Eliminating Threats Effectively.  
Mine Countermeasures Systems for the Modern Navy.

... a sound decision
The current global political changes and their influence on military operations require a restructuring of the armed forces of most countries. With the shift in threat from a comprehensive, global conflict to small-scale regional crises which often require power projection from the sea off a foreign coast, most navies are concentrating on increasing their capabilities in littoral warfare.

The requirement for joint expeditionary missions with a maximum degree of protection for involved military personnel and the need for fast, focussed and reliable intelligence information call for new solutions, especially in the underwater battlespace.

Due to their versatility, their insidiousness, their effectiveness and their low cost, naval mines have always been a weapon of asymmetric warfare. It is a well established truth in Naval Mine Countermeasures (NMCM) that only a well-balanced mix of NMCM techniques and systems can provide an effective instrument to counter the mine threat.

The ATLAS Integrated Mine Countermeasures System is the most complete and effective system available today to provide this mix of capabilities.

Many nations are strongly dependent on free waterways. Ships operating in the vicinity of the coastline need to address the characteristic threats of the littorals like for example the naval mine or other asymmetric perils. They also require rapid environmental assessment capabilities, for calibration and a realistic estimate of their sensor and weapon effectiveness.
Our overarching aim is to deliver a capability which enables the officer in charge of the MCM operation to obtain full situational awareness based on a complete and consistent picture of the mine threat situation to support him in taking the correct actions in order to fulfil his mission.

Our means in achieving this aim is a system of systems which provides an unparalleled density of relevant information from all sensors and effectors at the officer’s disposal.
The ATLAS Integrated Mine Countermeasures System (IMCMS) is a multi-role MCM Weapon System which covers the complete process of Mine Warfare including Minesweeping, Minehunting and Minelaying on up to task unit level as well as supporting functions such as hydrography, environmental assessment and surface and air surveillance.

The system is based on open architecture, state-of-the-art technologies and is operated from multifunction consoles allowing the control of each sub-system from any of the consoles. System integration is realised on hardware, software, data and functional levels. Therefore the information obtained from any of the sensors or effectors is available to each other subsystem and every operator if desired.

The Command, Control and Communication (C³) system takes charge of the complete MCM process ranging from planning (including transit phases), preparation (including environmental assessment), execution of the task and evaluation, reporting and documentation. It supports automatic evaluation of Task Orders and Operations Directives and the self-controlled generation of the required reports. The operators are provided with a very high density of relevant information to support the decision processes without losing the possibility to access unfiltered information if required.
The different subsystems such as the hull-mounted sonar, the self-propelled variable depth sonar, the autonomous underwater vehicle and the remotely controlled surface drones offer similar operational sequences for planning, execution and evaluation, thus providing a high degree of functional integration. In all cases, the basis for planning is a required percentage clearance and coverage, considering the environmental conditions. The platforms carrying the sensors follow predefined tracks and require a high-precision navigation. The result of their activities are the positions of mines and their status (either swept or detected, classified and/or neutralised.)

The IMCMS follows our company’s philosophy to provide system solutions “From sensor to shooter” by delivering the whole chain of Mine Warfare (MW) operations, starting with detection through the sonar array and finalizing in the mine disposal with SeaFox.
The ATLAS IMCMS is the core element of a modern Mine Countermeasures Vessel (MCMV) as a high performance, fully integrated and sea-proven equipment designed for highly effective Mine Countermeasures operations against modern types of mines in all kinds of waters.

- Comprehensive presentation of tactical and navigation data incl. WECDIS (ENC, DNC, Vmap, ARCS) and additional military layers for all MW-operations
- Generation and management of tactical data base
- Control of integrated subsystems (Minehunting Sonar, Autonomous Underwater Vehicle (AUV), Mine Disposal Vehicle (MDV), Self-Propelled Variable Depth Sonar (SPVDS))
- Navigation, peripherals, Automatic Dynamic Manoeuvring
- Remote Minesweeping (Unmanned Surface Vehicle)
- Planning for all MW operations

- Mission execution supported by:
  - Automatic control of own ship, surface and subsurface vehicles
  - Surface surveillance (Raw RADAR and ARPA)
  - Data logging
  - Comprehensive system status monitoring
- Post-mission analysis / Mission Evaluation
- Contact management
- Message handling
- Simulation for on-board training on system level
- Built-in test equipment (functional and hardware level) and maintenance
- Mine Warfare Data Center (shore-based or afloat)
- Link Capability
**MCM Command & Control and Communication (C³):**
The C³ system is best fitted for comprehensive MCM mission control and post-mission analysis. MCM Message Handling and all relevant Data Communication is supported automatically. The Combat Information Center (CIC) is equipped with identical Multifunction Consoles (MFC) for all operational capabilities at any workplace, providing interoperability and increased redundancy. Multifunction Consoles facilitate operations and keep all functions and information fully available throughout the system. There are interfaces to all standard subsystems required for modern Minehunting, Minesweeping and Mine Avoidance.

All standard MW missions are supported by the C³ system by means of specially designed planning modules for these kinds of missions.

