

# Innovation thrives in the

This is a nervous time for the defence sector. The Strategic Defence and Security Review (SDSR) due this autumn could mean cuts of up to 15% in the MoD's £37 billion budget. While that is significantly less than the 25% cut required of other government departments, it will undoubtedly pose a significant threat to a range of procurement programmes.

Figures from AJDJS show that the UK defence industry has a 21% share of the world's defence export market. It supports 300,000 people and is worth around £35bn per year, with an additional £5bn per year on average coming from exports.

The global nature of the ongoing financial retrenchment means the UK is not the only country where this applies. Other big defence procurers, such as France, Italy and the US, are also reducing defence spending and, given that for some UK suppliers the US Department of Defense is as significant a customer as the MoD, this is clearly a worry.

However, this country remains embroiled in a long-term conflict in Afghanistan and that means that there will continue to be a need for new and innovative design in this sector for the 'foreseeable future'. Equally, there are a number of long-term projects to which the Government remains committed, which means that innovation in design remains at a premium.

## Unmanned vehicles

Certain trends are clear in the defence industry at present. Chief among these is the increased demand for unmanned vehicles to do some of the 'dirty' and dangerous jobs required in combat theatres. The unmanned air vehicle (UAV) has proven its value in Iraq and Afghanistan, clocking up more than 1 million flight hours and providing invaluable visual intelligence, as well as offering a significant attack capability.

The latest and most spectacular leap in this area came with the unveiling at its Warton site of BAE Systems' Taranis prototype unmanned combat aircraft. Named after the Celtic god of thunder, the concept demonstrator will test the possibility of developing the first ever autonomous stealthy Unmanned Combat Air Vehicle (UCAV) that would ultimately be capable of precisely striking targets at long range – even in another continent.

Taranis is an informal partnership between the MoD and industry stalwarts such as BAE Systems, Rolls Royce, QinetiQ and GE Aviation. It is designed primarily to provide the MOD with critical knowledge on the technical and manufacturing challenges and the potential capabilities of Unmanned Combat Air Systems.

The most significant technical challenge overcome in the development of Taranis has been the difficulty of combining a number of elements within one vehicle, including autonomy systems developed for existing unmanned craft such as BAE's Mantis, according to Nigel Whitehead, group managing director, programmes and support, for BAE.

"A number of the individual technologies involved have been looked at in the past, but bringing them all together was a considerable challenge," he said.

Other specific technological issues that the Taranis designers faced included positioning the craft's power source within the middle of the body to help make it invisible to enemy sensors across the electromagnetic spectrum. Aerodynamics were also a considerable challenge as the craft is finless, so it was necessary to find a way to create directional stability.

For all its technical innovation, however, it is clear that the unveiling of this prestigious project was undertaken with one eye on the SDSR. Speaking at the event, Whitehead said: "Without wishing to pre-suppose the outcome of the Strategic Defence and Security Review, and any changes to the Defence Industrial Strategy that this may spawn, there is a clear and compelling need to realign the way in which the MoD and Industry work together. The Taranis programme holds many of the clues as to how this should work."

In response, Gerald Howarth, Minister for International Strategy Security, said: "Evidence from Taranis is already being used to shape the

Main picture: The Taranis Unmanned Combat Air Vehicle  
Above right: The Supacat SPV400



