

Towards Enhanced European
Future Military Capabilities

EUROPEAN DEFENCE
AGENCY ROLE IN
RESEARCH & TECHNOLOGY

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1. FOREWORD

Research & Technology (R&T) is one of the European Defence Agency's (EDA) top priorities. This has been confirmed by the European Councils of 2013 and 2015, and EDA continues to work in Member States' interests in this key strategic area.

In an unstable world it is clearer than ever that EDA Member States (MS) must continue to invest in capabilities that they will ultimately rely on to protect their vital interests individually and collectively. We, the defence community, need to continually remind ourselves that capabilities today are based on R&T decisions made many years ago. In some cases it was clear where the technology was going to be used but in many areas not. In a world of geopolitical instability we need the ability to apply technology to new development programmes, but we also need to maintain a strong industrial base to develop systems as yet unimagined, and to counter threats as yet unidentified.

This research base needs to be a healthy balance of major industrial players who can develop complete new platforms, but also smaller players who are capable of bringing new ideas to niche areas.

Although the need is widely recognised, funding remains a challenge. EDA MS rightly want to get the best value they can for defence research and EDA is uniquely placed to exploit collaborative EU research that is being carried out in the civil domain and to bring MS together to work on the military-specific aspects that are currently not part of the wider EU research activities. EDA can also ensure that MS make best use of existing EU funding mechanisms so that they can be used in innovative ways to fund defence related projects.

A game-changing development for R&T in the EDA and for European militaries is the move towards EU funds being used specifically for defence-related research without the "dual use" caveat. This development is being realised through a process known as the "Preparatory Action" (PA). The European Council of 2013 paved the way for setting up a PA with a view to establishing a defence-related research programme in 2021, when the next Framework Programme for research will be launched. Clearly in terms of new investment the signing of the delegation agreement between the Commission and EDA for the PA Pilot Project at the end of 2015 was a major step forward in this respect, with a significance far above its relatively small financial value. The Pilot Project, which is the precursor to the PA, and the PA itself are exciting initiatives and I very much hope that this will lead the way to a much wider defence research programme at EU level, with EDA playing a key role. This will assist Member States to focus their activities on areas that are key to future Capabilities for European Defence.

All of this needs of course to be considered in the context of the new EU Global Strategy, and to ensure that the EU remains a strategic player on the world stage, in particular sustaining technical credibility in innovative technologies. This will allow the EU to maintain political relevance and military interoperability with the US, which has been pressing ahead with innovation in its Third Offset Strategy.



Jorge Domecq

Chief Executive, European Defence Agency



2. INTRODUCTION

R&T makes a critical contribution to the preparation of future military capabilities and brings real and tangible operational benefits to European armed forces. Europe's defence systems have been developed as a consequence of major R&T investments that, given the length of development cycles, were made decades ago.

Such R&T investment underpins both European competitiveness and sustainable military capabilities. More than €500 million have been invested in over 150 R&T projects by MS since the creation of the Agency in 2004. Including industrial and in-kind contributions towards these projects, this figure raises to almost €1 billion.

The aim of R&T at EDA is not only to contribute to the development of future defence capabilities but also to meet current needs and be prepared to overcome unexpected threats through innovation, technology push, maturation of technologies and mitigation of risks. This is achieved through European cooperation among MS. Hence, R&T is an important element of the Agency's mission to develop capabilities in support of the European Common Security and Defence Policy. R&T activities are integrated with capability development industry & market activities which enables a results driven approach to R&T.

The EDA capability development plan (CDP) priorities have been agreed by MS and there has been a considerable effort to develop a clear view of the relationship between the CDP priorities and R&T. This has led to the development of the requirement for an Overarching Strategic Research Agenda (OSRA) which will provide a framework for evolution of both the CDP priorities and associated R&T requirements.

EDA's R&T community extends across Europe bringing together experts from MS Government, industry and academia. However, EDA is conscious of the need to monitor new technology developments in a systematic way on a global basis. To this end, EDA is developing a 'Technology Watch' process, which will improve MS collective awareness of technology developments outside of their traditional sphere of interest. It is intended that this platform will be available to other stakeholders, including the Commission's Joint Research Centre.

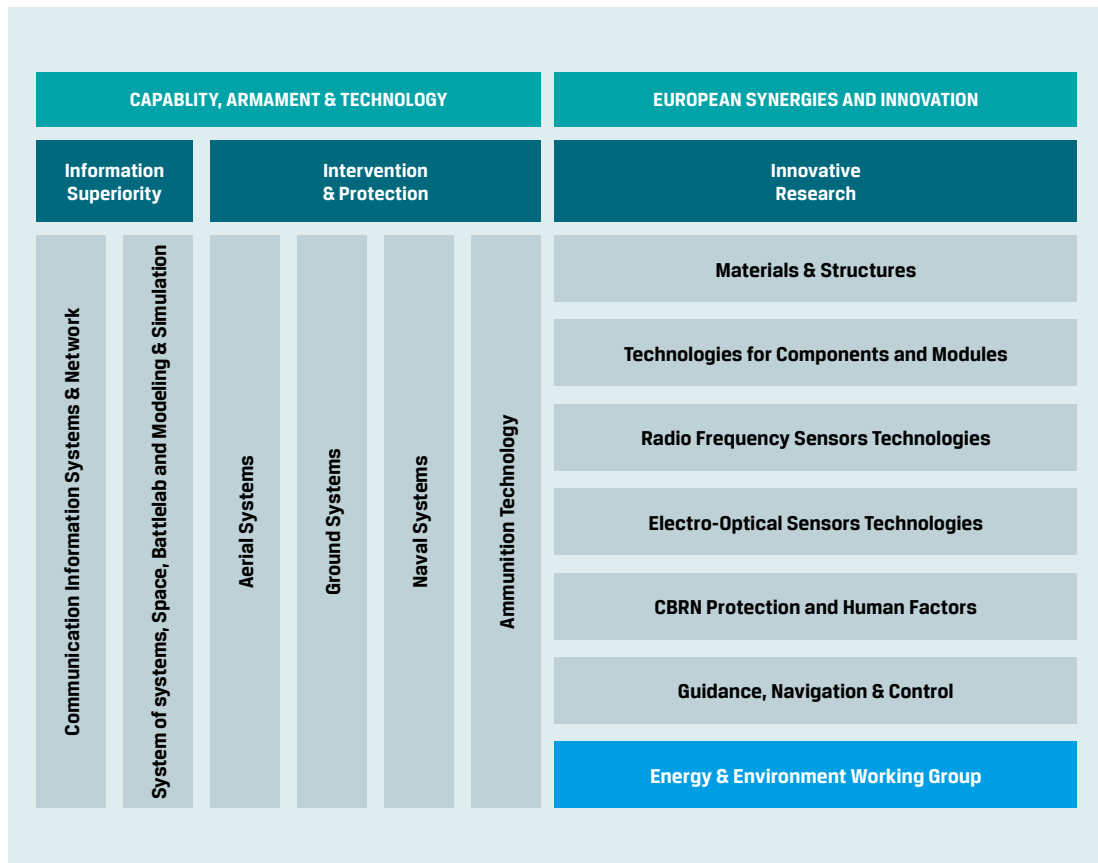


3. R&T CONTRIBUTION TO EUROPEAN DEFENCE CAPABILITY DEVELOPMENT

1. CAPABILITY TECHNOLOGY GROUPS

EDA supports cooperation in R&T and manages these activities via the EDA Capability Technology groups, or "CapTechs", which form a network of experts from MS government, industry, small and medium enterprises (SME) and academia dedicated to a particular technology area. There are 6 CapTechs located in the Capability, Armament & Technology (CAT) Directorate which deal with technologies closely related to capabilities and systems. There are 6 CapTechs located in the European Synergies & Innovation (ESI) Directorate which deal with underpinning technologies. The Energy & Environment Working Group is also located in ESI.

EDA CAPTECHS STRUCTURE



2. AD HOC PROGRAMMES & PROJECTS

Technology development is implemented through various project formats. The most common is the "Category B" project, prepared by a small number of MS and open to others under an "opt in" scheme. More comprehensive and complex activities are established as "Category A" projects or "Joint Investment Programmes" by all MS, with the possibility to "opt out". Preparatory activities to facilitate MS investments in Cat A and B projects can be funded from the EDA Operational Budget (OB), usually contracted as studies ("OB studies").

3. OVERARCHING STRATEGIC RESEARCH AGENDA

All CapTechs have established technology roadmaps as part of their Strategic Research Agendas (SRA), with the objective to cope with future national military needs identified in the Capability Development Plan (CDP). In order to ensure that each CapTech uses a systematic architecture for their strategic research, EDA is developing an Overarching Strategic Research Agenda (OSRA).

4. TECHNOLOGY WATCH

EDA needs a systematic understanding of evolving technical trends and their impact on future European defence capabilities, both long and short term. EDA proposed in 2014 the establishment of a Technology Watch activity from 2015 onwards. The Technology Watch (Tech Watch) activity will provide online short and medium-term inputs for EDA's process of technology evaluation.