During towed or remote sweeping operations the C³ system adheres a comprehensive sweeping gear control and Data Link for remote controlled drones as well as mine avoidance. Moreover a bi-directional exchange of control data between Minesweeper and simulation sweeping craft is implemented. The system supports all relevant requirements for remote control of rudder and propulsion as well as of the simulation sweeping equipment and is able to transmit the sweeping plan data for the autonomous operation of the drones and of drone data as e.g. position, heading and status.

**MCM Navigation and Vessel Control:**
The MFC’s with high resolution colour displays are specially designed for all of kinds of surface and underwater vehicles, i.e. MCMV, UUV (ROV, AUV), USV and other mine disposal vehicles.

A comprehensive navigation control based on sensor data from INS, DGPS and DOLOG provides precise position information for planning purposes and for tactical navigation. Separate modules for other navigation sensors can be interfaced. Manual and automatic vessel steering is supported by the Automatic Dynamic Manoeuvring (ADM) function. The ADM core modes are track and heading keeping, circling and circular transverse. Automatic steering and propulsion control considering a towed sweeping gear is fully supported.

Radar Video information from the vessel’s navigation radar is used for tracking of stationary and moving targets and for the display of radar information together with WECDis, thus providing surface surveillance and a consistent surface overview.
Sonar Suite: Hull mounted Sonar System HMS-12M:
The sonar array is a proven design and successfully in service in many nations as a further development of HMS-11M, which is in operation e.g. in the German Navy and has earned a high reputation concerning Minehunting within NATO. The stabilised sonar beams cover simultaneously a 90° horizontal sector and a 60° vertical sector for three-dimensional target location. The horizontal sector can be rotated by ± 180° to cover the complete azimuth. Using broadband technology the HMS-12M provides independent and simultaneous detection and classification of naval mines.

Up to three different frequencies are available for long-range detection or high-resolution classification. A simultaneously available depth classification drives the HMS-12M antenna to one of the best antennas worldwide. The sonar supports automatic tracking of stationary and moving underwater targets, seabottom classification algorithms and computer-aided detection and classification tools. Sonar performance prediction algorithms provide optimum sonar setting recommendations. A high stabilization accuracy and a low magnetic signature are indispensable for successful Mine Countermeasures. For best performance the complete sonar including hoisting unit is acoustically isolated from the ship’s hull.

HMS-12M operates in five different modes:
- Minehunting
- Mine Avoidance
- Side Scan
- Test
- Simulation
During Minehunting operations the Sonar System is used as a search and classification sonar for detection and classification of mine-like objects lying or moored on the sea bottom as well as of drifting mines or other moving objects as e.g. a UUV. Special modes for mine avoidance and route survey are supported. The operator can take advantage of Computer Aided Detection and Classification (CAD, CAC). In combination with the specially designed sonar aperture and processing feature a high and robust detection and classification performance is achievable.

Detection and classification of mine-like objects lying on the sea bottom in deep waters or below layers are performed either by a SPVDS or the MCM AUV whose sonars are fully integrated in the processing chain in the same way as the HMS.
SeaFox – One-shot Mine Identification and Disposal:
This fibre-optic guided one-shot mine disposal vehicle is used for semi-autonomous disposal of naval mines and other ordnance at sea. It is able to relocate acquired positions of underwater objects with the integrated homing sonar. After relocation, these objects can be identified by using the onboard CCTV camera.

SeaFox is available in three versions: An expendable combat version (SeaFox C) used for relocation, identification and disposal of mines and two recoverable versions (SeaFox I and SeaFox T) enabling inspection and training sorties at zero cost.

The SeaFox I uses the same vehicle but without carrying any explosives. Its main application is to inspect and identify underwater objects by means of the built-in TV camera and a high resolution sonar.

The SeaFox T is the training version of the SeaFox C, with a ballast weight and re-settable Safety and Arming Unit (SAU) instead of the warhead. Except for the explosion itself, the behaviour concerning operation and manoeuvring including execution of the arming sequence corresponds to the C variant, thus enabling operator training in full detail.

Main SeaFox features:
- Rapid Disposal: Fibre-optic guided expendable SeaFox reduces mission time compared to other ROVs. Mine disposal time is four times faster than recoverable ROV methods
- Effective Neutralisation: Warhead destroys all known mine types including insensitive explosives
- Precision: High resolution sonar and optical sensors, accurate positioning by using five thrusters
- Reliable Mission Success: SeaFox can approach the mine without restriction because even an unintentional mine detonation constitutes mission success.
- Low Ship-fitting Impact: minimal storage requirements, small size and low explosive contents. Control by stand-alone console or integration into existing MCMV display
- Low Life Cycle Cost due to fully reusable inspection/training vehicles
- System is fully qualified by German Navy, UK and US authorities
- More than 2,500 SeaFox vehicles have been sold to nine different navies worldwide.
SeaOtter Mk II - The Autonomous Underwater Vehicle

The ATLAS SeaOtter Mk II is an Autonomous Underwater Vehicle for the underwater battlespace. It is based on the well-proven SeaOtter Mk I vehicle of the Danish subsidiary ATLAS MARIDAN. The vehicle is unmanned and able to operate independent of a surface platform for a period of 24 hours with minimum external support. Due to its advanced autonomy, it can react to unforeseen events such as e.g. detection and avoidance of obstacles in the water column.

