Mr. David Sullivan, Committee Secretary
Senate Foreign Affairs, Defence and Trade Reference Committee
PO Box 6100
Parliament House
Canberra ACT 2600

29 December 2014

Dear Sir,

Re: Inquiry into the potential use by Australian Defence Force (ADF) of unmanned air, maritime and land platforms

Thank you for the opportunity to make a submission to this inquiry. As you may be aware, I have previously submitted a number of published articles on the use of unmanned air, maritime and land platforms to this committee. The express purpose of this correspondence is to be able to provide a useful summary of the key advantages (and some disadvantages) of these technologies, to this committee, based as much as possible on the criteria previously set by the committee.

For the purposes of clarity, the following definitions will be used when referring to the various kinds of unmanned systems; UAVs (unmanned aerial vehicles), UGVs (unmanned ground vehicles), and *maritime* unmanned systems consisting of UUVs (unmanned underwater vehicles) and USVs (unmanned surface vehicles). Additionally, the definitions UCAVs (unmanned combat aerial vehicles), UAS (unmanned aerial systems) and UWS (unmanned weapons systems) may also be used.

The use of UAVs in operational theatres of conflict has been nothing new, with the US and Western coalition partners (including Australia) using them to great effect both as Intelligence, Surveillance and Reconaissance (ISR) platforms , and as UCAVs to carry out 'targeted killings' of enemy combatants in Iraq and Afghanistan. UAVs have been particularly successful because of the key advantages that they possess over manned aircraft, which include:

- **Risk reduction** to both pilots and aviation assets
- **Longer on-station or 'loiter' times**, for example 12-14 hours as compared to a maximum of 2 hours for most fast jet aircraft. UAVs such as the 'Triton' or the 'Global Hawk' being capable of staying aloft for up to 24 hours to carry out routine ISR missions
- **Larger ISR area of scanning territory**, for example the Global Hawk is capable of scanning of up to 60,000 square kilometers of territory in a single 24 hour period,

making it particularly attractive as a key defence asset to monitor and patrol Australia's large coastline, and making it an excellent replacement for older RAAF maritime patrol aircraft such as the AP-3C Orion

- **Quiet** or 'stealthy' operation
- Significant **cost reductions in the price to purchase** these technologies when compared to the price to purchase modern fast jet fighter aircraft. As a case in point, the recent cost blow-out of the new U.S. F-35 manned fighter jet has risen beyond $100 million per jet
- Significant **cost reductions in the price to purchase additional parts/components** as compared to manned aircraft
- Significant **cost reductions in the training** of new UAV pilots as compared to the protracted training period required for pilots of manned aircraft
- The **ability to arm these technologies** for specific strike missions
- **'Human error' or split second decisions can be reduced** by using UAS as they have the capability of scanning, circling and zooming in on a target, and beaming that image back to an operating team so a decision to strike can be given more time to be decided. By comparison, pilots don't often have a very good view of what's happening on the ground hence the killing of innocents and/or friendly forces can occur
- The ability to operate pilot-less missions following a **pre-programmed flight path** using a computer and associated software
- Provide good **quality real-time intelligence/data gathering** over encrypted and non-encrypted communications networks, including audio relay (including day and night imagery using state-of-the-art cameras)
- The utility of **flexible and reconfigurable airframes**
- The utility of more **fuel and energy-efficient engines**
- The capability of **'swarming'** or in other words, operating in coordinated groups (this capability is currently 'experimental' though significant progress has been made to date in this area and the research continues)
- The flexibility of operating **combined manned and unmanned missions** (in this scenario, UAVs would receive instructions from the pilots of manned aircraft, and because of the shorter communications distances used, the UAVs would be less susceptible to hacking of their operating systems
- A **greater degree of operating autonomy** in the future, but one where man is always kept 'in the 'loop'
- **No aircraft runway needed** to operate many UAVs, particularly the smaller models, which can be operated using simple 'ground launchers' such as a catapult system, thereby providing significant cost savings on infrastructure
- **Technology miniaturization** is another significant advantage in that there are now UAVs as small as a hummingbird (and others as small as insects being developed) all of which can be remotely controlled. These same 'mini-UAVs' are armed with cameras and can easily beam back messages to mission headquarters while largely being even detected due to their small size

While many of the above key advantages also apply to the operation of both UGVs and maritime UUVs and USVs, these ground and sea platforms also have some unique applications of their own. For example, UGVs can be used to follow small military squads to act as **'porter' robots** to carry military equipment and weapons, to act as combat **'casualty extraction devices'**, and when armed, to act as **fire support vehicles**. They can also be used as **security vehicles** which can monitor and secure sensitive industrial sites, such as nuclear power plants, and to monitor luggage for potential explosive devices at airports.

