INQUIRY INTO DEFENCE INDUSTRY IN NEW SOUTH WALES

Organisation: Mission Systems Pty Ltd

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Dear NSW Legislative Council,

Defence Industry in New South Wales

In response to your invitation to submit ideas in relation to maximising opportunities for NSW businesses in defence industry, I want to highlight that NSW is now uniquely placed among the states to exploit a multitude of scientific and commercial developments in areas of maritime robotics technologies – particularly those with defence applications.

It is clear from a quick review of other submissions made to this inquiry that a common theme has emerged from industry respondents, who are now urging the state government to look beyond the traditional "big steel" industries of submarine and ship building to also consider pro-actively supporting the more sustainable *Strong, Smart and Connected* high-technology industries associated with increasing levels of automation in the ADF. I will focus specifically on the coming wave of autonomous maritime technologies and the opportunities they represent.

As a defence scientist and former head of the unmanned systems and autonomy group at the Defence Science and Technology Group's Eveleigh office (2012-2017), my job was to oversee the development and acquisition of unmanned systems for the Royal Australian Navy. In consideration of its prospective contribution to the high-technology economy of NSW and its important role in addressing some of the looming security problems of the Nation, I believe that the NSW Government should target special support for the maritime robotics sector for its immediate and on-going benefits to the state.

Mission Systems Pty Ltd

On leaving DST a year ago, I founded Mission Systems as a start-up business in the area of advanced robotic technologies with an academic colleague, Dr David Johnson, from the Australian Centre for Field Robotics (ACFR) at the University of Sydney. During my five years at DST, it became clear to me that our technologically advanced allies – and even our five-eyes partners – were less than willing to share key defence capabilities. This was particularly true in the area of anti-submarine warfare (ASW), which has lately assumed a high priority with both the RAN and the Australian government due to the proliferation of modern submarines throughout the Asia Pacific. The take away here is that Australia must find solutions to some of its most vexing security problems on its own and these solutions must be suited to our geography and vast maritime jurisdiction. Solutions which might work well for our neighbours in Asia may fail or prove impractical for Australia: *Our neighbours may have straits, but we have oceans.*

I will now briefly elaborate on the special advantages that I believe NSW holds in its capability to deliver autonomous maritime technologies for Defence. Like most other states, NSW has a Defence Industry Network (DIN) and a DST presence, but I will focus on what I believe really puts NSW ahead of the pack in terms of the defence relevance of its institutions and businesses.

Trusted Autonomous Systems (TAS) CRC

On the 18th of December 2017, Minister for Defence Industry, the Hon Christopher Pyne MP, announced the formation of the first Defence Cooperative Research Centre (CRC) for Trusted Autonomous Systems along with a list of inaugural participating members selected by an international panel of industry, academic and military experts.

https://www.minister.defence.gov.au/minister/christopher-pyne/media-releases/first-defence-cooperative-research-centre-formed

The $50M Defence CRC in Trusted Autonomous Systems will be a collaborative program that brings together industry (particularly small to medium enterprises), academia and publicly funded research agencies to create an interlocking research and innovation capability. It will focus on developing a Defence capability in the form of unmanned platforms that ensure reliable and effective cooperation between people and machines during dynamic military operations.

With its objective of applying the very best and latest in academic theory to real-world problems and the combined track records of its principals in defence science, Mission Systems was selected among the small number of inaugural partners. While Queensland will host the overall CRC, it is important to note that most of the key partners in the maritime program – namely Thales Australia (the overall maritime lead), Mission Systems, The University of Sydney and Ocius are all from NSW.

Mine countermeasures (MCM)

Sydney, of course, has always been a Navy town, with the harbour hosting a multitude of bases and depots. HMAS Waterhen at Waverton supports Australia's mine countermeasures and clearance diving (MCD) group, which will soon receive its first tranche of unmanned systems delivered under projects SEA 1770 and 1778. These systems represent a significant departure from the way our navy has traditionally undertaken mine countermeasures and will include unmanned "drone" boats and autonomous underwater vehicles – the first capability of its type to be operated by the RAN. Because of its inherent dangers, mine countermeasures saw early application of unmanned systems, with much of the sophisticated underwater technology originating in the United States. Poor underwater communications pose particular problems for these systems, which has driven the development of sophisticated autonomy and decision making software for MCM.

Our successful proposal to the TAS CRC mentioned above was for the development of detailed simulations of this new MCM technology to enable accelerated experimentation with new concepts of operation. After establishing an initial operating capability, the navy will institute spiral development of its mine warfare doctrine and technology, with a particular focus on adapting each to the other through the addition of after-market autonomy software. Although this spiral development is currently beyond what has been proposed under the TAS CRC, NSW industry stands to benefit through close collaboration with both the MCD group and overseas suppliers of cutting edge maritime technology. The RAN would benefit through autonomy solutions tailored to their own requirements with local industry reachback.

