to get the capital but that the rest of it's voluntary at the moment—is that right? It could be quite an expensive undertaking, so my question is about where a business model would come from. If government invested to get the capital works going, where would the business model come from with regard to paying for the ongoing service delivery? Who would pay for that data to be used at a global level?

Dr Hussain: You asked two questions?

Dr ALLEN: Yes.

Dr Hussain: The answer to your first question is that we're an amateur group of astronomers who built Australia's first mobile observatory. We try to run the operation of this initiative within our daily lives. Sometimes that gets hard but we do our best. The response of the public was phenomenal. We enjoyed that until the pandemic in 2020—

Dr ALLEN: Just out of interest: how much does one of these mobile telescopes cost, roughly?

Dr Hussain: I've never actually figured out the cost—what I spent in building the observatory. If I figured it out I might become depressed, so—

Dr ALLEN: Would it be \$10,000, \$100,000 or \$1 million?

Dr Hussain: Excluding the cost of the car, I think it sits somewhere around 30 grand. But this is a prototype; it is very, very basic—

Dr ALLEN: Yes. But if you had 10 of them you'd be looking at \$2 million or \$3 million in capital investment, or maybe a bit more, which is a small amount.

Dr Hussain: For the purposes of public education, of course we might not be any more expensive than our current prototype. But for something like detection of very small space debris, of course the telescope is going to be much more sophisticated and more top notch. Either you take it extremely seriously or you don't do it. There's no middle ground.

Dr ALLEN: And in order to professionalise it and then to capitalise on that professionalism, you'd have to have top-quality and then you'd have to have all the data connections and software behind it to make sure the monitoring is going on—

Dr Hussain: Yes.

Dr ALLEN: So it would be a big undertaking, I would imagine.

Dr Hussain: Yes. I did think of how to initiate such an thing. I thought that, first of all, it could be made like an innovative start-up or initiative for the Space Agency. If we could get industries on board, we could ask one industry to fund one observatory unit. I'm sure they'd be able to do that, and the rest of the infrastructure could be invested in by the government.

The incentive comes from the very high precision of the data. We're aiming to detect and track space debris of between one and 10 centimetres in size. That's the dark area we can't really track. This data could be sold to all the space agencies and organisations which are willing to make use of that for their own space situation awareness and manoeuvres. But there are also a lot of other space situation awareness initiatives going on in the world. Our aim is to use the vastness of Australia with the network of mobile observatories to achieve triangulation in order to achieve the highest-possible precision. This data can be used to deliver powerful lasers to start the de-orbiting of the debris.

Avoidance is good for preservation of space infrastructure, but unless we start de-orbiting the smallest of the debris the Kessler syndrome will happen sooner or later. The only way to stop that is to remove the amount of junk in space.

Dr ALLEN: How do you de-orbit?

Dr Hussain: I've been reading research about lasers, especially about the electro-optical system. The only problem with that is that current models of space situation awareness can only detect space debris up to 10 centimetres in size. Our network may be able to detect much smaller pieces, and then it becomes more practical to de-orbit a smaller piece of debris with that laser rather than a bigger one. What they're using is just a photon pressure, which is a very small amount of force. Using lasers to slow down the debris so that it burns itself up is the safest way to deorbit. We can't just shoot space debris and make 10 debris out of one, that just doesn't work. In my view, slowing down with [inaudible] pressure of lasers is the only way. What we need for that is extremely high precision data which [inaudible].

Dr ALLEN: With the space debris, especially in the lower quadrant, obviously it's potentially damaging to space equipment. Is it damaging to people on the ground as it falls?

Dr Hussain: No, it will burn up.

Dr ALLEN: It burns up as it re-enters into our atmosphere, so it's not a danger to the population?

Dr Hussain: No, not at all.

CHAIR: You can give that assurance?

Dr Hussain: Absolutely I can.

Mr PERRETT: Dr Hussain, why mobile rather than, say, three spots around Australia, including one in the chair's valley, darken valley, for triangulation? Why not three stationary spots rather than mobile? I assume it'll be hard to calibrate the equipment if it's mobile?

Dr Hussain: There are couple of reasons. One is the most dangerous space debris is in the lower orbit. They're only visible from a small distance. You might not be able to see one piece of debris from two observatories a few thousand kilometres apart because they're very low.

Mr PERRETT: The current data has it as 10 centimetres. Did you say 10 centimetres?

Dr Hussain: Ten centimetres or larger.

Mr PERRETT: So stationary establishments can now do to 10. You're saying mobile would let you go below 10?

Dr Hussain: What I'm saying is the space debris which is of most concern is in the lowest orbit around 500 kilometres—

Mr PERRETT: What is the technology currently in both those establishments that tracks data—that can get to 10 centimetres. Is that what you're saying?