5. WORKING WITH THE EUROPEAN COMMISSION

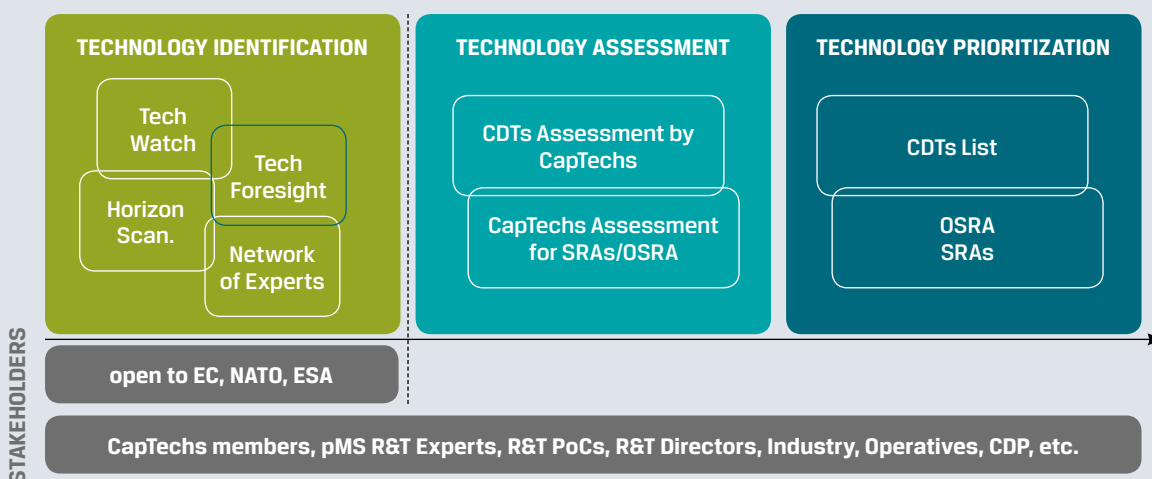
5.1 PREPARATORY ACTION

The European Commission is working with the EDA in establishing the Preparatory Action (PA) for CSDP-related research. In this regard, the EDA and the Commission have consulted Member States and industry on governance, modalities and content of the PA through a series of workshops. A Pilot Project has been launched by the Commission and two research topics have been selected at the end of 2015 for which a call for proposals will be published. The Pilot project is intended to pave the way for defence-specific CSDP related research projects at an EU level. The intention is to test the administrative mechanisms that allow EDA to manage defence research activities funded from the EU budget. The subsequent step in this process will be to establish the projects of the Preparatory Action itself. This should prove the mechanisms and identify the technical areas that could be built upon for a significant defence research programme. This defence research programme, if proved successful, is intended to form part of the 9th EU Framework Programme in 2021.

EDA, with its ability to bring together military customers and research managers, is uniquely placed to provide inputs to the programme. As an enabler of defence research, there is consensus that EDA could act as the implementing Agency, managing the research packages and will compliment EDA's ongoing R&T activities.

EDA will bring expertise on Capability Development and Defence Research, organise consultations among stakeholders and consolidate MS views which will provide the overall context for the EDA research programme with both a long term and short term view.

COMPREHENSIVE R&T PLANNING TO SUPPORT PMS



5.2 SUSTAINABLE ENERGY

The European Commission is also working with the EDA in supporting a Consultation Forum for Sustainable Energy in the Defence & Security Sector (CF SEDSS). The forum brings together experts from the defence and energy sectors to share information and best practice on improving energy management, efficiency and the use of renewable energy in military estate and infrastructure. This is achieved through assessing the existing EU energy legislation, in particular the Energy Efficiency Directive, the Energy Performance in Buildings Directive and the Renewable Energy Directive, in order to see how different measures could be implemented in the Defence sector thus contributing to on-going decarbonisation efforts in Europe. The Forum will also be a place to stimulate projects in key areas as well as identifying possible funding streams. Depending on the findings, the Forum might also develop recommendations on how to further develop directives or amending policy in relation to European funding mechanisms for Defence.

5.3 DUAL-USE TECHNOLOGIES RESEARCH FUNDING

The defence industry can find many opportunities for funding in the research themes of Horizon2020 and as such finds funding for civil projects and technologies which can also be applied for defence. The Commission's European Structural Investment Funds are also an area in which the EDA can assist MS to fund dual use R&T Projects. European Structural and Investment Funds (ESIF) can co-fund dual-use R&T projects as well as related key skills and competencies (KSC) for defence, at both national and transnational levels. EDA assists MS with project proposals when applying for ESIF co-funding. EU COSME programme (focusing on the Competitiveness of small and medium enterprises (SMEs) can also fund cross-border cooperation among defence-related SME clusters.

5.4 CRITICAL SPACE TECHNOLOGIES FOR EUROPEAN STRATEGIC NON-DEPENDENCE

The European Commission (EC), the European Space Agency (ESA) and the EDA agreed on a list of actions for strategic non-dependence in the area of critical space technologies. The list was elaborated in a joint task force together with the relevant organisations from MS, industry and academia and contains 39 non-dependence actions in technology domains such as materials, electronic or photonic components, green propellants or complex structures. Europe's ability to access key enabling technologies is crucial to both space and defence capabilities. Considering the similarities between the defence and space domains, ESA, EC and EDA have run the European non-dependence process through a joint task force for critical technologies. Its objective is to map key technology needs and to identify priority actions to be implemented within European or national programmes.

5.5 NATO SCIENCE & TECHNOLOGY (S&T)

The relationship between EDA and NATO is governed by international agreements which define the scope of possible interaction between the two organisations. Within this framework there are active staff-to-staff discussions which have been focused on areas of mutual interest such as Technology Watch. These staff-to-staff interactions between NATO and EDA have been strengthened recently by the briefing of the NATO Chief Scientist at the EDA Steering Board in R&T Directors' format and the reciprocal briefing of the NATO S&T Board by the EDA Chief Executive.





4. CAPABILITY TECHNOLOGY GROUPS OVERVIEW

CAPTECH: COMMUNICATION INFORMATION SYSTEMS AND NETWORKS

Contact: captech.information@eda.europa.eu

CapTech Summary: The INFORMATION CapTech is dedicated to technologies in support of enhancing military capabilities in the 'Knowledge' domain (Command and Inform). This covers communication systems from devices to networks as well as information systems from processing to fusion and presentation. Cyber Defence encompasses protection of these systems.

CapTech Overview: For EU military operations a variety of Information capability challenges have to be addressed due to the lack of communication infrastructure in mission areas. Hence the technology vision of the INFORMATION CapTech includes ubiquitous mobile and networked computing, smart and efficient communications, management of information at large scale, user-friendly interface and controls. In some of these areas INFORMATION is interacting with other Captechs for comprehensive end-to-end implementation of the 'information value chain' such as electronic or photonic components, base materials and standards. In this regard INFORMATION has to continuously manage supply chain dependencies and develop and maintain a roadmap on strategic non-dependence.

Due to its 'dual-use' character, military Information and Communication Technology (ICT) draws to a great extent from civil Research and Development. Moreover, many ICT activities are also on NATO's agenda, notably in the standardisation domain. Hence, the INFORMATION CapTech closely coordinates its efforts with activities of the European Commission (Digital Agenda) and NATO (NC3).

The Captech's SRA defined and prioritised nine key technical research areas: Ad hoc communications, wireless sensor networks, cyber defence, coalition network security and protection, common system interoperability, heterogeneous information sources, cognitive radio, long range communications with HF, electronic support measures for communications, long range communication with Satcom.

Current larger ad hoc investment projects cover the areas of ad hoc communications and wireless sensor networks. Future architectures and technologies will be studied in the most complex and challenging scenario for CIS – the urban environment. Future technologies for Cyber defence and satellite communications constitute two of the four EDA 'key programmes' from the December 2013 European Council conclusions. EDA has developed a Cyber Defence Research Agenda, outlining 13 focal areas such as encryption, advanced malware detection, security by design and human factors. 18 technology aims finally resulted in 55 lines of technology development. In satellite communications EDA manages, together with the Commission and the European Space Agency, the Governmental Satcom Programme (GOVSATCOM).

CAPTECH HIGHLIGHTS



The INFORMATION CapTech brings together cutting-edge technologies for military command, control, information and communication to serve our soldiers. Successful deliveries of cooperative investments include broadband and narrowband waveforms (ETARE, HDR-HF), tactical service oriented architectures (TACTICS), disruption tolerant networks (MIDNET), intelligence information interoperability (IN4STARS 2.0).

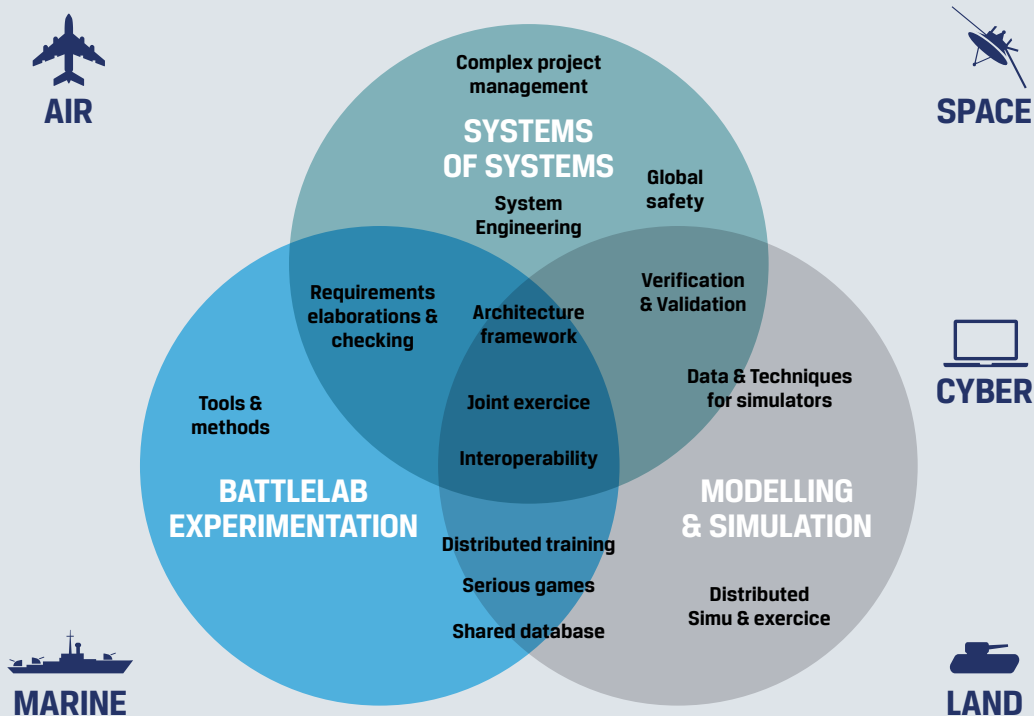
CAPTECH: EXPERIMENTATION, SYSTEM OF SYSTEMS, SPACE, MODELLING & SIMULATION

Contact: CapTech.Simulation@eda.europa.eu

CapTech Summary: The CapTech combines 3 overlapping areas which can be summarized as follows:

1. Systems of Systems: Space, System Engineering, interoperability, global safety.
2. Battlelabs/Experimentations: tools and methods, hybrid experimentations (connection CIS-Simu, distributed experimentation, real and simulated troops), concept experimentation, interoperability testbed.
3. Modelling and Simulation: Military Cloud, Distributed Training, Synthetic Training, environment database, data pooling and sharing, serious games.

