TESTING TIMES

Cathy O'Carroll *on the importance of driving defence's sustainable future with test and evaluation*

Climate change sits atop of the global agenda as a prominent issue for many industries. With the recent culmination of COP 26, the global environmental impact of human activity on the planet has never been under such scrutiny.

With mounting pressure to limit their carbon footprint, organisations around the world have announced ambitious decarbonisation targets with the hope of achieving net-zero emissions by 2050. The question is: how does the defence industry fit into this ambition of greater sustainability? In the UK, defence currently accounts for 50 percent of central government carbon emissions and as outlined in Boston Consulting Group's recent report, The Growing Climate Stakes for the Defence Industry, defence's contribution to global CO_2 emissions could hit as much as 25 percent by 2050 if changes are not made.

Climate change has the potential to unearth new threats to military forces and the societies they protect. Whether it's undermining the usefulness of current military assets or creating conflict between states over scarce resources, a deteriorating environment could add a new layer of complexity to existing risks while also giving rise to new threats yet to be considered by the defence industry. It's therefore critical that defence develops capabilities that reduce carbon emissions whilst also equipping soldiers with the tools to handle these emerging threats.

UK defence accounts for around 50 percent of central government carbon emissions

The use of sustainable Test and Evaluation (T&E) practices will be indispensable in the industry's collective fight against climate change. Testing, evaluating and certifying military equipment prior to its deployment will always remain a priority for military forces. However, the process of developing and testing equipment before it sees action has historically been a carbon-intensive exercise. What's more, training forces to use equipment effectively in the field has usually required long, drawn-out exercises which use large quantities of resources and munitions.

By using the latest advancements in digital technology, T&E can continue to safely deliver effective capabilities to the front line while also limiting the environmental cost these processes have on our world. Moreover, T&E can also provide the opportunity to evaluate sustainable technologies proving how they can be used most effectively in a climate changed-world.

In this piece, we examine the ways in which T&E can contribute to the defence industry's decarbonisation while still enabling forces to combat oncoming threats.

Sustainability gains have been found through the increased use of digital technologies in the design and T&E process. Instead of creating multiple iterations of a platform in physical form, manufacturers are able to design and augment platforms virtually using high-fidelity simulations.

DIGITAL SANDPIT

By creating a model of a given asset in a shared virtual environment, also known as a 'digital sandpit', manufacturers are given full flexibility to tweak and adapt its components, while also being afforded the ability to test the viability of an asset against the whole system or subsystems.

Such practices have been seen in the development of the hybrid electric Humvee concept, a project led by QinetiQ and AM General. Due to the restrictions of the pandemic, QinetiQ and AM General created a fully interactive virtual reality model of the Humvee, allowing manufacturers from both companies to work together online. By creating models in a digital sandpit, manufacturers were able to see the impact that the addition or subtraction of components would have on the Humvee and it's passengers.

While this enables a deeper understanding of an asset's physical properties and the prediction of the effects of different conditions on structural integrity, the digitisation of this process means the live testing of new prototypes is required at later stages in the development process rather than throughout. Instead, digital experimentation enables a reduction in the number of flying hours required to certify an aircraft or the number of live artillery rounds that must be fired to assure their safety, as examples.

The potential that synthetic environments can have on the future sustainability of developing assets is clear, however, their impact on training of soldiers could be just as powerful.

In order to be ready for any eventuality on the battlefield, soldiers need to have comprehensive knowledge and understanding of the assets they operate, achieved through training. Traditionally, this can require different forces across domains to come together to carry out live, joint exercises. While effective, the quantities of resources – such as fuel, ammunition and artillery – needed to support these operations are high, not mentioning the miles that units must travel to meet at a training site.

