An Interview with Scott Holmes: Human-Machine Teaming

Samuel Cox (SC): Can you give readers the bottom line up front (BLUF) about the Soldier Combat System Program and the Australian Army's work developing Human-Machine Teams (HUM-T)?
Scott Holmes (SH): The Soldier Combat System Program's remit focuses primarily on the dismounted element of the close combatant system. We don't just exist for the dismounted combatants though; we see ourselves as part of the close combatant fighting team which includes all corps whose primary role and responsibility is to complete their task or function within direct fire range of the adversary. This includes Engineers, Joint Terminal Attack Controllers (JTACs) and Forward Observers (FOs) in addition to the normal Tier 2 combatant suite of Infantry soldiers and Special Forces (SF).

Predominantly, the program has focused upon lethality and survivability; including load-carriage equipment, body armour, helmets, ballistic eyewear, gloves, and so on, which increase the survivability of a human as a system. Additionally, the weapon suites that we look after include the family of machine guns, handheld anti-armour weapons, small arms and the sight ancillaries and night-fighting equipment that enable the use of those weapons and sub-systems.

Rather than being an analogue force that seeks to extend traditional capability into the 21st Century, we're now looking at two forms of 'mass' that might give us a comparative advantage in the small team and close combatant environment: machines and data. The hypothesis is that using these more collaboratively with humans can give us faster decision cycles and action-responses.

SC: Why is HUM-T a step change for Australia's close combatants?
SH: Today's Soldier Combat System is analogue. We've maintained a comparative advantage regionally because the range, accuracy and lethality of our small arms has improved; our body armour has been capable of defeating the same improvements in lethality and accuracy that our potential adversaries have achieved; and because we've continuously improved the human performance factors of small team training, marksmanship, physical endurance and resilience.

These are the elements that have traditionally made the Australian close combatant a little bit smarter, a little bit fitter and stronger, a little better equipped, and a little bit more accurate with a more lethal weapon compared to the potential adversaries in our near region. As technology like night-fighting equipment and improved rifle sights become cheaper, they will proliferate, and that advantage edge will erode.

We'll remain at the leading edge of capability and our performance will continue to be excellent in comparison to our peers for a little while. However, we might have once held a 50% advantage in those areas that gave us the initiative at the point of contact. That advantage might close to within 5% in the next decade, and therefore the assurance of

creating and sustaining the initiative is nowhere near as likely as it once was. Now, if you're a small nation with a small population and at par in comparing force on force, human on human, team on team; the advantage of larger forces will become decisive.

This is where the step change comes. We want to invert the ratio from 3:1 (where traditionally an attacking force requires three times the number of soldiers than a defending force) and either get to parity or, ideally, switch things around so that an Australian force is able to achieve the lethality, situational awareness and survivability effect of 1:3. That is, we can overpower a force three times our size because of the efficacy of our total system. That would include robotic platforms, vehicles, a suite of sensors and the human. It's a layer of data which sits above that team and enables new forms of cooperation that seeks to ensure our teams are slightly better informed, that they can act slightly faster, and can do that continuously to create a cycle of sustained advantage.

SC: Why even explore human-machine teams? Especially with a focus upon close combatant capability? Why not seek to use technology to remove humans from the equation entirely? Don't we want to move beyond close combat into a space where our people are less at risk?
SH: Quite simply, the technology isn't capable enough to do that in all seasons, weather and terrain. We need a scale of effects where under perfect conditions the human is less exposed or potentially not involved, through to particularly difficult environments for machines to work in and for data to interpret. They include close country jungle environments where, for example, unmanned aerial and ground vehicles (UXVs) find it difficult to penetrate and path find; or complex urban environments where the volume of interactions is so dynamic that it's very difficult for robots to make sense of and apply common sense to those environments in the way that people would.

SC: Would a human necessarily make better decisions than a machine in those environments? A machine can process data inputs far quicker.
SH: You're absolutely right, and more importantly machines have a greater 'hive brain' capacity than humans do. A person is undoubtedly a greater supercomputer than anything that we're artificially producing, *but* humans can't easily connect the capacity of other individuals and their thoughts to a broader system of systems at speed.

So what? Well, machines certainly do have the capacity to aggregate the processing power and the sensor capacity of other machines into what we'd call 'the layer of autonomy' between systems. At that layer, it becomes much smarter than the sum of its parts, whereas that's not always the case with humans. The reason we have Command Posts (CPs) is to take the information provided by many subcomponents (usually people) and build it into a collective common operating picture. Computers will supersede this by rapidly exchanging data and accessing increasing levels of automation to process that data into digestible products.

