Chapter 3

Effectiveness

Introduction

3.1 This chapter will examine the effectiveness of unmanned platforms. This includes:

- the advantages of unmanned platforms;
- the cost-effectiveness of unmanned platforms;
- unmanned platforms in contested areas;
- the reliance of unmanned platforms on communications;
- the complementary role of unmanned platforms to manned platforms; and
- the reliability of unmanned platforms.

Advantages of unmanned platforms

3.2 A large number of submissions highlighted the technical advantages of unmanned platforms, particularly UAVs. Factors which were commonly listed included:

- risk reduction for pilots and assets;
- longer flight times and the ability to 'loiter' in target areas;
- larger geographic areas which can be covered for ISR;
- stealthy operation, lower observability profile, smaller size;
- lower cost of acquisition and operation than existing manned platforms including training, components and maintenance;
- flexible and reconfigurable payloads; and
- less demand on pilots/operators with the capacity to follow pre-programmed flight paths.

3.3 Defence characterised the ADF's adoption of unmanned platforms as occurring for the same reasons they had been taken up in the commercial sector—to reduce risks to personnel and to extend capabilities.[1] Several contributors summarised the advantages of unmanned platforms as being a preferred alternative for 'dull, dirty, dangerous' missions. For example Northrop Grumman explained:

> Dull missions might include lengthy intelligence, surveillance and reconnaissance (ISR) missions that involve prolonged periods of monitoring and observation. Dirty missions are those that might expose

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1 *Submission 23*, pp. 5-6.

> personnel to hazards, such as when undertaking chemical, biological, and nuclear detection operations. Dangerous missions are those that might be conducted in lethal operational environments. Unmanned systems perform all of these missions with far less risk to the operating personnel.[2]

3.4 Defence highlighted that unmanned systems are often able to provide a capability not previously available to commanders:

> The persistent surveillance provided by UAS platforms such as the Shadow, Heron and (in future) Triton, is considered a force multiplier for forces being supported. The utility of smaller platforms is that they can provide small ground elements with an airborne surveillance asset not previously available. Due to the smaller size of unmanned systems they are more economical, and can typically fly longer without refuelling or the risk of pilot fatigue. The ability to supplement traditional air elements in a cost-effective manner is a principal advantage of the smaller unmanned systems.[3]

3.5 Persistence was repeatedly identified as the key advantage of unmanned platforms, particularly UAVs. For example, Mr Brian Weston observed that aerial persistence was previously only achievable 'by cycling multiple manned aircraft…rapidly running down fleet and crew availability in the process'.[4] Similarly, Mr Anthony Patterson from Cobham Aviation Services, stated:

> With a manned aircraft you are essentially limited, depending on the crewing arrangements, to somewhere between six and 12 hours, and you have to return to a base of operations to swap out the crew. The real benefit of unmanned systems in the space is the fact that they can stay airborne, depending on the altitudes you are operating at, for 20 to 40-plus hours.[5]

Cost effectiveness

3.6 A number of complexities were observed in relation to the cost effectiveness of unmanned platforms. Several submitters and witnesses emphasised the 'back-end' of unmanned platform systems needed to be considered as well as the 'front-end' of the platform itself. Defence commented:

> Notwithstanding that the direct per hour operating costs associated with unmanned systems may be cheaper than traditional manned platforms, the total cost of the capability must be considered. Unmanned systems still require 'human-in-the-loop' procedures for operations, maintenance, and, where relevant, ISR data exploitation and dissemination. For systems that are capable of operating 24 hours a day, 7 days a week, the manpower overhead for operating and data processing becomes significant. In the case

2 *Submission 12*, p. 2.

3 *Submission 23*, p. 12.

4 *Submission 4*, p. 3.

5 *Committee Hansard*, 4 May 2015, p. 2.

