# Defence electro-optics: European perspective

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## ABSTRACT

In 2009 the United States invested in defence R&T 3,6 times and in defence research and development 6,8 times as much as all member states of the European Defence Agency (EDA) combined while the ratio in the total defence expenditure was 2,6 in the US' favour. The European lack of investments in defence research and development has a negative impact on the competitiveness of European defence industry and on the European non-dependence. In addition, the efficiency of investment is reduced due to duplication of work in different member states. The Lisbon Treaty tasks EDA to support defence technology research, and coordinate and plan joint research activities and the study of technical solutions meeting future operational needs. This paper gives an overview how EDA meets the challenge of improving the efficiency of European defence R&T investment with an emphasis on electro-optics and describes shortly the ways that governmental and industrial partners can participate in the EDA cooperation. Examples of joint R&T projects addressing electro-optics are presented.
**Keywords:** European defence technology research

## 1. INTRODUCTION

### 1.1 The role of the European Defence Agency

The European Defence Agency (EDA) was established in 2004 to promote the cooperation between the Member States in the military capability development, research and technology, acquisition of military equipment and strengthening the European defence technology and industrial base. This integrated way of working starting from the identification of a capability gap through research and development work to joint procurement programmes and to the creation of a competitive European defence equipment market was the major innovation in the EDA concept. Capability drive, customer orientation and duplication avoidance are the main characteristics of the EDA work. To avoid any duplication of work, EDA seeks actively cooperation with other relevant organisations like the European Commission, European Space Agency (ESA), OCCAR, LoI group and of course NATO. The Lisbon treaty, in which EDA is the only EU agency mentioned by name, has removed obstacles for funding military research and technology work under EU Framework Programmes and the cooperation between the European Commission and EDA has intensified considerably during the past year.

EDA’s role in defence R&T is to facilitate cooperation between Member States that fund the R&T work on case by case basis. In contrast to organisations awarding grants to support general technology development, the Ministries of Defence are end users of defence technology and for this reason they want to secure user rights to the results achieved. The strong involvement of MODs in the EDA projects also facilitates the later exploitation of R&T results in the development of military systems because the development work is financed mostly by the MODs.

### 1.2 European investments in military R&D

A healthy level of R&T investment is a prerequisite for competitive defence industry. In 2009 the United States invested in defence R&T 3,6 times and in defence research and development 6,8 times as much as all member states of the European Defence Agency (EDA) combined while the ratio in the total defence expenditure was 2,6 in the US' favour. In addition, the European research, development, test and evaluation expenditure is estimated to decline by 11 % between 2009 and 2015 according to a recent forecast published by Jane’s Defence Industry. The corresponding US expenditure is expected to decline by 21% in the same time period but the investment of BRIC (Brazil, Russia, India and China) countries will more than double and reach a level that is two times higher than the total European investment. The

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problem of the insufficient investment rate is further aggravated by duplication of work causing wasteful use of available resources.

## 2. EDA CONCEPT

EDA's mission and tasks are defined in a recent Council Decision[1] that replaced the Council Joint Action 2004/551/CFSP on the establishment of EDA. EDA's tasks address the development of defence capabilities in crisis management, the promotion and enhancement of European armaments cooperation, the strengthening of the European Defence Technological and Industrial Base (EDTIB) and the enhancement of the effectiveness of European Defence Research and Technology (EDRT). The capability drive is a hallmark of the EDA work and all EDA work supports the improvement of Common Security and Defence Policy (CSDP) capabilities. The capability priorities are specified in the recently updated Capability Development Plan (CDP) and they divided into three groups: actions (CDP "Top 10"), maturing actions (considerable progress has been made and the way ahead mapped out for future substantive collaborative work) and core drivers / environments (cross-cutting areas that provide a backbone to CSDP capability improvement). The CDP priorities are listed in Table 1.

