A critical next step:

The right choices for successful human-machine teaming

Advances in robotics and autonomous systems (RAS) are beginning to demonstrate the potential of human machine-teaming in military environments. Realising that potential requires Land forces to look at what lies beneath the surface.

Last December the UK's Army Warfighting Experiment (AWE) put a stake in the ground for the future of RAS in land-based military operations. British military personnel working with NATO allies delivered a ground-breaking exercise utilising over 50 systems to understand how global defence forces can exploit the technology in real combat scenarios. Driven by the British Army, it was a critical step to see what emerging platforms are capable of and to identify hypothetical use cases for that can be explored in future exercises. It should be celebrated as a huge leap forwards in global defence's understanding of the military potential of RAS capability.

But what AWE also demonstrated was the critical importance of linking different platforms with human operators to create powerful human-machine teaming that can deliver real impact in combat scenarios. Whilst hardware has visual presence and impact, it is the relationship between machines and users that is so vital to making them effective battlefield systems.

This places Land forces at an interesting juncture on the path to deployable and effective RAS. The next step will define whether we see the rapid implementation of assured capability featuring optimised human-machine teams, or a ponderous path to a place where individual platforms have some impact but, in many cases, place an additional burden on soldiers. The challenge Land forces now have is to make the right decisions about where to focus their efforts to create optimised human-machine teams. This must also include consideration about the right level of supervision of any semi-autonomous system, ensuring that technology remains consistent with UK legal and ethical standards.

Platforms are the physical embodiment of RAS in the real world. The range of physical technology on display is considerable and impressive. It is a natural area in which defence wants to invest to create a very visual representation of force potential. But 'off the shelf' hardware options are often limited to remote control – albeit with increasing levels of sophistication.

It is possible to explore the mobility of different platforms and how they perform across different terrains but they require human direction almost all of the time, and therefore close proximity between people and machines. The real value from these platforms – even those with seemingly straightforward use cases – is realised when operators and platforms work as a team, sharing the ownership of tasks with complementary roles, and maximising the value of having multiple assets in play. Remote control is not sufficient to achieve this balance. The key enabler here is the flow of information that defines how effectively the human-machine team works.

The software that manages this information flow, referred to as 'information architectures', is neither visible nor physically impressive. But they are the difference between platforms that add to soldiers' cognitive burden and platforms which can become a force multiplier as part of a human-machine team.

Essentially they turn controlled platforms into smart systems and from an asset to be managed, into a key component of an effective human-machine team. Where platforms can capture data, information architectures can combine that data, interrogate it and determine the next action. They route data between platforms, connecting them to ensure a unified autonomous approach - all seamlessly in the background without constant user interaction.

So whilst the physical robot has the innovative technology to support soldiers, it is the information architecture that needs to be carefully created and deftly implemented to ensure the effective passage of information between the two. Investing in this level of information management from the outset means Land forces will have scalable systems in place that can deliver capability today and lay effective groundwork for continuous evolution at pace into the future.

It is therefore important that all Land forces take some important considerations into account when investing their time and resources into the next stage of RAS deployment. At QinetiQ, we believe three are paramount:

1) **Focus on the human in the team and the amount of information they can handle.**

   Developing optimal human-machine teams featuring RAS capability needs to be done with an appreciation for the information burden users can cope with in the dismounted environment whilst maintaining operational effectiveness. This will ensure that information management to, from and between robotics platforms supports users, rather than gives them more to do.

2) **Enable the tactical separation of soldiers and machines to reduce reliance upon constant human interaction.**

   Utilise a level of supervised autonomous navigation to allow RAS systems to occupy contested parts of the battlespace where the risk to soldiers is too high.

3) **Enable effective human-machine teams by prioritising information fusion from multiple sources.**

   Data from a family of systems, sensors and effectors can be combined to create an ISTAR and engagement capability combining humans and machines that is truly agile and collaborative. Platforms cannot do this alone. It is the underlying software and architectures that makes this essential task possible through effective information management.

To see what a successful a focus on information architecture looks like we need look no further than the commercial technology sector for inspiration. Google Nest – Google's smart home offering - offers various pieces of new hardware for customers' homes. But Google's major investment has been the development of a smart home information architecture that enables those devices to work seamlessly together through a carefully managed flow of information.

In Defence the opportunity for success is no different and no less exciting. There will always be a desire to implement new platforms that act as a visual deterrent to the enemy and a visual stimulant to own personnel. But it is the optimised teaming of those platforms with soldiers, which generates a force multiplier. That requires suitable attention on enabling an effective flow of information between data sources, platforms, and people. Without this, human-machine teams cannot realise their potential, and Land forces will end up simply buying equipment, not creating effective capability. The next step is therefore a crucial one to get right. Get the information piece correct at the start and Land forces will be able to create effective human-machine teams that add value today, whilst also laying the correct foundations for optimising those teams as part of future forces.