> of UAS, the simple metric of cost per flying hour is not an accurate reflection of the true cost of operations.[6]

3.7 However, Defence also observed that for UGVs and UUVs involved explosives neutralisation or naval mine detection 'the cost of the system can easily be mitigated against the potential price of a human life'.[7] Similarly, Air Vice-Marshal Gavin Davies made the point that 'economy' is not just measured in dollars but is also 'about the ability to conduct the mission':

> If you were to consider, in a maritime domain, the acquisition of Triton, we are able to reach areas in Australia's maritime approaches that we could get persistence in, to identify whatever the mission is of the day for further ranges—we can stay for longer, we can gather more data and then make an assessment beyond that. The range of Triton is considerable; it is an economy of its own.[8]

3.8 Northrop Grumman described the assertion that UAVs are cheaper to buy or operate as 'overly simplistic and misleading'. It argued that a shift in perspective was essential 'to ensure that Australian force structure reviews no longer simply focus on platforms, but systems'.[9] It argued the 'up front capital comparisons with manned aircraft are often misleading as they are rarely based on a credible comparable operational metric, such as "surveillance product per square km"; rather simply being based on the "cost per flight hour" a measure that often bears little relationship to the "cost per unit of operational capability". It noted:

> Operators of military aircraft systems may point out that a fleet of UAS requires a significant number of ground based operators to analyse the enormous amount of data collected by the systems, and to support missions spanning 24 hours or longer...[10]

3.9 The increased use of civilian contractors and non-specialist personnel to operate unmanned platforms was a related issue. It was noted during the inquiry that Australia had been slow in adopting a civilian contractor base for UAV support for forward deployed areas of operation. It was also argued that efficiencies were being missed through an operational model of one pilot per aircraft and aircraft maintenance undertaken by trade-qualified aircraft technicians. Potentially, multiple unmanned platforms could be controlled from one ground station with significant maintenance being undertaken by non-technical aviation personnel.

3.10 The extra ISR capabilities of unmanned platforms were perceived as creating additional demands on processing, exploiting and disseminating (PED) intelligence

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6 *Submission 23*, p. 12.

7 *Submission 23*, p. 12.

8 *Committee Hansard*, 14 April 2015, p. 42.

9 *Submission 12*, p. 7.

10 *Submission 12*, p. 5.

systems. Mr Weston noted that the raw data produced by UAVs 'is of little use unless it can be filtered, assessed, analysed and disseminated to where it is most needed. He noted 'raw ISR data is perishable, so unless the surveillance data can be transformed into a refined and deliverable intelligence product quickly, the full capabilities of ISR UAS will remain under-exploited'.[11] Dr Andrew Davies from Australian Strategic Policy Institute (ASPI) described the change in the volume of ISR as 'extraordinary'. He noted that other countries 'have struggled with analysing all of the data coming back from high-endurance drones' as their systems of imagery analysis and intelligence exploitation were set up for static imagery rather than streaming imagery which required a different skill set.[12]

3.11 Similarly, Northrop Grumman stated:

> [W]hile unmanned systems greatly enhance Australia's ISR capabilities, such enhancement is dependent on a capable and sophisticated processing, exploitation and dissemination (PED) capability. The risk is that "front end" platform investment without the "back end" investment in supporting data processing and analysis systems will do little to improve national capabilities. ISR data is perishable; it must be processed and analysed quickly, then speedily passed to decision makers and end users. That is the role of a PED capability – without a co-investment in PED to match the platform procurement, the risk is that the value of the overall capability is diminished.[13]

3.12 Air Vice-Marshal Gavin Davies acknowledged:

> [T]he operation of the vehicle is not where the manpower-intensive elements are. It is in how much data is collected, what you do with the data and how you disseminate it. It is sometimes called 'the back shops' because of what you do with it and the analysis. That is where you can have a reasonably large personnel bill and that is where we need to begin to understand where opportunities lie.

3.13 At the hearing, Rear Admiral Peter Quinn noted that all modern platforms coming into service, whether manned or unmanned, were gathering more data that required processing:

> Defence is aware of that challenge and it is working to make sure that it can get the most out of these new platforms and all of the data that they provide…It is a combination of getting the right people, the right training, the right systems and the right processes in place to fuse all of this information together. This is for the platforms which are coming into service, not necessarily all of the platforms we have now. We know we

11 *Submission 4*, p. 9.