Table 1. Capability Development Plan 2011 priorities

| CDP "Top 10" | Maturing actions | Core drivers / environments |
|---|---|---|
| 1. Counter Improvised Explosive Device (C-IED)<br>2. Medical Support<br>3. Intelligence Surveillance and Reconnaissance<br>4. Increased Availability of Helicopters<br>5. Cyber Defence<br>6. Multinational Logistic Support<br>7. CSDP Information Exchange<br>8. Strategic and Tactical Airlift Management<br>9. Fuel and Energy<br>10. Mobility Assurance | 1. Maritime Mine Counter-Measures<br>2. Chemical Biological Radiological and Nuclear<br>3. Counter-Man Portable Air Defence Systems<br>4. Military Human Intelligence | 1. Comprehensive Approach<br>2. Network Enabled Capabilities<br>3. Radio Spectrum Management for EU Capabilities<br>4. Space<br>5. Single European Sky |

Intelligence, surveillance and reconnaissance (ISR), counter improvised explosive devices (C-IED), counter-man portable air defence systems (C-MANPADS) and chemical, biological radiological and nuclear (CBRN) protection are examples of CDP priorities whose achievement requires considerable R&T work. These priorities are also related to electro-optics demonstrating the significance of this technology area to the future CSDP capabilities.

Another driver for European defence technology research is to reduce dependence on non-European sources of technology. Dependence is a risk for security of supply and the EDA Member States have identified the non-dependence as a pre-condition for a robust, sustainable, globally competitive European Defence Technological and Industrial Base (EDTIB). So far non-dependence has been tackled on case by case basis at best but a comprehensive European approach has been lacking. The EDA recently arranged a high-level Conference in Budapest on European Technology non-Dependence (ETnD) under the Hungarian EU Presidency as a first step to produce an overall European approach. The conference clearly demonstrated the importance of the subject to the Member States and the EDA is already starting to implement the conclusions of the conference. Non-dependence is not only a technology issue and EDA with its comprehensive approach from capability planning to defence industry policy is particularly well suited as a cooperation forum for the Member States.

The European Defence Research and Technology Strategy established in 2008 enables the EDA to perform better in the tasks mentioned above particularly in the enhancement of the effectiveness of EDRT. The EDRT strategy has three parts: the "Ends" representing the areas where R&T investment is required in order to improve European defence capabilities, the "Means" describing the tools which improve the efficiency and accelerate the implementation of the "Ends" and the "Ways" implementing the "Ends" and the "Means" through roadmaps and actions plans. In other words, the "Ends" can be described as key technologies, the "MEANS" as process development and the "Ways" as an implementation plan. The "Ends" are accomplished through collaborative R&T projects balancing top-down capability drive and bottom-up technology push. The R&T directors of the 26 EDA Member States approved in June 2011 the second edition of the "MEANS" action plan focusing on the closer cooperation with the European Commission, the simplification of the project preparation process and the promotion of multidisciplinary programmes that are more likely to lead to common development projects.

The increased exploitation of civilian research and technology work in military systems is another way to reduce cost. The Lisbon treaty allows closer cooperation between EDA and the European Commission and one of the main tasks of EDA as a representative of defence technology end-users will be to promote that the potential of dual-use technologies for defence needs is taken into account in the future EC framework programmes

## 3. DIFFERENT FORMS OF R&T COOPERATION

In the EDA defence R&T projects contributing Members (cM) or participants sign an arrangement specifying the technical content of the project and the obligations between the cM. The legal instrument available including EUROPA Memorandum of Understanding and EDA General Provisions allow the cM great freedom to agree on project specific conditions but in most cases the cM decide to use the default provisions including "juste retour" (each cM funds the participation of its "own" industry or research laboratories). In cooperation between governmental laboratories, the arrangement mentioned above is sufficient but in more complex projects involving industry a contract or contracts are necessary between the industrial entities and the cM. EDA may also place a contract with the industrial consortium on behalf of the cM and in particular in projects requiring close coordination between industrial partners a single contract with the consortium simplifies project management and avoids ambiguities in liabilities. Recently 11 cM launched an R&T programme on Unmanned Maritime Systems (UMS) that uses an umbrella arrangement under which individual R&T projects can be launched without separate project arrangements. The cM of UMS may also use a programme bank account for their contributions which facilitates budget synchronization and problems with the transfer of funds to the following fiscal year in case of delays. During the last three years the total value of signed R&T arrangements has increased although there are strong annual variations that reflect the financial situation in the pMS (Table 2). The peak in 2009 is due to a large demonstrator project dealing with software defined radio and in 2010 pMS signed twelve new R&T arrangements with the total value of 107,6 M€.