FIGURE 1

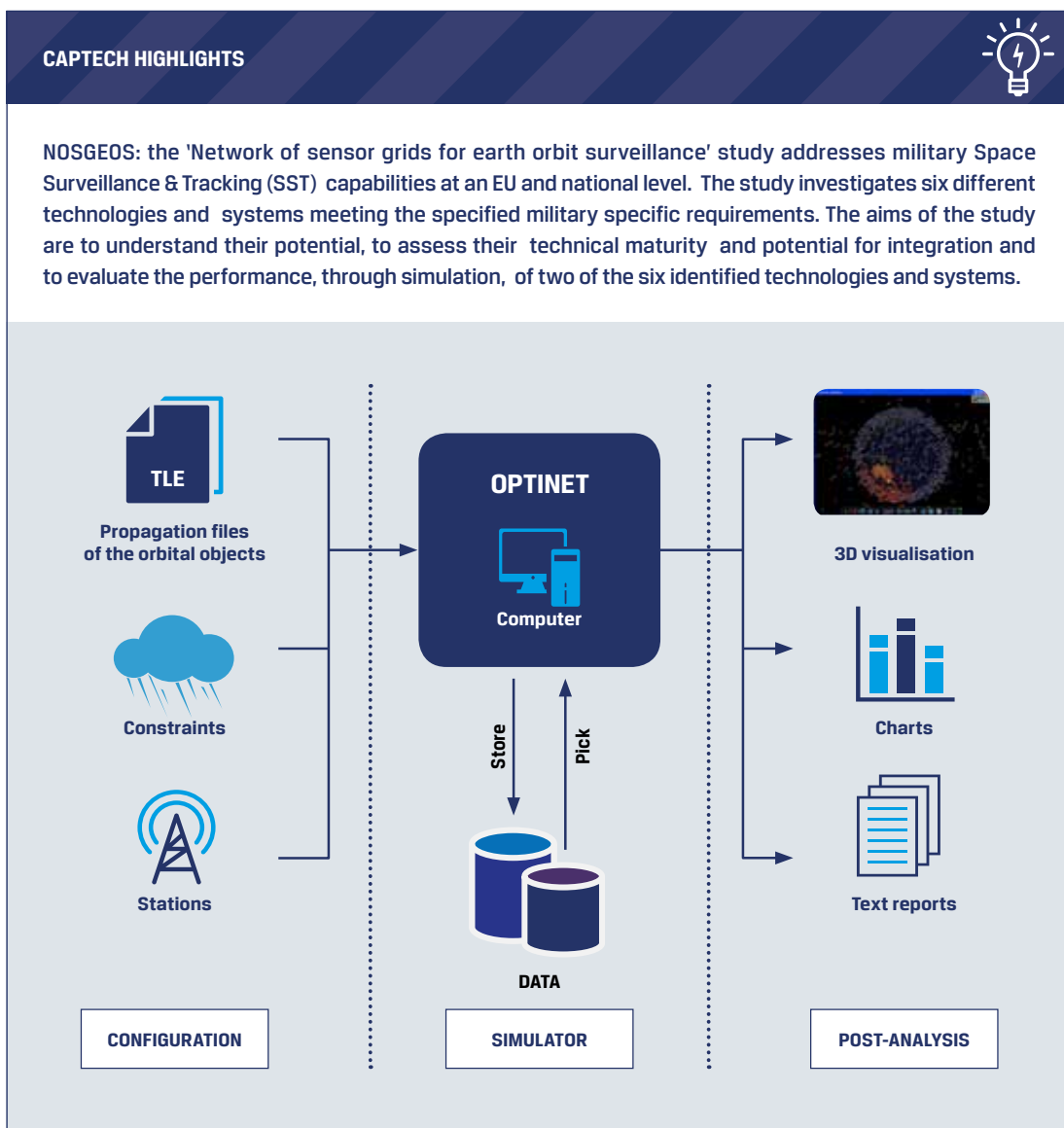


CapTech Overview: The main focus of cooperation in System engineering processes and tools will be toward the architecture frameworks, using NAF V3 as a description model. In relation to Space projects these are generally dealt with in Project Teams or other Captechs. However, the military requirements for Space Surveillance and Tracking (SST) needs further architectural and technological development. A 'system of systems' approach has been managed to enhance the technological roadmaps to fulfil the requirements. For Govsatcom programme preparation, an R&T roadmap for Satcom has also been produced. In the Modelling and Simulation (M&S) domain, EDA complements the work done in the NATO M&S Group (NMSG). The CapTech focuses on tools, methods and interoperability/compatibility needs to securely work in a distributed way (for simulation, experiment, evaluation, qualification and training purposes) and to share software or data. In light of the fact that most innovation in this area originates from small and medium enterprises (SMEs) EDA has opened a 'developer club for SMEs' called 'EDA M&S SME platform'.



M&S is a priority action highlighted in the last CDP revision. A specific EDA roadmap has been established to open discussion for various type of projects, including but not limited to, national policies, training issues, concept development, experimentations, Pooling & Sharing of assets/software/files and managing an EU military Cloud. Training & Simulation is not only an enabler for MS cooperation in EDA projects, but also gives real opportunities for Pooling & Sharing of methods and facilities.

Space systems studies has potential for opportunities to launch cubesat/microsat demonstrators with ESA support and to conduct a potential future study on MicroSAR data fusion. The Military Decision Making Process (MDMP) using Artificial Intelligence (AI) applications has development potential and could lead to future Cat B projects. ONSIM study has demonstrated the feasibility of using AI together with simulation in military time-constrained systems or operations.



CAPTECH: AERIAL SYSTEMS

Contact: CapTech.air@eda.europa.eu

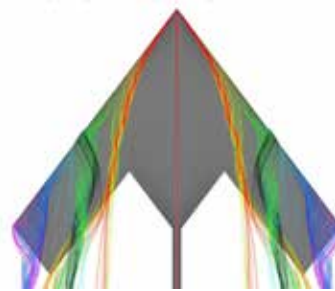
CapTech Summary: The Air Systems CapTech brings together specialists from government and industry in the air sector to investigate areas of common interest to support future research needs. The air CapTech also works closely with the ESI CapTechs where there are a number of areas of common interest and joint activities are arranged on a regular basis.

CapTech Overview: The most recent achievement is the successful completion of ASTYANAX, (follow-on of the JIP ICET HECTOR project on structural helicopter health monitoring). It aimed at defining innovative predictive maintenance tools for helicopters. Building on a successful system demonstration of a sensor network and predictive algorithms, three MS (Italy, Poland and Spain) decided to launch this follow-on phase in order to demonstrate the system on a real helicopter structure. The follow on from Astyanax, SAMAS is now in negotiation and will concentrate on RPAS structures.

ISSA is a project requiring wind tunnel test activities for the integrated simulation of non-linear aero-structural phenomena arising on combat aircraft in transonic flight. It has been progressing well and MS (Italy and Sweden) have now started discussions regarding a follow-on activity covering different phases of flight.

Global System Study (GSS) is a contract under the European Technology Acquisition Programme (ETAP) MoU, which is part of the overall ETAP research initiative between DE, FR, SP, IT SE and UK.

The Joint Investment Programme RPAS has progressed well with MIDCAS having successfully demonstrated a 'detect and avoid' capability. Two other projects having been launched, DESIRE2 and ERA, dealing with satellite command and control and automation respectively.



CAPTECH HIGHLIGHTS



MIDCAS: Flights with a demonstrator Detect & Avoid (D&A) system integrated in the Sky-Y RPAS test bed started in December 2014 at Grazzanise Air Force Base, Italy. First fully automatic coupled avoidance manoeuvres were performed by the RPAS based on combined cooperative and non-cooperative detection as well as non-cooperative detection only and put on collision course with a manned aircraft. The MIDCAS system had full authority over the RPAS flight control system.

The MIDCAS project is laying the groundwork for future developments in the field of RPAS air traffic integration. The project has gathered European industries within the field of D&A with the purpose to achieve jointly agreed results with European and global standardisation stakeholders. The MIDCAS project was launched in 2009 by five contributing Member States (France, Germany, Italy and Spain under the lead of Sweden) under the framework of the European Defence Agency, with a total budget of approximately €50 million.