We'd like to combine the two in a tactical environment: the analytical support, speed of processing, and 'hive brain' level of awareness offered by a machine, partnered with human understanding of context, mission and intent, empathy, rules of engagement (ROE), and laws of armed conflict (LOAC). Together, we suspect we'll achieve a far greater outcome than humans by themselves or machines by themselves.

SC: The comparative military advantage Australia has enjoyed in our region is diminishing. Is using unmanned machines and data to form mass a way for the Australian Defence Force to 'punch above our weight'?
SH: We're seeking a new and disruptive method of overmatch in close combat because we have a limited population and there is no capacity to grow it at the rate our near neighbours have already achieved. If there was a war of attrition, we'd simply be ineffective.

Now, we're not anticipating a war of attrition being the *raison d'être* of force design or the way we go about business, but our limited force can be multiplied by the speed at which data enables connection between machines, and rapid and accurate allocation of fires, regardless of the scale of conflict.

SC: What are the risks of HUM-T?
SH: I see two risks. Firstly, piecemeal introduction of 'products' that are not part of a broader system of systems is a risk that would create short term capability but likely reduce our capacity to absorb additional layers of capability over time. This is because giving Army individual products creates a liability in training, tactics development, integration and general change requirements to the extent that it is initially *disruptive to us* as the end-users until such optimisations take place. If the disruption we create for ourselves becomes too great, the capacity to stitch the products into a more competent and powerful system is diminished. Purchasing high technical readiness level (TRL) technologies without thinking about how we're going to bolt them together must be avoided. This is why an approach that includes smaller quantities of advanced capabilities early, 'learning by doing' at a small scale and developing a systems approach in a dedicated trials unit/space is preferred to inform larger acquisitions. The focus here is the whole system not just the physical products it comprises. Think of it as a learning, not an acquisition, system.

The second risk is that the network design that the Australian Army has pursued to-date has been specifically designed for command and control (C2). It is a resilient and capable network for producing common operating pictures, exchanging data useful for some levels of targeting, and for coordinating tactical effects and combatants in a tactical area. What this network design is not very good at doing is providing a collaboration space. A *collaboration space* would allow the information provided by many agents (an 'agent' can be air or ground robots, vehicles, humans, sensors, etc.) to support cooperation. The outcome is better use of digital data via access that is dynamically suited to the varied information needs and processing capacity of each agent. Until such a data environment exists, the potential gains of autonomy will be more limited.

SC: Whatever we develop in HUM-T can be used against us. Will HUM-T make the battlespace less survivable for Australian soldiers?
SH: Our potential adversaries could employ our systems, but I don't think they will be able to do so with the sophistication that Australia can any time in the next decade. You can copy the products, but you can't copy the system that brings it all together, including all the fundamental inputs to capability.

This is the difference that the Royal Australian Air Force (RAAF) has had over potential adversaries who have fielded platforms that are equal and equivalent to the actual air frames that the RAAF uses. It's the entire system of maintenance, resupply, pilot training and ground crews that turns the RAAF into the equivalent of an F1 race car, rather than an amateur hobby-racer at the local go-kart track.

Similarly, bringing together a human and a machine team with high levels of trust that will ensure the team actually works cannot simply be bought off-the-shelf. I think Australia is much more likely to create an advantage, to sustain that advantage and to quite possibly develop an even bigger gap than already exists between us and our competitors because we understand the system better than anyone else – if we commit now to exploring, learning and leveraging.

If an adversary has little understanding about how these systems work, we can neutralise a particular effect, at the right time, to then create a window of opportunity. Those are smart defeat mechanisms. It's our people that are the heart of this system, not the technologies.

Lieutenant Colonel Scott Holmes is an Australian Infantry Officer working in capability modernisation at Army Headquarters. Scott was a 2018 Chief of Army Scholarship winner and used this opportunity to commence a Doctorate of Public Leadership at the University of New South Wales. The study is focussed on the implications of a Fourth Industrial Revolution for Army.

For more from Lieutenant Colonel Scott Holmes, watch the recording of his Australian Army Research Centre seminar: Preparing the Australian Army for a Fourth Industrial Revolution.

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About the Author: *Samuel J. Cox is the editor of Grounded Curiosity. You can follow him on Twitter via the handle @samuel_j_cox*