Table 2. The number and the total value of new R&T arrangements signed in 2007-2010 except for JIP-FP and JIP-ICET programmes.

| R&T Arrangements signed | Year | | | |
|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 |
| Number | 11 | 11 | 19 | 12 |
| Total value (M€) | 36,1 | 76,2 | 131,0 | 107,6 |

The Joint Investment Programmes on Force Protection (JIP-FP, started in 2007) and on Innovative Concepts and Emerging Technologies (JIP-ICET, started in 2008) represent another type of defence R&T cooperation. In these programmes pMS define a number of R&T goals based on capability needs, EDA arranges calls for proposals addressing those R&T goals and companies and research organisations designated by the cM may submit proposals. Successful proposals are selected based on the evaluation by cM experts and the industrial return of a cM does not necessarily equal its contribution to the programme. All cM receive user rights to all results of the programme so a cM will receive full value for its money even if its industrial return is less than 100% of its contribution. The JIP-FP introduced the programme bank account scheme that has been used also in the JIP-ICET and UMS programmes. The main figures of JIP-FP and JIP-ICET programmes are presented in Table 3.

Table 3. The main figures of JIP-FP and JIP-ICET programmes.

| | JIP-FP | JIP-ICET |
|---|---|---|
| Number of cM | 20 | 11 |
| Total value | 74 M€ | 19 M€ |
| Date of Programme Arrangement signature | 14 May 2007 | 10 November 2008 |
| Number of projects | 18 | 12 |
| Number entities participating in projects | 125 | 75 |
| End of last project | September 2012 | December 2012 |

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One of the objectives of JIP-FP/ICET programmes was to encourage the participation of academic institutions and innovative small and medium enterprises (SME) in the European defence technology research. In addition, the programmes aimed at increasing the cooperation between the innovative newcomers and the established defence companies. These goals were clearly achieved and for example in the JIP-ICET programme two thirds of members of successful consortia were either SMEs or academic institutions (Figure 1). This portion is much more than in traditional joint projects that involve mostly large companies and governmental laboratories.

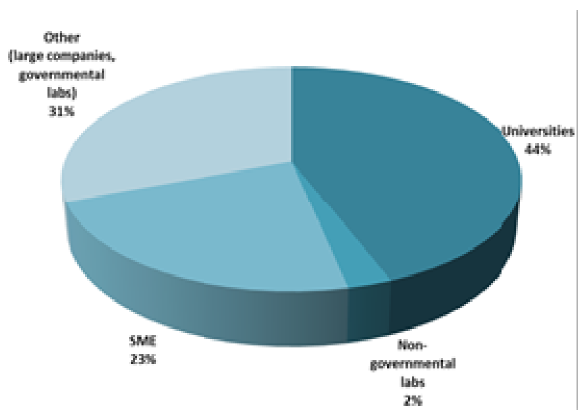


Figure 1. The composition of successful consortia in the JIP-ICET programme by organisation type.

As mentioned above, the European Commission and EDA are strengthening their co-operation in the area of defence technology research. A concrete example is the preparation of three so-called European Framework Cooperation (EFC) programmes on chemical, biological and nuclear protection (CBRN), unmanned aerial systems (UAS) and situation awareness (SA). The purpose of the EFC initiative is to improve coordination between the EC Framework Programme 7 and EDA activities in the development of dual use technologies. The preparation of the CBRN programme has advanced most and its Programme Arrangement is expected to be signed by the end of September 2011. It can be considered as a further development of the JIP-FP/ICET concept with open competition and a central budget.

In addition to R&T projects, EDA can fund technology studies from its operational budget. The purpose of these studies is to form a common understanding on the priorities within a certain technology area and to pave way for later R&T projects. The typical value of such a study is between 100 000 and 300 000 euros.

## 4. R&T COOPERATION IN PRACTICE

The practical R&T project preparation work at EDA is mostly done in 12 Capability Technology (CapTech) groups clustered in three groups: Information Acquisition & Processing, Guidance, Energy & Materials and Environment, Systems & Modelling. The 12 CapTech groups are listed in Table 2 and the groups most relevant to electro-optics are IAP1 and IAP3. The detailed technical coverage of each group is posted on the EDA website[2].