As defence technology (and especially autonomous systems technology) must continually evolve and improve to preserve tactical advantage, there will be an on-going requirement for sophisticated software development by suitably qualified businesses in NSW. This activity, focused as it would be on a particular naval problem, could easily be the genesis of a new and valuable industry sector with a much wider reach. The sovereign capability developed would be increasingly important not only in terms of the warfighting edge it would give our navy, but also in terms of export opportunities to allied nations and spin-offs into civilian robotics applications.

Persistent surveillance

In the 1960s, the United States constructed a vast array of underwater listening stations throughout the northern hemisphere to detect and track Soviet submarines. This sound surveillance system – or SOSUS – was a secret weapon during the cold war, keeping the US apprised of submarine movements. In the intervening period, much has changed in both geopolitics and submarine technology, with submarines now being harder to detect by virtue of being – on average – far quieter. This means that undersea monitoring must be smarter and adaptive to environmental conditions – always ready to exploit detection "windows" which occasionally open through the waxing and waning of background noise.

Form time to time, SOSUS-inspired systems have been proposed as a solution to what has recently become a serious problem – the incursion of foreign submarines into Australian waters. On some estimates, roughly 60% of the worlds submarines are now operating in the Indo-Asia-Pacific region. At the same time, our level of knowledge concerning what takes place beyond 1000 metres of our shore line is effectively zero.

Rather than investing in cold war technology, which would have significant operational draw backs and would probably also be ill-suited to our areas of chief strategic interest, I have long believed that a fleet of mobile autonomous systems would be a better fit for Australia. This robot fleet, comprising large numbers of indigenously constructed vehicles and sensors could be programmed to roam both above and below the surface, making autonomous decisions about what to report and what to ignore. They could be arranged to collaborate in both detection and communication and would be passive in the sense of not transmitting significant additional sound into the ocean, thus posing a minimal environmental impact. In fact, the acoustic and oceanographic data collected would be a boon for researchers in many areas of ocean resources, cetacean monitoring and climate science.

Speaking as an acoustician, roboticist and now businessman, I believe that this is now feasible and possibly also the basis of future industries in NSW. While working at the Massachusetts Institute of Technology in the early 2000's on the US-Navy funded PLUS-Net program, I actually participated in the early experiments on just such a system, which is now in operation. By its very nature, an Australian system would be distributed around the country and would support technology-based businesses involved in the continuous cycle of deployment, recovery and refit of platforms and sensors at a small fraction of the cost of crewed ships and submarines in the same surveillance role.

To quote the Australian Strategic Policy Institute's 2016 special report entitled "Australian border security and unmanned maritime vehicles":

"Today's in-service passive surveillance UMVs offer clear capability benefits for Australia's border security. It's likely that emerging and future conventional and hybrid UMV platforms will offer exponentially better capabilities for border protection, servicing more of the border protection task"...

"To reduce the organisational risk associated with being an early adopter of UMV technology, Maritime Border Command should consider an entrepreneurial public–private sector collaboration model. Such a framework could involve offsetting the operational costs and risks of a UMV capability by outsourcing UMV operation and maritime data collection to private enterprises. A private sector entity could develop and deploy capabilities on an ongoing contractual basis. Data management and the analysis requirement for UMV capabilities could be included in an outsourcing agreement or handled by Maritime Border Command. Such an approach would leverage the private sector's ability to acquire, deliver and operate new technologies more quickly than the public sector"...

"A partnered or outsourced approach could also have substantial economic benefits for Australian industries. From the manufacture of components to the construction and whole-of-life support of Maritime Border Command UMVs, there would be many opportunities for industry growth. There are innovation opportunities in platform development, energy-efficiency technology, sensor technology and data management. These private sector developments could translate into export sales, especially if a private maritime surveillance enterprise is successful in Australia".

Most importantly for NSW, there could be an industry based on the design and manufacture of systems, sensors and software with likely strong synergies with the existing Smart Sensing Network. This industry would be very different from conventional ship building, with the platforms being far smaller in size, but far more numerous and every bit as sophisticated. The workforce behind this industry would draw on all the advanced manufacturing skills of today as well as professions of the future involving robotics and machine intelligence. For the ASW problem in particular, a deep understanding of the acoustic environment would also be vital to addressing the threat from quiet submarines. Through my defence and academic contacts, I know that this meshes perfectly with many important multidisciplinary research initiatives in the planning stage – one in particular concerning humpback whale migration up and down the eastern seaboard of Australia. By virtue of their frequent vocalisations while submerged, transiting whales make excellent sources of opportunity for testing passive acoustic monitoring systems.

