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DIRECTORATE-GENERAL FOR EXTERNAL POLICIES

POLICY DEPARTMENT

The future of EU defence research

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DIRECTORATE-GENERAL FOR EXTERNAL POLICIES
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STUDY

The future of EU defence research

ABSTRACT

There is an increasing demand for the EU to become a 'Security Provider'. This demand comes from Europe's best ally, namely the U.S., but also from Member States themselves. For the first time ever the defence solidarity clause of article 42.7 of the Treaty on European Union was invoked in November 2015. Ultimately the demand to put 'more defence in the Union' comes from European citizens who wonder why Europe does not protect them in the current turmoil. From the answer to this question depends not only Europe's 'strategic autonomy', but possibly the future of the whole European project.

Several steps have already been initiated to answer the call for more defence in Europe. Since the beginning of his mandate, President Juncker has declared defence a 'priority', called for the implementation of the Permanent Structured Cooperation enshrined in the Lisbon Treaty and reiterated the long term vision of a 'European army'. In June 2016, a 'global strategy' will be issued and a Commission Defence Action Plan should follow by the end of 2016. A 'Pilot Project', adopted by the European Parliament in autumn 2014, has been launched and should open the path to a 'Preparatory Action on Defence Research' that may be voted in 2016 for the 2017-2020 budgets.

A natural underpinning of those efforts should be the undertaking of a full-fledged Union programme in defence research. The size, the shape and the steps to be taken towards setting it up are the subject of the present report.

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Methodology

The European Parliament's Directorate-General through its Policy Department gave the authors the task of carrying out this study on 18 November 2015, asking them to hand over their draft report by 22 February 2016 and their final report on 14 march 2016. The authors were asked to analyse the way security and defence research has been handled so far within the existing policy frameworks and financing instruments and to describe the current political and institutional initiatives aimed at enhancing support for defence research. They were required to develop, based on the Lisbon Treaty legal and institutional set-up, the options for designing, developing and implementing an EU level defence research programme, to describe the process depicting the objectives, content, and budget of such a programme, as well as its potential consequences on transatlantic relations.

The present study was prepared on the basis of desk research and interviews of a number of stakeholders entrusted with responsibilities in policy-making, programming or implementation of defence research, including representatives of EU Member States, the European Defence Agency (EDA), the European Military Staff (EUMS), the European Commission, the European External Action Service (EEAS), NATO, industry, Research & Technology Organisations (RTOs), Joint Technology Initiatives (JTIs) (see detailed list of interviewees in annex 1). Interviews have been used to collect information as well as to confront ideas and options.

Desk research covered a review of relevant documentation on defence planning, including the main strategic documents issued by Western countries since 2000, data on defence economics, European strategy and armed forces literature, EDA and NATO publications, as well as material coming from hearings conducted by National Parliaments, particularly the British Parliament.

Data collection and treatment has been arduous, due to the fact that existing statistics are incomplete, not standardised from one country to the next, and that time series covering R&D do not exist. Graphs provided by EDA have been transformed into raw data. This data has then been inflated with the coefficients deducted from those graphs to produce tables allowing comparison over time. Recent data provided by NATO as part of its current work to increase the public transparency of its members' defence expenditure, has also been used. However, NATO does not break down 'equipment' into R&D and major equipment. It is difficult to collect data on Europe's strategic competitors, namely Russia and China. Data presented has been obtained from defence attachés in those two countries and complemented with open specialised literature.

An important assumption of the paper is that defence research is part and parcel of the broader logic of the defence planning cycle. Efforts have been made to understand where and how it should be inserted into the larger EU CSDP planning. To do so, the authors have strived to extract from major Western countries' numerous strategic documents as well as NATO the invariant elements of the defence planning cycle, what they have called the 'strategic path'. These are presented in the form of matrixes in annex 2. Whenever possible those matrixes have been verified by national defence planners. Nevertheless, the authors bear the sole responsibility of residual errors.

The authors additionally benefited from insightful editing from Dr. Catherine Guicherd, an expert with a length of experience in relevant matters.

Executive Summary

In the wake of the Saint-Malo summit in 1998, European countries have taken a number of initiatives to develop 'the progressive framing of a common defence policy in the framework of a common foreign security policy' pursuing the aim for the Union to have 'the capacity for autonomous action, backed up by credible military forces, the means to decide to use them and a readiness to do so, in order to respond to international crises', as stated in the summit declaration.

Among those initiatives, much attention has been paid to defence research through existing bodies such as the ESA, OCCAR, the WEAG or LoI-FA, which are (or were) all intergovernmental undertakings. Without any doubt, the main initiative has been the creation of a European Defence Agency (EDA) in 2004 on the basis of a Joint Action formally adopted by the Council in the follow-up to the 2003 Thessaloniki Council which gave birth to the Treaty Establishing a Constitution for Europe.

Those initiatives have produced mixed results. The WEAG, despite its useful contribution, was dissolved in 2005, as its task was judged redundant with EDA. ESA and OCCAR can both be considered a success, but while the number of major collaborative programmes entrusted to OCCAR by EU Member States is increasing, ESA is mainly, not to say exclusively, focused on civilian programmes. The LoI-FA is striving to survive but its identity has become blurred, as it is today half-lobby, half-think tank. Alas, with regards to EDA, the results against the expectations are disappointing. EDA did not become the Agency of European 'Defence Capability, Research and Armament' imagined by its early promoters and the fathers of the 'Constitution'. As a matter of fact, EDA has been kept out of the major armaments programmes, such as the MALE drone or the future aircraft combat system by the Member States concerned. The blame has to go primarily to those Member States themselves who never launched the 'permanent structured cooperation' which would have given EDA its true 'raison d'être' by making it the natural vehicle for the conduct of collaborative European research and procurement programmes fed by quantified financial efforts of the committed Member States. EDA without PESCO is like the European Central Bank without convergence criteria. Nevertheless, EDA also bears its share of responsibility. Even with its budget constraints, it could have brought more added value to the national armament organisations in confronting the capability needs and the technological solutions. Many observers consider that EDA has not been able to build the requisite amount of trust and confidence with industrials and Member States.

Despite such a broad range of institutions and instruments, European defence research as a whole has declined sharply since 2006. Between 2006 and 2013, EDA countries' R&D has been reduced by a staggering 29.2 %, from EUR 9.7 billion (EUR 10.6 billion at constant price) to EUR 7.8, and R&T by 27.7 % from EUR 2.4 billion (EUR 2.9 billion at constant prices) to EUR 2.1 billion. Defence R&D has decreased at twice the rate of defence expenditure (14.7%) and is thus the main victim of budget cuts. Instead of pushing for more collaboration, the financial crisis has led the Member States to withdraw on their national bases. With only EUR 168 million in 2013 representing a bewildering 8 % of the R&T expenditure, European collaborative defence R&T barely exists.

Conscious of those ominous trends, several of the Union political bodies have begun to react. In 2013, the European Commission Communication named 'A strategy for a stronger and more competitive European defence industry' gave the wake-up call, which is bringing the Union slowly but surely from rhetoric to concrete action. The civilian programme Horizon 2020 has been opened more widely to 'dual use' projects. The European Parliament voted a pilot project (PP) in autumn 2014 paving the way to a Preparatory Action (PA) on defence research, the terms of reference of which are being defined and shall be examined by the Parliament in the next budget.

Between 2013 and 2015, the Union's action has been slowed down by interrogations about the legality of its involvement in such new province. Nevertheless, there are good reasons to think that the Union's involvement in defence research is fully compliant with the Treaties.

Will Union action bring any added value? The answer is yes, without any doubt. The first and foremost reason is that if nothing is done, European defence research will simply disappear. For the vast majority of European countries this is already the case. European defence research is concentrated in three countries, by decreasing order, France, the UK and Germany, whose cumulated efforts represented 92 % of European defence R&D and 86% of European defence R&T in 2013. The real record is even worse considering that both in France and in the UK a large part of defence research investment is dedicated to nuclear deterrence. After two decades of underinvestment, those fatal trends will have dire consequences. European defence companies will lack the technological ability to build the next generation weapons due to the absence of technological building blocs such as robotics, artificial intelligence, swarm weapons systems, lasers, infrared retinas, space surveillance and over the horizon radars… not to mention missile defence and ultra-sophisticated command and control systems. This will have a major impact on the European defence and technological industrial base, which will lose global competitiveness, exports markets, highly qualified jobs and industrial facilities, and will struggle to attract funds and talents.

However, the main effect of this underinvestment will be political and military. The Union's ambition to achieve 'strategic autonomy' and be a 'security provider' for its citizens will remain empty words, whereas the world around the EU keeps evolving fast. During the period 2006-2011, the US spent an average of EUR 9 billion per year on R&T and an average of EUR 54.6 billion per year on R&D. Thanks to its 'defense innovation strategy' (DII), more commonly referred as the 'third offset strategy' (3OS) this effort will even increase. For the fiscal year 2017, the US Defense Secretary has recently announced that EUR 67 billion will be requested in defence R&D appropriations. China's defence research budget is assessed to be slightly more than twice the size of the EU, at around EUR 20 billion. At constant rate of increase, some think tanks estimate that it will overpass the US's by 2022. Finally, the Russian defence R&D budget has doubled between 2012 and 2015. The conclusion is self-evident: a step change in the scale of Europe's R&D budget is urgent, and no single European country is financially capable to undertake it. Common Union action is therefore imperative.

In order for the EU to achieve the necessary critical mass, and avoid losing ground compared to other world actors, a European Defence Research Action Plan (EDRAP) should be launched without delay. It should include a substantial European Defence Research Programme (EDRP) for the next Multiannual Financial Framework (2021-2027). Only a common approach will create the necessary momentum which the intergovernmental method has failed to trigger over the last fifteen years. In parallel, EDA rules of governance should be revised and its budget drastically increased. Should such a reshuffle reveal politically impracticable, the Union should envisage the creation of a dedicated structure, possibly in the form of a Joint Undertaking. Finally, the links between the various elements of CSDP planning already in existence or in the making – the 'global strategy' and the Capability Development Plan' – should be strengthened, and missing ones should be developed, including a defence sub-strategy and an acquisition strategy including research and procurement in a top down approach.

Recommendations

1. The Union should launch an ambitious *European Defence Research Action Plan* (EDRAP) consistent with the 'Global Strategy' that will be issued in June 2016 by High Representative Federica Mogherini, and the Commission Defence Action Plan expected by the end of 2016. As defence research is a race against the clock, *in anticipation of a full-fledged European Defence Research Programme (EDRP), the Commission should ensure that a relevant share of the Horizon 2020 programme is dedicated to test facilities and low Technology Readiness Levels (TRL) activities taking into account the specificities of defence constraints.* The focus should be on Research & Technology Organisations' (RTO) studies working at fundamental S&T research (TRL 1 to 3) which could be used for defence purposes. Horizon 2020 permits an action on 'dual use' technologies, but the amount dedicated to such technologies represented only EUR 164 million in 2016 out of an average amount of EUR 7 billion per year. As the Preparatory Action (PA) on defence research, planned for 2017-2020, is only meant to test the mechanisms for the implementation of the full-fledged EDRP, it will not fulfil this need, neither in size, nor in scope. Therefore, the share of Horizon 2020 dedicated to real 'dual use' research should be increased in its final budget phase (2018-2020). *This is still possible in the context of the on-going midterm review, but time is running short.*

2. Within the next Multiannual Financial Framework (2021-2027), *the Union should launch a dedicated EDRP including also higher TRLs (TRL 3 to 7) and reflecting its level of ambition with regard to CSDP.* Taking into account: (i) the size of Europe's R&D, compared to its allies and competitors (currently less than EUR 8 billion per year, against EUR 67 billion in 2017 for the U.S., some EUR 20 billion per year for China, and a 50% increase for Russia over 2012-2015); (ii) the fact that no EU country is able to increase its level of effort significantly at the national level; (iii) the pledges made by EU NATO members at the Wales Summit in 2014 to increase their defence expenditure to 2% of GDP (which would represent EUR 84 billion at the 2014 budgetary conditions), *the EDRP should aim at a substantial increase in the overall European defence R&D effort*. It should cover all actors of innovation, from academia to SMEs and industry, and should be shaped in order to reduce the technological risks of the future European procurement programmes.

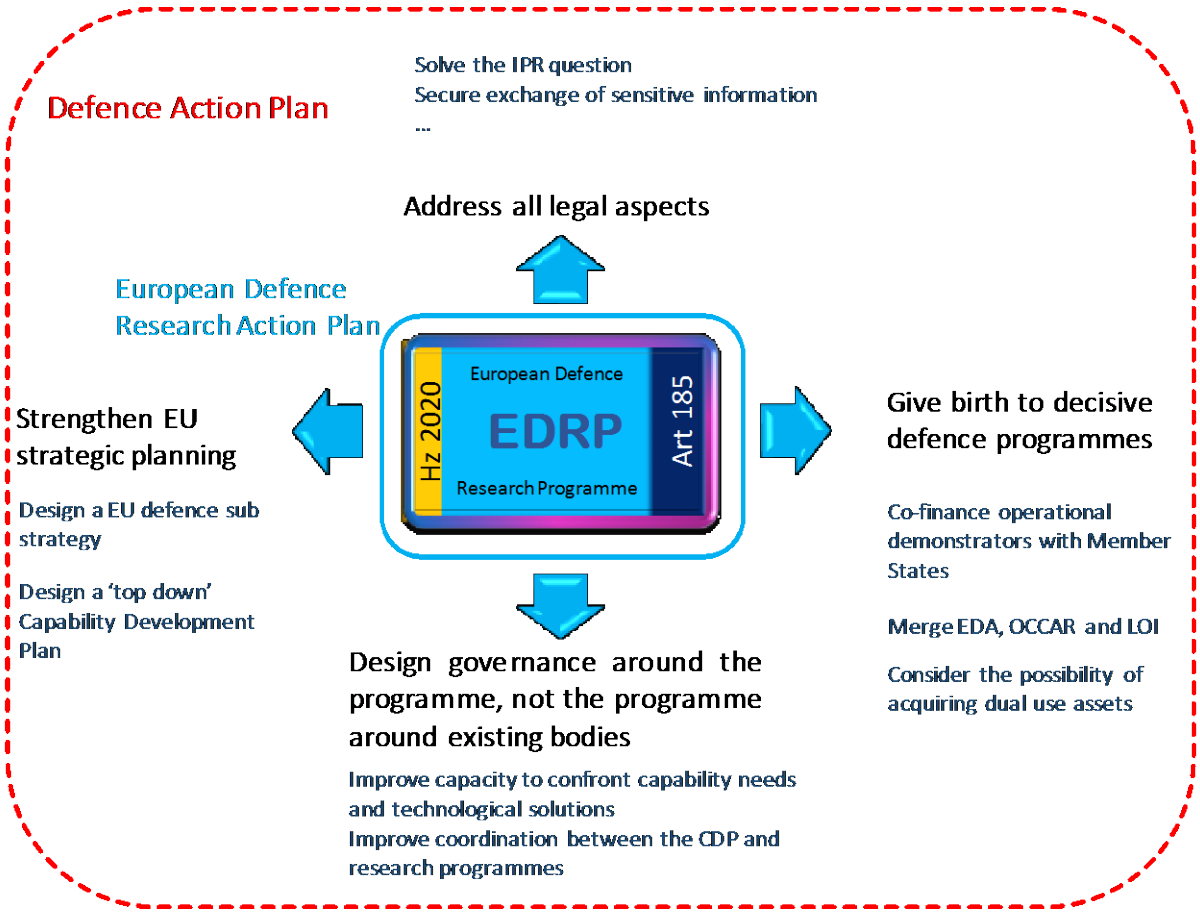
3. In order to give birth to sound defence procurement programmes*, a second step of the EDRP should be taken by 2023-2025, including co-financing by the Union and its Member States e.g.* under the aegis of article 185 of the Treaty on the Functioning of the European Union (TFEU), to produce operational demonstrators (TRL 7 & 8). The dedicated implementation structures required for article 185 TEU programmes could be hosted by EDA, or by OCCAR.

4. To implement this action plan, the *European Defence Agency is the natural institutional agent of the Union*. *However*, *EDA as is stands today will not be able to play this role* with a budget capped at EUR 30 million per year and unanimity as its standard mode of decision-making. Thus, the Union should reconsider both the means and the governance of EDA *and design the governance to fit the programme, not the programme to fit the governance.* If the EDRP is to become a game changer, then the selection of research projects and programmes is critical and shall be conducted in the common interest of the Union. At the technical level, EDA should bring more added value to Member States, being *the platform capable of matching the technological solutions with the military needs* defined by the EUMS. The latter's role should be enhanced, and backed by the Member States through the EUMC. *If no change reveals to be possible* in EDAs' endowment and governance, the Commission should consider the possibility of *creating a new CSDP Directorate General or* put forward a proposal for the creation of a *dedicated Joint Undertaking (JU)* in the form that has been done for the Joint Technological Initiatives (JTIs) within Horizon 2020. Whichever option is chosen, the funding of defence research from the EU budget will have to abide by the financial regulation and to fully respect the rights of the European Parliament regarding budgetary control.

5. *The Union shall strengthen its CDSP 'planning process'*, building on scattered existing components. For this, the Global strategy should be followed by a *defence sub-strategy* (or 'white paper' or 'white book') setting the Union's level of ambition and answering the question: what does the Union want to be able to achieve militarily? This new document shall then be followed by *a brand new Capability Development Plan*, matching capabilities with the Union's new level of ambition in a *top down approach*. Eventually, an '*Acquisition Strategy*' should be drafted to differentiate what can be bought from the shelf at best value for money, what has to be built, and in which areas research should be pursued. In addition, responsibilities for reaching the goals should be apportioned among Member States, as it is done at NATO. All planning and programming steps should be carried out on a cyclical and regular basis.

6. *Ways and means for the EDRP to give birth to decisive defence programmes must be explored*. The aforementioned *co-financing by the Union and Member States is certainly the most significant way* to tighten the link of defence research with defence programmes. *The merger of EDA with OCCAR and the LoI-FA should also be considered* in order to build a continuum between research and procurement programmes and enable EDA to scale up quickly its capacity to lead on the EDRP, building on OCCAR's and LoI-FA's experience. Furthermore, *the Union should also consider the possibility to acquire by itself dual use capabilities*, as it does already with satellites, and as NATO is doing on a limited scale by entrusting assets to some of its agencies (for example, the multinational Multi Role Tanker and Transport aircraft fleet). It might be possible to attribute this competence to EDA, provided that the aforementioned reform is taken forward. Alternatively, a dedicated structure could be created.

7. *More broadly, all the legal aspects must be clarified prior to the launch of the EDRP in 2021*, whether this is through the expected Commission Defence Action Plan or otherwise. Intellectual Properties Rights (IPR) should be covered in a way that does not discourage corporations (from the defence sector or not) from applying for EDRP tenders; the level of Security required for exchanging controlled sensitive information should be addressed, as well as relations with third countries which could participate. We also suggest the definition of 'European Defence Research Entities' (EDRE) to make sure that the Union's taxpayer money is conveyed to authentic European Defence Companies and undertakings. The guiding principle of spending must be: 'European money for European value'.


Defence Action Plan
Solve the IPR question
Secure exchange of sensitive information
...
Address all legal aspects
European Defence Research Action Plan
European Defence
EDRP
Research Programme
Hz 2020
Art 185
Strengthen EU strategic planning
Design a EU defence sub strategy
Design a 'top down' Capability Development Plan
Give birth to decisive defence programmes
Co-finance operational demonstrators with Member States
Merge EDA, OCCAR and LOI
Consider the possibility of acquiring dual use assets
Design governance around the programme, not the programme around existing bodies
Improve capacity to confront capability needs and technological solutions
Improve coordination between the CDP and research programmes

1 Introduction

Why does defence research matter?

When a State is looking for the best way to defend itself, it may come up with many different answers.

