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It is a great pleasure to be able to address this gathering today. Last year I had the privilege of attending the biennial Maritime Conference at The Darling Harbour Convention Centre conducted under the auspices of the Chief of Navy.

It was an excellent, stimulating conference, and I thought of it last week when here in Melbourne there was a ceremony to name the new LHD Canberra. The conference demonstrated the joint cooperation which is characteristic of the modern Australian Defence Force after well over a decade of sustained and diverse operations, from the immediate neighborhood to the Middle East and even Africa.

One particular pleasure I had was showing this slide to over 1000 naval officers. The collective intake of breath almost sucked the oxygen from the room.

There is a serious point I was trying to make however. The world and the region is changing and the ADF is changing too. In my view, Australia has always prospered more when it has followed a maritime strategy, engaging actively with the region with the ADF operating as a truly joint force.

The introduction of the LHDs enhances the application of that strategy significantly. I have made it very clear to the Army that we will need to be able to operate all of our equipment from these vessels in the future. That will include unmanned systems as well.

The Avalon Air Show and its associated forums are, likewise, globally recognised events, which bring together our three services, business and alliance partners and in this address I want to focus on where I think we all will work together to contribute to making Australia more secure and to defend her interests, wherever they may be.

I also want to pay due attention to the essential nature of military operations - something that can, I feel, be lost when we gather in comfortable surroundings such as these. I will turn that matter first.

Now I trust I will not prove to be a controversial guest if I provide something of an alternate voice in these proceedings. Make no mistake, Army needs your products and is already heavily reliant on you in our current operations. It may surprise you to learn that Army is the largest user of space assets in the ADF.

We are deeply enmeshed with our sister services and our joint partners through shared use of space, unmanned platforms, robots and remote sensors. Consider this slide.

Every aspect of our operations is enhanced by the technology that you provide, whether it is basic navigation and communications - or sophisticated situational awareness and target acquisition.

It is a complicated operating environment and that complexity is only growing, a point to which I will return shortly.

Our combat engineers rely on robotics to deal with the lethal threat of Improvised Explosive Devices, which pose, still, the greatest threat to our troops in Afghanistan. So at the outset, I want to place on record my gratitude to you for your expertise and professionalism. Your work in Research and Development into the future, as well as the equipment you supply us in the present, helps keep our soldiers alive. We are all in your debt.

However, it would be remiss of me not to offer a distinctive Army perspective on the current employment of UVS and the likely trajectory that our partnership with you will take as the Defence Force modernises and undergoes major re-equipping out to 2030.

In the case of the Army, we are in the midst of the most significant re-equipment program since the Vietnam War; and I say that sincerely, notwithstanding the budget savings that have curtailed or delayed some aspects of our major procurements. One of my jobs is to ensure that we make the best use of that equipment.

However there is an overriding and distinctive Army perspective is this: central to our identity is the ethos of close combat conducted by highly trained, balanced, combined arms teams imbued with foundation war-fighting skills.

At risk of sounding like a Luddite, or worse still, a uniformed Cassandra, may I reluctantly make one thing clear – no technology yet exists which obviates the need for close combat on the ground. From a soldier's perspective the problem of the final fifty yards across contested terrain remains unsolved.

Close combat remains necessary, lethal and essentially a human phenomenon. Every piece of kit that we deploy is ultimately directed at enhancing the capacity of our people to close with an enemy, destroy or capture them and come home to tell the tale.

The greatest thinker on war in the Western Tradition, Carl Von Clausewitz, warned that those who thought war could be rendered bloodless and sterile were guilty of both a cruelty and folly. He provides a timeless counter-weight against fads and panaceas.

Over the long - haul of my thirty-five year career, such panaceas have been greeted with great fanfare about once each decade. Whether called

Revolutions in Military Affairs, (RMA), or Effects Based Operations (EBO), precision strike, or Network- Centric Warfare (NCW), they have all had one flawed premise in common - that somehow technology can remove friction, violence and human factors from war and substitute omniscience, precision and predictability in their place.