# face of cuts

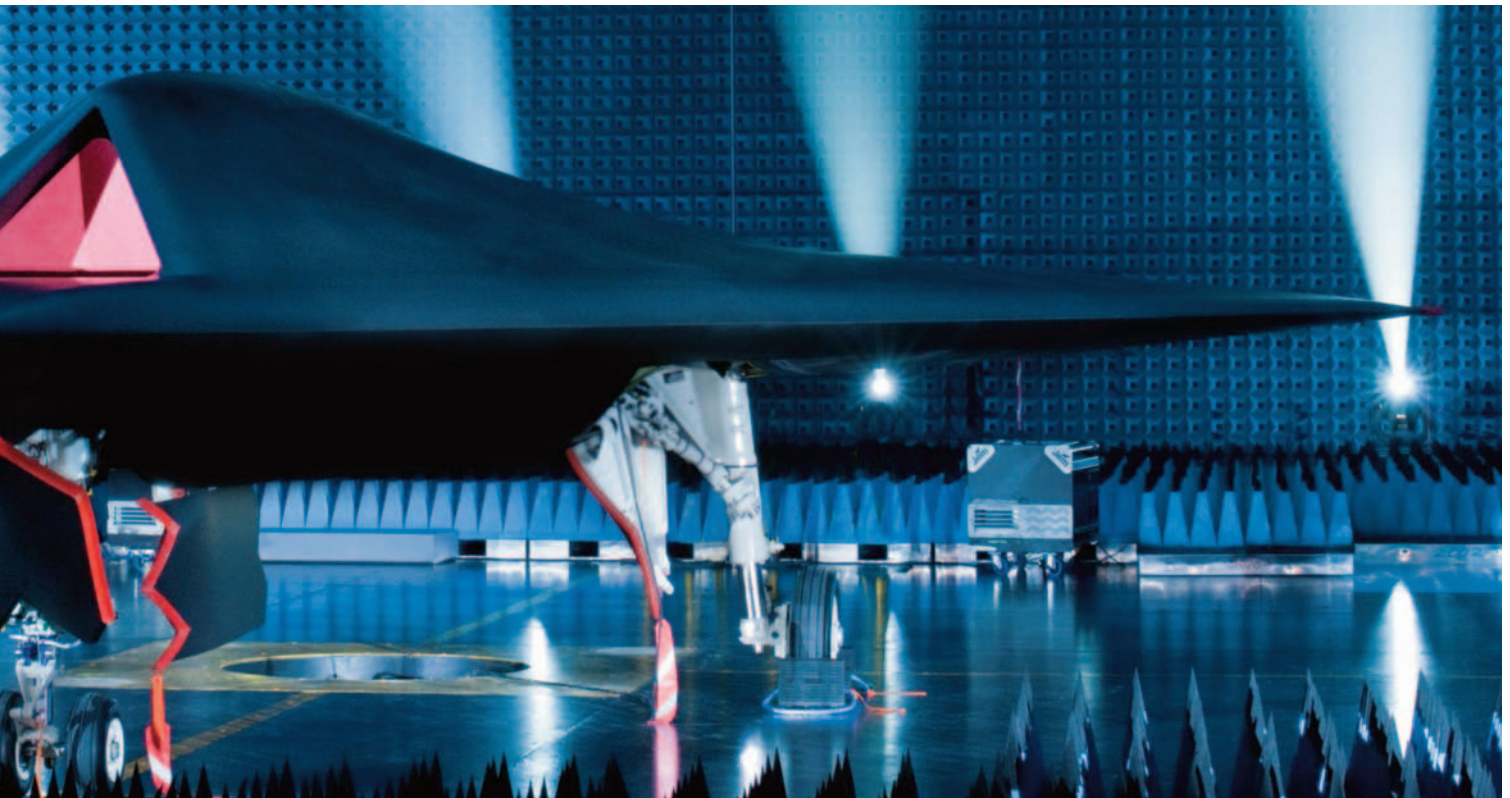
**The UK defence industry is one of the most successful in the world, but faces threats in the shape of government spending cuts. However, as Eureka discovers, there is no shortage of novel designs.**



direction of future defence research and will ultimately help us to make decisions on the effectiveness of remotely commanded Unmanned Aircraft operating alongside manned combat aircraft", but warned that the SDR "may mean giving up some cherished but outdated capabilities in order to reinvest in new ones".

So where does this leave design innovation in the defence sector? Clearly value for money is going to be a major consideration. However, given that Howarth said of the SDR that it 'will balance the needs of current operations in Afghanistan, which is our top priority, against the need to plan for other future conflicts', it seems reasonable to conclude that projects appropriate to that theatre are likely to continue to receive funding in the short term.

One such project is the Light Protected Patrol Vehicle (LPPV), designed to replace the Snatch Land Rover, the use of which has proved so controversial in Iraq and Afghanistan. There are currently two main contenders for this at the moment, namely the Ocelot, which is the result of collaboration between Force Protection Europe and Ricardo and the wholly British-owned Supacat SPV400. Both vehicles stem from efforts to produce vehicles that will protect their occupants against the improvised





*Above: The Supacat's transfer case from Xtrac  
Below right: The Questar vehicle from Marshalls Land Systems*

explosive devices (IEDs) which have become a major feature of the Iraq and Afghanistan campaigns.