Dr Hussain: They can definitely track my smaller debris as well. Such structures are very far apart from each other. In order to triangulate on a single piece of debris they need to be much closer to each other. The second thing is that, for example, if there is cloudy weather or it is overcast for weeks on end that will halve the amount of data collection that a fixed structure can do. A mobile observatory can just drive off to clearer locations with better forecasts. That will give a seamless operation. That's the main thing. The mobile observer network will offer a seamless operability and constant delivery of data.

Mr PERRETT: You had some attempt at articulating annual costs. You're talking vehicles, equipment, wages or are you talking volunteers? Are these space junkies that go out and do it for free?

Dr Hussain: I have been watching this space debris from my telescope. A lot of people would be interested in looking at it as a hobby. But in order to implement or execute the dual orbiting manoeuvre this effort needs to be very, very serious. As I said, you have to be fully involved in it, in all aspects from the financial to the technological point of view. Volunteers can't do that. It has to be initiated under the umbrella of the Space Agency.

Mr PERRETT: Is the Southern Cross Outreach Observatory Project new?

Dr Hussain: Yes. My friend sitting up the back—

Mr PERRETT: Alight. Two of you. We've got all of the stakeholders in the room.

Ms SWANSON: Thanks, Dr Hussain, for joining us today. I asked a witness earlier today about this very topic, about space junk, because we know that it's an increasing problem and it will be a big problem. The answer that was given to me was that this is an international issue and Australia, of course, must play its part. Perhaps my question goes in some way to answering Ms Bird's question earlier about why it was a government responsibility. Do you agree that we need to play our part in, firstly, minimising space junk and, secondly, eradicating it? Basically from what I can work out, you're saying that you're creating an internet of things for space junk. Would that be correct?

Dr Hussain: Absolutely.

Ms SWANSON: This is an international problem and Australia has to play its part? I'm interested in your thoughts on this.

Dr Hussain: Australia can play a pivotal role in detecting and mitigating the space debris issue because we have a vast uniform land with low light pollution, and low population, good infrastructure and clear and stable skies. I feel that it is our responsibility to the world to implement the best model of space situational awareness because you cannot implement it anywhere else in the world.

Ms SWANSON: It's an international problem but we are one of the only places in the world that can help get the data to solve it. Therefore, this must be an exportable product. That's the rub that I'm getting to here. Yes, we've got to be part of the solution. Perhaps we could use the monetisation of helping solve that problem to help fund other areas of our space industry. Am I catapulting us off into a fiction here, or is that a viable option? Do you follow me, Chair?

CHAIR: Yes, but it's sort of via the bees and the—

Ms SWANSON: Actually, it's not.

Ms BIRD: Could it be a government business that is generating income—which would be a very unusual model—or is the role for government to actually facilitate somebody establishing or producing such a business?

Dr Hussain: A few days ago someone asked me why no other country has established a natural [inaudible] observatory, and I said it's because they can't. Australia is the only place in the world you can do it. You can't do it in Siberia and you can't do it in the Sahara. The Sahara has dry desert but there is no infrastructure. And you can't do it in Europe because of light pollution. Australia ticks all the boxes for the establishment of such a network. There won't be any global competition in establishing a space situational awareness observatory. Based on the network of [inaudible] observatories. Australia is the only place, so there are no competitors. And the precision of data will be unmatched.

CHAIR: That was fascinating, Dr Hussain. It is great to meet someone with such a fascination. How does a paediatrician who was born in Pakistan and moved to Australia become so proficient in another field? What drove you?

Dr Hussain: I actually left the paediatrics profession. I'm now a general practitioner in rural and remote medicine. The reason for that was to have access to clear skies. Secondly, I am also a Swinburne graduate in astronomy. I graduated in astronomy in 2018. I also completed a course in space applications in the Australian context at Swinburne University in 2019. I was recently a top 10 finalist in designing an engineering model of a city on Mars. My design is post office ticketed; I have already applied for a US patent for that design, and we're waiting for it to be approved. I also launched a startup company and managed design for engineering and innovative solutions for human habitation on Mars with two geniuses. One is an engineering genius in Melbourne and one is a business and administrative genius in Pakistan. So we've got a team of three. We are very positive on that.

Ms BIRD: But you have no sports or hobbies!

Dr Hussain: My colleagues say I am working in general practice as a hobby! That's not true. I am as passionate in medicine as I am in space.

CHAIR: That's great. That's really good. Thank you for coming today, Dr Hussain. If you have been asked to provide any additional information, please forward it to the secretary by 26 March 2021. You'll be sent a copy of the transcript of your evidence and will have the opportunity to request corrections to transcription errors. Thank you very much for your attendance. I'd like to thank the members and the witnesses for their time today.

Committee adjourned at 15:15