With respect to maritime applications, USVs have the advantage of both speed and maneuverability, and when armed, and operated remotely make for excellent **'unmanned' patrol boats** which can police illegal offshore people-smuggling and drug-smuggling activities. Similarly, UUVs have the key advantage of stealth, and apart from their obvious **naval combat applications**, they can also be used across a wide spectrum of civilian maritime applications including **oceanographic assessments,** monitoring of **underwater pipelines and communications cabling**, and for **fisheries audits.**

In this short summary I have spent a lot of time outlining the key advantages of these unmanned platforms, but it should also be noted that they have some inherent disadvantages, or weaknesses, which also need to be highlighted and considered. These include:

- In some areas **international law** may have not kept pace with technological advancements, and particularly with respect to the 'Law of Armed Conflict', it may need to be revised

- The use of UAS and UCAVs being used in countries where war has NOT been declared, ie. Pakistan. Would the forces using these UWS be liable to **war crimes prosecution?**

- UAVs and UCAVs are **only effective in uncontested airspace**. They are not yet at the level of sophistication where they could be deployed to oppose modern fast fighter jet aircraft

- UAVs and UCAVs are easily **susceptible to ground-to-air AND air-to-air missile strike** (though new self-defence measures are currently being developed to reduce this risk)

- Unmanned platforms have **critical vulnerability to cyber attacks** (though new systems are currently being developed to eliminate this risk)

- The challenges of imposing new domestic laws and regulations so as to allow UAS to **share airspace** with both civilian and military aircraft

- **Time lag in communication** between UAV and its command centre (often only minutes)

- **Privacy issues**. Unmanned platforms should not be used illegally to spy on law-abiding citizens

- **human psychological factors** and the potential 'limits' that they can impart

While each and every one of the above 'challenges' are legitimate and are due serious consideration, it should be said that all of them will inevitably be resolved. In fact, many solutions are already currently being worked on to address these various issues and problems.

The growing importance of increasing automation and unmanned platforms is evident in the way that the world's biggest militaries are increasingly, expansively and permanently incorporating these technologies into their own UWS hierarchies. Countries such as Israel, the U.S and China are currently leading the way in this area. In my personal view, the key advantages of these unmanned platforms considerably outweigh their disadvantages, and Australia cannot afford to ignore these rapid developments. It needs to increase their utilization within the ADF. Some key areas of national security where Australia would stand to gain the most benefit would be to (1) have a weaponised (long endurance) UAV platform with excellent ISR capabilities for coastal monitoring and protection, and (2) to operate UCAVs as stealthy, penetrating 'quick strike' platforms (3) an equally important area would be the acquisition of both UUVs and USVs to patrol Australia's littoral/coastal regions (from above and below the water's surface). Lastly, (4) the acquisition of 'catcher drones' or a UAV/UAS intercept (shoot down or GPS signal jamming) system as a preventative measure against drone intrusions in established no-fly zones, and other important or sensitive government sites.

The future is one of increasing automation which will impact many facets of our daily lives. This includes robotics, autonomous systems, miniaturization, big data, and advanced manufacturing (including 3-Dimensional printing). Technological advancements cannot be ignored, and as history has shown, they are readily utilized as 'time waits for no one'. These advancements are the future. The field of aviation will simply integrate unmanned aviation into its fold, as will equally the other key fields utlising unmanned platforms. The enormous benefits of unmanned platforms to us as a society span across a wide spectrum of fields including defence, policing, agriculture, natural disaster management, search and rescue/evacuation, fire control, security and crowd control, (driverless) maritime, road and air transportation, surveillance, military medicine, research and development, military transportation, traffic management, forestry and fisheries, offshore oil refineries, to name but a few..

Although these unmanned platforms will be immensely useful to us in the way we do things both now and in the near future, we should remember that such technology comes with responsibilities, and we will have to be ever vigilante as to whom we entrust it to. As a case in point, imagine a potential scenario where a 'Predator' UAV armed with a number of Hellfire missiles, has been 'hacked' by terrorists, or simply malfunctions due to a 'system error'..? the end result could be disaster on an unprecedented scale. Hence the importance of ensuring that this technology is strictly contained, and that only authorized and trained personnel are always at the helm.

Recently, Professor Stephen Hawking, one of the world's leading scientists from London, predicted that 'man we will be overunn by machines in the future'. While there is a risk that this could happen in the very distant future, the realisation is still frightening.. With increasing automation, the rapid pace of technological advancement, and with advancing super-computer and optogenetics research into the 'superhuman brain' we need to be careful to ensure that every successive advance is kept in check, and that we never allow highly intelligent 'super computers' complete autonomy, as the

result could potentially be devastating for our species. Also, because at the end of the day, we still need to be able to hold on to the characteristics of empathy and sensitivity that define our species..

In summary, while unmanned platforms are immensely useful and advantageous and should be incorporated at a greater level within the ADF (for the reasons recommended above), in the longer term future, we need to be aware that there are also considerable risks in allowing the 'machines' complete operational autonomy (and therefore strategies to mitigate these risks should be developed and strictly maintained) as man should ALWAYS remain 'in the loop'.

I trust that this summary will provide the Committee with a comparative view of the issues, which will encourage useful debate on the use of unmanned platform technologies by the ADF.

If I can be of any more help please do not hesitate to contact me.

Yours Sincerely,

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