In times not so remote, the common response was to gather as large an army as possible. Indeed, numbers can make a difference, as experience from the Napoleonic wars to World War I has demonstrated. However, since ancient times, the world has also witnessed outnumbered groups of warriors capable to defeat larger armies because of their armaments, their logistics but also their determination, their readiness, their capacity to unite in 'Leagues' such as in Delos, the cleverness of their strategists, using 'stratagems' of all sorts, from Achilles's horse to what we call nowadays 'special operations'.

Among the numerous ways to *offset* a numerical disadvantage, the role of *technological supremacy* is crucial. This has been so since the Middle Ages with the introduction of artillery and firearms, and remains true today. Superiority in military capabilities often – even if not always – brings *decisive operational advantage*. The search for technologically superior weapons during World War II, and even more after, has dramatically changed the way to conduct war. Due to their *technological edge*, the U.S. and its allies have been able to defeat uncompromising enemies, such as Japan, and to deter strategic challengers, such as the Soviet Union.

Superiority in military capabilities is therefore considered as *the* best way to keep foes at bay and to protect allies. This consideration, borne of experience, is precisely what underpins the 'Defense Innovation Initiative', also known as the 'third U.S. Offset Strategy' (3OS), announced by the U.S. in 2014.

If we Europeans really believe that '*Defence matters*', as the first words of the European Council conclusions in December 2013 state, '*now more than ever*', as the new Chief executive of the European Agency stated in 2015 then, for sure, *defence research matters even more*.

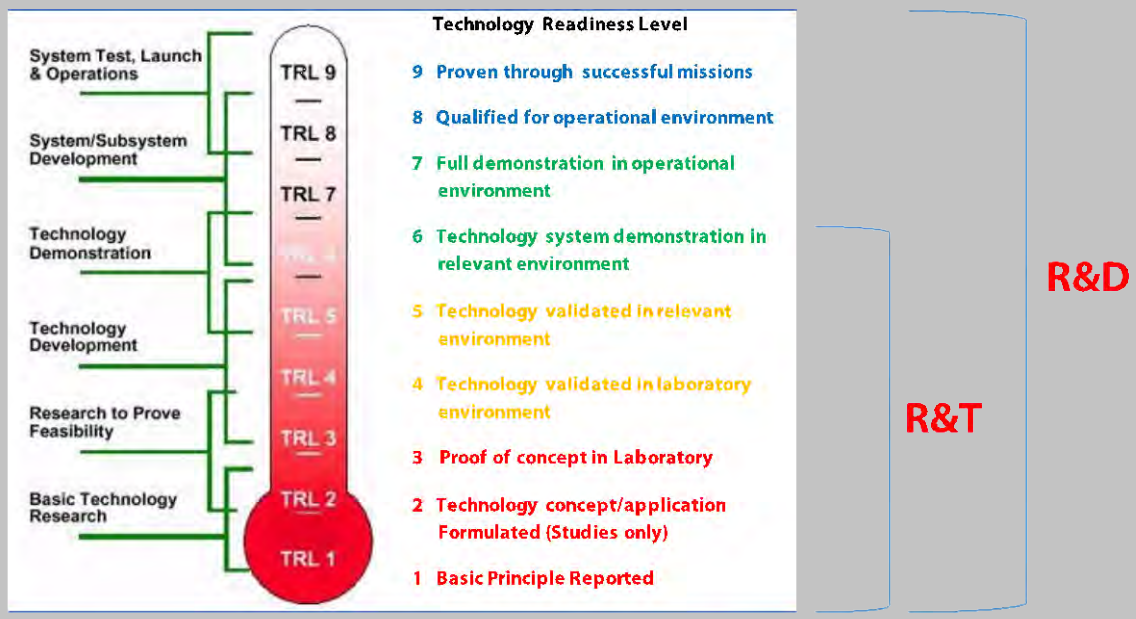
Defence research matters because it is the crucible in which defence capabilities are forged. It matters because it is a key that enable us to keep the doors open towards strategic autonomy. It matters because in an ever changing world, it is the long-term investment we need to keep alive our freedom of action, to defend our values and to preserve our liberties.

This is what is at stake.

DEFINITIONS OF R&D, R&T AND DUAL USE

Research and Development (R&D) has been well established across different industries since the early 20th century. Definitions vary from business to business and nation to nation, but the primary idea is to capture the creation of new knowledge to be used in products and processes.

The R&D process is often structured to align with technology readiness levels (TRL), which were originally developed by NASA in the 1980s and are intended to measure the maturity of evolving technologies (devices, materials, components, software, work processes etc.) during development and sometimes during early operation. Again, different industries and nations have specified the levels according their specificities, but the general idea is well illustrated by this description:



Source: European Defence Agency definitions used for R&T and R&D expenditure

Dual-use technologies[1] refer to any technology which can satisfy more than one goal in one given time. Nevertheless, the term has been most widely used to describe technologies developed for military purpose that have also had great impact on civilian applications (internet; Global Positioning System (GPS); microwave etc.). Spill-over can also be described the other way around, for example the European Commission Trade export controls regime defines dual-use as 'goods, software and technology normally used for civilian purposes but which may have military applications, or may contribute to the proliferation of Weapons of Mass Destruction'.

In the following report the words 'defence Science & Technology', 'defence research' and 'defence R&D' must be interpreted as equivalent whilst 'defence R&T' might be named also as 'defence fundamental science'. 'S&T' is more and more in use within NATO and the main Armaments agencies as the French DGA.

[1] This definitions is extracted from the 'Session européenne des responsables d'armement' – 26th report – Institut des Hautes études de défense nationale ' p 145 http://www.ihedn.fr/userfiles/file/formations/Rapport_SERA26%2323.pdf

2 The way security and defence research has been handled in Europe for the last fifteen years

2.1 Defence research

2.1.1 Many structures have been set in order to improve collaboration

The idea of pooling defence research efforts and programmes at a European level is not new. Several tools have been forged to enable European States to cooperate in a more *permanent* and *structured* way than mere ad hoc military programmes.

(a) In **1976**, the Defence ministers of the then 13 European NATO nations, except Iceland, established a forum for armaments cooperation, the **Independent European Programme Group** (**IEPG**) with the aim of creating a European Armaments Agency. In **1993** the **Western European Armaments Group (WEAG)** was established. Its task, inter alia, was to manage executive functions in research and technology projects, to harmonise requirements and to open up national defence markets to cross-border cooperation. In 1996 the WEAG was incorporated in the Western European Union Organisation (WEAO), the scope of which was enlarged to six new European nations in 2000. Duplicating in large remits with the European Defence Agency, established in 2004, **the WEAO was closed in May 2005**.

(b) In **1996** the Defence Ministers of France, Germany, Italy and the United Kingdom established **l'Organisme Conjoint de Coopération en matière d'armement (OCCAR)**. Legal status was completed in January **2001** and the 'Organisme', being endowed with legal personality, became an 'Organisation'.

> Article 8 of the Convention on the establishment of OCCAR provides that:
>
> 'OCCAR shall fulfil the following tasks and such other functions as the Member States may assign to it:
>
> (a) management of current and future cooperative programmes, which may include configuration control and in-service support, as well as research activities;
>
> (…)
>
> (d) coordination and planning of joint research activities as well as, in cooperation with appropriate military staffs, studies of technical solutions to meet future operational requirements
>
> (e) coordination of national decisions concerning the common industrial base and common technologies;
>
> f) coordination of both capital investments and the use of test facilities.'

Belgium and Spain joined the organisation respectively in 2003 and 2005. Other States can participate in OCCAR programmes without being members, as Turkey, the Netherlands, Luxembourg, Finland, Sweden and Poland do.

(c) To try and address the fragmentation of the European defence industry, a '**Letter of Intent' (LoI) was signed in July 1998** by the defence ministers of France, Germany, Italy, Spain, Sweden and the UK. The 'LoI Framework Agreement Treaty' formally endorsed this letter in July 2000. It aimed to create 'the political and legal framework necessary to facilitate industrial restructuring in order to promote a more competitive and robust European Defence Technological and Industrial Base (EDTIB) in the global defence market.' It intended to address this objective through work in six broad areas: security of supply, transfer/export procedures, security of information, research, treatment of technical information and harmonisation of military requirements. Each of these areas was assigned a sub-committee tasked with

the establishment of common policies under the guidance of a strategic level Executive Committee (ExCo). Sub-committee 4 was specifically in charge of Research.

(d) The **European Defence Agency** (**EDA**) legal status is derived from two sources of Law.

The first one is the Lisbon Treaty (Treaty on European Union – TEU), taking over, on this regard, the wording agreed in the draft Treaty Establishing a Constitution for Europe (TECE), endorsed in its broad lines at the Thessaloniki European Council of June 2003**.** The Treaty includes three references to EDA:

> Article 42. 3. states that: 'Member States shall undertake progressively to improve their military capabilities. The Agency in the field of defence capabilities development, research, acquisition and armaments (hereinafter referred to as 'the European Defence Agency') shall identify operational requirements, shall promote measures to satisfy those requirements, shall contribute to identifying and, where appropriate, implementing any measure needed to strengthen the industrial and technological base of the defence sector, shall participate in defining a European capabilities and armaments policy, and shall assist the Council in evaluating the improvement of military capabilities.'
>
> Article 45 assigns to the Agency, 'subject to the authority of the Council' the task, inter alia, to '(d) support defence technology research, and coordinate and plan joint research activities and the study of technical solutions meeting future operational needs' (…)
>
> Article 3 of Protocol number 10 on Permanent Structured Cooperation states that: 'The European Defence Agency shall contribute to the regular assessment of participating Member States' contributions with regard to capabilities (…).

The second source is the July 2004 Council Joint Action 2004/551/CFSP creating EDA as a Common Foreign and Security Policy (CFSP) body reporting to the Council of the European Union. EDA was therefore created long before the entry into force of the Lisbon Treaty (1st December 2009), as the Thessaloniki European Council had tasked the appropriate bodies of the Council 'to undertake the necessary actions towards creating, in the course of 2004, an intergovernmental Agency 'in the field of defence capabilities development, research, acquisition and armaments'.

Council Decision 2015/1835 of 12 October 2015, amending the 2004 Joint Action, goes into further details as regards the roles of EDA. In particular, it specifies that EDA shall: (…) (a) contribute to identifying Member States' military capability objectives and evaluating observance of the capability commitments provided by the Member States; (…) (b) promote the harmonisation of operational needs and the adoption of effective, compatible procurement methods (…); (c) propose multilateral projects to fulfil the objectives in terms of military capabilities (…); '(d) support defence technology research, and coordinate and plan joint research activities and the study of technical solutions meeting future operational needs, in particular by:

> '(d) support defence technology research, and coordinate and plan joint research activities and the study of technical solutions meeting future operational needs, in particular by:
>
> i. promoting, in liaison with the Union's research activities where appropriate, research aimed at fulfilling future security and defence capability requirements and thereby strengthening Europe's industrial and technological potential in this domain;
>
> ii. promoting more effectively targeted joint defence R&T;
>
> iii. catalysing defence R&T through studies and projects;
>
> iv. managing defence R&T contracts;
>
> v. working in liaison with the Commission to maximise complementarity and synergy between defence and civil or security-related research programmes.'

The Agency is also in charge of (e) strengthening the industrial technological base and, possibly (f) supporting permanent structured cooperation. Currently, 27 countries – all EU Member States except Denmark – participate in EDA.

(e) The European Space Agency (ESA) was established in **1975**. Although its purpose is 'to provide for, and to promote, for exclusively peaceful purposes', the links between space and defence are obvious. As a matter of fact, the cooperation between ESA and EDA is important on key policy topics relating to space and security like governmental satellite communications, navigation, or intelligence, surveillance and reconnaissance (ISR). In June 2015 an Arrangement was signed between the two agencies to provide a structured relationship and a mutually beneficial cooperation through the coordination of their respective activities. The cooperation will in particular aim at exploring the added value and contribution of space assets to the development of European capabilities in the area of crisis management and the Common Security and Defence Policy. Future capability packages are to be defined, as Governmental Satcoms (Advanced Research in Telecommunications Systems programme), DeSIRE (demonstration of satellites enabling the insertion of RPAS {Remotely Piloted Aircraft System in Europe} and of course cyber-defence which will need to incorporate the space segment in capabilities development.

(f) It is also important to mention the different NATO-related organisations playing a role in pooling defence research efforts and procurement. Formed in 1998, the **NATO Research and Technology Organisation** (**NRTO)** promotes and conducts co-operative scientific research and exchange of technical information amongst 26 NATO nations and 38 NATO partners. The NRTO was folded in June 2012 and the new **NATO Science and Technology Organisation (NSTO)** picked up its legacy. The **NATO Support and Procurement Agency** (**NSPA)** is NATO's main logistics and procurement agency and it is the executive branch of the **NATO Support and Procurement Organisation (NSPO).** The NSPA was created from the expansion, in April 2015, of the role of the preceding NATO Support Agency (NSA), to include all aspects of systems procurement from initial acquisition throughout sustainment. NATO also creates agencies to meet *ad hoc* needs, such as NAHEMA, formed in 1992 to manage the NH-90 Helicopter programme.

2.1.2 These structures have produced mixed results

The political, industrial and military landscape has changed significantly since those institutions were created. The European Commission has taken an ever-closer interest in defence industrial and market issues. The defence industrial base has also become increasingly fragile with the reduction of military budgets. Against this backdrop, all institutions have evolved significantly.

(a) First of all, with the birth of EDA, and taking account of OCCAR's activities, **the LoI reoriented its work** to assume more and more the role of a 'think tank' role a robust lobbying force to support or oppose Commission action[2]. With regard to defence research, after the signature of an Implementing Arrangement in 2003, the LoI's sub-committee 4 was disbanded and the Group of Research Directors (GRD) was established with the aim of 'fostering co-ordination of joint research activities, increasing the advanced knowledge base and encouraging technological development and innovation'. In addition, national representatives influenced and initiated the EUROPA MoU (memorandum of understanding), which enshrines the principle of information exchange for R&T co-operation. The GRD continues to be an important body to improve European co-operation under the EUROPA framework, although it has not been possible for nations to agree on a Code of Conduct with transnational defence companies on closer R&T co-operation. It also seems that the GRD works closely with EDA R&T experts. This close co-operation

[2] Gov.UK Defence and armed forces guidance – Letter of Intent: restructuring the European Defence Industry https://www.gov.uk/guidance/letter-of-intent-restructuring-the-european-defence-industry

includes, for example, a dialogue on the improvement of EDA's R&T processes, new approaches to R&T co-operation, the analysis of the impact of the Lisbon Treaty and identification of future R&T priorities. The GRD also sponsors sub-groups on disruptive technologies and environmental R&T co-operation. It claims to have played an active role in guiding/supporting the European Commission (and EDA) in its work to develop a preparatory action on CSDP-related research.

(b) Without any doubt, **OCCAR has been a successful organisation**. It handles a portfolio of thirteen European procurement programmes (see annex 5), for a total of EUR 50 billion, amongst them five major structuring programmes: the A400M Transport aircraft (EUR 21 billion), launched in 2003, the BOXER multi-role armoured vehicle (EUR 2,1 billion), launched in 1999, the Multi Missions Frigates FREMM (EUR 10,5 billion) launched in 2006, the Tiger Combat Helicopter (EUR 7,7 billion) launched in 1988, and the FSAF-PAAMS air defence systems (EUR 3,8 billion) launched in 2003. OCCAR's operational budget is EUR 3.1 billion in 2016 and will be at maximum EUR 4.6 billion in 2017. OCCAR's creation was meant to solve the major problems that had damaged previous cooperative programmes[3]:

- The highly corrosive 'work-share equals cost share', or 'Juste Retour' approach, which had to be abandoned in favour of genuine competition to stimulate the strengthening and rationalisation of the European industrial base, and to get the best capability for money, and its replacement by the principle of 'Global Balance', whereby data is collected on national work-share only in hindsight, across all programmes over many years.
- The selection of staff based upon competition and not nationality, to ensure the highest quality. Indeed, OCCAR is able to manage its EUR 3.5 billion annual turnover with a team of just 230 people, and an operating cost overhead of 1,3 %.
- The creation of a cooperative structure that allows non-OCCAR states to participate in the programmes on equal terms, as Turkey's did in the A400M programme.

OCCAR has significantly grown over the last two years, with the integration of three new programmes in 2015 ('Pattugliatori Polivalenti d'Altura', 'Logistic Support Ship' and 'Maritime Mine Counter Measures') and the integration in progress of another two programmes, one of them being the European MALE (Medium Altitude Long Endurance) RPAS Programme with strategic importance for the European Defence Capabilities (see annex 5).

(c) The role of ESA in the field of defence must be seen as a mixed success with regard to military applications. As Jean-Jacques Dordain, the former Director General of ESA said in an interview in February 2014: 'Finally, as concerns military space activities, this represents so far the largest deficit of Europe as compared to other space powers. Space in Europe has been started as a civilian activity and military space activities are limited in size and scope so far. However, there is an increasing number of programmes that, even though civilian may have military or security-related users – such as Galileo or Copernicus. The ESA itself is not a civilian agency. It is an agency for peaceful purposes and may have programmes with a security component. If and when Europe needs space as an enabling tool for its security and defence policy, ESA will be prepared to develop the required programmes.'[4]

(d) With regards to EDA, **results against expectations are disappointing.** Despite a great deal of initiatives, a tremendous amount of work, sophisticated codes of conduct and strategies as well as good

[3] List below drawn from a speech by Tim Rowntree, OCCAR Director, UK Defence Forum, 5 February 2014 https://www.eda.europa.eu/info-hub/opinion/2014/02/19/speech-tim-rowntree-occar-director-uk-defence-forum-on-5-february-2014

[4] ESA website – Jean-Jacques Dordain interview : http://www.esa.int/About_Us/Jean-Jacques_Dordain/The_European_Space_Agency_director_general_in_interview

relations with other bodies involved in EU defence research, not to mention the broad access granted to industry, EDA has not lived up to expectations raised by its original denomination: 'the Agency in the field of defence capabilities development, research, acquisition and armaments'. The best proof of this is that the Future (European) Combat Aircraft System (FCAS) is managed on a national basis (France-UK), just like the future (European) Remotely Piloted Aircraft System (RPAS) (France-Germany-Italy). Several recent studies[5] have shown how EDA has been gradually marginalised. It important to understand the reasons that underpin this situation.

First of all, in the minds of its initial French and German advocates, EDA was part of a larger plan, which aimed at creating a '*Defence Euro-zone*'[6], more precisely a 'Defence and Security European Union' (UESD)[7], clearly inspired by the Monetary and Economic Union[8]. At the root of this project was the idea that quantitative (and in the case of UESD also qualitative) *convergence criteria*, appreciated by an independent body, would lead gradually to the desired end state, *i.e.* military integration and a common defence buttressed by a common Army. This was the very raison d'être of the 'Permanent Structured Cooperation' (PESCO). By the time the Treaty Establishing a Constitution for Europe had become the Lisbon Treaty and entered into force, however, the leaders who had originated this idea had disappeared from the stage and their successors had a totally different view of what European Defence should be. Since then, the concept of Defence-Euro-zone has slipped into oblivion and EDA without PESCO has become a sort of European Central Bank without economic convergence criteria[9].