12 *Committee Hansard*, 14 April 2015, p. 26.

13 *Submission 12*, p. 7.

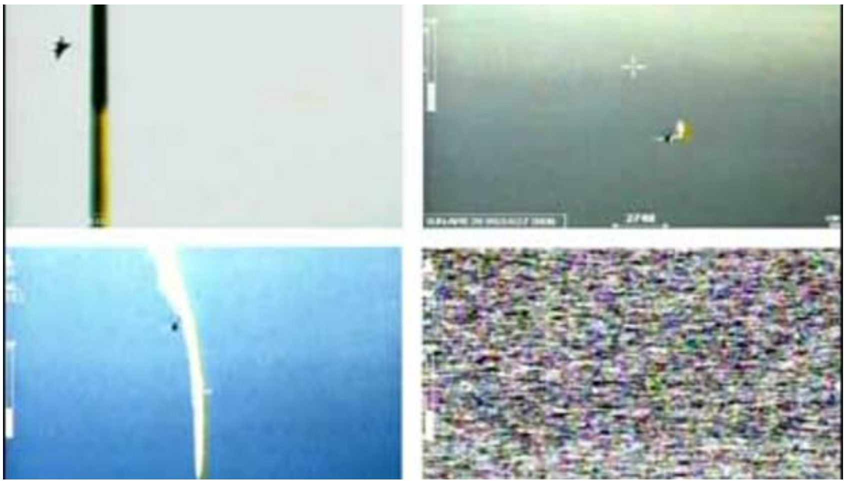
have a challenge; it is being addressed. We know that we will have to ramp up in that area.[14]

Contested airspace

3.14 While submissions were clear on the technical advantages of UAVs in uncontested airspace, there was less clarity in relation to their value in contested airspace. A number of examples were mentioned where UAVs had been ineffective in contested airspace. These included:

- in 1999, a number of US Predator UAVs were shot down during operations over the former Yugoslavia;
- in 2002, a US Predator UAV was shot down by an Iraqi aircraft;[15]
- in 2008, a number of Georgian surveillance UAVs were destroyed by air defence systems and manned aircraft;[16] and
- in 2011, Iranian forces captured a Lockheed Martin RQ-170 Sentinel, a stealth HALE UAV reportedly operated by the US Air Force for the Central Intelligence Agency.[17]

Figure 3.1 – Images from video feed of Georgian UAV[18]



14 *Committee Hansard*, 14 April 2015, p. 47.

15 *Submission 2*, Clinton Fernades, 'Welcome to the future: the use of drones in war', *Dissent*, Summer 2012/2013, p. 50.

16 For example, United Nations Observer Mission in Georgia, *Report of UNOMIG on the incident of 20 April involving the downing of a Georgian unmanned aerial vehicle over the zone of conflict*, 12 May 2008.

17 For example, Greg Jaffe and Thomas Erbrink, 'Iran says it downed US stealth drone; Pentagon acknowledges aircraft downing', *Washington Post*, 4 December 2011.

18 AAP, 'UN: Russian jet shot down Georgian drone', *CBS News*, 26 May 2008, available at: http://www.cbsnews.com/news/un-russian-jet-shot-down-georgian-drone/ (accessed 23 June 2015).

3.15 Dr Davies considered that '[in] a more contested environment in which the adversary has a sophisticated anti-air capability, something more capable than Reaper would be required'. He stated:

> For now, that would likely be a manned strike platform with support from electronic warfare and situational awareness platforms. In the future, there's likely to be higher performance (and almost certainly higher cost) unmanned options such as the stealthy Unmanned Combat Aerial Vehicles under development, such as the American X-47B and European Taranis...[19]

3.16 Others emphasised the potential advantages of UAVs in contested airspace. For example, Flight Officer Gary Martinic wrote:

> UAV designs of the future will likely be capable of 'hyper-manoeuvrability' (or extreme lateral acceleration), achieved through advances in avionics and the use of composite materials and stealthy airframes, which would give them considerably enhanced ability to avoid detection by radar. Contrarily, the extreme g-forces generated could not be withstood by a human pilot sitting at the controls. UAV designs of the future will also likely be more rugged, giving them enhanced levels of 'battle damage survivability' in situations of air-to-air combat.[20]

Communications and navigation

3.17 The reliance of unmanned platforms on communications with controllers and external guidance (such as GPS navigation) was highlighted during the inquiry.[21] UAVs may be vulnerable to a variety of communications and cyber threats.[22] For example, Dr Clinton Fernandes noted:

> For all the technical advances in endurance, sensors and firepower, the key vulnerability in drones remains the potential for interference and jamming of GPS signals. They can be overridden by more powerful signals from television towers, or spoofed so as to make them believe that they are somewhere other than where they actually are.[23]

3.18 Defence noted that 'reliable and predictable system operation is predicated on a reliable data link, and/or system automation'. Defence also observed that 'the data links that control unmanned systems and deliver ISR information back to the Commander in the battle-space are potentially prone to cyber attack and/or

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19 *Submission 13*, 'ADF and armed drones', p. 1.

20 *Submission 1*, Gary Martinic, 'Drones' or 'Smart' Unmanned Aerial Vehicles', *Australian Defence Force Journal*, Issue 189, 2012, pp 47-48.

21 For example, Dr Derek Rogers, *Committee Hansard*, 14 April 2015, p. 20.

22 For example, Kim Hartmann and Christoph Steup, 'The Vulnerability of UAVs to Cyber Attacks – An Approach to the Risk Assessment', *5th International Conference on Cyber Conflict*, 2013.

23 *Submission 2*, Clinton Fernades, 'Welcome to the future: the use of drones in war', *Dissent*, Summer 2012/2013, p. 50.

exploitation'.[24] Notably, one of the small projects being undertaken by the DSTO relates to how 'unmanned aircraft might cope in an environment where GPS navigation may be denied'.[25]

3.19 Cobham Aviation Services also emphasised:

> The challenge with [UAVs] are the communication links, as the sensors on board are able to collect a vast array of data that has to be passed to a ground station and/or troops on the ground in order to be able to become 'actionable intelligence'. Particularly where beyond line of sight operations are involved high bandwidth satellite datalinks are required.[26]

3.20 It was also noted during the inquiry that in order to appropriately control the use of force within the restraints of the relevant rules of engagement the communications infrastructure between unmanned platform and the operator must be robust. The problem of latency in the operation of remotely operated UAVs was also raised. Flying Officer Martinic explained:

> This is the time delay between when an operator sends a signal to a UAV and the time it takes to respond. While this would usually only be a matter of seconds (or micro-seconds), it is relevant to the argument as to the responsiveness of UAVs versus the reaction time of on-board pilots.[27]

Complementary role to manned platforms

3.21 There was a broad consensus during the inquiry that unmanned platforms were unlikely to replace manned platforms for the ADF in the medium term. Instead, a complementary model for unmanned platforms with overlapping capabilities was perceived the optimal mix. For example, Mr Weston described an emerging new force structure paradigm:

> [O]ne of complementary manned and unmanned air capabilities which exploit the advantages of both manned and unmanned air capabilities. Typically this means that an unmanned but persistent ISR capability might be combined with a manned airborne response capability to provide a more capable and flexible defence force.[28]

3.22 Northrop Grumman also described 'a new force structure paradigm' with 'manned aircraft and unmanned aerial systems working in a complementary fashion, to maximise overall operational effectiveness, and to minimise the risk to aircrew'. It noted that '[a]nalysis, combined with a significant amount of operational experience

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24 *Submission 23*, p. 14.

25 Dr Ken Anderson, DSTO, *Committee Hansard*, 14 April 2015, p. 44.

26 *Submission 14*, p. 4.

27 *Submission 1*, Gary Martinic, 'Drones' or 'Smart' Unmanned Aerial Vehicles', Australian Defence Force Journal, Issue 189, 2012, p. 51.