I reject that premise. None of the recent operations that we have been involved in, directly or observed, nor the consensus as to the changing character of war, undermines that conviction.

Be assured that this assertion gives me no joy. As Douglas MacArthur memorably observed in the twilight of his career, none bears so much privation and suffering in war as the soldier. If there were a clean, risk- free way to prevail on the modern battlefield I would be the most relieved person in this room.

But after each false dawn - whether Desert Storm, Iraqi Freedom, Enduring Freedom or the vaunted air war against Milosevic in 1999, the initial euphoria has generally given way to the harsh reality that ground combat remains central to war. And ground combat is a predominantly human activity subject to all the uncertainty cruelty and violence that was evident at Waterloo, Shiloh, Gallipoli, Verdun or Stalingrad.

More recently senior defence and security experts purported to have discovered a new way of war, reliant on small teams of special forces soldiers orchestrating precision strike weapons. The evidence from the initial operations in Afghanistan seemed to justify this assessment.

But a decade later our significant technical edge over the Taliban, and the complex Iraqi insurgency, has not delivered the decisive results forecast against either. Enemies operating below our threshold of detection have forced us to fight at close quarters in order to achieve operational success.

All of this constitutes a sobering message.

Now please do not misconstrue my point. Unmanned vehicles and robots are integral to these current fights, and right now they are saving Australian lives and giving us a winning edge over very determined and innovative enemies.

But I would be irresponsible not to express the cautionary note that the research of Army's Future Warfare Concepts teams suggests that we are unlikely to have engineered close combat out of war by 2030. There are a number of reasons for this, both technical, organisational and ethical. I will touch on each in turn.

At this time, a key vulnerability of UVS systems is bandwidth requirements over extended ranges. The Royal Australian Engineers currently utilise robots for disarming bombs and improvised explosive devices. Because these have relatively low band width requirements and are operated from a relatively short distance away, they are not considered too vulnerable.

However, some Armed Unmanned Ground Vehicles (A-UGV) being developed by advanced armies will have higher bandwidth demands, similar to UAVs, as well as longer ranges between vehicle and operator. A data link interruption may result in a task coming to a halt, or worse if attacked by an enemy through cyber means may be hijacked to present a danger to the operating force.

Moreover, the most effective employment of UVSs has, to date, been against irregular enemies. Against a near peer competitor they may not enjoy the overwhelming technical superiority that gives them such unrestricted access to all domains.

Contemporary militaries must be careful not to incorrectly extrapolate the nature of current use, which is primarily in the context of irregular war, into any future near peer conflict.

There are few countermeasures to these technologies in the current operational theatres. Future scenarios should always be assumed that any or all of the five domains (air, land, sea, space, and cyber) can be contested. This may lead to the acceleration of platforms with greater autonomy.

As I keep reminding Australian soldiers and their commanders, the Army must provide the Government with ready, relevant land forces capable of delivering the land force contribution to decisive joint operations as part of a maritime strategy in the Defence of Australia and its interests. We must not, and will not, bench mark our capability against the Taliban.

At an organisational level, both the strategic and tactical, the employment of increasingly autonomous UVS will challenge international alliances, treaties and protocols.

The autonomous access to foreign bases, intelligence and communications networks for drones and broader unmanned systems is uncharted territory. It has already been demonstrated through the spread of UAV technology that the deployment of UVS by technically advanced nations will result in an accelerated proliferation of UVS programs across the globe.

In the early stages of UVS integration there will be some significant command and control issues to address. The use of tele-operated systems means that the current C2 arrangements could remain, but the use of semi-autonomous systems, or a mix of autonomous and manned systems, will require complex parallel C2 structures.

The natural evolution of advanced decision support systems will assist in moving toward automated decision-making and the ability to rapidly process information and formulate an appropriate response almost instantaneously. This includes the ability to monitor, interpret, analyse and fuse multiple sources of information from across the sensory spectrum.