In the standard version for minehunting, the vehicle is equipped with the ATLAS synthetic aperture MCM sonar developed for high probability detection and classification of naval mines in a high-clutter environment. The self-supporting flatfish structure provides a large deck area for down-looking as well as side-scan sensors and provides excellent stability in pitch, roll and heading for critical measurement applications. The extended modularity of SeaOtter Mk II enables the exchange of different modules for propulsion, energy packages, communications, navigation and payload as well as the capability to cope with modules of various dimensions. Due to the extended endurance of up to 24 hours, special care was taken to equip the system with a high degree of redundancy in all critical sub-systems.

The system is capable of operating in two modes:
- Un-tethered autonomous mode (standard)
- ROV-Mode (optional), with fibre-optic link

Due to the modular payload concept of the vehicle it can be used for a wide range of military applications including:
- Minehunting
- Intelligence, Surveillance, Reconnaissance (ISR) missions
- Rapid Environmental Assessment (REA)
- Force Protection
- Anti Submarine Warfare training
- Support of Special Forces.
SeaOtter advantages:
- Rapid deployment
- Proven Technology
- High flexibility due to modular approach
- Completely self-sufficient system without external aid
- Unique precision in navigation
- Identification and Evasion
- Online Mission Replanning
- Auto Detection/Auto Classification
- Fully integrated in IMCMS
- Air transportable
**Future Mine Countermeasures:**

At least for the near future there will still be the need for highly specialized units to do post-conflict, large area clearance operations in Naval Mine Countermeasures. It is nevertheless our aim to also provide non-dedicated assets with a mission-tailored, effective MCM capability.

To this end we are now offering our platform-oriented Integrated Mine Countermeasure System IMCMS in a new, mobile, flexible and capability-oriented version based on offboard, stand-off systems while retaining the features and advantages of IMCMS.

The concept for this rapidly deployable mission package is to store the elements of the system in standard 20 or 10 foot containers.

Core part of this mobile MCM System is a containerised Combat Information Center which provides the key capability of the IMCMS Command, Control and Communication system. Depending on the specific operational requirement and host platform infrastructure, this core element can be supplemented with a variety of containerised systems including e.g. SeaOtter, SeaFox I, SeaFox C, USV based influence minesweeping gear, a power generator, a Launch and Recovery System, a clearance diving store and, if required, accommodation containers.

In principle the system is self-contained, however, depending on the capabilities and technical configuration of the host platform, a data exchange with the C³ system of the host and a utilisation of the communication systems to provide an exchange with other units or a Mine Warfare Data Centre is feasible.
Operational Benefits of IMCMS

There is only one key question:

What is the value of the system to the war fighter?

**Speed**
- Up to three times faster in detection and classification than traditional systems
- Up to four times faster in identification and neutralization than traditional systems

**Confidence in Achieved Results**
- High azimuth resolution of the HMS due to very long array (2m)
- High range resolution due to broadband processing
- Extremely fast identification of minelike contacts
- High level of integration of various sensors including different Minehunting sonars (HMS, AUV, SPVDS)

**Redundancy**
- Minehunting sonars (hull-mounted sonar HMS-12M and side-scan sonars on AUV/SPVDS)
- Different platforms carrying Minehunting sonars (ship, SPVDS and AUV)
- Fully exchangeable Multifunction consoles
- Up to four remote controlled surface sweeping crafts
- High number of self-propelled ammunition instead of limited number of ROV

**Functional Integration**
- Information of all sensors is directly and automatically distributed to the client application
- All information is shared automatically and function oriented within the system
- Like a “pilot in an airplane” the Mine Warfare Officer is truly in charge of the complete ship including monitoring
  - Navigation
  - Sonar
  - Radar
  - Mine Neutralization System
  - Ship’s Propulsion System
  - Recognized Maritime Picture
  - Status of Comms, EMCON, Readiness, Air/Surface/Subsurface/NBC Warnings

**Increased Safety**
HMS provides a high probability of early detection and correct classification, thus offering a high degree of protection for the manned platform. The IMCMS enables maximum use of off-board vehicles to keep the crew out of the minefield. These vehicles include autonomous underwater vehicles and up to four remotely controlled surface simulation craft.

**Low Manning**
The typical complement of a MCMV equipped with IMCMS is five officers, 40 enlisted or less. A typical manning of the CIC during Minehunting-operations is one officer and three enlisted or less.

**International Interoperability**
The IMCMS is in service / under contract for the Royal Netherlands and the Belgian Navies, for the Royal Swedish Navy, the Finnish and the German Navy, including a total of 31 MCMV.

Therefore, in the future, IMCMS and its sub-systems will be an inherent part of both standing NATO MCM forces, providing a high degree of interoperability.

**Worldwide Customer Base**
Due to the high number of worldwide customers, ATLAS has experience in providing systems in waters ranging from arctic to tropical conditions with a wide range of environmental conditions.

SeaFox is in operation by nine different navies worldwide.