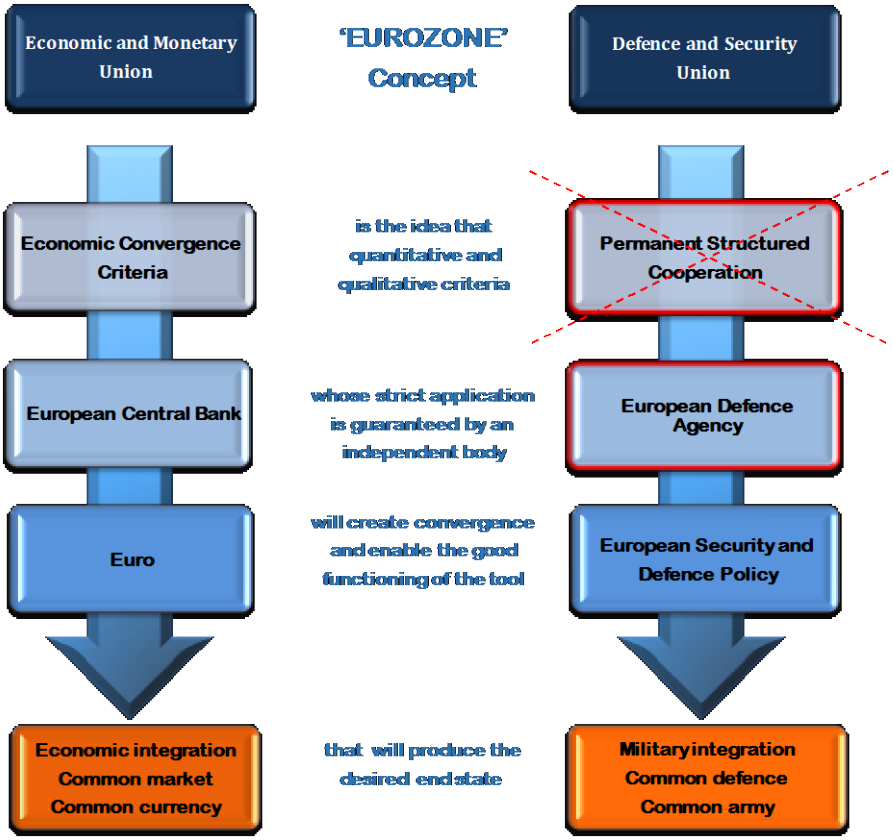
[5] Möling C. 'State of play of the implementation of EDA's pooling and sharing initiatives and its impact on the European defence industry' Study by Christian for the European Parliament – Directorate for external policies – June 2015 http://www.europarl.europa.eu/thinktank/en/document.html?reference=EXPO_STU(2015)534988 ; Karampekios N. and Oikonomou I. 'The European Defence Agency – Arming Europe' editions, 2015.

[6] Final report of working group VIII – Defence to the European Convention December 2002 item n° 54 http://register.consilium.europa.eu/doc/srv?l=EN&f=CV%20461%202002%20INIT

[7] Contribution by Mr Dominique de Villepin and Mr Joschka Fischer, members of the Convention, presenting joint Franco-German proposals for the European Convention in the field of European security and defence policy http://european-convention.europa.eu/pdf/reg/en/02/cv00/cv00422.en02.pdf

[8] Schoutheete (de) P., 'La cohérence par la défense – Une autre lecture de la PESD', *Chaillot Paper* no. 71, EUISS, Paris, October 2004 p.36

[9] Mauro F. : 'The Permanent Structured Cooperation: 'the Sleeping Beauty of the European Defence' - GRIP – May 2015 http://www.grip.org/en/node/1751



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Between 2003 and 2004, whilst the ratification of the TECE was still under process, there has been a sullen opposition between the supporters of a strong Agency with substantial resources playing a major role for in Armament, *i.e.* the inception and implementation of military programs on the pattern of the French 'Délégation Générale pour l'Armement' (DGA) (which at the time employed around 12 000 persons) and the supporters of a body limited to providing advice and coordinating the programmes of the Member States[10]. The supporters of the second vision won the intellectual dispute at the very birth of the Agency.

Second, the Agency's missions have gradually lost clarity and their respective degree of importance and priority has become blurred. However, the order of the tasks is fundamental, as Nick Witney, at the time Director General within the British Ministry of Defence, rightly stated before the House of Lords[11]. Initially a first directorate called 'capacity' was supposed to merge all the national needs into one. A second directorate, 'Armaments', was tasked to transform those needs into military programmes. A third directorate, 'Research and Technology', was supposed to coordinate research activities, whether they would be carried out by the Agency itself, by the Member States or as part of Commission programmes (the framework programmes for Research and Technological Development and the then future programme for Security). A fourth directorate was in charge of dealing with the challenging task of improving regulatory aspects in view of creating a European market of defence equipment[12].

However, progressively all Agency's missions have been stove piped with no obvious order of processing. New missions, like 'access EU funding opportunities', 'fostering SMEs' or 'taking care of energy problems',

[10] Hearing of Mr. Jacques Bayet, Director Corporate Services at the EDA, 13 April 2005, French Senate – Délégation pour l'Union européenne http://www.senat.fr/europe/r13042005.html
[11] House of Lords - Transcript of oral evidence taken by Sub-Committee C 9 October 2003 item 3 http://www.parliament.the-stationery-office.co.uk/pa/ld200203/ldselect/ldeucom/169/16914.htm
[12] id.

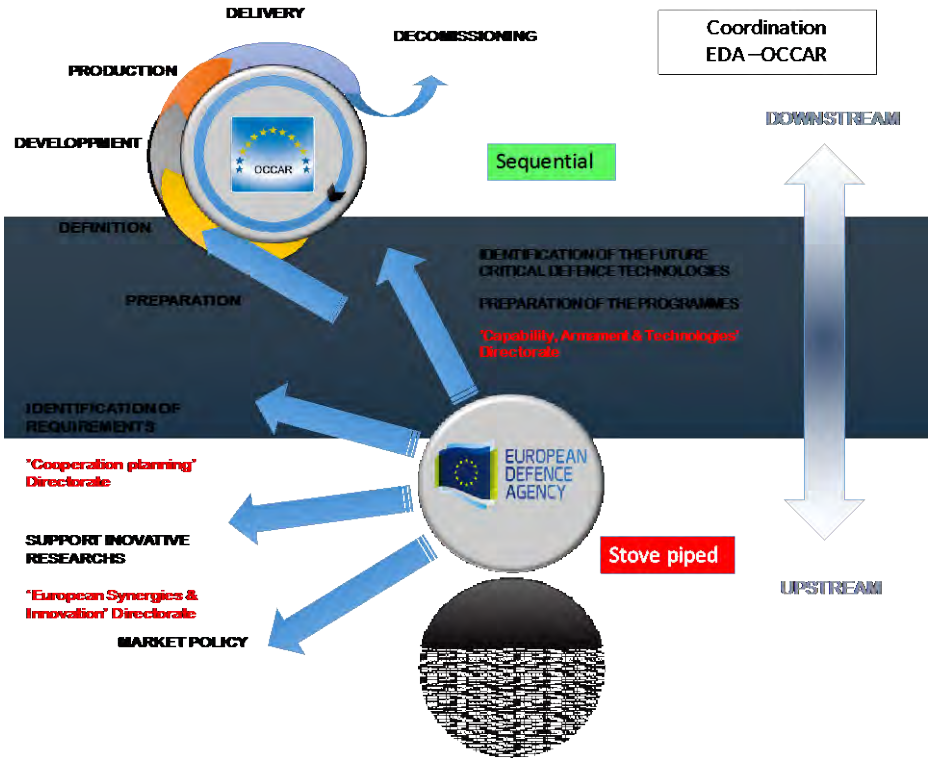
have appeared and been over-emphasised. The fourth mission, related to the defence market, ended up in a competition with the Commission. Fundamentally, even the primary mission of the Agency, which was to identify the needs in military capabilities, has not been fulfilled correctly because it supposes that the Member States 'play the game' and give a fair view of their capabilities plans for the future. Reality is far from this. A 'capability development plan' mechanism has been set up, with a first edition in 2008 and a second in 2014. However, as Sven Biscop and Jo Coelmont put it: 'this elaborate process has generated more paper than capabilities' [13]. Member States bear full responsibility for this situation. They are not motivated in investing in capabilities at a European level only because it has been identified as a priority shortfall but they prefer to keep their diminishing resources to fulfil their national requirements. *Ad hoc* programmes and projects funded by Member States through EDA, which represent a total investment of approximately EUR 500 million since EDA's creation, further testify to this lukewarm interest, as they have delivered few visible results for defence capabilities and shown poor leverage effect in stimulating international cooperation.

Thirdly, the rules of governance allowed the decision-making body of the Agency, *ie* the 'Steering board', to take decision by qualified majority [Statutes article 9. 2] with the exception of a so called 'emergency break' that allowed a Member State to oppose the decision. To our knowledge, the QMV has never been utilised and unanimity became the rule. Moreover, if Article 22 of the decision on the EDA adopted in October 2015 indicates that contributions from the general budget of the Union may be made to the *ad hoc* budgets established for *ad hoc* projects or programmes of EDA, the Council, further to the opposition of an important Member State, did not agree on an amendment that would have recognised a Commission voting right within the EDA Steering Group which takes all decisions, including financial ones, concerning *ad hoc* programmes and projects[14]. EDA is therefore made to respond to political imperatives, whereas it is meant to be a technical advisory body. As a result, the organisation suffers a kind of '*schizophrenia*', in the words of a close observer.

Fourth, there was a clear intent in the initial design of EDA that it would gradually weave all other bodies involved in defence research and procurement. As the Final report of the Defence group in the European Convention put it: 'the Agency would incorporate, with a European label, closer forms of cooperation which already exist in the armaments field between certain Member States (OCCAR, LoI)' [15]. But sight of this objective has been totally lost. Furthermore, in order to avoid conflicts, EDA has naturally oriented its activities 'upstream' the strategic path leading from capability requirement to procurement towards certification and standardisation, while OCCAR is specialising 'downstream' on definition, development, production and 'in-service' support.

Finally, there has been a scissors effect between the means given to the EDA and the tasks assigned to it. With only 125 personnel, a budget blocked at EUR 30.5 million for six years and more tasks assigned to it at every Council, the Agency is facing an overstretch of its capacities. Deduction made of its operational costs, the Agency can spend on research a mere EUR 6 million per year, out of proportion with the needs of European defence.

[13] Biscop S. and Coelmont. J. 'Europe, Strategy and Armed Forces' Routledge 2012 p. 122
[14] Europe Diplomacy & Defence No. 795 and No. 835
[15] Ibid. Final report item n° 64



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2.1.3 Cooperation in defence research has sharply declined

Although EDA Member States have seen an increase of their GDPs between 2006 and 2013, they have reduced their defence expenditure[16] by 15 % over the period. The average level of this expenditure represents a mere 1.45 % of GDP.

Nevertheless, procurement and R&D has been reduced from EUR 42.3 billion in 2006 to EUR 37.5 billion in 2013, less than personnel-related expenditure. In 2007, EDA Member States agreed on a set of four collective benchmarks for investment, with no obligation in terms of timeline or adoption of these benchmarks as national targets. The first of these benchmarks is that investment-related expenditure should represent at least 20 % of total defence expenditure. Surprisingly, this first benchmark has been respected. The second benchmark, agreed in 2007, is that R&T expenditure should represent 2 % of total defence expenditure. This has not been the case. R&T expenditure represent a mere 1,1 % of defence budgets. Between 2006 and 2013 EDA countries' R&D decreased by a staggering 29.2 % and R&T by 27.7 %, i.e. at twice the rate of the decrease in defence budgets A demonstrated by the table below, *R&D is the main target of budget cuts*.

[16] The figures in the tables below come from the EDA Data portal - 15 January 2013. In order to ensure a real comparison, only the constant prices inflated at the 2013 economic conditions are displayed, using EDA's own inflation coefficients. http://issuu.com/europeandefenceagency/docs/eda_defence_data_2013_web/1?e=4763412/12106343

EUROPEAN DEFENCE EXPENDITURE in billion euros constant prices 2013	2006	2007	2008	2009	2010	2011	2012	2013	Variation in value	Variation in %	Bench-mark
DEFENCE EXPENDITURE EDA COUNTRIES	218	216	212	208	202	196	190	186	- 32	- 14,7 %	
as a % of GDP	1,77	1,69	1,64	1,68	1,60	1,53	1,49	1,45			
Investment (equipment and R&D)	42,3	44,3	44,3	43,8	44,8	39,6	39,3	37,5	- 4,8	- 11,2 %	
as a % of defence expenditure	19,4	20,5	20,9	21,0	22,2	20,2	20,7	20,2			20,0 %
equipment	31,6	34,1	35,1	34,8	35,9	31,6	31,7	30,0	- 1,7	- 5,3 %	
as % of defence investment	74,9	76,9	79,2	79,5	80,0	79,7	80,8	79,9			
R&D	10,6	10,2	9,2	9,0	8,9	8,0	7,5	7,5	- 3,1	- 29,2 %	
as a % of defence investment	25,2	23,1	20,8	20,5	20,0	20,2	19,2	20,1			
as a % of defence expenditure	4,9	4,7	4,4	4,3	4,4	4,1	4,0	4,0			
R&T (subset of R&D)	2,9	2,7	2,6	2,4	2,2	2,2	2,0	2,1	- 0,8	- 27,7 %	
% of defence investment	6,8	6,1	5,9	5,5	4,8	5,6	5,2	5,6			
as a % of defence expenditure	1,3	1,2	1,2	1,2	1,1	1,1	1,1	1,1			2,0 %

Authors' own production – FM 2016 - from EDA restated figures

With regard to European collaboration, the picture is even more gloomy. Expenditure made on collaborative equipment has decreased from EUR 6.6 billion down to EUR 4.5 billion, which represents a decrease of 32 %. Collaborative projects represent only 15 % of total equipment expenditure, whereas the agreed benchmark was 35 %.

Finally, it is no surprise that European collaborative R&T expenditure has suffered most, coming down from a modest EUR 280 million to a mere EUR 168 million. This represents a disconcerting 8 % of R&T expenditure, instead of the agreed benchmark of 20 %.

EUROPEAN COLLABORATION in billion euros constant prices 2013	2006	2007	2008	2009	2010	2011	2012	2013	Variation in value	Variation in %	Bench-mark
on defence equipment	6,6	6,5	7,5	7,6	7,6	7,6	5,8	4,5	- 2,1	- 31,9 %	
as a % of defence investment	20,9	19,0	21,3	22,0	21,2	24,0	18,2	15,0			35,0 %
on defence R&T	0,28	0,35	0,43	0,31	0,26	0,27	0,14	0,17	- 0,1	- 39,1 %	
as a % of defence R&T	9,5	13,1	16,6	12,8	11,8	12,1	6,8	8,0			20,0 %

Authors' own production – FM 2016 - from EDA restated figures

Despite the financial crisis and the cuts in defence budgets the Member States withdraw on their national basis instead of pooling their decreasing means. European Collaborative Defence R&T today falls well below the level targeted at the end of the 1980s[17].

[17] The EUCLID Programme (collaborative defence R&D in the Independent European Programme Group - IEPG) was approved at the IEPG Ministerial in June 1989. The initial budget for 1990 was set at ECU 120 million (calculated as 2% of the then defence R&D budget within the IEPG nations), with a yearly increase target to reach eventually ECU 500 million, which would be around EUR 762 million nowadays.

2.2 Security research

2.2.1 How it all began

The 9-11 terrorist attack triggered plans worldwide to initiate research programmes for the development of technologies to enhance citizens' security and to counter terrorist threats.

In 2003, the '*European **Security Strategy',*** better known as the 'Solana Strategy', analysed for the first time the EU's security environment, identified key security challenges, amongst them terrorism, organised crime, natural disasters and disease.

In February 2004, the European Research Commissioner, Philippe Busquin, presented a Communication on Security Research to the European Parliament. The same year a '*Group of Personalities on Security Research (GoP)*' published its cornerstone document: '*Research for a Secure Europe*'[18]. In this document the GoP paved the way for a European Security Research Programme with recommendations about the programmatic focus, possible procedures and a suggestion for a necessary budget, starting around EUR 1 billion.

Against this backdrop, the Commission launched a ***Preparatory Action*** entitled 'Enhancement of the European industrial potential in the field of security research 2004-2006'. The planned budget was €65 million and it was strongly supported by the GoP. Finally, the GoP recommended to establish a '*Security Research Advisory Board (ESRAB)***'** in order to draw strategic lines of action to prepare the research agenda of a European Security Research Programme (ESRP) as well as to advise on the principles and mechanisms for its implementation.

The next strategic document *'Meeting the challenge: the European Security Research Agenda'*[19] was produced by ESRAB. The document proposed, in essence, a comprehensive Security Research programme in the context of the 7th Framework Programme (FP7) 2007-2013. As the overarching missions defined by ESRAB are still valid until today, it is worth recalling them:

- Border security
- Protection against terrorism and organized crime
- Critical infrastructure protection
- Restoring security in case of crisis

Based on the suggestions and recommendations developed by the GoP, the Preparatory Action and ESRAB, the Commission, as well as several national governments, initiated security research programmes in 2007.

This being said, security research amounted to a modest EUR 1.4 billion of the 50 billion of the FP7 2007-2013. It was expected to generate new knowledge and promote the application of new technologies in the field of civil security. The programme covered the following areas:

- Security of citizens (technology solutions for civil protection, bio-security, protection against crime and terrorism)
- Security of infrastructures and utilities (examining and securing infrastructures in areas such as ICT, transport, energy and services in the financial and administrative domain)

[18] Research for a Secure Europe, Report of the Group of Personalities in the field of security Research; Office for Official Publications of the European Communities, 2004;
[19] Office for Official Publications of the European Communities, 2006, ISBN 92-79-01709-8

- Intelligent surveillance and border security (technologies, equipment, tools and methods for protecting Europe's border controls such as land and coastal borders)
- Restoring security and safety in case of crisis (technologies and communication, co-ordination in support for civil, humanitarian and rescue tasks)
- Security systems integration, interconnectivity and interoperability (information gathering for civil security, protection of confidentiality and traceability of transactions)
- Security and society (acceptance of security solutions, socio-economic, political and cultural aspects of security, ethics and values, social environment and perceptions of security)

There was a clear determination to limit the research areas to 'civil security' and to exclude defence related research.

2.2.2 European & national security research programmes

Parallel to the European security research programme, several Member States initiated their own programmes in the field, focused on specific national security tasks. Germany and France in particular started full-fledged programmes on civil security, parallel to the European effort. Germany invested roughly EUR 250 million in the 2007-2011 timeframe.

Initially, fears of a possible duplication, of an uncoordinated process or double funding were brought up and discussed at length. In response, the German ministry in charge (BMBF) and 'l'Agence Nationale de Recherche' developed an effective strategy in coordination with the Commission, to harmonise national and European programmes.

The national programmes made it possible to establish a national research community, which did not exist before, and they brought their know-how in the European context. The figure[20] above gives an

[20] Acatech Diskutiert Sicherheitsforschung Chancen und Perspektiven Petra Winzer, Eckehard Schnieder, Friedrich-Wilhelm Bach (Hrsg.) Acatech- DeutscheAkademie der Technikwissenschaften, Springer-Verlag Berlin Heidelberg 2010 http://www.acatech.de/de/publikationen/berichte-und-dokumentationen/acatech/detail/artikel/sicherheitsforschung-chancen-und-perspektiven.html p. 16

overview of the main topics in the corresponding European and national research programmes in the time sequence of the research tenders. Obviously there were topics of common European and national interest (critical infrastructure protection), but also areas of different interests (European Border Security versus Security of Supply Chains).

The approach applied for security research since its beginning in 2007 could serve as a pattern for a future European defence research programme. This would mean using the technological know-how and the strategies of national programmes as a basis for a EU-funded research programme, concentrating on EU-specific topics.

Horizon 2020 is structured around three complementary and interlinked priorities: (1) Excellent Science; (2) Industrial Leadership; (3) Societal Challenges.

Priority (3), Societal challenges has the following seven focus areas:

1. health, demographic change and wellbeing;
2. food security, sustainable agriculture, marine and maritime research and the bio-economy;
3. secure, clean and efficient energy;
4. smart, green and integrated transport;
5. climate action, resource efficiency and raw materials;
6. Europe in a changing world - Inclusive, innovative and reflective societies
7. **Secure societies– Protecting freedom and security of Europe and its citizens**

The objective of 'Secure Societies' is to support EU policies for internal and external security and to ensure cyber security, trust and privacy in the Digital Single Market.