Because of this need, both vehicles feature V-shaped hulls. In the case of the Ocelot, the hull contains a Steyr 3.2 litre straight six diesel powerpack, propshaft, six speed ZF gearbox, AxleTech differentials, fuel tank and all the suspension gear except for a torsion bar, which is mounted alongside the hull. In the event of an attack, the vehicle can keep moving, even if it has lost a wheel as the rest of the automotive parts are protected.

The Supacat SPV400 combines an integrated blast and ballistic protection system, including a protected all composite crew pod and V-shaped hull. Using the latest composite and ceramic armour systems, the crew pod is constructed as a separate module, sealed off from potential secondary projectiles, such as kit and electronic devices, which are housed in a rear compartment. All seats are mine blast protected.

**Technology transfer**

One interesting aspect of the Supacat's design is the way in which technology has been transferred from motorsport into the military arena. It has employed the expertise of Xtrac, a leading designer and manufacturer of high technology gearboxes, differentials and driveline components, which are used throughout motorsport. For this project, its transfer case features high and low range gears, which can be actuated whilst the vehicle is on the move, enabling rapid transfer between on-road and more extreme off-road terrain. The transfer case centre differential provides a 50:50 torque split to the front and rear

axles and is electronically controlled. The unit also has provision to drive a power take-off (PTO) as well as the power assisted steering (PAS).

Xtrac has also developed front and rear axles for high mobility military vehicles. The new axles employ a speed sensitive locking differential, which is less aggressive for the application than the usual torque sensitive configuration, and is thus better able to deal with sudden shock loads. Designated 'Milspec 1002', the differentials are passive and lock automatically without intervention from the driver. They come from the same stable that helped Volkswagen win this year's 14-day Dakar Rally with a 1-2-3 victory. The axles have been designed and packaged to be fully compatible with an 'existing vehicle platform' and have been successfully tested over 'thousands of miles' without failure.

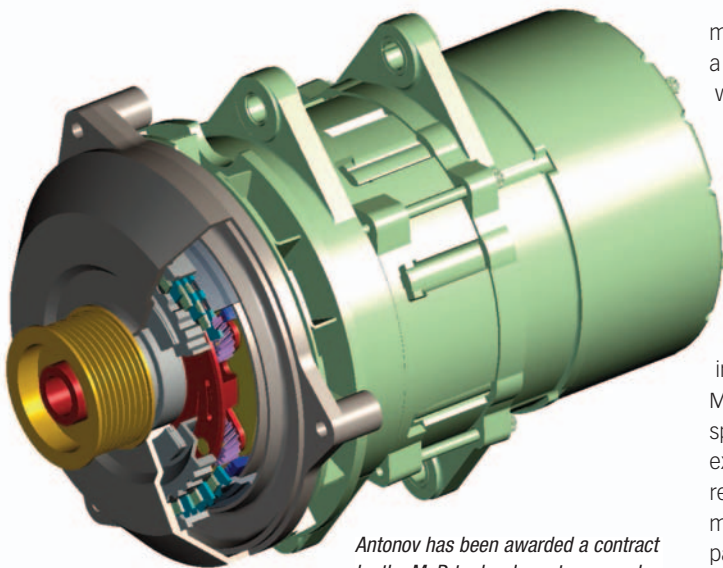
Of course, this 'two-way street', whereby technology developed for the defence sector migrates to civilian applications and *vice versa* is a long-standing aspect of the industry. Many of the companies at the recently held DVD and Farnborough Airshow events are active in both fields and were only too keen to talk about non-military applications for their technologies.

Another major raft of technologies to come out of the Afghanistan campaign has been the need for improved sensor-based systems and information sharing, in order to detect threats and enemies before they have a chance to inflict much damage. Here again, the value of unmanned systems is shown to be paramount. At the DVD exhibition, John Harris from Marshalls Land Systems showed both a 'Trakkar' unmanned mobile 'follow me' platform to run behind soldiers and carry some of their kit, and a small 'Questar' vehicle that can be remotely, semi- or fully autonomously-controlled. Equipped with a camera, it has been developed from the 'Saturn' system that was part of Team Stellar which won the RJ Mitchell Trophy in the MoD Grand Challenge in 2008.