CAPTECH: AMMUNITION TECHNOLOGIES

Contact: captech.ammunition@eda.europa.eu

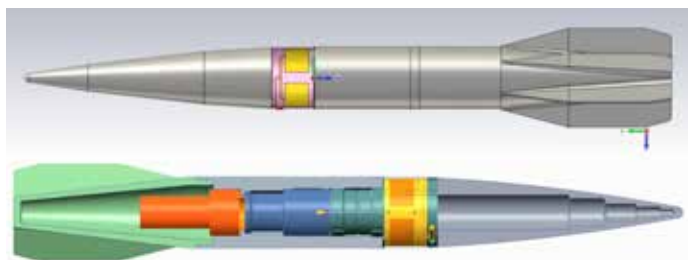


CapTech Summary: Research in Energetic Materials, Missiles and Munitions (EMM) are the CapTech AMMO's main scope of work. The need to better understand, evaluate and analyse Energetic Materials (propellants, explosives and pyrotechnics) for weapons systems is a key driver of cooperative R&T projects. Also covered by the CapTech are topics such as predictive modelling of new Munition designs; gaining knowledge of detonation and blast effects; research on ballistic design (internal, external and terminal ballistics), and integration of these into platforms and weapon systems.

CapTech Overview: Increased precision, improved safety and minimised undesirable human and environmental side-effects are key enablers for EU armed forces. Demand for new EMMs with improved efficiency, performance and reduced sensitivity to inadvertent initiation generates the need and opportunity for research activities. Investigation of Open Architecture is also an important feature since modularity will promote affordable new Munitions designs within current budget constraints. Likewise, development of 'Through-Life Management' to enable predictive maintenance of Missiles and Munitions could achieve substantial cost savings. Strengthened European coordination could optimise research activities into suitable alternative EMM substances given new European regulations on chemicals and their safe use (REACH). Joint research on new solutions will support the competitiveness of Defence Industry and avoid further Non-European dependencies, loss of key skills and knowledge.



Research priorities encompass investigation of Scalable Effects for Ammunitions, harmonization of n-Dimension of Freedom (n-DOF) Simulation and exploitation of Open Architecture's potential for Munitions, with an expected cost reduction for future designs. Other priorities consist of enabling EMM to operate more efficiently in complex environments (countering conventional, asymmetric or hybrid threats) with improved environmental and safety requirements, and strengthening European know-how on EMM via the development of joint research activities.



CAPTECH HIGHLIGHTS



The project 'Formulation and Production of New Energetic Materials' (FPNEM) started in August 2010 with a predicted duration of 4 years, and involved 7 CMS (SE, CZ, DE, FR, IT, PT and NO) and 11 European Industrial entities and Research Institutes. The final outcome was the preparation and demonstration of new energetic material formulations for warhead or propelling charges (missile, gun and rocket). A follow-on project 'Energetic Materials Towards an Enhanced European Capability' (EMTEEC) will start in 2016 to develop mutual awareness and knowledge of selected future energetic materials, production methods for critical components including raw materials, and small scale evaluation techniques. This project will enhance European capability to develop and produce advanced Energetic Materials.

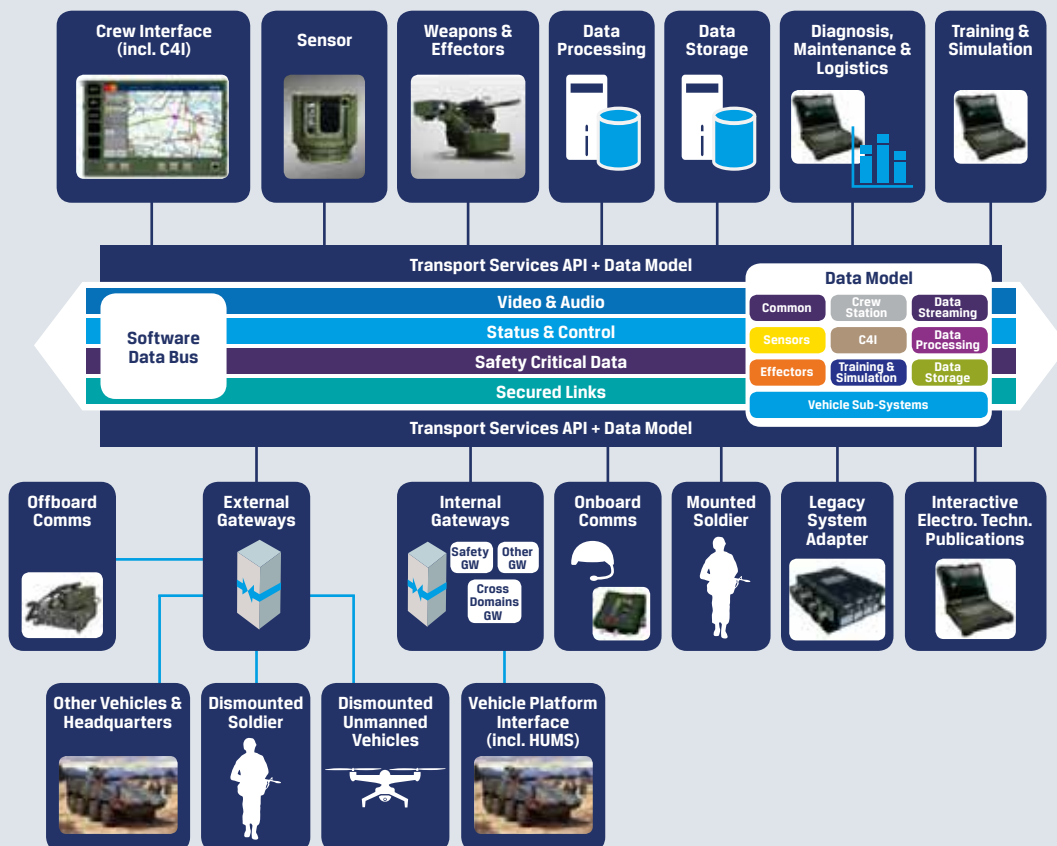
CAPTECH: GROUND SYSTEMS

Contact: CapTech.land@eda.europa.eu

CapTech Summary: CapTech Ground Systems (Land) is currently addressing the following technology gaps: fully integrated, reconfigurable and upgradable platforms and mission systems; modular multipurpose vehicle design; power generation and energy storage; enhanced autonomy, conveying and ground traffic insertion of unmanned ground vehicles (UGV); enhanced agility and performance of soldier systems and enhanced detection and identification of IEDs while on the move.

CapTech Overview: One of the main activities in the short and medium perspective is the standardization of open system architecture in land vehicles. Two EDA LAVOSAR studies have been conducted to address this topic. The results are used to support NATO Generic Vehicle Architecture standardization affords by providing key inputs to STANAG 4754 or its future developments. A vehicle which is built according to an agreed set of standards can be improved by simply adding, replacing or upgrading sub-systems. Overall cost savings upcoming from implementation of an open system architecture are estimated at 10% to 25% of the Mission System cost.

LAVOSAR BUS-CENTRIC SYSTEM OVERVIEW



A problem identified by military users of in-service Armoured Multi-Purpose Vehicles is their being too heavy. This is addressed by the L-AMPV project which aims at delivering detailed information (material, weight, size and price) of vehicle components or parts currently used. It also recommends how to reduce the weight of these parts taking into account the performance throughout the life-cycle of the system.

Power management is addressed through software and hardware architecture to manage issues such as energy management in electromagnetic guns and electric armour. New solutions for energy generation based on high-temperature Proton Exchange Membrane (PEM) fuel cells and reforming technology for land vehicles have also been addressed recently by the CapTech.

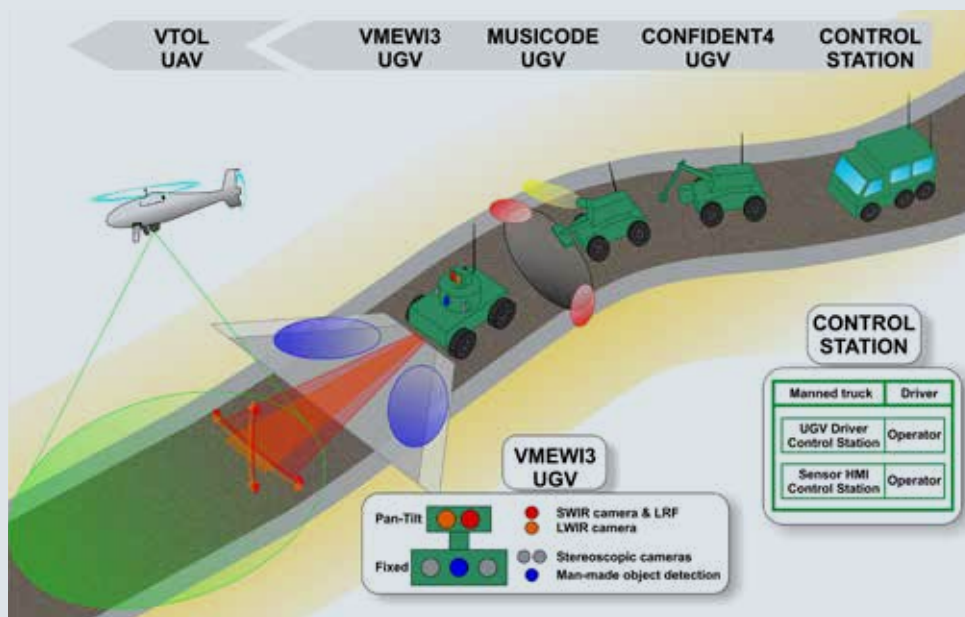
HYMUP UNMANNED VEHICLE DEMONSTRATOR



UGVs are mainly used in Explosive Ordnance Disposal (EOD) operations. However, according to recent studies further use will expand to tasks like communication nodes, Intelligence Surveillance and Reconnaissance (ISR), medical evacuation, Chemical, Biological Radiological and Nuclear (CBRN) protection and autonomous convoys. Some aspects of autonomy in terms of vehicle-following or obstacle-avoidance are addressed in the HyMUP project aiming to prove the feasibility of mounted combat missions of unmanned systems coordinating with regular manned vehicles. Additionally protection of autonomous systems against enemy interference and safety requirements for combined manned-unmanned missions is currently targeted by CapTech activities.