Specific objectives are to:

- prevent and combat serious and organized crime;
- increase the security of infrastructures and utilities;
- fight crime and terrorism;
- manage crises and disasters;
- integrate civilian and military capabilities;
- increase trust in digital societies and tackle cyber security;
- coordinate and structure the research security area in Europe.

Horizon 2020 clearly demonstrates that security research is a third level priority only. This definitely represents a significant underestimation of the needs, in the light of current terrorist threats, the magnitude of the refugee crisis, the rise in financial crime, climate change-induced disasters, etc.

3 Current political and institutional initiatives aimed at enhancing support for defence research

3.1 From rhetoric to action: the political build up between 2013-2015

3.1.1 The Commission communication of July 2013

The first ever-European political document to emphasize the importance of defence research was the communication of the Commission of 5 December 2007 called 'A strategy for a stronger and more competitive European defence industry'[21]. However, the first document to call for a concrete action was the communication of the Commission of 24 July 2013 named 'Towards a more competitive and efficient defence and security sector'[22]. Action 4-2 of this Communication provides that: 'The Commission will consider the possibility to support CSDP-related Research, such as through a Preparatory Action. The focus would be on those areas where EU defence capabilities would be most needed, seeking synergies with national research programmes where possible'.

This initiative was immediately welcomed by the European Parliament in a resolution adopted on 21 November 2013 which 'welcome(d) the Commission's intention to launch a preparatory action for EU-funded research in support of CSDP missions, and invite(d) the Commission to make a specific proposal as a precursor to such programmes early in the forthcoming multiannual financial framework'[23].

Preparing the December 2013 European Council on Security and Defence the 'Final Report' of the High Representative/Head of the EDA on the Common Security and Defence Policy stated that the 'way forward' should be to:

- '- *encourage Member States to commit to the necessary levels of investment in R&T* to support the capabilities of the future, and to do so increasingly through cooperation where this provides benefit. This could be further enhanced through joint research programmes with the European Commission through common funding with Member States; and/or Pre-commercial procurement and joint undertakings that leverage public-private funding.
- '- *endorse a comprehensive research strategy* to exploit synergies between national dual-use programmes and European research.
- '- *consider how to stimulate innovative funding solutions* for stimulating private funding in defence R&T.
- '- *launch a 'Critical Defence Technology' programme to fund Technology research for 2014-2020***,** that matches the Commission CSDP research[24].
- '- *support a Preparatory Action* from the Commission on CSDP-related Research, seeking synergies with national research programmes.'

[21] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52007DC0764&from=EN
[22] http://ec.europa.eu/internal_market/publicprocurement/docs/defence/130724_communication_en.pdf
[23] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2013-0514+0+DOC+XML+V0//EN
[24] http://eeas.europa.eu/statements/docs/2013/131015_02_en.pdf

3.1.2 The 2013 Council conclusions

In its conclusions of 25-26 November 2013, the Council of the EU provided that:

'35. *The Council encourages Member States to continue to invest in R&T in order to retain defence R&T expertise and contribute to innovation and competitiveness*. Recognizing the consequences of the trend to cut in defence R&T, the Council encourages the Member States, EDA and the European Commission to preserve and further develop identified critical defence technologies, increase collaborative investments, maximize synergies between national and EU instruments and monitor the development of critical defence technologies.

'36. *The Council calls for concrete actions to exploit the potential for synergies between civil and defence research*, notably: intensified cooperation between the European Commission, Member States and EDA in research programmes; *innovative solutions for stimulating private funding in R&T*; and proposals for relevant research topics which could be funded under a *Preparatory Action* from the European Commission on CSDP-related research, to be prepared together with Member States, EDA and EEAS. As a matter of priority, the Council encourages the European Commission and EDA to work on solutions with the Member States, industry and research institutions to set up an EU framework allowing and improving the mutual use of civilian and military research results for dual use applications, including results on the so called "key enabling technologies" stemming from Horizon 2020 and other civil focus programmes'[25].

In its 19-20 December 2013 conclusions the European Council:

'18 (…) ***invite(d) the Member States to increase investment in cooperative research programmes, in particular collaborative investments, and to maximise synergies between national and EU research***. Civilian and defence research reinforce each other, including in key enabling technologies and on energy efficiency technology. The European Council therefore welcomes the Commission's intention to evaluate *how the results under Horizon 2020 could also benefit defence and security industrial capabilities*. It invites the Commission and the European Defence Agency to work closely with Member States to develop proposals to stimulate further dual use research. *A Preparatory Action on CSDP-related research will be set up, while seeking synergies with national research programmes whenever possible*' [26].

The European Council also invited the High Representative and EDA to put forward an appropriate *policy framework on defence cooperation* by the end of 2014, in full coherence with existing NATO planning processes'.

3.1.3 The Commission 'roadmap' in June 2014

Building on the Council's decision, the report from the Commission on 24 June 2014 called '*a New Deal for European Defence*' [27] identified the lack of investment in research and innovation as a 'threat for the long term competitiveness of the European defence industry and Europe's defence capabilities' and expressed its intention to support CSDP-related research, in three ways:

1. *Dual-use research***:** 'the Commission will maximise synergies in both directions between the civil research of Horizon 2020 and the defence research co-ordinated by the EDA within the scope

[25] http://www.eeas.europa.eu/top_stories/pdf/20131126_council_conclusions_en.pdf
[26] http://www.europarl.europa.eu/meetdocs/2014_2019/documents/sede/dv/sede110914ecconclusionscsdp_/sede110914ecconclusionscsdp_en.pdf
[27] http://www.europarl.europa.eu/meetdocs/2014_2019/documents/sede/dv/sede110914dealeuropeandefence_/sede110914dealeuropeandefence_en.pdf

allowed by the rules of both. To this aim it will also examine possibilities of expanding the scope and status of the existing European Framework Co-operation agreement with the EDA. (…)'

2. ***Preparatory Action (PA)***: 'The purpose of a PA is to illustrate the value added of an EU contribution in new research areas – complementing the CSDP-related civilian research on-going under Horizon 2020. The PA will last for a maximum of three years. The total amount of funding will depend on the available budgetary resources at the time of adoption and will need to respect the ceilings in the EU Financial Regulation 1081/2010 for the PA. ***If successful, this PA would prepare the ground for a possible CSDP-related research scheme, which could be funded under the next multi-annual financial framework***. While this cannot substitute for national investment in defence R&D, it should promote synergies with national research efforts and encourage industrial co-operation. The scope of the PA will be defined in consultation with Member States, the European Parliament, EDA, EEAS and industry. A successful PA will need to recognise the specificities of defence-related research including: research areas and models, intellectual property rights, confidentiality of results, co-funding and rules of participation, the role of Member States, while ensuring attractiveness for industry participation. The question of governance will be a central issue.
3. In addition, the Commission intends to '*develop schemes for pre-commercial procurement,* which can be used, where appropriate, as a way of bridging the gap between research and the market'.

3.1.4 The policy framework for systematic and long term defence cooperation

Following the invitation of the European Council, at the end of 2014, the High Representative and the European Defence Agency put forward a policy framework to foster more systematic and long-term defence cooperation[28]. This 'Policy Framework' was adopted by Council of the EU on 18 November 2014.

This important document recognises that 'defence cooperation is underpinned by convergence of planning processes and exchanges of information at all levels'. It asks for more political will and a change of mind-set in order to ensure that opportunities to enhance cooperation will be seized. The Member States make the commitment to deepen defence cooperation in Europe as a way to develop, deploy and sustain future-oriented military capacities, which they may make available, 'on a national and voluntary basis, for national, multinational, CSDP, United Nations or NATO engagements'. Member States also declare their intention to 'make full use of the European Agency as a catalyst for cooperative programmes, as provided for in article 42 TEU' (although they would not increase its budget.

3.1.5 The European Council meeting on 25 and 26 June 2015

This Council had raised high expectations in the field of European defence, which were then considered disappointing, as no new significant initiative came through. Nevertheless, the Council[29] recalled the needs for *'the EU budget to ensure appropriate funding for the preparatory action on CSDP- related research, paving the way for a possible future defence research and technology programme'*.

[28] http://www.europarl.europa.eu/meetdocs/2014_2019/documents/sede/dv/sede031214defencecooperation_/sede031214defencecooperation_en.pdf

[29] http://www.consilium.europa.eu/en/meetings/european-council/2015/06/euco-conclusions-pdf/

3.2 The first concrete initiatives: European funding of defence research

3.2.1 The Horizon 2020 on 'dual use' research

EU security research can be analysed through the resources dedicated to the cluster "Secure societies – Protecting freedom and security of Europe and its citizens" in the 2016-2017 Work Programme of Horizon 2020[30].

A broad spectrum of the technologies and competences encompassed in the Programme can be subsumed as "dual use", amounting to a total around *EUR 164 million*. This includes: Critical Infrastructure Protection (2016 budget EUR 20 million), Security (2016 budget EUR 113.25 million) and Digital Security Focus Area (2016 budget EUR 29 million).

Examples drawn from the calls for proposals include:

- Prevention, detection, response and mitigation of the combination of physical and cyber threats to the critical infrastructure of Europe
- Integrated tools for response planning and scenario building
- Broadband communication systems
- Chemical, biological, radiological and nuclear (CBRN) cluster
- Detection techniques on explosives: Countering an explosive threat, across the timeline of a plot
- Risk-based screening at border crossing
- Through-foliage detection, including in the outermost regions of the EU
- Architectures and organizations, big data and data analytics for customs risk management of the international goods supply chain trade movements
- Data fusion for maritime security applications
- Border Security: autonomous systems and control systems
- Cyber Security for SMEs, local public administration and Individuals
- Economics of Cybersecurity
- EU Cooperation and International Dialogues in Cybersecurity and Privacy Research and Innovation
- Cryptography
- Addressing Advanced Cyber Security Threats and Threat Actors
- Privacy, Data Protection, Digital Identities

These are definitely no pure defence areas, but the technologies and competences needed to address them belong to the assets of defence-oriented SMEs and big defence industries.

This programme has to be seen as a chance for the defence industry. However, it remains a far cry from full-scale development programmes and production programmes hoped for by defence industrial companies.

[30] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-security_en.pdf

3.2.2 The Pilot Project on CSDP research

The Pilot Project (PP) on 'CSDP research' was voted during the autumn 2014[31], on the basis of an amendment brought by MEP Michael Gahler. It marks an important watershed since it was the first time that the word "military" appeared in the budget of the European Union. In accordance with the budgetary terms of reference, the Pilot Project will serve to test and assess certain governance aspects of the forthcoming preparatory action, in particular the capacity of EDA to act as an executive or implementing agency for implement research projects in the field of CSDP with EU funding on behalf of the EU on the basis of a Delegation Agreement between the Commission and the EDA.

The scope of funding remains modest with *EUR 1.5 million* for the fiscal years 2016 and 2017. Funding covers two projects: one 'high-risk, high-payoff research activity the outcome of which could potentially reshape future operations' and 'one research and development activity for certification against military and - if applicable - civilian requirements'. The implementation of the pilot project is under way. The Delegation Agreement was signed in November 2015 and calls for proposals through EDA are scheduled for February-March 2016.

3.2.3 The Preparatory Action for CDSP-related research

Following a similar strategy to the one employed for the aforementioned civil security research, Elżbieta Bieńkowska**,** Commissioner for Internal Market, Industry, Entrepreneurship and SMEs, has set up a Group of Personalities (GoP) composed of politicians, academics, think tankers and defence company CEOs to advise on how the EU could support CSDP related research. The first meeting of this group took place on 30 March 2015 and it presented its results on 23 February 2016

In addition to the GoP report, five workshops have been organized in 2015 by EDA with Member States and the Commission, two of them including Defence Industry's representatives.

Against this backdrop, a detailed proposal for the Preparatory Action should be presented by the Commission to the European Parliament and the Council in early 2016. Should the requisite budget be approved at the end of 2016, the Commission will take the necessary steps to ensure the launch of the Preparatory Action in 2017.

Members of the GoP

1.	Fernando Abril-Martorell	CEO of Indra
2.	Carl Bildt	former Prime Minister and Minister of Foreign Affairs of Sweden
3.	Antoine Bouvier	CEO of MBDA
4.	Håkan Buskhe	CEO of Saab
5.	Paul de Krom	former Secretary of State for Social Affairs and Employment President and CEO of TNO, a Dutch applied research organization
6.	Tom Enders	CEO of Airbus Group
7.	Commission's	Michael Gahler MEP, European Parliament rapporteur for the Communication on defence;
8.	Elisabeth Guigou	President of the Foreign Affairs Commission of l'Assemblée nationale, former Minister of European Affairs, of Justice and of Employment;
9.		Ian King CEO of BAE Systems

[31] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2015:069:FULL&from=EN item 02 04 77 02

10.	Bogdan Klich	former Minister of Defence, member of the Polish Senate
11.	Mauro Moretti	CEO Finmeccanica
12.	Reimund Neugebauer	President of the "Frauenhofer-Gesellschaft", applied research organization;
13.	Arndt Schoenemann	Managing Director of Liebherr-Aerospace Lindenberg GmbH, Chairman of ASD Supply Chain and SME Group
14.	Teija Tiilikainen	Director of Finnish Institute of International Affairs
15.	Nick Witney	former EDA Chief Executive, Senior Policy Fellow with the European Council on Foreign Relations (ECFR).

Should the Preparatory Action be launched, its budget will be modest, due to legal ceilings, between EUR 40 million and EUR 100 million for a four-year time span (2017-2020).

3.2.4 Towards a future European defence research programme?

If successful, the Preparatory Action will pave the way to a European Defence Research Programme (EDRP) in the next EU Multiannual Funding Framework, thus making a quantitative and qualitative difference to the current situation and demonstrating the added value of a permanent EU scheme.

This research programme is supposed to be clearly defence-oriented, consistent with existing national defence research efforts, and taking into account the unique aspects of the defence sector in its governance principles and modalities.

4 Possible futures for EU defence research

4.1 Some specificities to bear in mind

4.1.1 In search of the decisive operational advantage

First and foremost, defence research is aimed at giving a *decisive operational advantage* to the forces. Aviation in World War I, Radar in World War II, Stealth technology during the Cold War, were all weapons that made operational differences due to disruptive technologies. A defining characteristic of defence research is the constant pursuit of the technological edge that will offer operational advantage. Thus, 'innovation is at least as important a product of the defence sector as the physical products that embody the new ideas'[32]. Defence research is a major outcome of the procurement system.

Secondly, defence science and technology often gives an important and sometime pivotal impulse to industry at large and contributes to economic growth with a multiplier effect. History is full of worldwide commercial successes that originate in defence research, such as the internet, the microwaves, liquid crystals, to some extent the cell phones, etc. Indeed, serendipity plays a great role in research. Thus, direct funding of Research and Technology Organisations (RTOs) is certainly one of the wisest way for States to invest their money, without compromising market rules of fair competition. The contribution offered by the 'European defence industrial and technological base' to employment, exports and innovation, not to mention high qualified jobs is well-documented.

However, it is fundamental not to confuse the cause and the effects. The primarily goal of defence research is to satisfy 'operational needs'. Or to put it in other words: 'The defence industry is there to

[32] William P. Rogerson Incentive models of the Defense Procurement Process – Northwestern University – Handbook of defense economics volume 1 – Keith Hartley & Todd Sandler – North-Holland 1995, p. 312.

support European defence ministries and their armed forces and not, as perhaps some others have tended to think, the other way round'[33]. And this is the reason why defence research has to be oriented and focused in order to procure the most needed weapons' systems.

4.1.2 Walking down the strategic path

In order to understand the way modern states orientate their defence research, it is useful to go through the 'defence planning' process of some of the major Western countries, comparing them among themselves as well as with NATO's and the EU's planning processes. A brief description of those processes and corresponding 'strategic' documents for the US, the UK, France and Germany, NATO and the EU is provided in Annex 3. Five invariants phases stand out in the defence planning cycle, which may be summarised as follows.

(a) The Strategic 'planning' phase.

This phase generally (but not always) starts with an attempt to describe the '*global trends*' or 'strategic trends', 'strategic horizons' or 'strategic foresights' from all disciplines (demography, economics, politics, science and technology etc.), and this for all regions of the world.

Then comes (again, not always) the attempt to draw from those global trends *the military implications*. This involves trying to identify friends and foes (states as well as non-governmental organisations) and making a 'threat assessment', and sometimes also a 'risks assessment' (e.g. pandemics, floods, global warming…). The document produced at the end of this sub-phase can be classified, like in France ('atlas des menaces'), or made public like in the UK, which, for the first time in 2014 published a document called the 'future operational environment – 2035'.

In both 'global trends' and 'operational trends', 'defence S&T often play a large role, providing insights into the weapons and the procedures that potential foes could use against one's country.

At the end of this phase comes the most important document of the defence planning which sets the '*level of ambition*' of a Nation. Setting this level of ambition is always a matter of confronting the will of the country as it sees its role on the global scene (what we can call the '*ends*'), the resources it is prepared to match against its ambitions (the '*means*') and the '*ways*' to match its ends with its means. Asserting the ends is the easiest part and often an occasion to flatter the national ego. Explaining the means is always painful and thus very often ends up in a pithy statement. The designation of the document setting out: '*what do we want to be able to do militarily*?' varies a lot from country to country. The 'ends' may be described in a 'White Paper' or 'National Security Strategy' (US), or 'Security Strategy' (UK), or 'Strategic Concept' at NATO and generally associated with the 'means' when they are expressed. The 'ways' to match ends with means can be defined in a 'political guidance' or 'defence planning guidance' or 'defence sub-strategy'. Sometimes these guidance documents are classified. Sometimes, their outlines are published, like in the US 'Quadrennial Defense Review'. Sometimes the corresponding information is included in a larger 'Strategy' or 'White Paper' (France). Sometimes, all three elements are part of the same document, like in the latest (2015) UK's 'National Security Strategy and Strategic Defence and Security Review'.

(b) The 'programming' phase.

This phase aims to answer the questions: what is our force structure? what do we lack in order to fulfil the 'political guidance' we have agreed upon? The answers to those questions constitute the 'requirements catalogue'? what do we have in excess and should get rid of (always a painful step that is

[33] Nick Witney – Hearing by the House of Lords 9 October 2003 - ibid – answer to Lord Harrison http://www.parliament.the-stationery-office.co.uk/pa/ld200203/ldselect/ldeucom/169/16914.htm

seldom taken), and finally: **'***what capabilities should we acquire that we do not have yet***'**? This gives birth to a document, which can be called 'capabilities development plan' (EU) or 'minimum capabilities requirements' (NATO) or 'defence equipment plan' (UK), or simply 'requirements' (US).

The word '*capability*' in itself is tricky and cannot always be translated in all languages due to false cognates. A 'capability' is the *ability* to achieve a desired effect in a specific operating environment. This effect can be delivered by either military or non-military solutions. It relies on a lot of factors, or combination of factors better known as 'DOTMLPF': doctrine, organisation, training, material, leadership and education, personnel and facilities. Thus the word 'capability' must not be confused with the word '*capacity*', which usually describes a mere hardware equipment or system of hardware.

(c) The 'apportioning' phase

This phase concerns exclusively the alliances and basically answers the question: '***who does what?'*** This question might lead to other painful questions to answer. Do all the nations in an Alliance have to fulfil a percentage of the desired capabilities and which ones (the 'approved target packages' in NATO)? Shall we limit the percentage of capabilities given by one country? Shall we specialize, (which means abdicating the capability to go to war alone) or not?

(d) The 'implementation phase'

This phase includes three important elements.

The first is the *budgetary strategy,* which answers the question: *within which timeline and backed with which amount of money are we going to acquire the desired capabilities?* Due to the inherent length of the procurement processes, this phase requires the elaboration of multiannual budget programming instruments.

The second is the *procurement strategy*, which pursues the questions: what can we buy from the shelf? What shall we build ourselves? Alone or in a collaborative way? Which type of collaboration: European or broader? In which combat systems do we need cutting edge technologies, and in which can we be satisfied with 'good enough' equipment?

