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PERSPECTIVE ON REMODELLING OF TORPEDOES INTO ASW EXERCISE TARGETS

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Abstract: *This paper wants to be a thorough analysis of the development of an anti-submarine (ASW) exercise target, from the perspective of the technical management required. Although such ASW exercise targets have been developed for some years as specifically dedicated autonomous underwater vehicles (AUV), an ASW torpedo in the arsenal of the Romanian and Bulgarian Navies is appropriate for remodelling. Its dynamic properties and the propulsion system can be reshaped so that the torpedo would travel slower, but for a longer period of time. These new features match the fundamental requirements of the live ASW training exercises of the specialised vessels (frigates, corvettes, etc.). The authors foresee in this article the possibilities of transformation and the necessary steps for this remodelling.*
Keywords: *ASW, exercise, smart defence, torpedo, AUV*

INTRODUCTION

New NATO R&D approaches evolving from the paradigms "connected forces" and "smart defence".

In may 2012, the Chicago Summit Declaration on Defence Capabilities: "Toward NATO Forces 2020" established the goal of NATO Forces 2020 as "Modern, tightly connected forces equipped, trained, exercised and commanded so that they can operate together and with partners in any environment… Smart Defence is at the heart of this new approach. The development and deployment of defence capabilities is first and foremost a national responsibility. But as technology grows more expensive, and defence budgets are under pressure, there are key capabilities which many Allies can only obtain if they work together to develop and acquire them. We therefore welcome the decisions of Allies to take forward specific multinational projects, including for better protection of our forces, better surveillance and better training. These projects will deliver improved operational effectiveness, economies of scale, and closer connections between our forces. They will also provide experience for more such Smart Defence projects in future." [1]

It is obvious that in present times, dealing with an acute financial crisis and responding to evolving geo-strategic challenges are fundamental changes in approaching the R&D process. The new operational and logistic requirements of the NATO assets involve the raise of the financial effectiveness, or the benefit/cost ratio. The new economic conditions render as unaffordable the individual, national research and development activities. On the other hand, NATO and the European Union have to strengthen their capacities to address common security challenges. As the allies' forces give the strength of NATO and UE, subsequently the "Connected Forces" concept is to be applied to all branches of the military – their training, equipment, interoperability and experience.

As quoted above, the paradigm of "Smart Defence" is the most important and feasible philosophy that has to be enforced in order to connect the forces. In a few words, smart defence involves common efforts, plans and resources to converge on a coherent allied policy in terms of interoperability, equipment and training. As part of this policy, the "smart R&D" is based undoubtedly on trans-national cooperation. It is almost impossible for a nation of NATO or EU to develop by itself a sound and compatible set of assets in the ongoing financial environment. Working together to develop and acquire them is the only feasible option.

OPTIONS FOR ROMANIAN-BULGARIAN JOINT NAVAL R&D PROJECTS

In the same vein, the European Union's "Pooling and Sharing" is self explanatory for the development of R&D of the member states. As geographically, culturally and economically connected for centuries, Romania and Bulgaria happened to share also equipment of their Naval Forces. Nonetheless, Bulgarian and Romanian Navy officers' education & training has many similarities. That is why RO and BG scientific research and development can approach joint efforts for smart defence. Common naval projects will deliver improved operational effectiveness, economies of scale and closer connections between our forces.

Sharing common equipment is already in place. We will only mention here the Russian-made anti-submarine torpedo SET 53, as object of our research. This heavyweight torpedo has been used for decades in both fleets as the main ASW weapon. Yet, as this torpedo is morally obsolete but still existent in the arsenals and having logistic support for maintenance and repairs, the need of employing it for other purposes, with little technological/financial effort arises. The immediate logical alternative for it is the remodelling into an ASW exercise target, an autonomous underwater vehicle that can simulate the operational behaviour of a submarine. The target is generally used for live exercises of ASW search, detection and attack by specialized ships and aircraft (frigates, corvettes, ASW helicopters, maritime patrol aircraft, etc.).

A torpedo is actually a high performance AUV – why wouldn't we use it as a "gentler" AUV? This idea, developed initially at the "Nikola Vaptsarov" Naval Academy of Varna, was discussed with the researchers of the "Mircea cel Batran" Naval Academy of Constanta. Both parties recognized pretty fast the importance, relative ease and usefulness of the SET 53 torpedo's transformation into an ASW exercise target. As all the necessary prerequisites for this remodelling are present in both navies, the common work started. The first results consist of the analysis to follow next.