Enhanced detection and identification of IEDs while on the move is addressed by the IED Detection programme where three projects will develop technology demonstrators for early warning, stand-off detection and confirmation and identification capability gaps to support future route clearance capabilities beyond 2020.

ARTISTIC VISION OF FUTURE ROUTE CLEARANCE OPERATIONS



CAPTECH HIGHLIGHTS



JIP CEDS: This programme deals with soldier systems and specifically the Combat Equipment for Dismounted Soldier (CEDS) programme, where nine feasibility projects have been conducted addressing technological advancements in observation, energy, human factors and survivability areas. Additional activity aiming to develop an open system architecture to promote interoperability and interchangeability for national dismounted soldier programmes, both at the system level and the component level, are currently ongoing.

CAPTECH: NAVAL SYSTEMS AND THEIR ENVIRONMENT

Contact: CapTech.maritime@eda.europa.eu

CapTech Summary: The maritime domain is a complex environment. It serves as a transport corridor, provides marine resources, is seen as a living environment (habitat) and is used to project power and stability. The maritime environment presents a series of complex challenges for EU navies, that must adapt and modernise often within the confines of reducing resource envelopes. The CapTech vision is broad, and aims at 'sustaining and developing European naval capabilities by coordinating with European civil maritime stakeholders and sustaining the European Naval Technological Industrial base, while acknowledging operational, economical and societal trends'.

CapTech Overview: The CapTech is guided by the Strategic Research Agenda (SRA) that has elaborated a shared direction among the Governmental (end users) and non-governmental members of the CapTech on the most pressing technical challenges to address in the coming 15-20 years. The SRA topics are broad and on the platform level focus on surface and underwater platforms design, manufacturing, integration and life-cycle improvement. This includes R&T for improving naval platform hydrodynamics, structural and mechanical design, guidance, control, propulsion, energy, protection and signature control. In total the SRA elaborates 19 proposed areas and these have been prioritised into three main strategic objectives.



Continue R&T work on Unmanned Maritime Systems and inserting new projects as appropriate.

Work on R&T relevant to surface platforms focussing on affordability, modularity, mission flexibility, integrated platform/payload design and integration of Unmanned Vehicles (UxVs) in naval task groups.

Work on R&T relevant to submarines relating to modularity, integration of UxVs and safety.



CAPTECH HIGHLIGHTS



Unmanned Maritime Systems (UMS). The defence research and technology programme on European Unmanned Maritime Systems for Mine Counter Measures and other Naval Applications (UMS) aims at delivering the next generation of technical solutions that will ensure that European MS possess the capabilities to operate at sea. With the necessity to develop complex technical solutions, an emphasis has been placed upon cooperative efforts that are mutually beneficial for Member States in terms of delivering real and tangible solutions as well as maximising the cost benefit ratio of the resource outlay.

The UMS programme consists of 15 coordinated projects which are administered under one programme arrangement. Launched in September 2009, the programme has 10 contributing MS plus Norway and a combined monetary value of €56 million. With the successful completion of projects the programme has proven to be a successful vehicle for the effective delivery of technical solutions.

The individual projects are characterised by varied participant geometry, and are undertaken by industry, national research centres and universities. The principle areas of focus centre on Mine Hunting and Minesweeping. Additionally the programme also addresses the non-technical aspects of autonomous systems such as safety and regulation, and standardisation and integration.

CAPTECH: TECHNOLOGIES FOR COMPONENTS AND MODULES

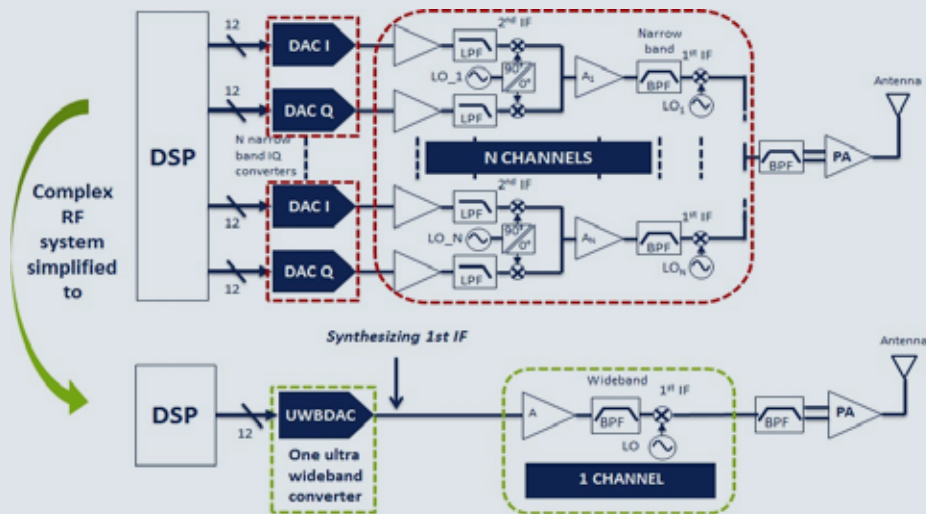
Contact: Captech.components@eda.europa.eu

CapTech Summary: The COMPONENTS CapTech covers technologies for components and modules in the electronics and photonics area. It focuses on innovative, strategic and key enabling technologies. Defence electronics & photonics are critical key enablers for enhanced system design, performance, integration and functionality. For the European defence industry it is a critical area to achieve and sustain value chains of strategic technologies to which access is essential and thus European strategic autonomy is needed.

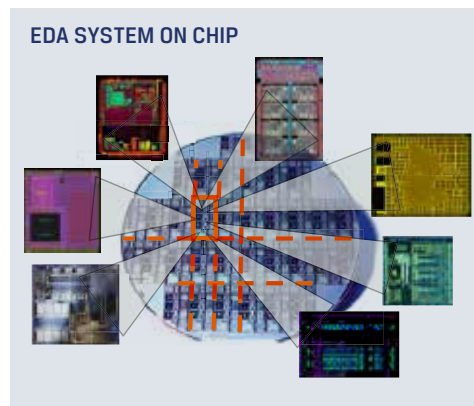
CapTech Overview: The CapTech has been very successful recently with active industry, research, academia and MoD experts participation, an average yearly investment of about €15 million in R&T projects and a large portfolio of projects with impact on military systems and capabilities.

The THIMS (Technology for High Speed Mixed Signal Circuits) project, conducted by FR and DE industries, develops and demonstrates the availability of state of the art high-speed Mixed-Signal technology and industrial production processes which provide cost effective sources. The ultrafast converters, applicable for high performance military applications have been successfully demonstrated and qualified for products.