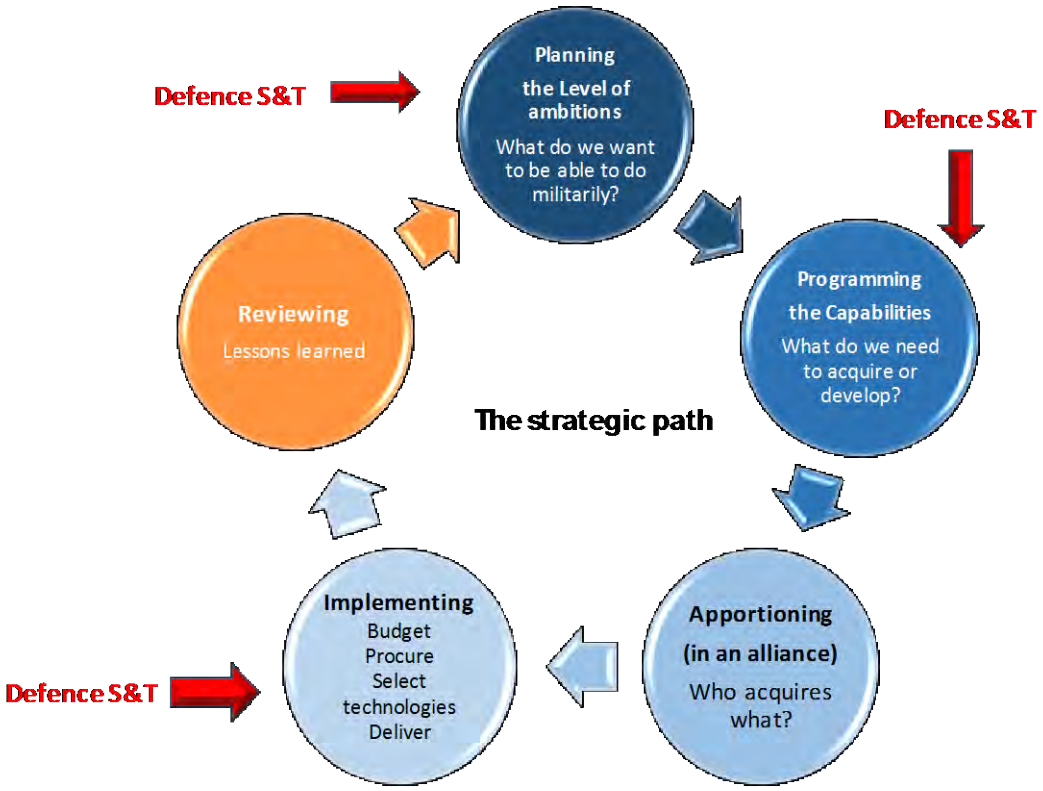
Finally comes the *research strategy*: which technologies would we prefer to choose to meet our desired capabilities? Are they available? What are the critical technological solutions we have to develop or acquire?

As the procurement strategy is closely intertwined with the research strategy, sometimes a unique document called **'***acquisition strategy***'** covers both**.** One of the best documents of this type is the UK's : 'National Security through Technology– Technology, equipment and support for UK Defence and Security'[34], published in 2012. Sometimes, a **'***Militarily Critical Technologies List***'** (MCTL) is made available to the wider public [35] , or in a more restrictive manner to selected interested parties in order to facilitate investment.

[34] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/27390/cm8278.pdf
[35]See for the US: https://acc.dau.mil/CommunityBrowser.aspx?id=717597

(e) The 'review' phase

The aim of this phase is to assess the results, to distribute the merits and the blames and above all, to draw 'lessons learned'. It can be conducted by the defence administration or by an external audit office, and most of the time by both bodies.



Authors' own production – FM 2016

An important point to understand is that not only that defence research is mainly *capability-driven*, but that it is part of a process and only acquires its value if it is duly *oriented upstream* and *followed downstream by sound armaments programmes*.

A difficulty at EU level – like at NATO – comes from the fact that, in a national defence planning process, the end buyer is at the same time the agent who orientates military needs, funds research and owns procurement programmes. The EU, like NATO, has to find ways to adapt to this challenge.

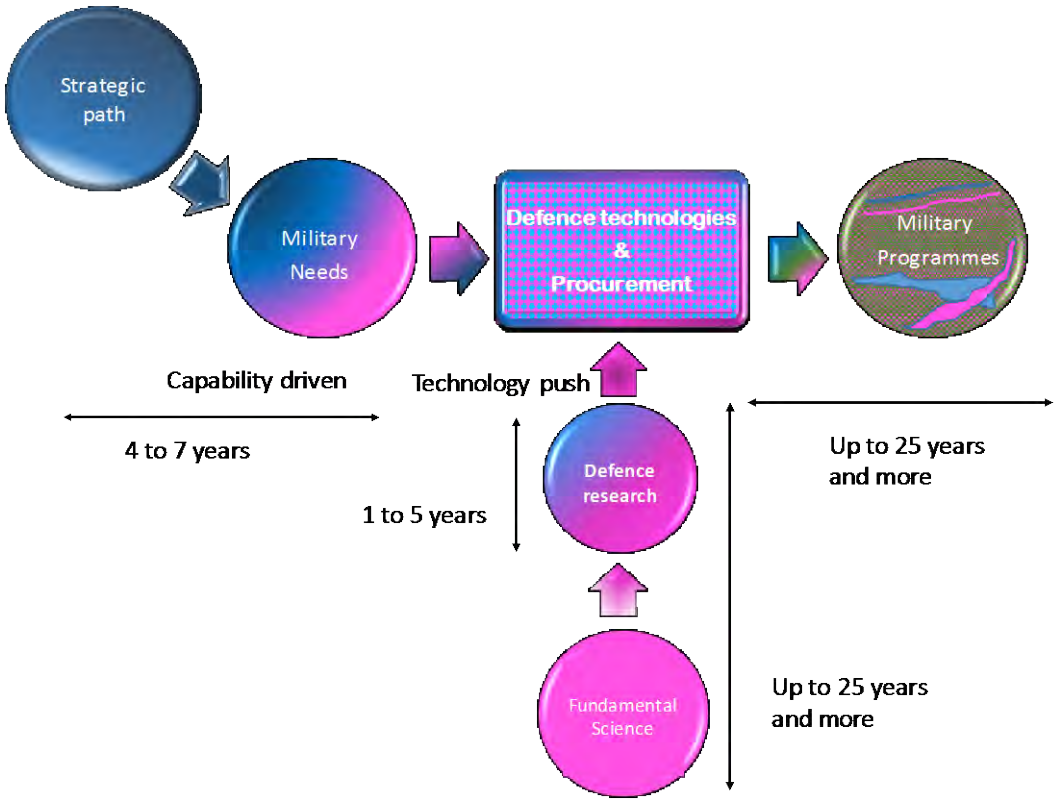
4.1.3 The capability-technology conundrum

Once the requirements have been defined, the next logical step is to steer the technology towards the requirements. This is particularly difficult step as this is where a crucial confrontation takes place (or should take place) between the top-down capability-driven path – what do we need to produce the weapons we need? – and the bottom-up technology-push: what do we know from present technologies that could be used as weapons, or decisively improve weapons? The simplest example that comes to mind to illustrate the way fundamental science, technology and capabilities are intertwined is the nuclear weapon. There would have been no nuclear bomb without Einstein having first discovered the relativity equation.

Technology solutions and capability needs are the yarn and the weft of the defence fabric. Once the fabric has been weaved, it is impossible to discern what is what. This is why there must be a fruitful dialogue between the capability officers, in charge of addressing the military needs, and the experts (both from the state and industry), capable of bringing technological solutions. This is why most people speak about the necessity of a '*holistic approach*'. The problem should not be addressed in terms of leadership

between the capability and the technological streams. Rather, the way the dialogue between technology and capacity is organised, is crucial to the success of the entire procurement process. All nations involved in armament programmes have set up sophisticated procedures to organise this dialogue[3637].

On the other hand, it is important to be aware that the length of the strategic cycle (four to seven years) and the technological maturation process (up to fifteen years) are not the same.



Authors' own production – FM 2016

The development of a 'future combat aircraft system' by France and the UK is a good example of the way in which technologies and capabilities twist together. If British and French defence planners were asked today whether they will need a new combat aircraft system in the ten years to come, they will probably answer no. Thus, from the perspective of strategic thinking, there is for the time being no 'operational need'. However, crafting new technological demonstrators help defence planners better understand what technology is capable to provide, and therefore to 'push the envelope'. To a certain extent, technology will orientate the military needs and influence strategic thinking. In the design phase, the ultimate nature of the final weapon is not yet known, nor even future full operational use. Even after production has begun, the weapon will continue to evolve in unanticipated ways and MoD's demands as well. The road that leads from strategic thinking to military technology is a two-way street.

[36] For instance, in France the dialogue between the 'officiers de cohérence opérationnelle' and 'architectes de systèmes de force' has been organized through the 'instruction générale 125/EMA-1516/DGA 2010' http://www.moodle.ead-minerve.fr/pluginfile.php/7989/mod_resource/content/1/Livret%20125-1516.pdf ; in the UK, see 'National Security through Technology: Technology, Equipment, and Support for UK Defence and Security' February 2012 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/27390/cm8278.pdf

[37] See French Senate's report 4 July 2012 'Les capacités industrielles militaires critiques' Sen. Daniel Reiner and others http://www.senat.fr/notice-rapport/2011/r11-634-notice.html

An example of weaving Technology uptakes with Capability needs

A short presentation of the US DARPA by itself [38]

'Established in 1958 as part of the U.S. Department of Defense, DARPA is designed to pursue opportunities for transformational change rather than incremental advances. It does so collaboratively as part of a robust innovation ecosystem that includes academic, corporate, and governmental partners. And while its focus is always on the Nation's military Services, which count on DARPA to create new strategic and tactical options, DARPA's work has historically catalysed fundamental breakthroughs that have benefited broader society as well.

'DARPA has demonstrated time and again how thinking beyond the borders of what is widely considered possible can yield extraordinary results. In the military domain, DARPA made early and timely investments in ballistic missile defense, stealth aircraft technology, unmanned aerial vehicles, and precision guidance. It also played a significant role in developing the Internet; designing the electronics that undergird the information revolution, and making the global positioning system (GPS) as mobile and ubiquitous as it is today. From the enormous rocket engines that powered the first manned space flight to the smallest microelectronics in smartphones at home and on the battlefield, DARPA has been at the forefront of technological innovation.

'By focusing its efforts at the boundaries of knowledge and at the edges and intersections of disciplines, DARPA has also helped create new communities of scientists and engineers, both inside and beyond the traditional defense community. Along the way, companies and sometimes entire industries have sprung from DARPA-funded research—reflecting the agency's commitment to pursue its ideas all the way from initial concept to demonstration of practical feasibility through prototype development.

'DARPA programs are led by program managers who come from academia, industry, national laboratories and other parts of government for stints that typically last just a few years—a time limit that helps drive the agency's signature sense of urgency. They are supported by technical and administrative teams motivated by the DARPA tenet that a program is not successful until it has made a difference for national security. Toward that end, and recognizing that some revolutionary goals inevitably prove unachievable, programs are heavily milestone-driven and redirected or discontinued when barriers prove intractable.

'DARPA's programs are conducted under the oversight of six technical offices: the Defense Sciences Office, the Information Innovation Office, the Microsystems Technology Office, the Strategic Technology Office, the Tactical Technology Office, and the agency's most recent addition, the Biological Technologies Office.'

DARPA IN NUMBERS

USD 2.9 billion budget (EUR 2.7 billion) in fiscal year 2015

219 government employees, including 94 technical programme managers

250 programmes across six technologies offices

2 000 contracts, grants and other agreements with companies, universities, and laboratories

[38]: http://www.darpa.mil/about-us/about-darpa

4.1.4 Other well-known specificities of defence research

First of all, *defence research is critically important* to all nations caring about their '*strategic autonomy*'. In the broader sense, strategic autonomy is the ability for a political entity to conduct war by itself whenever it decides to do so. More specifically, strategic autonomy consists in bringing together three freedoms: the *freedom of appreciation* which relies on the actor's own sources of intelligence (such as satellites and special services), the *freedom of decision,* which means to plan and conduct operations, and last but not least, the *freedom of action*. It also implies security of supply.

Freedom of action implies the capacity to *produce*, *operate*, *deploy*, *maintain*, *modify* and eventually *sell* one's own weapons. As there is no possibility to produce state of the art weapons systems without mastering science and technology, there is some sort of equivalence between the latest and 'strategic autonomy': there is therefore *no strategic autonomy without defence research*. This is the reason why technological studies are often considered by procurement agencies as the *apple of the eyes*. They should be the last items to reduce in times of budget restrictions.

'Strategic autonomy' in European Union political wording

The words 'strategic autonomy' seems to appear for the first time in a resolution adopted on **29 February 2010**[39] in which the European Parliament 'stresses that the Union must enhance its **strategic autonomy** through a strong and effective foreign, security and defence policy, so as to preserve peace, prevent conflicts, strengthen international security, protect the security of its own citizens and the citizens concerned by CSDP missions, defend its interests in the world and uphold its founding values, while contributing to effective multilateralism (…)'

In its **July 2013** Communication 'Towards a more competitive and efficient defence and security sector'[40], the European Commission declared: 'The European Defence Technological and Industrial Base (EDTIB) constitutes a key element for Europe's capacity to ensure the security of its citizens and to protect its values and interests. Europe must be able to assume its responsibilities for its own security and for international peace and stability in general. This necessitates a certain degree of **strategic autonomy**: to be a credible and reliable partner, Europe must be able to decide and to act without depending on the capabilities of third parties. Security of supply, access to critical technologies and operational sovereignty are therefore crucial.'

Since then, the concept of 'strategic autonomy' has been used many times including in Regulation (EU) n° 1285/2013 of the European Parliament and the Council of 11 December 2013 on the implementation and exploitation of European satellite navigation systems: 'The aim of the Galileo programme is to establish and operate the first global satellite navigation and positioning infrastructure specifically designed for civilian purposes, which can be used by a variety of public and private actors in Europe and worldwide. The system established under the Galileo programme functions independently of other existing or potential systems, thus contributing amongst other things to the **strategic autonomy of the Union**, as emphasised by the European Parliament and the Council.'

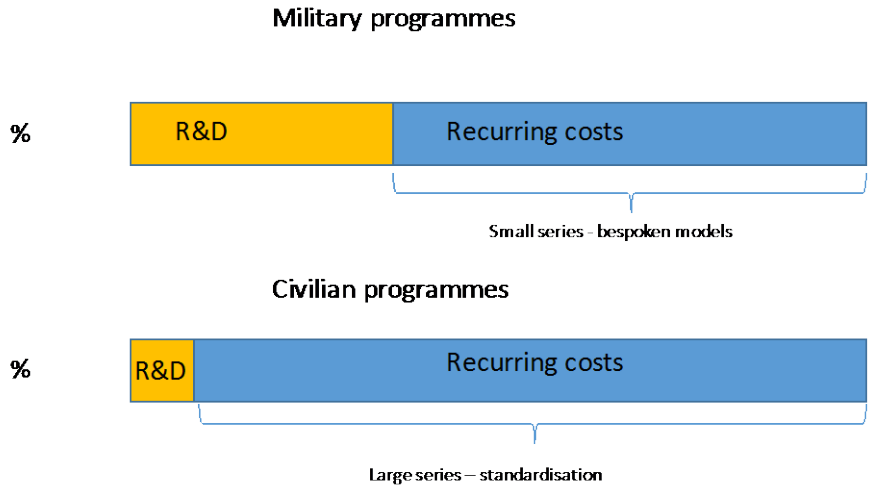
Secondly, *defence science and technology is a long and onerous process*. It supposes the capacity to build human competences, which is a long term process that needs enduring actions. Having good scientists able to produce discoveries, good engineers capable of translating new ideas into practical technological solutions, and excellent craftsmen with unique know-how, takes a long time and can easily be lost. It implies offering people with rare competences financial incentives and attractive careers. Defence S&T

[39] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A7-2010-0026+0+DOC+XML+V0//EN#title1

[40] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013DC0542&from=EN

also relies on testing facilities and industrial plants that are onerous to build and to sustain, such as wind tunnels, shipyards, military academies, advanced computing networks, microelectronics etc., not to mention nuclear testing facilities. In many ways, furthering defence research can be compared to planting seeds. It is long and difficult process, and the results may take a long time in coming.

Third, *the share of defence research in the making of programme is high*, military programmes are almost always bespoken to the needs, the series are often small and exports are subject to authorisations. This explains that reducing even a single unit from a limited series (let's say one frigate out of a series of eight) increases dramatically the price per unit. This also explains why building only a few models of a series can reveal extraordinary expensive. The 'fourth generation' Aircraft carriers (Gerald Ford class) would cost as much as USD 15 billion if the programme was to be kept for only one ship[41]. All those factors combined explain that there are only few ways to reach the 'industrial Grail' of sharing non-recurring costs. The first is having a big and deep market, like the US one. The second is to build cooperative programmes, as this has been tried in Europe for the last fourty years. The third is to export.



Authors' own production – FM 2016

Fourth**,** innovation in defence research might also come from the *combination of existing technologies and doctrines.* For instance, there is fundamentally no technological breakthrough in the drone revolution. The principal innovation of drone is that they use existing elements together in order to produce desired effects: endurance, permanence, pilots' life-saving, discrete observation… *This is one of the reasons why SMEs are so important in the defence innovation process.* While large corporations tend to be good at improving what they have been good at doing, newcomers are often more risk-oriented, quicker to react and better suited for exploiting radically new technologies or combining existing technologies.

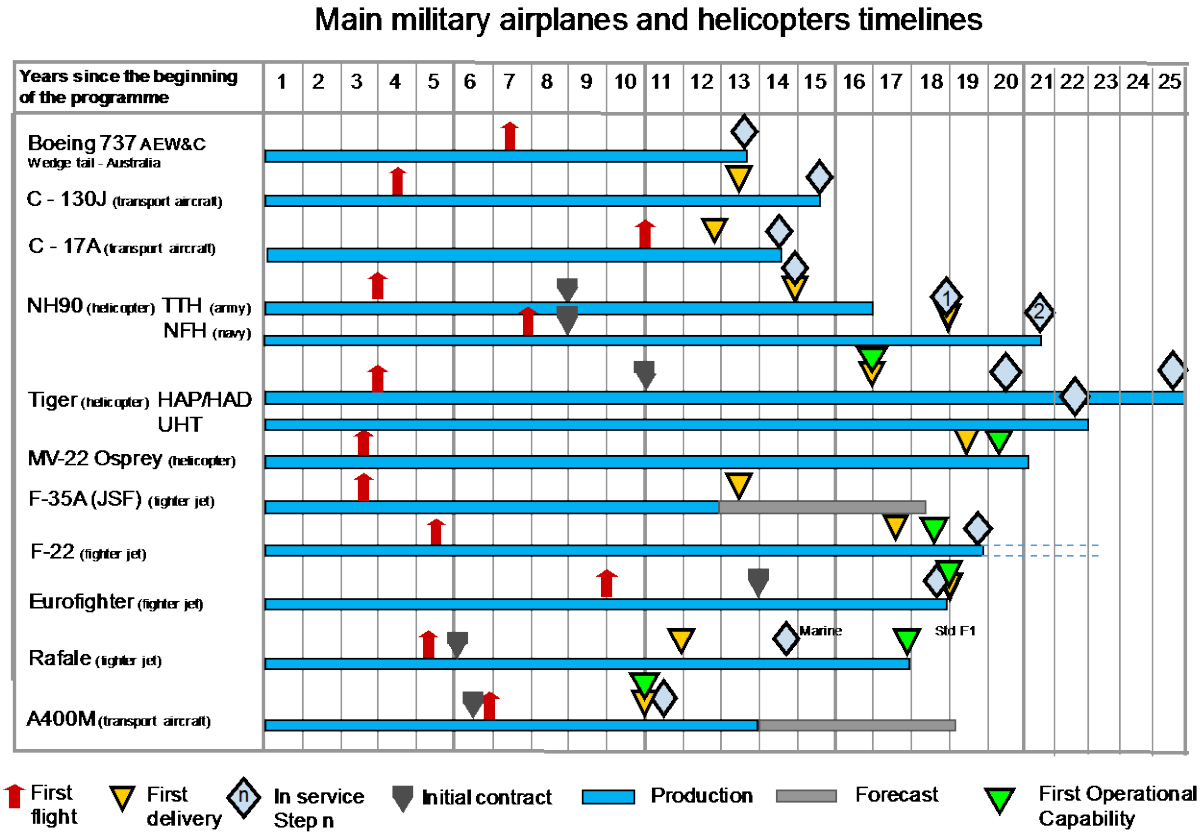
Fifth, *at a low level of Technology Readiness Level (until TRL 3) there is almost no difference between civilian and military research.* It is all fundamental science and can provide 'dual use' programmes**.** However, there might be technological areas of specific military interest at that level if they promise lead to equipment demonstrating high performance under extreme and non-cooperative operational conditions, or that will be furtive, discrete, agile, resilient, or ballistic resistant, etc. The importance of satisfying capability needs becomes more important at higher TRL levels. After TRL 7, there is no more 'pre-commercial defence R&D', there are only 'procurement' prototypes.