World-class institutions

Having lived and worked in the New England area of the United States earlier in my career, I have seen how particular areas with the right mix of iconic academic institutions and business infrastructure can quickly become hubs for new niche technologies such as maritime robotics. I believe I see similar

essential ingredients in NSW, with high-quality educational institutions – both regional and Sydney based – along with a major defence customer and a vibrant startup culture. I have also seen how successful high-technology businesses such as Hydroid and Bluefin Robotics have spawned additional businesses activity in manufacturing and support areas.

In addition to being an inaugural member of the TAS CRC, the Australian Centre for Field Robotics at the University of Sydney supports an ocean-going maritime robotics program and has an international reputation on par with that of US institutions such as the Robotics Institute at Carnegie Mellon University and the Massachusetts Institute of Technology. I see institutions such as ACFR as an essential ingredient to a successful maritime robotics enterprise in NSW.

Existing core industry base

Autonomous maritime systems are now more than capable of carrying out many maritime surveillance tasks that continue to tie up scarce naval assets – their role being not so much to replace expensive ships and highly trained crews, but to extend their reach while allowing personnel to re-focus on the types of jobs that humans are needed for, i.e. the more nuanced assessment of information leading to decision making. From my own experience, I know that the RAN appreciates this point and would enthusiastically support the use of robotic technology if only it could be proved sufficiently robust in service. Hurdles to be overcome in achieving this vision include the right mix of economic incentives as well as the resources needed to trial the maritime robots of the future, which already exist in prototype form in the workshops of several small businesses throughout NSW, such as Ocius at the University of NSW and Ron Allum Deepsea Services in St Peters.

Navy of the future

Ship building is an important industry and most people think of ship building programs first in any discussion of economically significant defence projects. But the tide is turning, and the navy of the future will need to be different from that of today. While there may never be substantially more ships or crews, the importance of intelligence gathering throughout areas of strategic importance will only increase in the new world order. The intelligence of the future regarding ship, aircraft and submarine movements will be gathered not by crewed platforms, but by sophisticated unmanned systems – maritime robots equipped with sensors and on-board computers capable of autonomous decisions.

With other states focusing predominantly on naval ship building programs, only to be forced to periodically re-tool and re-train during the inevitable valleys of death between projects, I would urge the NSW government to prioritise the more sustainable, but no less economically valuable industries of the future that are set to transform the platform-centric thinking of defence planners.

Autonomous warrior 2018

Later this year, NSW will host the "Autonomous Warrior" exercise in and around Jervis Bay, in which various autonomous maritime technologies from the industries and navies of allied nations will be assembled and demonstrated. This activity will mark another stage in the developing awareness of autonomous systems by world navies and could be pivotal to the ADF's perception of their utility. For the state government, AW'18 could be a watershed moment in cementing NSW as the home of maritime robotics development in Australia, and the beginning of active support for this industry sector through a structured mix of business incentives. Matching federal funding available through the Trusted Autonomous Systems CRC to NSW businesses would be one way of achieving this, with all projects pre-vetted for quality and relevance by the CRC review process.

The way forward

Independent to this submission, Mr Robert Dane of Ocius – a sydney-based manufacturer of unmanned surface vessels for surveillance – has proposed that an area south of Jervis Bay be gazetted for the testing and evaluation of autonomous maritime systems. Being adjacent to the ADF's East Australian Exercise Area (EAXA), this area is frequently used for maritime defence trials. Establishing such an area, providing it could be sufficiently de-conflicted with existing shipping and fishing activities, would be a great start to NSW assuming a leading role in maritime robotics.

It is important that the unmanned systems of the future, whether they are surface craft, underwater or air vehicles are trialed under the full spectrum of ocean conditions for months rather than days at a time. It is only by doing this that the technology will ever reach the levels of dependability and economic viability needed by the navy. I applaud the Ocius initiative in requesting such a zone – which would be only the second in the world – as an important first step to building the fleet of the future and seek the state government's further support of the nascent maritime robotics industry in NSW in solving some of Australia's most important long-term security problems.

Conclusion

With the Federal Government having already expended considerable effort identifying and narrowing its defence industry priorities, it falls to state governments to target specific priorities based on their state's strengths and ambitions. I have outlined here a few reasons why I believe a *Strong, Smart and Connected* **maritime robotics** sector is deserving of special support in NSW.

I have also suggested a couple of ways that direct support might manifest, such as matching federal funding for maritime robotics projects in NSW, citing mine countermeasures and persistent surveillance as two commercial opportunities. Lastly, I would encourage the NSW government to support the Ocius proposal for gazetting an appropriate region off the NSW coast for testing and evaluation of autonomous maritime systems. This would be a concrete step towards establishing a persistent surveillance technology demonstrator along the eastern seaboard, which would be a world-class technological objective, and ultimately very important to the nation.

Yours Faithfully,

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