THIMS DIGITAL / ANALOGUE CONVERTERS

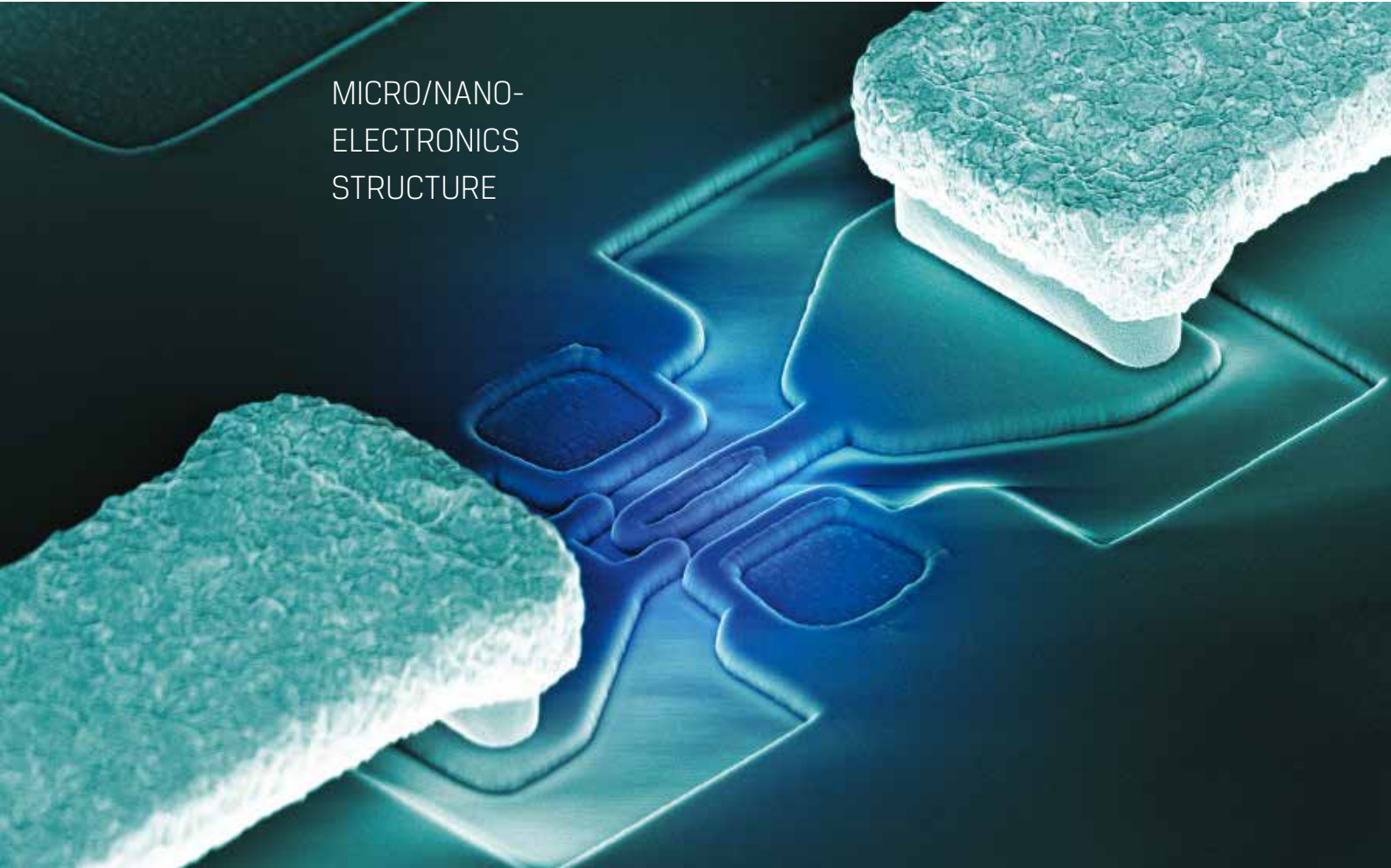


EDA SoC (System on Chip) is a cooperative project with 14 industry and academic partners from four EDA member states (FR, IT, DE, NO) with an entire investment of about €22 million. The established European supply chain provides access to European defence equipment manufacturers for design and production of complex System-on-Chip solutions in advanced technologies. All defence applications with digital electronic systems (radio, radar, EW, etc.) demand integrated solutions which provide real time high performance capability, high level of programmability, flexibility, reliability and compliance with safety and security specifications. EDA SoC technology is a key enabling technology able to cover those requirements.



Further cooperative projects include stand-off Improvised Electronic Devices detection, high performance compact optoelectronic microwave oscillators for improving Radar front end signal processing and advanced 3 dimensional packaging for rough military applications such as precision guided ammunition.

MICRO/NANO- ELECTRONICS STRUCTURE



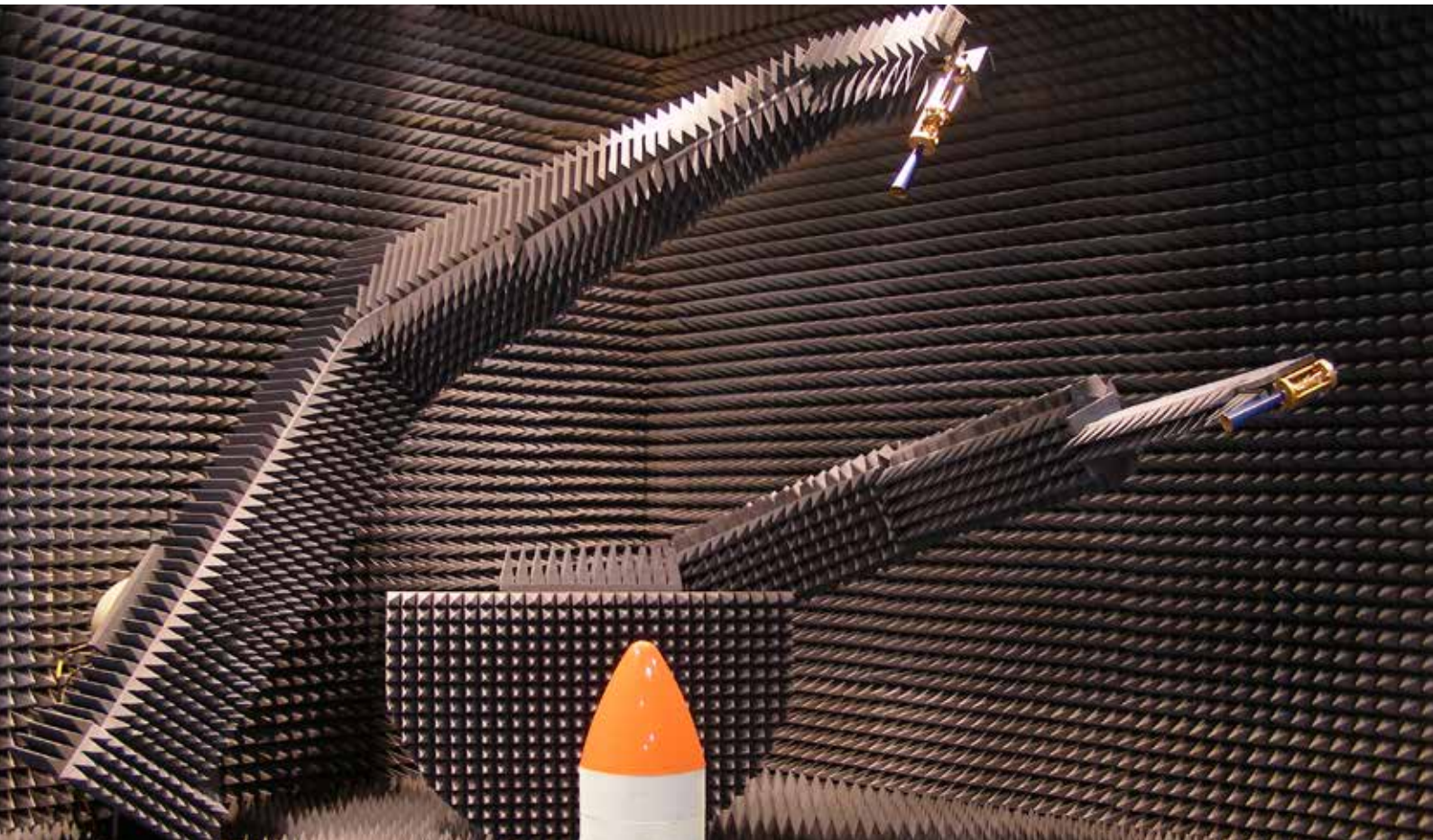
CAPTECH HIGHLIGHTS



One major **COMPONENTs** work strand aims at establishing a European supply chain for next generation defence application for RADARs, Communications and Electronic Warfare (EW) technologies, using Gallium-Nitrid(GaN)-on-Silicone-Carbid(SiC) semiconductor technology. Four consecutive projects (**KORRIGAN, MANGA, MAGNUS, EUGANIC**) and thematically related activities have attracted substantial and continuous investments from various member states in the past decade close to €100 million. **MANGA** has successfully developed know-how and production processes for 100 mm SiC wafer production and GaN-on-SiC epitaxy. The recently contracted EuGaNIC project will bring the technology to a fully European industrially qualified process. **MAGNUS** has successfully been conducted by a large industry consortia from FR, DE, NL, SE and UK. It has designed and developed multiple applications and demonstrators of cutting edge enabling technologies such as Monolithic Microwave Integrated Circuits (MMIC) and highly integrable transmit and receive modules for phased array antennas to be used in advanced Radars, Communications or EW systems covering the electromagnetic spectrum from 2-18 GHz.

CAPTECH: RADIOFREQUENCY SENSORS TECHNOLOGIES

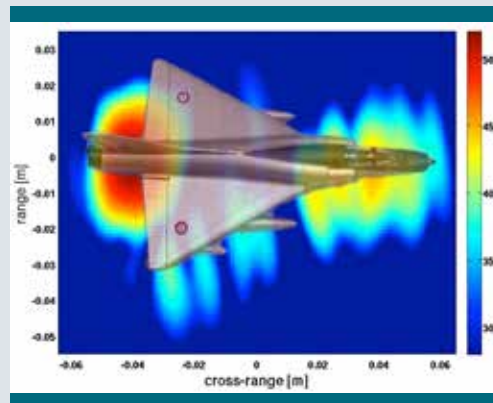
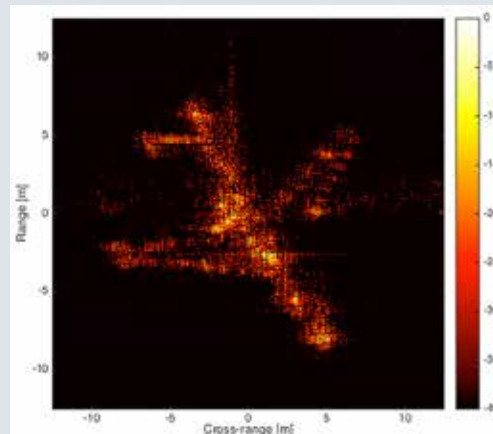
Contact: Captech.radar@eda.europa.eu



CapTech Summary: The RADAR CapTech deals with Radar and Electronic Warfare (EW) sensor systems applying Radiofrequency (RF), magnetic and electronic technologies from a system and sub-system perspective. Surveillance from space by RF sensors in the maritime domain is also addressed. Activities are not limited to just equipment as all related topics such as signal processing, electromagnetic propagation and signature control and reduction are considered.

CapTech Overview: The Multi-function RF systems concept has captured significant attention in this domain. Next generation sensors support, in a single system, combinations of functions provided by radar, EW, communications or 'sense and avoid' technologies. The programme 'Scalable Multifunction RF Sensor Systems' (SMRF) has been working on this challenge since EDA's inception with the additional requirements of scalability and modularity. It has been shown to be necessary to use System Engineering frameworks to allow different companies from the EDA participating MS to collaborate to create these highly complex systems. The use of Model Based Systems Engineering (MBSE) has been proven to be essential for the future of SMRF. The Ad-Hoc Cat B project AMBASSADOR (2012-2013) aimed to be an Advanced Model-Based Approach to SMRF.