[41] http://www.defensenews.com/story/breaking-news/2016/02/02/carter-unveils-budget-details-pentagon-requests-5827b-funding/79686138/

In this regard, we must be aware that defence research has little in common with security research (see above and section 2.2). The capabilities that one seeks to obtain are not the same since we care of equipment that produce a military purpose.

Sixth, *weapons are not industrial products like others***.** As they are designed to conduct war, their export is always politically sensitive. Assurances have to be found that the country who will receive the arms is trustworthy and will not misuse them. From the buyer's side, the country who sells the arms must also be trustworthy and not risk defaulting in delivering supplies and ammunition in war time.

Seventh, *bringing all these elements together makes the art of forging the tools of cutting edge warfare a long and risky business* for corporations as well as for states. Very often great 'paper' solutions prove practically impossible to develop at affordable prices. For one success, a lot of dead-ends have to be explored. As defence scientists and defence industries are asked to produce objects not only better, but decisively better, additional costs and delays are part of the game. Very often, governments add to the difficulty by reducing their commands or changing their requirements.



Authors' own production – FM 2016

4.1.5 The new nexus between defence research and civilian research

The description of the specificities of defence research would not be complete if we omitted the fact that 'the centre of gravity in cutting edge military applicable research is shifting abruptly away from the defence establishment to relatively new commercial firms with loads of cash to invest'[42]. Indeed, international commercial corporations are taking the lead over defence industries. The defence sector,

[42] 'Creative Disruption – Technology, Strategy and the Future of the Global Defense Industry' – by Ben FitzGerald and Keeley Sayler – June 2014 – Center for a New American Security http://www.cnas.org/tech-strategy-future-global-defense-industry#.Vq_drcfy5oU . This section is largely inspired by this report.

which has for generations exported transformational capabilities to the commercial sector, is nowadays becoming an importer of the technological advances taking place worldwide. Globalization has blurred the frontiers between defence and civilian industries, diluting the sources of technological innovation and placing them beyond the control of any single government or entity. Those trends are producing disruptive effects.

First, the changing technological environment is reshaping the entire Western defence industry. As a matter of fact, there are no defence companies among the Top 20 industrial research and development spenders worldwide[43]. The combined market capitalisation of the American 'Big Five' defence firms (Boeing, Lockheed Martin, General Dynamics, Raytheon and Northrop Grumman') is approximatively half that of Apple, which could buy the two largest firms, Boeing and Lockheed Martin, with its 'cash on hands'[44]. This position has left defence firms reluctant to jeopardise the support of their stakeholders by allocating cash to fund defence R&D, thereby increasing the influence of commercial R&D as a source of innovation. 'Money-led' global companies tend to disinvest from the defence business with all imaginable consequences, particularly in terms of attraction power on young talents.

Second, the technological revolution is impacting on the global security environment. Information and communication technologies are used to enhance terrorist recruitment efforts and increase self-radicalisation. Cryptology available on the shelf is used by terrorist networks. Drones can be used by terrorist groups, as Hezbollah has demonstrated; they could be used within European boundaries to disrupt security on sensitive sites. Furthermore, given the commercial availability and relative affordability of related tools such as computer-aided design software and 3-D printers, non-state actors can also manufacture untraceable weapons, buy component parts, or acquire the capacity to pinpoint targets with GPS devices they buy on Amazon.com.

As a consequence, defence administrations should consider rethinking their entire acquisition process in a manner that encourages both innovation from, and collaboration with the commercial sector. These are daunting changes that imply the development of nimble acquisition strategies in order to respond to unanticipated shifts in priorities and in the environment. In this regard, the question of Intellectual Property Rights (IPR) must be looked at with great care. Commercial companies are not ready to give up their IPR for 'dual use' products that can have large commercial developments. On the other hand, defence administrations have to be cautious, favour true innovation and not carry on 'paying dinosaurs to disrupt'.[45]

The transfer of leadership we are witnessing from military to civil research will have momentous implications in terms of policy choices and industrial impact. This is the reason why the US defence Planning and budgeting process better known as 'Planning Programming Budgeting and Execution' (PPBE) which is the mother of all defence planning in the Western countries, is the subject of severe criticism that would merit further developments[46]. It is not possible, in the context of the present study, to address those issues in-depth. However, the issue will require further analysis and policy debate in the years to come.

[43] Strategy& 'the global Innovation 1000 : Top 20 R&D spenders 2005-2014' http://www.strategyand.pwc.com/global/home/what-we-think/innovation1000/top-20-rd-spenders-2014
[44] 'Creative Disruption' ibid p. 11.
[45] Centre for a new American Strategy Ibid p.15
[46] See: Reforming the Pentagon's Budgeting Process – Michelle Shevin-Coetzee – Center for a New American Security 2015 http://www.cnas.org/sites/default/files/publications-pdf/CNASReport-PPBE-160203.pdf

4.2 European defence research is coming to an end

4.2.1 An extreme concentration on three countries

In 2013 three countries - France, UK and Germany – concentrated 92 % of European defence R&D and 86 % of European defence R&T. Only the first two, France and the UK, spend more than one billion euro in R&D per year. France alone represents 43 %, but an important part of this research is dedicated to the nuclear deterrent, and this share might increase in the coming years due to the decision to renew all nuclear programmes[47]. UK R&D represents 37 %. This means that in case of a Brexit, European defence research would be dramatically reduced and rely mainly on France (its share would then represent 68.5%).

Also in 2013, European collaborative R&T represented a mere EUR 168 million, with France alone accounting for 66 % of this collaboration. *Collaborative R&T represents 8 % of European R&T*. An important reason why other countries only invest very small amounts in defence R&D is due to the scale effect and the high financial barrier to enter the field. The fact is that, in order to develop defence R&D, *a critical mass is needed*.

This situation divides Europeans countries into two groups: on one side, the *defence consumers* group with little or no defence research at all and few industries and, on the other side, the *defence producers* group which are striving to conduct at least some armaments development. That increases the natural divergences on regulatory subjects like open market procurement or protected markets.

[47] In the budget request for 2016 the technological studies ('études amont') dedicated to Nuclear deterrence represented 34 % (EUR 237 million) of the total (EUR 706) slightly in increase compared to 2014 (31 %). Source French Senate: avis n° 166 sur le projet de loi de finances pour 2016 de MM. André Trillard et Jeanny Lorgeoux p. 48 http://www.senat.fr/rap/a15-166-5/a15-166-51.pdf

EDA COUNTRIES 2013	Defence expenditures	Equipment	R&D	R&T	European collaborative R&T	R&D		R&T	
In Million €	186 427	30 071	7 578	2 100	168	Cumulative	in %	Cumulative	in %
France	39 391	8 816	3 280	752	111	3 280	43	752	36
UK	40 693	6 717	2 793	506	1	6 073	80	1 258	60
Germany	33 784	5 094	927	542	n.a	7 000	92	1 800	86
Italy	20 078	2 363	149	restricted	5	7 150	94	1 800	86
Sweden	4 673	1 010	118	65	13	7 268	96	1 865	89
Poland	6 720	1 358	94	10	4	7 362	97	1 875	89
Spain	9 549	1 138	91	54	27	7 453	98	1 928	92
Netherlands	7 702	956	59	59	3	7 512	99	1 988	95
Finland	2 862	588	34	26	2	7 546	100	2 013	96
Czech Rep.	1 597	149	15	7	1	7 561	100	2 020	96
Belgium	3 939	209	8	8	1	7 569	100	2 028	97
Slovakia	726	51	3	0	0	7 572	100	2 028	97
Romania	1 847	198	2	2	0	7 574	100	2 030	97
Austria	2 432	209	1	1	n.a.	7 575	100	2 031	97
Portugal	2 591	260	1	1	1	7 576	100	2 032	97
Slovenia	381	5	1	0	0	7 577	100	2 032	97
Greece	3 060	481	1	1	1	7 577	100	2 032	97
Crotia	639	68	1	0	0	7 578	100	2 032	97
Estonia	361	103	1	0	0	7 578	100	2 032	97
Hungary	912	89	0	0	0	7 578	100	2 032	97
Luxembourg	176	44	0	0	0	7 578	100	2 032	97
Bulgaria	611	32	0	0	0	7 578	100	2 032	97
Cyprus	290	11	0	0	0	7 578	100	2 032	97
Ireland	891	68	0	0	0	7 578	100	2 032	97
Latvia	214	23	0	0	0	7 578	100	2 032	97
Lithuania	267	28	0	0	0	7 578	100	2 032	97
Malta	41	3	0	0	0	7 578	100	2 032	97

Authors' own production – FM 2016 - restated data from EDA data portal

The trend in European R&D and R&T is marked by sharply declining budgets over the past few years. As the table below demonstrates, within the five years from 2009 and 2013, European defence R&D has been cut by EUR 1,4 billion, with all countries reducing their expenses. European defence R&T has been reduced by EUR 360 million, falling to a mere EUR 2,2 billion. Since 2015, those cuts have been halted, but this will not fundamentally change the bleakness of the picture. Therefore, in many areas, hard choices will have to be made, including sacrificing studies in promising fields, to try and preserve core technologies, with a priority to the nuclear deterrent for the two countries that invest the most in R&D.

Constant prices 2013	2009		2010		2011		2012		2013		Variation over the period		Average per year	
	R&D	R&T	R&D	R&T	R&D	R&T	R&D	R&T	R&D	R&T	R&D	R&T	R&D	R&T
Million euro	8 982,2	2 460,6	8 946,0	2 195,0	8 028,9	2 268,6	7 522,4	2 015,0	7 578,4	2 100,0	- 1 403,8	- 360,6	8 211,55	2 207,85
France	3 962,7	967,1	3 742,0	857,1	3 402,9	783,7	3 526,3	642,8	3 500,0	752,0	- 462,7	- 215,1	3 626,8	800,5
UK	2 963,8	562,8	3 026,2	restricted	2 780,7	restricted	2 482,9	523,1	2 464,4	506,3	- 499,4	- 56,5	2 743,6	530,7
Germany	1 164,4	434,4	1 520,5	411,8	1 092,4	423,8	925,0	421,2	918,1	542,0	- 246,3	+ 107,6	1 124,1	446,6
Poland	95,1	13,6	126,7	14,5	172,8	121,6	144,7	86,0	143,6	10,0	+ 48,5	- 3,6	136,6	49,2
Spain	244,8	107,2	169,4	85,4	153,1	83,9	110,9	64,1	110,1	53,6	- 134,7	- 53,6	157,7	78,8
Italy	149,2	restricted	67,1	restricted	183,8	restricted	93,1	restricted	92,4	restricted	- 56,8	n.a.	117,1	n.a.
Sweden	161,6	98,5	111,6	89,8	105,8	80,0	86,2	80,0	85,6	64,5	- 76,0	- 34,0	110,2	82,6
Netherlands	112,3	112,3	78,1	78,1	71,6	71,6	71,2	71,2	70,7	59,2	- 41,6	- 53,1	80,8	78,5
Finland	47,2	13,4	40,5	17,7	18,6	6,2	37,3	29,2	37,0	25,6	- 10,2	+ 12,2	36,1	18,4
Czech Rep.	22,2	8,0	21,1	7,6	16,8	6,8	16,3	7,1	16,2	6,9	- 6,0	- 1,1	18,5	7,3
Greece	5,0	3,9	10,9	0,2	8,1	0,0	7,9	0,0	7,8	0,6	+ 2,8	- 3,3	7,9	0,9
Belgium	9,9	9,5	9,6	8,9	8,6	8,1	7,9	7,4	7,8	7,8	- 2,1	- 1,7	8,8	8,3
Slovakia	5,6	2,6	0,1	0,1	0,6	0,6	5,1	0,3	5,1	0,0	- 0,5	- 2,6	3,3	0,7
Romania	2,5	0,3	2,2	2,2	2,0	2,0	2,1	2,1	2,1	1,7	- 0,4	+ 1,4	2,2	1,7
Austria	8,0	7,5	1,0	1,0	1,1	1,1	2,1	1,8	2,1	1,0	- 5,9	- 6,5	2,9	2,5
Estonia	0,4	0,3	0,8	0,7	0,2	0,0	1,1	0,0	1,1	0,0	+ 0,7	- 0,3	0,7	0,2
Portugal	9,7	9,7	7,3	7,3	8,4	2,4	0,9	0,6	0,9	0,9	- 8,8	- 8,8	5,4	4,2
Slovenia	12,0	9,3	8,1	5,9	0,9	0,8	0,8	0,7	0,8	0,3	- 11,2	- 9,0	4,5	3,4
Hungary	3,7	0,7	0,3	0,0	0,4	0,0	0,5	0,1	0,5	0,0	- 3,2	- 0,7	1,1	0,2
Bulgaria	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+ 0,0	+ 0,0	0,0	0,0
Crotia	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+ 0,0	+ 0,0	0,0	0,0
Cyprus	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+ 0,0	+ 0,0	0,0	0,0
Ireland	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+ 0,0	+ 0,0	0,0	0,0
Lithuania	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+ 0,0	+ 0,0	0,0	0,0
Malta	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+ 0,0	+ 0,0	0,0	0,0
Latvia	0,2	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	- 0,2	+ 0,0	0,1	0,0
Luxembourg	1,7	0,0	2,2	0,2	0,0	0,0	0,0	0,0	0,0	0,0	- 1,7	+ 0,0	0,8	0,0

Authors' own production FM 2016 - restated data from EDA portal

It is difficult to compare the evolution from national budget documents and figures given by EDA which rely on harmonised definitions. The table [below] therefore has to be read with the usual caveats as regards the definition of budgetary categories and averaging currency fluctuations.

In current billion €			2011	2012	2013	2014	2015
France	Defence budget		41,84	41,23	41,27	42,06	41,77
	R&T		0,8	0,78	0,86	0,87	0,86
		in %	*1,9*	*1,9*	*2,1*	*2,1*	*2,1*
	R&D		3,28	3,44	3,29	3,56	3,64
		in %	*7,8*	*8,3*	*8,0*	*8,5*	*8,7*
U.K.	Defence budget		39,2	39,9	39,1	42,3	n.a.
	R&T		0,61	0,45	0,51	n.a.	n.a.
		in %	*1,6*	*1,1*	*1,3*		
	R&D		2,03	1,61	1,76	1,95	n.a.
		in %	*5,2*	*4,0*	*4,5*		
Germany	Defence budget		31,98	33,51	32,8	33,13	32,97
	R&T		0,40	0,43	0,55	0,49	0,42
		in %	*1,3*	*1,3*	*1,7*	*1,5*	*1,3*
	R&D		0,83	0,88	1,05	0,83	0,79
		in %	*2,6*	*2,6*	*3,2*	*2,5*	*2,4*
Italy	Defence budget		23,87	22,8	23,13	22,8	21,88
	R&T		n.a.	n.a.	n.a.	n.a.	n.a.
		in %					
	R&D		0,06	0,06	0,06	0,06	0,06
		in %	*0,3*	*0,3*	*0,3*	*0,3*	*0,3*

Source French Senate: avis n° 166 sur le projet de loi de finances pour 2016 de MM. André Trillard et Jeanny Lorgeoux p48 http://www.senat.fr/rap/a15-166-5/a15-166-51.pdf.

For Germany, the figures have been restated with the help of the Permanent Representation of the Federal Republic of Germany to the EU.

For the UK the only open source figures available are published in "Departmental Resources Statistical bulletin" (Excel Table 5 available at the following website : https://www.gov.uk/government/statistics/defence-departmental-resources-2015. UK fiscal year goes from1 April to next 31 March. In GBP million the figures are: 2010/11: 2 029 m£ ; 2011/12 : 1 605 m£ ; 2012/2013 : 1 758 m£ ; 2013/2014 : 1 952 m£. There is no forward budget for research and development in UK MOD because development expenditure is mostly part of the equipment programme applied as needed against the development requirements of individual projects. Defence Economics (UK MOD's statisticians) seek to classify R&D activity within the Organisation for Economic Co-operation and Development's (OECD) Frascati Guidelines (i.e. R&D considered to be new, novel or innovative), which align to National Accounts definitions. Frascati uses a definition of Research not 'Research and Technology' therefore UK has no openly published 'R&T' figure. Nevertheless, for comparison's sake, EDA uses an equivalent figure. The line 'R&T' for UK shows figures presented in the French Senate's report mentioned above.

4.2.2 A fatal lack of investment for decades

Compared to the US, European R&D is suffering from a severe lack of investment. US R&D effort is six times the EU's and US R&T is four times the EU's.

COMPARISON EU-US Bn€ in current prices		2006	2007	2008	2009	2010	2011	Average per year
Equipment								
	European Union	29,1	32,2	33,3	32,5	34,3	29,2	31,8
	United States	71,5	72,7	79,8	92,6	100,8	91,9	84,9
R&D								
	European Union	9,7	9,6	8,6	8,4	8,6	7,8	8,8
	United States	54,7	53,3	51,1	56,7	58,1	53,8	54,6
R&T								
(subset of R&D)	European Union	2,7	2,5	2,5	2,3	2,1	2,1	2,4
	United States	10,6	9,7	7,3	8,2	10	8,3	9,0
Total investment								
	European Union	**38,8**	**41,8**	**41,9**	**40,9**	**42,9**	**37**	**40,6**
	United States	**126,2**	**126**	**130,9**	**149,3**	**158,9**	**145,7**	**139,5**

EDA Defence Data portal - presentation and last column are Authors' own production - FM 2016

EDA has not published any comparison between EU and the US since 2011, due to methodological difficulties to compare the aggregates.

As an average, *the technological gap between the US and the EU is around EUR 6,5 billions per year in R&T and a EUR 45 billion per year in R&D.*

Due to the scale effect, those trends will endure. Scarce funding not only jeopardises the competitiveness of European industry, but puts at risk its survival. All things being equal, the medium and long-term picture looks even more ominous. In ten years' time, a full spectrum of European defence research will hardly exist any more, and only one or two countries will keep the capacity to build some of the most needed weapons involving cyber technology, advanced computing, electronic warfare, missiles, undersea and air attack capabilities, satellites and counter space capabilities, let alone missile defence.

The gap between the EU and the US seems *bound to widen* even further after the launch of the US 'Defence Innovation Initiative' (DII), often referred as the 'third offset initiative', in November 2014.

The first, fundamental assumption of the DII is the fact that 'the United States has relied on a technological edge ever since WWII'[48]. This has allowed the US to offset the Soviet Union's conventional superiority a first time in the 1950's with President Eisenhower's 'New Look build-up of America's nuclear deterrent' and a second time in the 1970's with the 'Long-Range Research and Development Planning Program' that helped develop new systems such as extended-range precision-guided munitions, stealth aircraft and new intelligence, surveillance and reconnaissance platforms.