But what stands out about the system is what can be done with



information from the video camera. Using software developed at Cranfield University, it is possible to identify enemy soldiers from their behaviour. Harris said that, for the Grand Challenge, the vehicle had a radar so it could detect weapons. But Matt Breach, chief engineer for collaborator Finmeccanica Battlespace Solutions, said that it now just used a 'classification approach, threading and weeding' and identified hostile actions correctly approximately 80% of the time. In terms of potential civilian applications, it had already shown it could classify cars, correctly identifying 4x4s for example, and had the potential to identify sick animals or people or malfunctioning machines. It is unlikely to be as accurate as an alert human, but humans are not always alert or looking at the right screen. Breach said there are plenty of 'dull, dirty and dangerous' situations which are better watched over by machines, if only in order to alert humans when something significant is happening.



*Antonov has been awarded a contract by the MoD to develop a two-speed alternator for military vehicles*

This will not work, of course, for land mines, once they have been laid, but after 40 years of R&D, US company Non Intrusive Inspection Technology (NIITEK) offers a technology, originally invented by German scientist Günter Wichmann, that enables reliable identification of buried explosive hazards. This uses ground penetrating radar with a bandwidth of from 200MHz to 10GHz. Asked about the basis of this success, Juan Navarro, NIITEK's executive vice president and general manager said: "The key is signal fidelity – the signal must be very stable and very clear." The company was awarded a \$106.5 million contract from the US Army for the supply and support of 76 Husky Mine Detection Systems for high reliability clearance of buried mines in support of US peacekeeping operations around the world in June 2010. Deliveries will be made over the period to May 2011.

Some 100 million land mines are buried in 65 countries. Most of the casualties are civilians. Information on where land mines and enemy and friendly forces are located needs to be shared as soon as it is acquired.

A Generic Vehicle Architecture initiative aims to link systems in

different vehicles so that all can have access to their positions; and with sensors such as sniper detection and infra red camera systems, where the enemy is and what they are doing. Participants include: the MoD, IBM, Selex/Galileo and Iveco. A new Defence Standard 23-09 is to apply to both legacy and future systems, which can hopefully be plugged in and used with minimal cost and delay. Until now, the task of integrating a range of different systems successfully with each other has been far from trivial, but there was a working demonstration that mapped where the various elements of a convoy were as they moved round the site at the DVD event, a system that is now ready for deployment.

According to unmanned aerial vehicles vendors, the integration of battlefield information including that derived from UAVs has long been a 'Holy Grail' for system developers, but attempts at deployment in Afghanistan show that it has yet to become a reliable reality on the battlefield. Hopefully, that situation is about to change.

Businesses too often succeed or fail according to whether management can see what is really going on and here too, there is often a need for interfaces to allow IT islands of automation to communicate with each other and to management systems. Lieutenant Colonel Paul Winchcombe of the MoD described an FLIS (Future Logistic Information Services) initiative at DVD to try to reduce their current 275 applications to two. Release 1 is already being rolled out, to be followed by full rollout in 2014. The remaining potential delivery partner – the only other one dropped out – is Boeing. The JAMES (Joint Asset Management Engineering) ERP application for the land environment will be rolled out separately.

All IT and smart weapon systems require electric power, and with increasing demands, Antonov has been awarded a contract by the MoD to develop a two speed alternator for military vehicles. With two speeds available, it can match the output of a larger and more expensive single speed alternator in its low speed range and could also replace the multiple generators that are often required for heavy-duty military vehicle applications. The project has been undertaken in partnership with a 'major manufacturer of alternators and starter motors'. The two speed alternator provides full electronic control of the speed change through an active clutch mechanism. The project has currently reached the stage of detailed engineering design.

**'Bullet-proof custard'**

Other interesting developments in the sector include BAE Systems' corrosion monitoring system that consists of sensors made of materials and coatings similar to the substrate of a vehicle or structure, that are attached at various locations to measure corrosion rates electrically. It is one of the developments to come out of the company's Advanced Technology Centre, as is a shear thickening gel called 'Liquid Armour' (nicknamed 'bullet-proof custard'), which thickens and becomes sticky on impact and sounds like a potential alternative to d3o's shear material used to protect against sporting injuries.

[www.adsgroup.org.uk](http://www.adsgroup.org.uk)

[www.xtrac.com](http://www.xtrac.com)

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