The challenge of Non Cooperative Target Recognition (NCTR) by Radar has been addressed by the CapTech as shown by the three Cat B projects: Commencing with SPERI – 'Signal Processing For Enhanced Radar Imaging', followed by ERIT – 'Enhanced Radar Imaging Technique' (2012-2016), ACACIA – 'Advanced Classification techniques for object recognition with radar' (2014-2017) and MAPIS – 'Multichannel Passive ISAR for military applications' (2015-2018).



New proposals like COGITO will make use of cognitive techniques for NCTR with a better use of the spectrum and RFBIO will analyze the biological effects of RF Fields.

OB studies have been centered on the issues of Compressive Sensing - RICS (2013) as a new paradigm in acquisition, conformal AESA antennas in UCAR (2014) and Resource Management in Multifunction RF Systems (2015).

CAPTECH HIGHLIGHTS



SIMCLAIRS. The 'Innovation and Technology Partnership for Studies for Integrated Multifunction Compact Lightweight Airborne Radars' (ITP SIMCLAIRS) aimed to build the technology base of a European capability in the field of light and compact RPAS payloads with a combination of Synthetic Aperture Radar / Moving Target Indicator, Foliage Penetrating and Electronic Support Measures in an integrated ISTAR package. Innovative funding models included open calls to include SMEs and Academia in a competitive scheme.

CAPTECH: MATERIALS & STRUCTURES

Contact: CapTech.Materials@eda.europa.eu

CapTech Summary: The CapTech Materials & Structures covers underpinning technologies on structures and materials. Its main objective is to support the European armed forces on current and future challenges within these areas of research, in close collaboration with the other EDA CapTechs and other international entities. Its work is generally of TRL of 2 to 4, although work in higher TRLs is not ruled out. Materials CapTech projects aim to develop technologies on materials and structures, production processes, test procedures and solutions that are applicable in one or more of the four defined key domains: naval, land (including soldier system), air and cross-cutting.

CapTech Overview: The priority axes of research already identified encompass solutions for the protection of structures taking into account new European regulations (e.g. REACH), stealth properties or structural and operational performance. Research is also foreseen in improved design concepts to cope with vulnerability problems, weight and cost reduction or the introduction of functional materials. Armour (including transparent structures) and the increased use of composites, smart and micro/nanomaterials are also part of the shared strategy. Essential in the overall approach is the viability of integration of innovative solutions to operating new systems while addressing trough-life support related aspects and costs.

The major issues are covered in its SRA, dealing among others with fundamental strategic issues raised by the Critical Defence Technologies, and the Key Enabling Technologies in the Horizon 2020 programme. In each of the four key domains it is described the current status of the technology and technological gaps. An example of the areas for future work:

1. Air domain: Performance / Low Weight Design for military Applications; Improved Modelling of failure and damage propagation; Materials for additive manufacturing; High temperatures composites for missiles and jet engines; Integration of Structural Health Monitoring Systems.



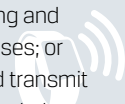
2. Naval domain: Self-healing materials or coatings; Monitoring of signature; New armoured solutions; Repair by additive manufacturing; Structural health monitoring of structures; Lightweight Structure / New design concept for deck with metallic solutions.



3. Land domain: Reparability (monitoring, repair, assessment); New lighter protections; New protection capability with light weight structures; New lighter protections for soldier.



4. Cross-cutting domain: Graphene-based technologies; Novel manufacturing processes, automated layer up, and in-situ process verification; Multifunctional materials for dynamic, multispectral camouflage; Self-indicating materials; Structural health monitoring and verification of manufacturing processes; or Smart textiles to collect, analyse and transmit information, to protect and reduce heat stress.



CAPTECH HIGHLIGHTS

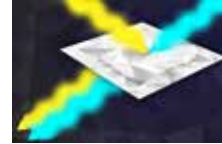


The BaToLUS project, **Battle Damage Tolerance for Lightweight Unmanned Aerial Vehicle (UAV) Structures**, brought about a successful development of new rapid prototype modelling capabilities. The project involved major European aeronautical industries, top-rated European research institutes and also small European enterprises. The EDA led cooperation brought together a "critical mass" for an effective scientific dialogue, thus allowing the Nations to benefit from synergies in their respective industrial capabilities.

CAPTECH: ELECTRO-OPTICAL SENSORS TECHNOLOGIES

Contact: Captech.optronics@eda.europa.eu

CapTech Summary: The EOST promotes and manages research in optical sensor systems and signal processing technologies. Based on MS prioritisation an EOST Strategic Research Agenda with roadmaps was constructed, and it encompasses spectral imaging, alert processing, laser counter measures, laser sensors, imaging software, modelling and imaging.



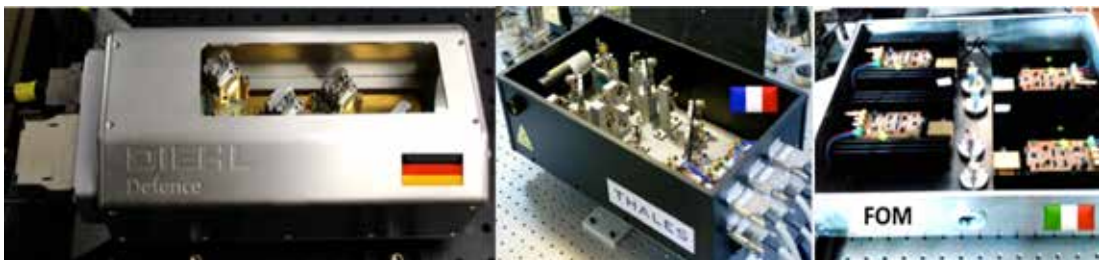
CapTech Overview: In the priority area of Laser counter measures, in order to have protection of air assets in EU military operations and civil missions against 'Man-Portable Air Defence Systems' (ManPADS), EDA launched a more detailed study called "MISSION" (Mid Infrared Semiconductor laSer modules for defence applicatiONs), that explored the technology of Quantum Cascade Lasers (QCL) in order to increase the efficacy of DIRCM (Directed Infrared Countermeasure) subsystems against MANPADS. The study proposed the mastering of Quantum Cascade Lasers (QCL) for defence applications, manufacturing laser demonstrators based on different optical architectures targeting the DIRCM application (TRL 4 to 5), and finally performing laboratory and outdoor tests.



In the same area the project ALWS (Airborne platform effects on Laser systems and Warning Sensors) analysed the influence, due to turbulence caused by aerodynamic flow, engine plume, rotor downwash effect, on laser based DIRCM and Missile Warning Systems (MWS), with particular effort on the laser propagation. The activities will end in 2017 and the participating members States are Germany, Italy, France and Sweden.

Spectral Imaging and Alert Processing is the highest priority among MS for cooperation in the future. In relation to the Spectral Imaging the main challenges are optimization of spectral band selection, compensation of atmospheric effects, development of onboard hardware and software for real time anomaly and target detection, new data reduction techniques to allow the transmission and storage of continuous data streams and high quality multiband detectors beyond MWIR/LWIR.

The technology domain 'Alert Processing' deals with high level processing of imaging sensor data aimed at robust detection, recognition and tracking of military targets in complex environments.



CAPTECH HIGHLIGHTS



The **MISSION** project started in 2012 and lasted 36 months to fuse the independently launched national QCL developments of the participating member states of Germany, France and Italy. The activities focused on the development of the growth and the processing technology of QCL chips and on the related laser system technology for defence applications, especially DIRCM. The MISSION project harmonised the national efforts into a European capability to build DIRCM lasers based on the QCL technology. Future projects within the framework of EDA should concentrate on enhancing the network that was established among the participants in order to optimize the components technologies.

CAPTECH: CBRN PROTECTION AND HUMAN FACTORS

Contact: Captech.CBRN&HF@eda.europa.eu

CapTech Summary: The work of the area Human Factors includes the following four work strands:



The Human Factors CapTech supports many of the CDP Priority Actions regarding systems development and human skills development elements as well as other CDP work. Specifically it supports the CDP Action on Providing Medical Support to Operations. The aim is to provide support to MS regarding care including the provision of adequate levels of support both on and off duty to ensure that the demands placed on them and their families are reasonable in order to increase the operational performance and sustainability of personnel in their military career and in their lives. Projects are ongoing and planned regarding preventive measures, avoiding mental health disturbances and problems such as post traumatic stress disorder (PTSD).

Captech Overview: Besides the ongoing SRA work for long term planning purposes, the CapTech has prepared several projects in the areas of individual and team performance, such as optimisation of training (centrifuge and simulator High G) for air crew and optimization of psychological screening in recruitment as a follow on to a successful first feasibility phase. The CapTech is dealing with Social Cultural modelling, sharing methods for enhancement of recruitment and selection for the European Armed forces, and performance under extreme conditions. Human performance enhancement technologies have been studied through an operational budget study.

CAPTECH HIGHLIGHTS



'Improving Military Selection: Screening of Psychological Resilience (INSPIRE)'. Psychological or mental resilience can be described as the ability to cope with mental challenges and to recover from those quickly, in order to be able to reach the short and long term performance goals. This project aims at the first phase, the selection of military candidates. Standard selection tests are being used, including personality questionnaires, but they are not developed to screen for resilience potential. The screening instrument that will be developed in this Project does not yet exist. During this selection phase, screening of the mental resilience potential is required to enable the Defence organisations to select on mental resilience potential as well as to enable the service members to gain insight and control over their own development in mental resilience. The project has been carried out by a consortium of research labs from Netherlands, Germany and Belgium.