The second assumption is that this advance is eroding, and that countries like Russia and China have been heavily investing in military modernisation programmes to blunt the US military's technological edge, fielding advanced aircraft, submarines, and both longer range and more accurate missiles, but also

[48] Reagan National Defense Forum Keynote, delivered by Secretary of Defense, Chuck Hagel, 15 November 2014 : http://www.defense.gov/News/Speeches/Speech-View/Article/606635

new anti-ship and air-to-air missiles, counter-space, cyber, electronic warfare, undersea, and air attack capabilities.

Thus, the 'third offset initiative' is an ambitious effort to 'identify and invest in innovative ways to sustain and advance America's military dominance for the 21st Century. It will put new resources behind innovation and focus on investments that will sharpen America's military edge'.

This technology effort is aimed at establishing a new 'Long-Range Research and Development Planning Program' that will help identify, develop, and obtain breakthroughs in the most cutting-edge technologies and systems – especially from the fields of robotics, autonomous systems, miniaturisation, big data, and advanced manufacturing, including 3D printing. This programme will look towards the next decade and beyond.

In the near-term, the DII will assess what technologies and systems ought to be developed over the next three to five years and beyond. This first step will closely associate the private sector, including firms and academic institutions outside DoD's traditional orbit, because 'DoD no longer has exclusive access to the most cutting-edge technology or the ability to spur or control the development of new technologies the way it once did'. [49]

4.3 The necessity of a vigorous and immediate action at a European level

4.3.1 Would a European defence research programme comply with the legal framework?

The legality of the Union funding a defence research programme is not well documented and it seems that few lawyers have ventured in this province[50]. A recent Joint Communication of the Commission and the HR/VP to the European Parliament and the Council about 'Capacity building in support of security and development' has brought little light on this thorny issue[51]. However, we have good reasons to think that the funding of such an instrument as the European Defence Research Programme (EDRP) from the EU budget would be fully compliant with the treaties.

There are potentially two legal bases on which defence research could be funded within the treaties. If defence research is considered as a *sub-action of the Common Security and Defence Policy* (CSDP) which is '*an integral part*' of the *Common Foreign and Security Policy* (CFSP) then it has to follow the rules and provisions on *Title V TEU* on the Union's external action and CFSP. Conversely, if defence research is considered as a *sub-action of research* then it falls under the provision of *Title XIX TFEU* on 'Research and technological development and space'.

In accordance with Article 40 of TEU, the same measure cannot be financed on a CSDP legal basis and on the legal basis of the TFEU. A choice must therefore be made of whether the EDRP should be based on a CFSP/CSDP or a Research legal basis. Such choice must be supported by objective factors, mainly the aim and the content of the programme.

[49] See also: Center for Strategic and Budgetary Assessments 27 October 2014: 'toward a New Offset Strategy: Exploiting U.S. Long-Term Advantages to Restore U.S. Global Power Projection Capability' http://csbaonline.org/publications/2014/10/toward-a-new-offset-strategy-exploiting-u-s-long-term-advantages-to-restore-u-s-global-power-projection-capability/

[50] See: 'Le financement de la R&D de défense par l'Union européenne' Olivia Cahuzac, sous la direction de Axel Dyèvre' Les notes stratégiques de la CEIS – avril 2013 https://ceis.eu/fr/note-strategique-le-financement-de-la-rd-de-defense-par-lunion-europeenne/

[51] http://data.consilium.europa.eu/doc/document/ST-8504-2015-INIT/en/pdf

(a) Is defence research part of CFSP/CSDP?

Article 24 TEU provides that 'The Union's competence in matters of common foreign and security policy shall cover all areas of foreign policy and all questions relating to the Union's security, including the progressive framing of a common defence policy that might lead to a *common defence*'.

The question arises as to whether defence research belongs to the CFSP/CSDP.

(a-1) Concerning CFSP, Article 25 TEU characterises the content of the CFSP as the fact for the Union of (i) defining the general guidelines; (ii) adopting decisions defining actions to be undertaken, or positions to be taken by the Union and the relevant arrangements and (iii) by strengthening systematic cooperation between Member States in the conduct of policy.' Obviously, defence research has little to do with those guidelines and cooperation which belong to the realm of politics and have no financial implications. This leaves us with the 'actions to be undertaken by the Union'.

Those actions comprise (i) decisions adopted by the Council 'where the international situation requires operational actions by the EU' (Article 28). This refers to the 'missions outside the Union for peace-keeping, conflict prevention and strengthening international security' (ii) the appointment of European Union Special Representatives (EUSR) with a mandate in relation to particular policy issues (Article 33) (iii) decisions adopted by the Council that 'define the approach of the Union to a particular matter of a geographical or thematic nature' (Article 29).

It seems reasonable to think that defence research cannot be covered by Article 28 TEU, which relates to operational action to be decided by the Council where the international situation so requires, nor by Article 33 TEU, which relates to EUSR, nor by Article 29 TEU which relates to positions to be taken by the EU on foreign policy issues concerning third States or international organisations and not matters internal to the Union or its Member States, like defence research.

(a-2) As far as the CSDP is concerned, it (i) provides the Union with operational capacity drawing on civilian and military assets (Article 42(1) and 43 TEU) to be used on missions outside the Union for peace-keeping, conflict prevention and strengthening international security; (ii) include the progressive framing of a common Union defence policy leading to a common defence when the European Council unanimously so decides; (iii) contains a provision whereby Member States will improve their military capabilities (Article 42(3) TEU) in particular through the action of the EDA; (iv) allows the EU to set up entities performing their tasks under CSDP (Article 42(4)) like the European Security and Defence College (ESDC).

Defence research is not part as such of a '*mission outside the Union*' as provided for in Article 42(1) TEU. Should the European Council have decided 'a common defence' there would be little doubt that defence research, like in all Member States would belong to the realm of defence, and its expenditure would follow the special rules of CFSP. But such it is not the case for the moment. Should some Europeans countries have triggered the PESCO mechanism, defence research could possibly be part of an action conducted by the EDA with a view to assisting the Member States in the improvement of their military capacities under Article 45 (1) (d) TEU. The question is therefore whether the funding as such of defence research policy is covered by the exception to the principle of the funding; as provided for in Article 41 (2) TEU which reads as follows:

> 2. '*Operating expenditure to which the implementation of this Chapter gives rise* shall also be charged to the Union budget, except for such *expenditure arising from operations having military or defence implications* and cases *where the Council acting unanimously decides otherwise*. (…)

Neither 'operations' nor 'military and defence implications' are defined in the treaties. However, 'operating expenditure arising from operations having military or defence implications' are to be

understood as expenditure related to operations carried out '*outside the Union*' with the '*operational capacity* drawing on civilian and military assets '*provided by the Member States*' for crisis management purposes under the political control and strategic direction of the Council (Articles 38, 42.1, 42(2) and 38 TEU. Such an interpretation is based on the following: the use of the word 'operations' in the treaty which refers clearly to crisis management operations outside the EU; the practice of the Council which authorised or did not exclude the financing by the EU budget of EU actions having military or defence implications (ESDC, military exercises, EDA) and to the spirit of Article 41(2) which aims at excluding as much as possible the interference of the EU institutions with the functioning of military operations

As mentioned above, defence research is not a military operation carried out outside the Union. Therefore, the operational expenditures arising from defence research are not concerned by the exception provided for in Article 41(2) [52]**.**

In this regard, we shall observe that applying the basic principles of interpretation, valid under EU law, exceptions must be interpreted narrowly. Therefore, this article cannot give birth to a general provision prohibiting the funding by the Union of all possible actions with military or defence implications in the framework of CFSP.

To sum up those explanations, in the event that defence research could be funded under CFSP either through a common defence still to be decided or through the EDA, our understanding of the TEU is that Article 41 (2) would not forbid the funding by the Union.

On the contrary, should the defence research be considered as not belonging to CFSP/CSDP, the restriction provided for in Article 41(2) would not apply since such a restriction is applicable only to '*expenditure to which the implementation of* [CFSP] *gives rise'*. In that case, the funding a defence research policy implemented by virtue of a non-CFSP policy would be possible.

(b) In this regard, there is no doubt that defence research can be implemented in the field of research policy in the framework of Title XIX TFEU

The Union's competence in the field of research is based on Title XIX TFEU ('Research and technological development and space'). Article 179 provides:

> 1. The Union shall have the objective of strengthening its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely, and encouraging it to become more competitive, including in its industry, while promoting all the research activities deemed necessary by virtue of other Chapters of the Treaties. (…)
>
> 3. All Union activities under the Treaties in the area of research and technological development, including demonstration projects, shall be decided on and implemented in accordance with the provisions of this Title.

[52] Doubts might arise with the German translation of the treaty which uses slightly different terminology and reads: 'operating expenditure (…) shall also be charged to the Union budget, except for such expenditure arising from *measures* (and not operations) having military or defence *policy* implications (…)'[52]. This seems to be a translation error (treaty texts were negotiated in English). This different wording may also be understood in a general context in which there is strong aversion in Germany for against the Union funding any military or defence expenditure. As The European Institute for Security Studies noted: 'the broad interpretation of 'operations' as activities beyond CSDP remit would be problematic, when considering the many activities with 'military or defence implications' that are already financed by the Union's budget' (EUISS June 2015 http://www.iss.europa.eu/uploads/media/Brief_18_Train_and_Equip.pdf)

It is important to note that in this title, the Treaty always refers to 'Research' and never uses the restriction that could have been brought by the adjective 'civilian'. There is therefore no Treaty prohibition forbidding the Union to support defence research. If such was not the case, there would have been no need for the Horizon 2020 regulation to expressly restrict the programme's scope to civilian research[53].

Within the TFEU framework, the Union may fund research programmes through:

(1) a **multiannual framework programme (Article 182)** entirely funded by the Union

(2) a **'supplementary programme'** with ad hoc rules, involving the participation of certain Member States only (**Article 184**)

(3) the participation, in agreement with the Member States concerned, **in research and development programmes undertaken by several Member States**, including participation in the structures created for the execution of those programmes (**Article 185**)

(4) cooperation with third countries or international organisations (**Article 186)**

(5) joint undertakings or any other structure necessary for the efficient execution of Union research, technological development and demonstration programmes (**Article 187**).

In conclusion, defence research can be funded by the Union *on the legal basis of Title XIX TFEU* ('Research and technological development and space').

Initiatives under Article 187

Joint Technology Initiatives (JTI) are long-term Public-Private Partnerships and are managed within dedicated structures. JTIs support large-scale multinational research activities in areas of major interest. They are a means to implement the Strategic Research Agendas (SRAs) of a limited number of European Technology Platforms (ETPs). As part of an 'Innovation Investment Package' ten partnerships with the industry and Member States were proposed, and one more followed. The EU's contribution of €9 billion to the package will unlock a €10 billion investment from the private sector and €4 billion from Member States. Most of the funding will go to JTIs. These are run as Joint Undertakings that organise their own research agenda and award funding for projects on the basis of open calls. The table below gives an idea of the sums involved.

http://ec.europa.eu/research/jti/index_en.cfm?pg=home

[53] Regulation (EU) n° 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 -. Article 19-2: 'Research and innovation activities carried out under Horizon 2020 shall have an exclusive focus on civil applications
http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/fp/h2020-eu-establact_en.pdf

Innovation Investment Package - total investments (2014-20) (in € millions)

Joint Technology Initiatives			
JTI	**EU (Horizon 2020) + EU Member States (for Electronics only)**	**Industry**	**Total**
Innovative Medicines Initiative 2	€1725	€1725	€3450
Fuel Cells and Hydrogen 2	€700	€700	€1400
Clean Sky 2	€1800	€2250	€4050
Bio-based Industries	€1000	€2800	€3800
Electronic Components and Systems	€1215 (+ €1200 from EU Member States)	€2400	€4815
Total JTIs	*€7640 (€6440 from Horizon 2020 + €1200 from EU Member States)*	*€9 875*	*€17 515*
Joint Programmes with Member States			
Public–public Partnership	**EU (Horizon 2020)**	**Member States**	**total**
European and Developing Countries Clinical Trials Partnership 2 (EDCTP 2)	€683	€683	€1366
European Metrology Research Programme (EMPIR)	€300	€300	€600
Eurostars 2 (for SMEs)	€287	€861	€1148
Active and Assisted Living Research and Development Programme	€175	€175	€350
Total joint programmes	*€1445*	*€2019*	*€3464*
SESAR Joint Undertaking			
JU	**EU (Horizon 2020)**	**Eurocontrol and other members**	**total**
European Air Traffic Management System (SESAR)	€600	€1000	€1600
TOTAL			**€22579**

Source: http://europa.eu/rapid/press-release_IP-13-668_en.htm

4.3.2 What would be the added value of a European action, if any?

The 'EU added value' can be defined by what the Union can achieve that the Member States alone cannot. In the field of defence research, this added value would be multifold.

(a) The Union is the only entity capable of gathering the critical mass needed for defence research activities

As we saw, in order to start or maintain defence R&D activities it is essential to overcome the financial and technological entry barrier. Only three European countries – France, the UK and Germany, are able to put forward EUR 1 billion per year for defence R&D. The fourth one, Italy, only spends EUR 150 million a year on defence R&D, and other Member States even less. Thus, bringing a substantial financial support, the action of the Union could reveal decisive in preserving fundamental defence S&T and avoiding the risk of European missing on technology uptakes.

(b) The Union can provide budgets with greater certainty and predictability than Member States

Defence R&D and even more defence R&T is very often considered as an adjustment variable in the defence budget. It is indeed easier to cancel fundamental research programmes or even technological studies than reducing, delaying or cancelling major procurement programmes. Few individuals will protest against the abandonment of a study which has not been launched, whereas major industries will often join the military in lobbying against the reduction of procurement programmes.

This is particularly damaging because defence research needs continuous effort over a long period of time. Thanks to its 'rigidity' the European Multiannual Financial Framework guarantees a certain degree of predictability and protects EU expenditure – including a possible defence research programme – from the internal political turmoil of Member States.

In addition, Commission-led programmes managed according to a well-established and standardised set of rules ensure operational and financial accountability, and lay strong emphasis on evaluation. Political accountability vis-à-vis the Council and the Parliament is ensured through the standard budget approval process and discharge proceedings, whereby the risk of micro-management by Member States is lower than at EDA.

(c) The Union can bring up efficient governance in the field of defence research and better value for money

After ten years of experimentation within EDA, the intergovernmental method, with no use at all of the Qualified Majority Vote, has proven largely inefficient. First, conducting a defence planning process with limited financial resources implies to be able to make hard choices, which means being capable of giving up national preferences. This is hardly possible within a decision process where unanimity is the rule. Furthermore, the link between 'EDA's capability development plan' and effective implementation is too weak. In all these aspects the 'Community method' would certainly bring greater efficiency.

With regard to value for money, the 'cost of non-Europe' in defence procurement is well-documented. In 2013, the European Parliamentary Research Service issued a study on 'the cost of Non-Europe in CSDP'[54], in which the loss was estimated from EUR 26 billion a year on the basis of conservative calculations, to EUR 130 billion per year at the higher end. Tackling the problem at the root, through defence research, would be the best way for Europe to get more value for its money.

(d) A Union budget will ensure that all European countries share responsibility in defence research programmes

At the root of the process aimed at framing a 'common defence' lies the idea that all countries should contribute in due proportion of their importance, either in kind with sound military capabilities, or through budget commitments. This idea was reflected in the 'Permanent Structured Cooperation' (PESCO) model, imagined to compensate the effects of an all-out enlargement. This mechanism, similar to the Economic Convergence criteria, was supposed to ensure an equally proportioned contribution to the overarching goal of the common defence among those willing to participate. This idea is still workable, but it is in the hand of Member States, which have shown their aversion to engage in significant structural changes after the trauma of the two 2005 failed referendums.

To a certain extent, PESCO is based on the same idea as NATO's policy of 2 %[55] enacted at the Wales summit in 2014 (and advocated since long time ago by the US), with this big difference that NATO commitments are mere political commitments, whilst PESCO is a legally binding.

In the absence of PESCO, the Union budget will ensure that all countries participate in the common effort, with no free riders, and without adding burdens to national defence budgets.

[54] The Cost of Non-Europe in Common Security and Defence Policy – Blanca Ballester - December 2013 http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/494466/IPOL-JOIN_ET(2013)494466_EN.pdf

[55] 'The politics of 2 percent – NATO and the Security Vacuum in Europe' Jan Techau – Carnegie Europe – September 2015 http://carnegieeurope.eu/2015/08/31/politics-of-2-percent-nato-and-security-vacuum-in-europe/ifig

(e) A Union action plan will narrow the defence research gap among European Countries and facilitate the networking of Research and Technology Organisations

In exchange for their financial contribution through the Union budget all European Countries would be associated with the construction of the European defence research and technological base. The point is not to create research centres out of the blue, or duplicate existing facilities. On the contrary, the aim is to make smart investments, associate every stakeholder and above all, enable actual Research and Technology Organisations (RTOs) to act as a whole to avoid duplication.

The fragmentation of the European RTOs landscape is such that it is hardly possible to draw a table of all those organisations in order to assess the similarities and differences between them (see table below). The Security Research Programme has at least proved efficient in improving the coordination and networking among organisations that hardly knew each other's existence although they worked in complementary and sometimes similar fields.

Such results could also be achieved through a EDRP that would imply building a smart European layer in the field of defence research, which was the task originally assigned to EDA.

Major Research & Technology Organisations with Defence Research in their portfolios.

2014		Country	Turnover (M€)	Number of employees
AIT	Austrian Institute of Technology	Austria	131	932
CEA	Commissariat à l'énergie atomique et aux énergies alternatives	France	4 400	16 110
CNES	Centre National d'Études Spatiales	France	1 927	2 390
DLR	Deutsches Zentrum für Luft und Raumfahrt	Germany	846	7 730
DSTL	Defence Science and Technology Laboratories	United Kingdom	516 **	3 907
FOI	Swedish Defence Research Agency	Sweden	120 *	1 000
FRAUNHOFER	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung	Germany	2 060	23 800
IABG	Industrieanlagen Betriebsgesellschaft mbH	Germany	165	1 000
INTA	National Institute for Aerospace Technology	Spain	100	1 200
ISL	French-German Research Institute of Saint-Louis	France/Germany	52	375
ONERA	The French Aerospace Lab	France	207	2 001
SINTEF	Research, technology and innovation	Norway	303	1 876
TECNALIA	Research & Innovation Foundation	Spain	99	1 434
TNO	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek	Netherlands	526	3 009
UAR	Upper Austrian Research GmbH (UAR)	Austria	62	616
VTT	Technical Research Centre of Finland LTD	Finland	251	2 375

In alphabetic order, from open sources
* 2013 ** 2013/2014
Authors' own production - KT 2016

This list must be understood as a rough first overview only as fair comparison across institutions is very difficult due to issues in currency conversion rates, different definitions of the financial year, different reporting rules for finances and personnel, a wide range of organisational set-ups (from government agencies to non profit organisations), organisations with a broad spectrum of technical research areas including defence vs organisations with defence research only, etc.[56]

[56] University research is not included above. Procurement agencies like the French DGA or the British QinetiQ are composed mainly of 'experts' and not researchers, and therefore not listed.

5 Ways and means for a successful European Defence Research Programme (EDRP)

5.1 What should be the size of the EDRP?

There is no technical answer to the question of what the optimal size of a future European defence research programme should be. There is only a political answer to a political question: what is the Union's level of ambitions? Nevertheless, a number of elements have to be taken into account, considering the global environment as well as EU countries' own commitments.

