Stand-off and deliver: French/UK MMCM programme charts an unmanned course into the minefield

The governments of France and the United Kingdom have committed initial funding for the design and definition of an offboard system prototype intended to blaze the trail for a radically different approach to mine countermeasures operations. Richard Scott reports

In late March 2015, an industry team led by Thales was awarded a GBP17 million (USD26.5 million) contract by European defence procurement body OCCAR to deliver the first phase of the French/UK (FR/UK) Maritime Mine Countermeasures (MMCM) programme. Long in the making, this initial contract is intended to be the first step in a process that, if all goes to plan, will culminate in the fielding with both navies of an unmanned 'end-to-end' minehunting and neutralisation capability sometime after 2020.

Tracing its inception back to the 2010 Lancaster House co-operation agreement between France and the United Kingdom, the MMCM programme reflects the shared vision of a future stand-off MCM approach
using unmanned systems and sensors to perform mine detection, localisation, classification, and disposal - and in so doing, keeps personnel at a safe distance outside the minefield. Indeed, both partner nations have already framed parallel national requirements: France in the shape of its Système de Lutte Anti-Mines Futur (SLAMF) programme; and the UK under the umbrella of the Mine Countermeasures and Hydrographic Capability (MHC).

The USV demonstrator craft Sterenn Du pictured during trials in Brest, western France. Sterenn Du forms part of France’s national ESPADON technology demonstrator programme. (Richard Scott/NAVYPix)

The FR/UK MMCM programme is intended to build on offboard MCM technology demonstration and risk reduction already performed by the two partners at a national level. In the case of France, in 2009 the Direction Générale de l’Armement (DGA) launched a technical demonstration programme known as ESPADON (Evaluation incrémentale de Solutions Potentielles d'Automatisation de Deminage pour les Opérations Navales) to de-risk both the overarching concept and key enabling technologies for the projected SLAMF architecture. An industry team of DCNS, Thales, and ECA supported the ESPADON programme; the programme involved extensive trials of autonomous vehicles in French waters, including launch and recovery from the experimental twin-hulled unmanned surface vehicle (USV) Sterenn Du.

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First steps

While France and the UK had previously participated in a European Defence Agency (EDA) project for future MCM requirements definition, it was a joint declaration on defence and security co-operation signed at the Lancaster House summit in London in November 2010 that formalised agreement for the two nations to align plans to co-operate on elements of future MCM equipment and systems. "This could provide efficiencies, ensure interoperability, and help sustain the Franco-British industrial base in the underwater sector," the declaration stated, adding: "We will therefore establish a common project team in 2011 to agree the specifications for a prototype mine countermeasures system."

While the respective national programmes had subtly different drivers, dependencies, and legacy constraints, cross-Channel staff work plans meant that by the February 2012 UK/France summit, when the two governments made their next joint declaration on defence and security co-operation, they were in a position to announce that they had aligned future MMCM capability plans. "We agreed to take an incremental approach whose first major step will begin in 2013 with the development and realisation of a demonstrator/prototype of offboard systems based on unmanned technologies. The Joint Project Office already established within OCCAR will begin a European competitive process in 2012 for a common assessment phase," said the declaration.

By the end of April 2012 a project procurement strategy had been approved. This authorised OCCAR's integration support team to begin the competitive dialogue procedure for the FR/UK MMCM programme.

The statement of requirement subsequently released by OCCAR for the FR/UK MMCM demonstrator called for a stand-alone system "able to carry out the tasks necessary to detect, classify, identify, and neutralise the mine threat". It stated that the selected contractor would be required to produce "an MMCM system prototype to be used as a basis for the replacement for the current MCM capability to meet the French
need, [and] produce an MMCM system demonstrator to de-risk the introduction of unmanned MCM systems that sustain and enable the upgrade of current [UK] Hunt-class based capability, as well as de-risking the introduction of longer term portable and ship-based capability to meet the UK need”.

Atlas Elektronik UK, ECA, QinetiQ, Thales SAS, and Ultra Electronics Sonar Systems each received an invitation to participate in dialogue (ITPD) for the development, production, and qualification of the demonstrator suite. The scope of requirement/key deliverables encompassed: system definition studies; mission package design including detailed studies, modules, and command-and-control assessment; interface studies for the mothership required to host; configuring and operating the mission package to include legacy and future host platforms; delivery of two complete systems (one for France and one for the UK); a qualification plan including system trials at sea; and at-sea launch and recovery of a USV from a host platform.