CapTech Summary: As CBRN threats are of concern, highly dynamic and difficult to predict, innovation is needed to cope with current and future challenges. Cat A and B Ad Hoc R&T activities are conducted and under preparation in the fields of CBRN detection, hazard management including decontamination and its control, medical countermeasures and personal and collective protection measures including preparatory work for Test and Evaluation (T&E) standards for detection and personal protective equipment.

Dual-use synergies are pursued with civil research activities under the European Framework Cooperation. The Captech supports capability development in the CDP Priority areas of 'Enhance C-IED' and 'CBRNe Capabilities in Operations' and 'Provide Medical Support to Operations'.

CapTech Overview: CBRN protection work in the EDA framework follows the EU concept of CBRN protection and includes detection/identification (networks), decontamination, next generation (collective and individual) protection measures, M&S of protection architectures and medical countermeasures.

Ongoing work on in the field of CBRN protection includes sharing of typing data on B agents, T&E protocols for detection and identification of equipment for biological threat agents and modelling of chemical dispersion in urban environments. Under preparation are projects on analysis of threshold standards for exposure of military personnel to hazardous chemicals, T&E standards for personal protective equipment and medical counter measures management. The CapTech supports the CDP Topic "Providing CBRN protection in the field" by developing tools for risk management regarding countering 'Dirty bombs' (IED with CBRN payload).

The CapTech CBRN protection supports the Joint Investment Programme on CBRN protection, that started in March 2012 and is running with 14 projects. Contributing members are Austria, Belgium, Czech Republic, Germany, Spain, France, Ireland, Italy, Netherlands, Poland, Portugal, Sweden and Norway. The Ad hoc budget allocated to the JIP CBRN programme is €12 Million.

The JIP CBRN programme includes the following topics: improved standoff detection of C agents, simultaneous analysis of CBR agents (mixed samples), next generation (point) detection for B agents and M&S of CBRN protection architectures/systems, future technologies for decontamination (control), next generation personal and collective protective equipment and CBRN sensor networking.



CAPTECH HIGHLIGHTS



The **T&E BioDIM** Phase 1 project ran from December 2012 to December 2014 (24 months). The project was led by the Norwegian Defence Research Establishment FFI and the participating nations were France, Germany, Norway, Sweden, The Netherlands, Austria, Spain and Italy. The overall aim of the project was to establish requirements and criteria for Test and Evaluation (T&E) of Biological Detection and monitoring (Bio DIM) Equipment as defined in the EDA Integrated Biological Defence System Architecture (IBDSA) report. A generic T&E framework was developed and potential ways of resolving the current limitations and weaknesses of T&E processes for BioDIM equipment were highlighted. Minimum requirements, guidelines and general recommendations for T&E of BioDIM equipment were proposed whenever appropriate, including recommendations on how to approach conceptual and procedural harmonization of T&E processes.

ENERGY & ENVIRONMENT WORKING GROUP

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Working Group Summary: The trinity of energy challenges: security of supply, cost, and environmental impact can only be addressed through a comprehensive approach to energy management within the Defence Sector. Addressing the challenges comprehensively requires a number of measures including energy data collection, analysis and sharing (DCAS) in order to define the scale and complexity of the challenges; education & training to ensure a common understanding of energy management principles and to ensure continuous, incremental and strategic improvement in energy performance is achieved; investment in energy technologies and demonstration projects based on accurate energy usage data and MS identified operational needs.

Working Group Overview: Workstrands addressed by the Energy and Environmental Working Group (EnE WG) since its establishment at the June 2014 Steering Board include; development of a Strategic Research Agenda, development of the 'Demand Management (Smart Camp) Technical Demonstrator' which was deployed to Mali in October 2015 and will complete its trial phase in early 2016, using defence estate for energy generation including the on-going management of the energy performance procurement (Go Green) project, sustainable procurement, 'Smart Blue Water Camps' water management project and the Commission funded 'Consultation Forum for Sustainable Energy in the Defence and Security Sector' (CF SEDSS).



PROJECTS ON-GOING & PLANNED

Data Collection, Analysis & Sharing (DCAS) project.



- Technology Assessment.
- Demand Management (Smart Camp) Technical Demonstrator.
- Water Management (Smart Blue Camps) project.

- Using defence estate for energy generation.
- Biofuels.



Energy Management Systems (EnMS) training for Member States.



Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS).





WORKING GROUP HIGHLIGHTS



Demand Management "Smart Camp" Technical Demonstrator. In October 2015 the EDA successfully installed energy management equipment at Camp Koulikoro, the location for the European Union's Training Mission (EUTM) in Mali. The elements installed include software to manage the energy demand of a test building, fixed solar photovoltaic panels on a test building (16KWp), flexible soldier-portable solar photovoltaic panels as well as monitoring and metering equipment for water and electricity. The objectives are to:

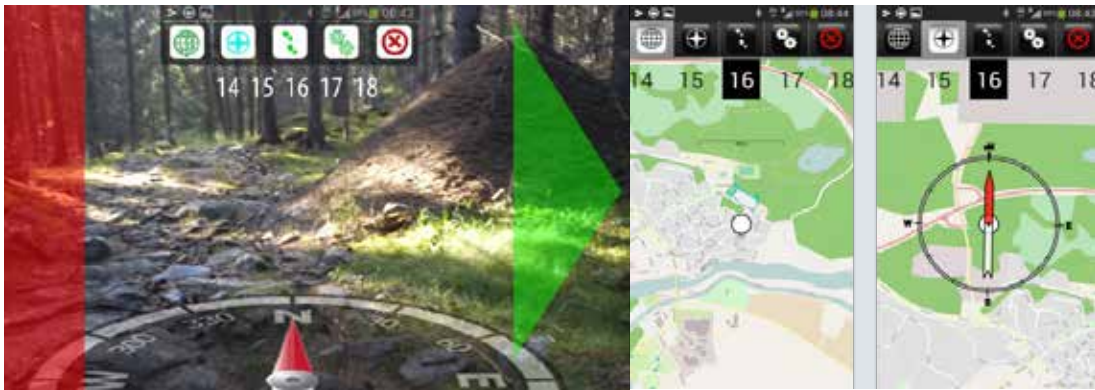
1. Test efficiency of various types of photovoltaic panels in specific climatic conditions;
2. Test the integration of renewables with battery storage in an operational deployment scenario;
3. Test demand management technology and its impact, if any, on inhabitants;
4. Raise awareness of energy efficiency and renewable energy as a military capability;
5. Encourage energy efficient behaviour among troops;
6. Collect reliable data for analysis and sharing with other MS and further work;
7. Collect data to develop benchmarks for planning support tools for CSDP operations.

Following the test phase, further work can be envisaged including an upscaling of the equipment installed to provide more renewable power to the camp, water management technologies, waste management technologies including waste to energy conversion and further efficiency measures. moving towards 'zero net energy' military deployed camps including building fabric technology, services technology, demand management technology and water management technology.

CAPTECH: GUIDANCE, NAVIGATION AND CONTROL

Contact: Captech.navigation@eda.europa.eu

CapTech Summary: CapTech Guidance, Navigation and Control deals with increased precision, localisation performance and automation through collaborative research and technology development in the area of guidance, navigation and control for defence (autonomous) systems. The field of autonomous systems, navigation and decision taking is very important for future defence capabilities that will rely more on autonomous or semi-autonomous systems. The CapTech work therefore supports the system-related CDP priorities.



CapTech Overview: The CapTech's first finalised project examined how to exploit better prior knowledge in sensor processing, bringing together real time sensor data with higher level navigational data. A second project that finished recently aimed at improving autonomous decision making algorithms for autonomous 'systems of systems'. The project will allow for further research work through simulation models on levels of autonomy in decision making. Regular workshops on 'future guidance and control' supported the SRA development and prospective proposals for the project portfolio. The topic of indoor navigation was initially considered in an EDA study on 3D positioning. The CapTech is now continuing to prepare a collaborative project in this field of indoor navigation.

CAPTECH HIGHLIGHTS



AUTONOMOUS DECISION MAKING based coordination techniques for Heterogeneous Autonomous Vehicles - (ADM-H). The purpose of the ADM-H project was to increase the maturity level of ADM algorithms

and techniques for the coordination of heterogeneous groups of unmanned systems cooperatively engaged in a military mission and the exploitation of the operational advantages of using such systems in future defence theatres. This has been achieved with:

- ADM architecture development and development of ADM algorithms through development of technologies for new functions.
- Development of a simulation system model and operationally relevant scenarios for performance assessment of ADM techniques and algorithms.



R&T INVESTMENT IN EDA FOR 2013-2015

EDA-FUNDED
R&T STUDIES
2013-2015

More than

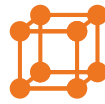
**4 million
euros**

have been invested in more
than 20 studies



CATEGORY A R&T
PROGRAMMES
2013-2015

**€ 32.6
million**



CATEGORY B R&T
PROJECTS AND
PROGRAMMES
2013-2015

**€ 115
million**

committed for twenty six
new Project or Technical
Arrangements (incl. VAT and
co-funding).



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TOTAL OF NEW CONTRACTS FOR EDA-FUNDED STUDIES,
CATEGORY A AND B PROJECTS AND PROGRAMMES

€ 151.6 million



committed for new contracts (15 EDA-funded studies, five Category B projects' contracts and one JIP-UMS contract).

LINKS TO FURTHER INFORMATION

EDA Links for R&T subjects of interest:

- EDA website: <http://www.eda.europa.eu/>
- All EDA working environments: <https://my.eda.europa.eu/Pages/Home.aspx>

After registration in MY.EDA, you could be interested to ask for access to:

- R&T general:
- Capability needs: Capability Development Plan (CDP)
- Test and Evaluation facilities: DTEB
- Technological landscaping: Techwatch
- EU Defence standardization: see EDSTAR in the ECP



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