TECHNICAL ISSUES RAISED BY THE TORPEDO'S REMODELLING INTO AN ASW EXERCISE TARGET.

As mentioned before, there are already commissioned ASW training targets. Let's have a look on the most commonly known ones.

a) The MK 39 EMATT (Expendable Mobile ASW Training Target)

This product of Lockheed Martin simulates diesel electric submarines by operating at various speed, depths, and headings. It generates passive discrete tones, broadband noise, active emissions, and echo repeats. EMMATT can be launched by air and surface ASW platforms.[2]

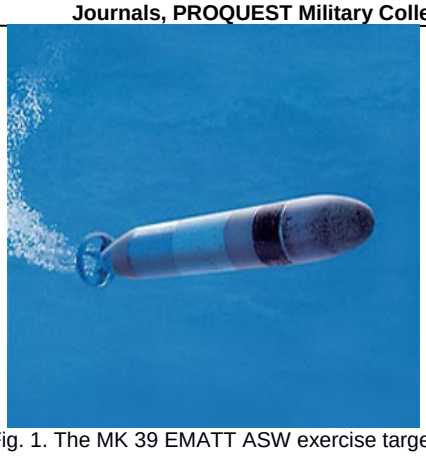

Fig. 1. The MK 39 EMATT ASW exercise target

b) MK 30 Mod 2 Anti-Submarine Warfare (ASW) Target System (ATS)

Manufactured by Raytheon, MK 30 Mod 2 ATS simulates a submarine's dynamics of speed, depth and manoeuvres. It delivers realistic signatures of passive and active acoustics and magnetic anomaly detection. It is launched from ASW helos or surface ships.

Fig. 2. The MK 30 Mod 2 ASW Target System (ATS)

c) AUV62-AT

The AUV62-AT, manufactured by Saab, consists of a family of 21" torpedo-shaped AUVs, 4 to 7m long, dedicated to autonomous mine reconnaissance or ASW exercises. It communicates with the parent craft either surfaced using WLAN with UHF/VHF or SATCOM, or submerged, with a Hydro Acoustic Link. The Swedish AUV62-AT can follow pre-programmed routes or be navigated online by the operator using radio communication or the underwater acoustic link. [3]

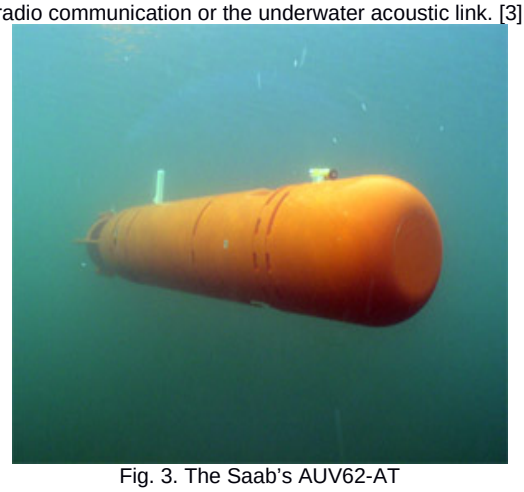

Fig. 3. The Saab's AUV62-AT

As it can be noticed, all these vehicles resemble very much a torpedo, the best example being illustrated by the AUV62-AT AST. The RO and BG Navy's SET 53 anti-submarine torpedo has a high degree of opportunity for remodelling into an ASW exercise target, as presented below.