Table 2. EDA CapTech groups

| **Information Acquisition & Processing** | **Guidance, Energy & Materials** | **Environment, Systems & Modelling** |
|---|---|---|
| IAP1<br>Components | GEM1<br>Materials & Structures | ESM1<br>Naval Systems & their Environment |
| IAP2<br>RF Sensor Systems & Signal Processing | GEM2<br>Energetics, Missiles & Munitions | ESM2<br>Aerial Systems & their Environment |
| IAP3<br>Optical Sensor Systems & Signal Processing | GEM3<br>Ground Systems & their Environment | ESM3<br>Systems of Systems, Space, Simulation & Experiment |
| IAP4<br>CIS & Networks | GEM4<br>Guidance & Control | ESM4<br>Human Factors & CBR Protection |

The CapTech groups have launched the process of creating Strategic Research Agendas (SRA) for their technology areas. The SRAs will evaluate the civilian technology development in 10 and 20 year time frame and identify gaps where the civilian technology development is not sufficient for the achievement of military capability needs but specific military R&T work is necessary. The SRAs will also propose roadmaps for European investments in the development of military technology over the coming ten years and they will show how associated technologies can be matured and become ready for insertion in system development. The first SRA covering electronic components (including electro-optical components) is ready and the SRA on the optical sensor systems is expected to be finished by the end of 2011.

Industrial experts from EDA Member States may join the CapTech by submitting an application available on the EDA website[3]. When the application is approved, the new expert will also be granted an access to the CapTech forum that contains all main documents relevant to the CapTech work. Governmental experts are nominated by the National Captech Coordinators.

## 5. EXAMPLES OF EDA PROJECTS RELATED TO ELECTRO-OPTICS

Examples of recent or running EDA R&T projects dealing with electro-optics or related data fusion are presented in Table 4.The Joint Investment Programmes address subjects that interest most EDA Member States and tend to concentrate on low Technology Readiness Level while a category B project with more limited number of contributing members is typically selected for high TRL technology development. However, there are no strict rules for choosing the project type.

Table 6. Examples of recent or running EDA projects related to electro-optic sensors.

| Technology | Acronym | Name | Type | Indicative value (M€) |
|---|---|---|---|---|
| Electro-optics | CANARIO | CWA analyzer based on low cost dual band IR microsystems | Cat B | 4,5 |
| | DUMAS | Technology demonstration of a dual mode seeker system | Cat B | 12,7 |
| | DUCAS | Detection in Urban scenario using Combined Airborne imaging Sensors | Cat B | 6,5 |
| | ATLAS | Advanced techniques for laser beam steering | Cat B | 3,6 |
| | SNIPOD | Sniper Positioning and Detection | JIP-FP | 2,8 |
| | MUSAS | Multi Sensor Anti Sniper System | JIP-FP | 5,7 |
| | NANOCAP | Novel nanostructured optical components for CRBN detection and high performance opto-microwave links | JIP-ICET | 1,9 |
| | ACTIM | Active Imaging | Study | 0,15 |
| Data fusion | DAFNE | Distributed and adaptive multisensor fusion engine | JIP-FP | 3,8 |
| | D-FUSE | Data Fusion in Urban Sensor Networks | JIP-FP | 5,2 |
| | MEDUSA | Multi Sensor Data Fusion Grid for Urban Situational Awareness | JIP-FP | 5,6 |

## 6. CONCLUSIONS

The main incentive for the member States to participate in the EDA R&T cooperation is to save costs, and on the other hand defence industry is able to offer its customers better value for money through cooperative projects. However, in 2009 the collaborative defence R&T expenditure made 14,4% of the total defence R&T expenditure of the EDA Member States which is still considerably less than the 20% target set by the Ministers of Defence. The current economic austerity has again reminded the Ministries of Defence of the benefits of research and technology cooperation and it will strengthen the positive trend for joint projects although budgetary problems may have a negative impact in the short term. The key challenges for EDA in the next few years will be strengthening the links between the European defence and civilian research and technology in cooperation with the European Commission and the European Space Agency and further development of forms of cooperation so joint projects can be launched faster and with less administrative burden.

## REFERENCES


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[3] www.eda.europa.eu/Aboutus/Howweareorganised/Organisation/RandTdirectorate/CapTechs/CapTechsexperts/CaptechContactForm