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The MMCM system of systems solution proposed by Thales. (Thales)

The MMCM system architecture proposed by the Thales/BAE Systems team comprises a USV equipped with an autonomous navigation system and an obstacle detection/avoidance sonar; a threat identification

**Definition and design**

Stage 1 will mature the design, through to a Critical Design Review, of a primary system capable of delivering an ‘end-to-end’ mine neutralisation capability. This activity, spanning 15 months, includes working groups involving end users and subject matter experts to address all aspects of the technical solution: system architecture and system interface control; information assurance and security; safety and environmental compliance; acceptance criteria and process; human factors; and logistics support.

Simulation and modelling of the MMCM architecture, down to subsystem level, will be a key part of Stage 1. In particular, modelling of the full functional architecture will identify interactions with the MMCM system environment, and with other systems in service or currently in development in the UK Royal Navy (RN) and the French Navy.

"This contract is fundamentally about building a system based on mission requirements," Jean-Francois Ghignoni, marketing and strategy director for Thales’ underwater systems business, told *IHS Jane’s*. "We've worked a lot on designing a system of systems based on existing technology building blocks to meet the requirements laid down by the two nations, and expressed through a series of vignettes and operational cases.
"It is a system of systems based on the needs of commonly defined operational scenarios. The two navies have been instrumental in pulling together and harmonising their respective requirements. That is fundamental to this Anglo-French co-operation."

"These commonly defined scenarios are the driver behind our solution," he added. "They are hugely detailed and very much reflect the current and future direction of travel in MCM with regard to threats and environments. Targets will be more difficult to find, and so we must approach the problem in a different way."

The overarching goal of the MMCM programme is to design, develop, manufacture, and qualify a primary system that can effectively address four classified operational scenarios. Each of these high-level scenarios includes more than 20 individual vignettes to address individual tasks within the given scenario; these vignettes have specific performance-level acceptance criteria (for example, probability of classification of mines, time required to clear a minefield of mine threats, assessment of residual risk, and the ratio of removal/neutralisation of mines). Performance-level modelling also includes timing for launch-and-recovery of unmanned assets, and exploitation by operators of collected data; it also takes into account footprint with regard to personnel and logistics. In addition, the MMCM system of systems is required to meet more than 500 technical and functional specifications.

The individual vignettes are designed to exercise and demonstrate the system of systems in particular conditions (taking into consideration specific operational and environmental constraints). Operational scenarios aggregate a number of vignettes to demonstrate the ability of the system of systems to operate within the required performance envelope of the mission parameters specified by the FR/UK user community.

"This represents a significant challenge," observed Ghignoni, "as it is the first unmanned offboard system that sets out to replace the minehunter end-to-end. So we saw what was available across Thales on the basis of the experience France had built up in ESPADON, and the exposure to the research and demonstration work that have informed MHC in the UK. Then we looked at what else was available in France and the UK, and what was available globally.

"We needed to be in a position to present answers to all the questions asked by the different operational scenarios. The negotiation phase was lengthy because it needed to be ... OCCAR had different approaches to assess and wanted to be sure [on behalf of the two nations] that it was headed in the right direction."
The USV platform being developed for MMCM is a derivative of the Halcyon demonstrator platform previously designed and built by Thales and ASV. (Thales)

High-resolution sonar

Thales views its SAMDIS high-resolution, high-frequency, synthetic aperture sonar payload as a key MMCM discriminator. Developed with the support of the DGA through the ESPADON programme, the system employs three separate beams - projecting 35 deg backward, broadside, and 35 deg forward - to create a multi-view sonar picture that dramatically increases the single pass probability of detection and probability of classification, and minimises the probability of false classification.

"The realisation of our solution is in large part possible thanks to the superior detection and classification performance delivered by the SAMDIS multi-view synthetic aperture sonar payload," Ghignoni explained. "It is important to understand that, within the overall system, it is the ability to make the best use of SAMDIS that will enable the replacement of the conventional minehunter vessel."