This delivers an unprecedented understanding and view of the battle space across all five domains and, in theory, it may remove the issues of decision paralysis from the cycle. It also has the potential of overwhelming an adversary through the speed of decision-making alone.

From an ethical perspective, maintaining the human in the loop may be seen as preferable but may not be practicable depending on the adversary. If we are facing an enemy that is equipped with advanced decision-making C2 systems, it is possible that a system with a human in the loop may not be able to match the speed of decision making.

This could be significant given the manner in which the combination of autonomous UVS and advanced C2 could orchestrate the battle space. This will underscore the requirement to protect these networks and protect all parts of the system from cyber attack that again is likely to fall prey to advanced artificial intelligence systems.

Such technical progress will almost certainly require legal, ethical and cultural adjustment. This will neither be as easy nor as swift as the technological change. In particular, international humanitarian law has not been created with the operation of semi-autonomous and autonomous systems in mind. Currently, there are no international protocols governing the employment of autonomous systems.

Once the threshold of 'autonomous lethality' is crossed a plethora of legal issues arise. Firstly, who is accountable? In the case of autonomous systems it could be argued that programmers, manufacturers, military commanders, and in the case of advanced AI, the robot itself, all could be considered responsible for the actions of the platform.

Secondly, as it stands, soldiers have the ability to refuse an order that they believe is illegal under the rules of war. Is it likely that an autonomous system will be programmed with the ability to refuse an order? Will commanders be willing to employ systems that can reject orders? In addition, can advanced AI capable of self learning be bounded by a moral and ethical code? All of these considerations bear implications for Laws of Armed Conflict and Rules of Engagement.

Outside of more general societal issues, each stage of the UVS evolutionary continuum presents specific cultural challenges for the military profession. With any increase in use of UVS across the spectrum of conflict there will be resultant cultural challenges.

As autonomous UVS technology begins to alter the manner in which combat and operations are conducted, the individual demands on human operators will change along with the necessary skill sets required to support such equipment.

Social concepts such as unit cohesion and teamwork will need to evolve along with the traditional values of the military. This is likely to be

compounded by a tendency toward increasing levels of centralisation of control that the use of advanced decision support and C2 systems may entail.

Ultimately, unmanned systems will continue to evolve becoming more complex, sophisticated and capable. The potential utility offered by these technologies poses both a significant opportunity to the ADF and Army, as the organisations themselves continue to evolve, but it also poses very significant challenges. Given the significance of the related issues, pragmatic and prudent consideration must be given for a technology that has the potential of significantly changing the character of war as we know it.

In closing, let me briefly explain how Army is reforming its organisation, as I believe this will enable us effectively take up these technologies in the future.

The Army today is in some ways unrecognisable from the force that responded to the East Timor crisis in 1999. Initiatives such as the Hardened and Networked Army (HNA), Enhanced Land Force (ELF) and the Adaptive Army have increased our combat weight, protection, situational awareness and sustainability.

As an example, consider these two slides showing Australian infantrymen in 1999 in Timor, and a soldier in Afghanistan a decade later.

Changes we are making now, under Plan Beersheba, are providing a long overdue reform of our force generation and learning cycles, which is in turn enhancing our ability to rapidly adapt to doctrinal and technological innovation.

It is my aim to enhance Army as a value proposition in an era of cost consciousness by equipping our like brigades with common vehicle fleets and inventories. In time, whatever path UVS evolution takes we have the structures and training systems to leverage those developments throughout the land force and in partnership with the rest of the ADF. You are all certainly part of that future.

But to reiterate a key point I made at the beginning. For me war, and all other military operations, will always remain fundamentally human affairs. Let me show a final slide to give emphasis to this.

Whatever military technological advances are made in future, they need to be framed within the legal and ethical standards that our Nation and our people accept as the core of our identity. Change is a constant, to use the hackneyed phrase. So to must be the rule of law and primacy of values that make us human.

I suspect I have raised some uncomfortable questions today. It is only fair I now invite you to do the same to me.