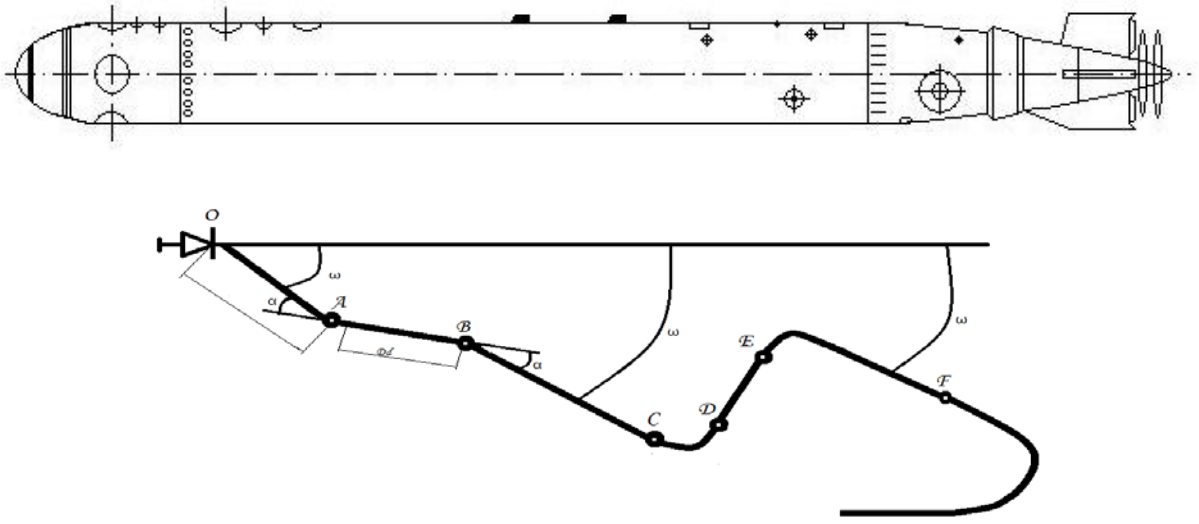

Fig. 4. General view and trajectory of the SET 53 ASW torpedo

The SET 53 ASW torpedo's technical characteristics (for the training variant) are the following [4]:

- ✓ DC electric propulsion, i.e. energy stored in batteries
- ✓ Speed in excess of 20 knots, run time approximately 10 minutes
- ✓ Autonomous control on initial stage of trajectory: course gyro-compass, depth/pitch sensor, roll gyroscopic sensor
- ✓ Passive acoustic homing on final stage of trajectory
- ✓ Recoverable and reusable

The technical problems of the torpedo's remodelling into an ASW exercise target emerge from the basic question: What do we need to change? We conclude that the necessary steps of the transformation would be to lower the speed (preset before launch), to increase the time of operation and to equip the torpedo with acoustic transducers for passive/active detection by ASW vessels. Meanwhile there are functional

features that should be preserved, as the autonomous control, the trajectory programming and the launching systems, keeping similar maintenance procedures.

Thus, the courses of action for the remodelling consist of four main paths:

- ✓ Decrease the voltage at the electric motor's input
- ✓ This could increase the time of battery's discharge
- ✓ Reassessment of the autonomous control capabilities to deal with alterations of the SET 53 torpedo's hydrodynamic features
- ✓ Equip it with acoustic transducers for passive/active detection by ASW vessels

Taking in account these requirements of transformation and the ways of doing it, the life cycle of that remodelling would need to comprise the phases presented in Fig. 5.[5]

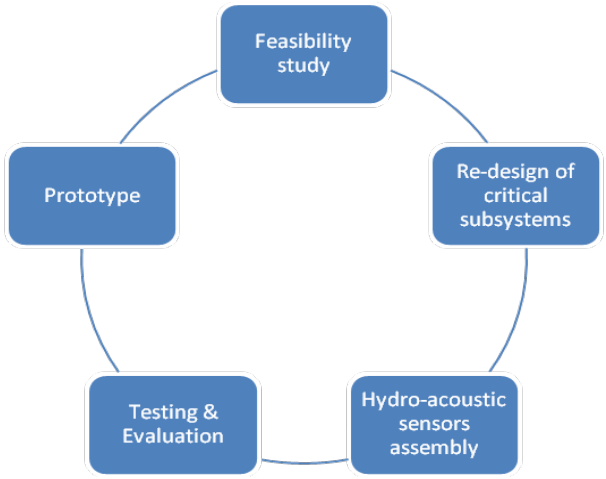

Fig. 5. The life cycle of remodelling the SET 53 torpedo

CONCLUSIONS

This joint Romanian-Bulgarian project addresses and responds to the new challenges lying ahead of our Naval Forces, as members of the NATO alliance and EU. The concept of "Smart Defence" can be applied to acquisition/modernization of equipment and also to the naval personnel's training in the Black Sea area. Remodelling the SET 53 torpedo into an ASW exercise target has also higher cost efficiency. The funds necessary for research and development and actual changes of the functional systems are significantly lower than in the case of purchasing very reliable, yet expensive ASTs. From the management perspective, due to the fact that both countries still have maintenance/repairs facilities decreases a lot the costs of the infrastructure required for the transformation. Moreover, the full professional employment of RO and BG research and development agencies' capabilities is a gain, as well.

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