Detection is not so much the problem; rather, the issue is correctly classifying contacts as mine targets and rejecting false targets. "Conventional sidescan sonars only look at the target broadside, and that raises the possibility that you will miss the target with a single pass," Ghignoni said. "SAMDIS is different in that it looks at objects from three different aspects. So it is a true 'in-stride' multi-aspect sonar with the ability to perform detection and classification in a single pass. It means that the sonar is able to view contacts from different angles.

"Our objective is to ensure that, as far as is possible, we can complete a pass without the need to manoeuvre or reposition the vehicle, and so maximise the coverage rate. Of course, there may be times when you do need to re-visit a target, but we want to avoid that unless absolutely necessary."
Thales has been developing SAMDIS since 2011. Engineered from the outset for integration into AUVs, the system can also be fitted in a towed body for deploying behind manned or unmanned surface craft (being known as T-SAM in this application). SAMDIS is used in both the AUV and T-SAM versions within the MMCM architecture.

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BAE Systems' NAUTIS+ mission management system (MMS) will provide a centralised operations point for command, control, and monitoring of the primary system. The core of the MMS is based on the existing NAUTIS command-and-control system. (Richard Scott/NAVYPIX)

System architecture

One of the big decisions for the rival MMCM teams was to decide on their preferred system architecture and its attendant concept of operations (CONOPS). "In the end, we went for a non-USV centric solution," said Robinson. "We took the view that, if you put all your tools on one platform and it failed, then the whole mission fails.

"So we separated out the AUV capability from the towed sonar capability so as to ensure there was no single point of failure in the system. Our aim was to build in redundancy and simplify the system overall. That meant reducing the burden on the USV, adopting a more straightforward [CONOPS], and allowing the AUV to be operated independently.

"The USV has its own mine and obstacle avoidance sonar, so it can search for moored mines in volume," added Robinson. "Also, SAMDIS needs a larger vehicle to be effective, in terms of endurance for task and onboard power for the sonar - but the larger the vehicle, the more difficult the launch-and-recovery task [from a USV] becomes. In our architecture, the USV is only required to deploy with one of two payloads [the T-SAM towed sonar or the ROV].
"It is a different approach from ESPADON, which had envisaged the USV operating as an 'AUV taxi,'" added Ghignoni. "We studied both USV-centric and non-USV centric options very closely during the bid phase. We compared the two, simulated both from a systems standpoint, and concluded that the best option - and in our view the more robust approach - was to go non-USV centric. It avoids a single point of failure, it increases the operational flexibility (with the AUV capability delivered independent of the USV), and limits the 'drone of drones' architecture so as to reduce overall complexity."

ECA's A-27M vehicle forms the basis for the AUV component of the MMCM concept. (ECA)

The AUV, derived from the A-27M long-endurance multi-mission vehicle within ECA's Alister family of underwater vehicles, is designed to be capable of performing covert detection/classification/localisation at ranges of up to 30 n miles from the host platform (a reach consistent with that required for an MCM 'breakthrough' during an amphibious operation). The integration of the AUV and the SAMDIS payload was proven at sea during an exercise in June 2014.

The USV component of the MMCM system will build on the private venture Halcyon demonstrator, but with some design modifications. "The platform will be slightly longer in length and slightly narrower in beam, with a re-designed mast," Robinson said. "Also, the transom will be slightly lower, and what was the well deck will be made into a flat area for power supplies and winches."

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Swimming forward

According to Robinson, the first key programme milestone is a Preliminary Design Review coming at the end of 2015. "That will be followed by a Critical Design Review in late Q2/early Q3 of 2016 at the end of Stage 1."

Inputs from Stage 1 will provide key inputs into the respective SLAMF and MHC programmes. Although there is no commitment by either nation beyond the design stage, the joint contract with OCCAR includes an option to extend the work to cover development and system manufacture (Stage 2) and incremental
qualification trials and acceptance (Stage 3) of the system of systems over a 30-month period. "This would cover the build of two identical system of systems for evaluation by the respective partner navies," Robinson said.

A further option covers a 24-month period of support for an independent operational evaluation (Stage 4) by the French and UK navies in the 2019 time frame. "From the French side, there is an intent to make use of the system at the earliest opportunity, and enable a rapid transition into service as a part of SLAMF," Ghignoni said. "The plan of the DGA and the French Navy is that the MMCM system should be operated from a new, non-signature treated, mothership."

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