However, with advancements in training technology, soldiers are able to collaborate on joint operations remotely through Live, Virtual, Constructive (LVC) training techniques. These training methods combine live assets with simulated and emulated to imitate scenarios that soldiers might encounter on the battlefield. Through implementing these techniques, organisers can remove the need for soldiers and their platforms to travel or use resources in live exercises, with exercises instead being replicated using simulation technologies. Particularly in the case of virtual training, soldiers can be put at the controls of simulated systems which mimic

DEVELOPING AND TESTING KIT BEFORE IT SEES ACTION HAS ALWAYS BEEN VERY CARBON INTENSIVE

the conditions and scenarios that they would likely encounter in the field.

Simulated training can either be done over a closed loop, meaning simulators within the same area are connected, or between disparate groups – ie between forces. For exercises that require the full integration of forces, the latter can remove the need for forces to travel, lower platform usage during live exercises and reduce the quantities of munitions used.

Similar to how LVC training can reduce the travel time needed to move from training exercise to training exercise, trial visualisation technology can reduce the requirement for customers and manufacturers to travel to sites to watch demonstrations or training exercises take place.

Trial visualisation involves live streaming a demonstration to a location where manufacturers and customers can observe. A trial occurring at one range could be live streamed to multiple sites distributed nationally or internationally. Customers would be able to watch a trial in real time from their own bases, almost totally removing the need for any personnel to travel to and from demonstrations.

Ensuring that platforms and their capabilities perform at their optimum level at all times is a core priority for every military force. However, to ensure platforms operate at peak performance, military forces have to carry out regular T&E exercises to assess a platform performance. While necessary, the process of carrying out T&E on platforms, particularly while they're on deployment, has traditionally been a carbon-intensive task.

For example, naval minehunter vessels require their magnetic, acoustic and hull vibration signatures to be assessed regularly to ensure they do not trigger mines while out on exercise. To perform T&E, these vessels typically sail home to a fixed testing range in order to have these signatures assessed. Aside from being an incredibly drawn-out process,

vessels unnecessarily waste fuel travelling back and forth between fixed testing ranges and their sites of operation.

However, advances in technology could enable operators to assess an asset's capabilities anywhere in the world through the use of a deployable testing range. Once calibrated in a fixed facility, a deployable range can be sent to any given location to run T&E assessments on an asset while it's on exercise, saving the need for an asset to travel back and forth between bases. Additionally, the data can be fed back to a remote headquarters for analysis and data mining, made possible by developments in

T&E CAN STILL DELIVER EFFECTIVE CAPABILITIES WHILE LIMITING THE ENVIRONMENTAL COST

sensors, computing power, connectivity and secure satellite communications.

Deployable ranges are not the final form that decentralised T&E could take. Additionally platforms could carry assets onboard to provide constant data to inform the operational status of any given platform, all without human intervention.

Currently, platforms and weapons undergo a thorough assurance programme that may include subjecting the asset in question to differing environments and potential threats. This defines the assets tolerances and forecasts its service life. However, once it enters service equipment can be dependent on human inspection to gauge its condition, or may even fail before some imperceptible flaw becomes evident.

To counter this, manufacturers have moved towards integrating sensors to monitor the forces and environmental factors acting upon it throughout its life. Integrating this data with predictive modelling of the failure modes of weapons will allow a more accurate assessment of a weapon's remaining operational life. This will in turn reduce the number that are disposed of unnecessarily, and consequently, those manufactured in the first place, ultimately saving resources.

The clock is ticking on the world's opportunity to avert itself from a climate disaster. The longer the issue is left to fester, the more extreme and unpredictable the defence landscape will become. With this unpredictability comes increased opportunity for new and emerging threats to take hold, creating new challenges for Western forces to consider in the constant effort to stay ahead of adversaries.

However, the impact of the defence industry's activity on the environment could be reduced through investing in more sustainable T&E practices, and using T&E to explore and validate the use of novel approaches and technologies that are more suited to a climate changed world. Not only will this limit the quantities of resources which are invested into the development and testing of assets and training, it will also lead to enhanced sustainability, reduced emissions and greater resilience against the impact of climate change in operations across defence. These steps will ensure defence organisations can reduce their impact on the environment while also meeting the demands that modern, forward-thinking defence needs ●

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