28 *Submission 4*, p. 3.

has proven that a "Hybrid Fleet" of manned and unmanned systems delivers a higher level of capability at significantly lower operating costs'.[29] Mr Ken Crowe, from Northrop Grumman, expanded on this complementary relationship between manned and unmanned platforms (such as between the unmanned Triton complementing the manned P-8A Poseidon aircraft).[30] He stated:

> The unmanned helicopter goes out and does the dull, dirty boring missions at three am—the comms relay missions, the ISR missions that nobody wants to do—in dangerous or boring situations. And that leaves and preserves the manned helicopter to respond and to keep to its core war fighting mission. By complementing the manned and the unmanned together, you extend the life of the manned helicopter, you reduce its utilisation down to its core functions and you off-load a lot of the intelligence, surveillance and reconnaissance onto the platform that is best suited for it. The skill sets are complementary. The same skill sets relating to interpretation of the battlefield and the interpretation of the sensor data that exist on the helicopter exist back in the ship, looking at the screens from the unmanned helicopter. The maintenance activities are more or less the same—they are both helicopters…[31]

Reliability of UAVs

3.23 There were differing views expressed on the reliability of unmanned platforms. Several contributors suggested that large scale military UAVs have experienced a higher failure rate than manned platforms leading to concerns about their use over civilian areas or interactions with civil aviation. For example, the Northern Territory Government observed:

> One of the ongoing issues associated with operating unmanned aerial platforms is the public perception of safety associated with the use of those systems. In particular, the general public have concerns with the likelihood of unmanned aerial platforms colliding with commercial or other military aircraft over populated areas.[32]

3.24 Similarly, PREMT highlighted that '[s]afety concerns are most severe when it comes to [UAVs], especially UAVs that are large enough and fly high enough to interfere with civil aviation'. [33] Dr Brendan Gogarty also commented:

> Drones experience much higher accident rates than manned vehicles (up to 100 times higher), but the reasons for this are more complex than simply technical. In fact they are more related to controller complacency and the

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29 *Submission 12*, p. 5.

30 *Committee Hansard*, 14 April 2015, p. 18.

31 *Committee Hansard*, 14 April 2015, p. 18.

32 *Submission 9*, p. 8.

33 *Submission 22*, p. 2.

> reduced feedback that results from removing the pilot from the cockpit…as much as they related to technical faults.[34]

3.25 A recent *Washington Post* report highlighted the relatively high number of incidents involving US military UAVs. The common causes of incidents included:

- a limited ability to 'detect and avoid';
- pilot/operator error;
- persistent mechanical defects;
- unreliable communication links.[35]

3.26 Significant incidents included a US operated Shadow UAV colliding mid-air with a US Air Force C-130 cargo plane. Notably, in 2010, it was reported that an RAAF Heron crashed short of the airfield in Kandahar, Afghanistan and required costly repairs.[36] On 1 November 2010, ADF's Herons in Afghanistan were suspended from flying for 24 hours following 'a series of landing gear malfunctions'.[37]

3.27 Defence noted that the majority of large complex UAVs designed for combat operations were introduced into service 'with little consideration to peace time operations in civilian airspace'. It stated that the 'ADF continues to develop its unmanned capabilities responsibly' and considered that any transport, health and safety implications posed by the use of unmanned platforms are 'presently insignificant, given the scale of operations and maturity of these capabilities'.[38] At the April hearing, Air Vice-Marshal Davies highlighted the high number of flying hours of military UAVs and argued that '[t]he statistics are showing clearly that these are safe vehicles'.[39]

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34 *Submission 18*, p 2.

35 Craig Whitlock, 'When drones fall from the sky', *Washington Post*, 20 June 2014.

36 Ian McPhedran,'Defence in spy plane cover-up', *Daily Telegraph*, 10 September 2010.

37 Department of Defence, 'Heron Unmanned Aerial Vehicles Return to Flight Status after Temporary suspension of flying', *Media Release*, 3 November 2010.

38 *Submission 23*, p. 14.

39 *Committee Hansard*, 14 April 2015, p. 45.