5.1.1 Europe's strategic competitors

Viewed in a historical perspective, *Asia's share of global defence spending has more than doubled since 1990* from 9 % to 23 %, while Europe's share has dropped from 43 % to 23 %[57]. According to some analysts[58], defence R&D is the fastest-growing budget category in Asia, projected to rise by 29 % from 2014 to 2018. Some 77 % of the global increase in defence R&D through 2018 will come from China, India, and Russia. According to a 2014 Deloitte's study: 'China's declared policy commitment to reach the global defence technology frontier by 2020, demonstrated by the emergence of the J31 stealth aircraft, naval aviation, cyber capabilities, and a military space programme, has catalysed a region-wide move toward advanced defence technology, including naval aviation, precision strike, stealth, network communications, and cyber. The race toward the global technology frontier is seen as both an essential element of a defence policy, and a key contributor to economic development'[59]. Although it is not possible to obtain a reliable breakdown it can safely be assumed that China is investing massively in the field of Information Technology where it could most easily conquer a decisive operational advantage over the Western allies. Assuming that China invests in R&D about as much as the US and Russia (10 %) in percentage of its defence budget (USD 216 billion or EUR 197 billion) - a conservative assumption -, this means that in 2014, its defence R&D budget amounted to almost EUR 20 billion. This would be more than twice as much as all EDA countries together. Taking into account global R&D spending, including civilian research, according to some analysts, at current rates of growth and investment, China's total funding of R&D is expected to surpass that of the US by about 2022[60].

With regards to *Russia*, 'applied scientific research in the area of defence'[61] amounted to Ruble 286 billion (EUR 4,1 billion at 2015 exchange rate) in the 2015 budget while it increased to Ruble 311 billion (EUR 3,5 billion)[62] in the 2016 budget. The Russian Minister of Defence has 47 scientific institutions under its control. In addition to these efforts, Russia set up an 'Advanced Research Fund' starting in 2015 with a budget of circa EUR 200 million, which might be seen as a first answer to the 'third offset initiative'.

[57] Stockholm International Peace Research Institute (SIPRI), military expenditure database http://www.sipri.org/research/armaments/milex/milex_database

[58] Deloitte Global defense outlook 2015 p14 https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Public-Sector/gx-2015-deloitte-global-defense-outlook.pdf

[59] Ibid Deloitte Global defense outlook

[60] Battelle '2014 global R&D funding forecast' https://www.battelle.org/docs/tpp/2014_global_rd_funding_forecast.pdf

[61] http://www.minfin.ru/ and http://www.roskazna.ru/ According to SIPRI, the Russian defence budget amounted to USD 84 Bn (EUR 77 Bn) in 2014

[62] these values take into account the strong decrease in the Russian value: in 2015 the average exchange rate was 67,4 Ruble for 1 €, while it is today 85 Ruble for 1 €. But the effort must be seen in national purchasing power.

	In Rubble billion at current prices	2012	2013	2014	2015	2016
Defence		**1 864,6**	**2 107,6**	**2 495,1**	**3 383,9**	**3 145,1**
2.1	armed forces	1 394,2	1 622,6	1 917,9	2 665,6	2 233,6
2.2	force modernization			kept secret		
2.3	force readiness	7,3	6,8	6,7	6,7	5,4
2.4	economic readiness	4,9	5,7	5,4	5,5	3,8
2.6	nuclear	27,4	29,3	37,9	46,3	48,4
2.7	international commitments	6,6	5,8	5,8	9,8	9,5
2.8	defence research	170,8	197,8	241,3	284,6	311,2
2.9	other	253,1	234,0	274,4	346,5	363,4
	Defence research in percentage of the def.	9,2%	9,4%	9,7%	8,4%	9,9%

Authors' own production - FM 2016 figures from: http://www.minfin.ru/ and http://www.roskazna.ru/

5.1.2 Competitiveness within the North Atlantic Alliance

Although it is not yet clear how much new money will underpin the DII, Defense secretary Ash Carter has indicated that the budget request for 2017 would amount to USD 71.4 billion ***(EUR 63.7 billion*** at the current exchange rate) ***for R&D alone***[63].

In comparison, *European countries active in defence research are too few and do too little*. In the last six years for which EDA's statistics are available (2006-2011), the US effort has offset that of the Europeans one by EUR 275 billion with regards R&D, and EUR 40 billion with regards the R&T, even more if we refer to constant prices.

The U.S. is aware of, and concerned by the increasing technology gap within the Alliance and US DoD[64] has proposed to address it in two ways. The first is *specialisation*: 'as we don't need a lot of duplication, especially at the depressed defence levels that we have now (…) we need to be thinking as an alliance about the potential advantage in specialisation'. The second is 'to get all NATO partners to *respect the 2 percent level* of national output to defence, as agreed at the NATO Wales summit in Wales in September 2014'.

5.1.3 Commitments made at the Wales NATO Summit

At the NATO summit in Wales in November 2014 all Allies reiterated their long standing commitment to dedicate at least 2% of their GDP to the defence budget, and pledged in addition to aim, within a decade, to increase their annual investments to 20% or more of total defence expenditure'[65].

For 2015, the recent figures published by NATO show a little improvement as the decrease of expenditure on equipment (major equipment + R&D) has almost stopped (see annex 3).

[63] http://www.defensenews.com/story/breaking-news/2016/02/02/carter-unveils-budget-details-pentagon-requests-5827b-funding/79686138/

[64] 'Offset Strategy and its implications for Partners and allies' speech delivered by Deputy Secretary of Defense, Bob Work, 28 January 2015 http://www.defense.gov/News/Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies

[65] http://www.nato.int/cps/fr/natohq/official_texts_112964.htm?selectedLocale=en

2014	Defence expenditure		Equipment expenditure (R&D + major equipment)		Wales Summit Agreed defence expenditure at 2 % (minimum) of GDP			Wales Summit Equipment exp. at 20 % (min) of new def. Exp.		
In current prices	1 as % of GDP	2 USD Millions	3 as % of Def. Exp	USD Millions	as % of GDP	USD Millions	Effort to match the commitment	as % of Def. Exp	USD Millions	Effort to match the commitment
Belgium	**0,97**	5 192	**3,52**	183	2,0	10 689	**+ 5 497**	20,0	2 138	**+ 1 955**
Bulgaria	**1,32**	747	**1,03**	8	2,0	1 134	**+ 387**	20,0	227	**+ 219**
Croatia	**1,41**	805	**7,35**	59	2,0	1 144	**+ 340**	20,0	229	**+ 170**
Czech Rep.	**0,96**	1 975	**6,53**	129	2,0	4 105	**+ 2 130**	20,0	821	**+ 692**
Estonia	**1,93**	513	**22,15**	114	2,0	530	**+ 17**	22,1	117	**+ 4**
France	**1,84**	52 006	**24,74**	12 865	2,0	56 584	**+ 4 578**	24,7	13 998	**+ 1 132**
Germany	**1,19**	46 102	**12,94**	5 967	2,0	77 366	**+ 31 263**	20,0	15 473	**+ 9 506**
Greece	**2,20**	5 226	**8,17**	427	2,2	5 226	**0**	20,0	1 045	**+ 618**
Hungary	**0,87**	1 210	**7,76**	94	2,0	2 767	**+ 1 557**	20,0	553	**+ 460**
Italy	**1,09**	24 448	**11,17**	2 730	2,0	44 951	**+ 20 503**	20,0	8 990	**+ 6 260**
Latvia	**0,94**	293	**7,55**	22	2,0	626	**+ 332**	20,0	125	**+ 103**
Lithuania	**0,88**	427	**14,06**	60	2,0	968	**+ 541**	20,0	194	**+ 134**
Luxembourg	**0,39**	253	**22,61**	57	2,0	1 297	**+ 1 044**	22,6	293	**+ 236**
Netherlands	**1,15**	10 332	**10,68**	1 103	2,0	17 902	**+ 7 570**	20,0	3 580	**+ 2 477**
Poland	**1,85**	10 104	**18,84**	1 903	2,0	10 899	**+ 795**	20,0	2 180	**+ 276**
Portugal	**1,30**	3 003	**8,43**	253	2,0	4 602	**+ 1 600**	20,0	920	**+ 667**
Romania	**1,35**	2 692	**15,77**	425	2,0	3 981	**+ 1 290**	20,0	796	**+ 372**
Slovakia	**0,99**	997	**11,12**	111	2,0	2 005	**+ 1 008**	20,0	401	**+ 290**
Slovenia	**0,98**	486	**0,66**	3	2,0	990	**+ 504**	20,0	198	**+ 195**
Spain	**0,91**	12 614	**13,49**	1 702	2,0	27 627	**+ 15 013**	20,0	5 525	**+ 3 823**
UK	**2,20**	65 827	**20,25**	13 330	2,2	65 827	**0**	20,2	13 330	**0**
EDA countries	**1,48**	**245 252**	**16,94**	**41 545**		**341 219**	**+ 95 968**	**20,8**	**71 134**	**+ 29 589**
Denmark	**1,17**	4 056	**10,99**	446	2,0	6 913	+ 2 856	20,0	1 383	+ 937
Norway	**1,52**	7 336	**21,17**	1 553	2,0	9 669	+ 2 333	21,2	2 047	+ 494
Albanie	**1,35**	178	**16,65**	30	2,0	264	+ 86	20,0	53	+ 23
Turkey	**1,70**	13 583	**25,08**	3 406	2,0	15 968	+ 2 385	25,1	4 004	+ 598
NATO - Europ	**1,47**	**270 405**	**17,37**	**46 980**		**374 034**	**+ 103 628**	**21,0**	**78 621**	**31 642**
Canada	**1,02**	18 150	**13,03**	2 365	2,0	35 708	**+ 17 558**	20,0	7 142	**+ 4 777**
US	3,79	654 264	25,96	169 820	3,79	654 264	0	25,96	169 820	+ 0
North America	**3,37**	**672 414**		**172 185**		**689 972**			**176 961**	
NATO	**2,51**	**942 820**	**23,25**	**219 164**		**1 064 005**	**+ 121 186**	**24,0**	**255 582**	**+ 36 418**
NATO - EDA in %		**26,01**				**32,07**				
NATO - Europe in %		**28,68**		**21,44**		**35,15**			**30,76**	
NATO - North Am in %		**71,32**		**78,56**		**64,85**			**69,24**	

Authors' own production - FM 2016 Restated information from NATO w http://www.nato.int/SGReport/pr-2016-11-def-exp-tables_e.xlsx
Column 1 from NATO download 'defence expenditures of NATO countries(2008-2015) table 3
column 2 from table 2
column 3 from table 6 a
All others columns are deducted from the three previous ones

http://www.nato.int/SGReport/pr-2016-11-def-exp-tables_e.xlsx

Although the Wales Summit decision did not specify the respective portion of R&D and equipment in the 20% commitment, this would represent ***a massive increase in defence R&D for most EDA Member States.*** The table above shows that, starting from the 2014 situation, European countries members of EDA would increase their overall military expenditure by EUR 72.3 billion (USD 96 billion)[66] from which EUR 22.3 billion (USD 29.5 billion) would be in defence 'equipment' (major equipment + R&D). For some countries the step would be huge, especially as those European countries that should make the biggest effort are those that tend to spend less on defence.

If the same percentage of these additional defence funds was to be spent on *R&D* as currently (R&D represented 20.1 % of 'equipment' expenditure in 2013 as an average for the whole EDA countries – see table in 2.1.3. section), this would mean *an extra EUR 4.5 billion per year* for EDA countries from the 2014 level. For *R&T* (which represented 5.6 % in 2013 as an average for the whole EDA countries – same table in 2.1.3. section), this would mean *EUR 1.2 billion per year in additional funding*. Such an increase would then bring the EDA countries' overall R&T budget to EUR 3.3 billion per year, compared to the 2013 EUR 2.1 billion (same reference).

As mentioned above, as per the 'third offset initiative', the US might spend EUR 63.7 billion per year on defence R&D as of 2017. Should the proportion of US R&T on R&D remain at the same level as the 2006-2011 average (16.5% - see table in section 4.2.2.), this would amount to some EUR 10.5 billion per year for R&T, i.e. *approximately three times the EDA countries' yearly average if they respect their Wales commitment.*

Assuming that the critical size for a defence R&T programme is at least EUR 500 million (which is approximately what Germany spends on R&T per year) and so that the Union is on par with the Member States efforts, without surpassing them, it should invest *between EUR 500 million per year and EUR 3.3 billion per year on defence R&T* (EUR 3.3 billion/year = EDA countries R&T under the Wales commitment, as indicated above).

in billion Euro per year		R&D	R&T	
U.S.	2017	63.7	10.5	
from which DARPA	2015	2.7		
China	2016	20.0	?	
Russia	2016	3.5	?	
EDA participating Members States	2013	8.0	2.1	
Wales Summit Committments	2014	+ 4.5	+ 1.2	
EDA participating Members States + commitments		12.5	3.3	
critical size for an R&T programme			0.5	

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5.2 What should be the scope of the EDRP?

A question of utmost importance is how to allocate funding to the different areas of defence research.

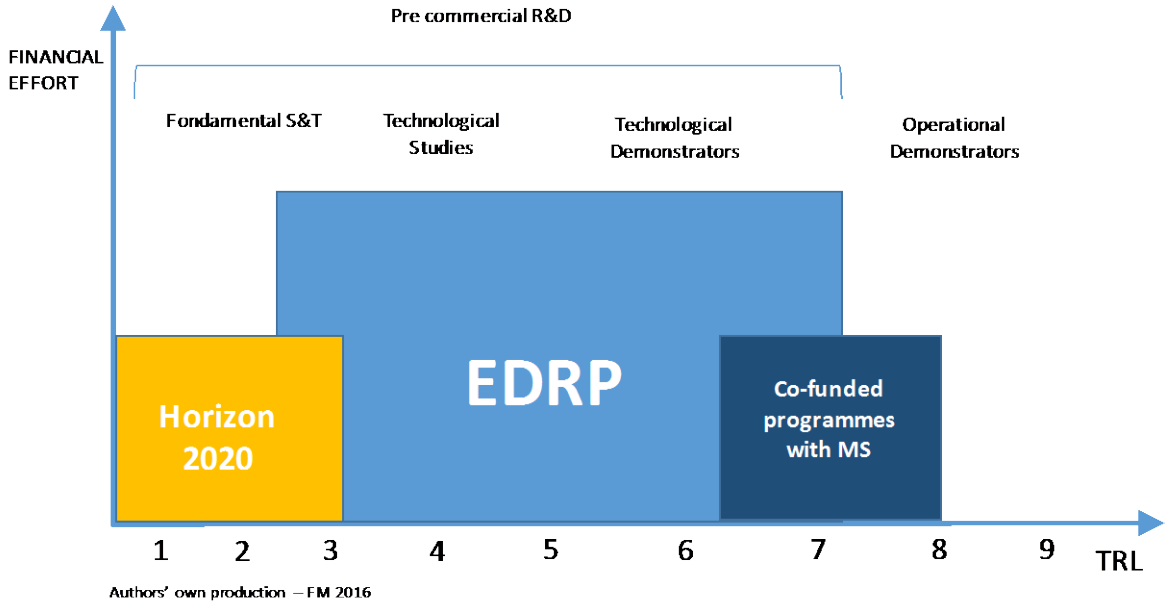
Taking into account that the technological race is a race against the clock, that Europe has already lost a lot of ground, and that it takes time to set up new programmes, acting within an exis ting and well-tested framework would be the most pragmatic way to start. As a first step, for the years 2018-2020, *an envelope should be dedicated to fundamental 'dual use' Science & technology (Technological Readiness Level*

[66] Fluctuations in exchange rates alter significantly the figures in euros. We used as average conversion rate the same rates than the ones used by NATO *i.e.* in 2014: €1 for $1.326 and in 2015 €1 for $1.119.

1 to 3) within Horizon 2020, to support existing infrastructures and academic Initiatives that are of specific interest for the defence community. This would allow European defence planners to take advantage of scientific progress and preserve long term capacity. Such programming would have to respect the legal boundaries of Horizon 2020. For instance, the Union could help maintain, renew and streamline aging national test facilities, such as wind tunnels, as they play a crucial role in experimentation and are totally 'dual use' compatible. It could also invest in critical military industrial capabilities such as advanced computing means, through existing networks such as PRACE[67], or electronic components through ECSEL's Joint Undertaking[68], optronics, lasers, infrared enablers, radars for space detection, robotics, artificial intelligence, communications, advanced manufacturing (3D-printing), new materials. In all those industrial sectors, European States, although having excellent researchers, are in great danger due to the lack of investment. The creation of new Joint Technological Initiatives (JTIs) might also be taken into consideration. This action should be taken as soon as possible in order to interconnect within the mid-term review and here the European Parliament might want to take immediate action.

As a second step, a *full-fledged European Defence Research Programme (EDRP)* should focus on technological studies funded exclusively by the Union. The main objective of this programme would be to reduce technological risks (TRL 3 to 7). The Preparatory Action will pave the way to establishing the most suitable governance arrangements for such a programme. Here again, time is short. Lessons learned from the PA will not be completely drawn when the moment will come to prepare the next Multiannual Financial Framework.

Finally, *co-funded programmes under the aegis of Article 185 of the Treaty on the Functioning of the European Union (TFEU)* could be launched with willing Member States, in order to bridge the way towards the highest TRLs and provide a link between Defence S&T and defence programmes. This could be implemented at a later stage, by 2023-2025.



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[67] Partnership for Advanced Computing in Europe http://www.prace-ri.eu
[68] http://www.ecsel.eu/web/index.php

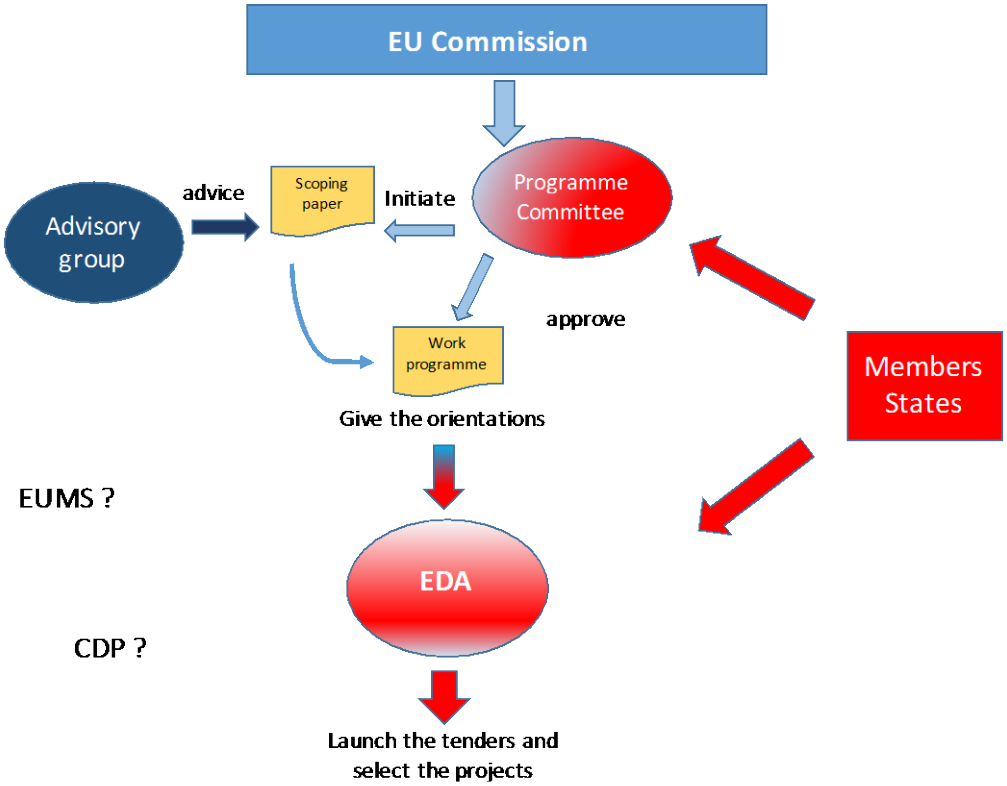
5.3 How to connect EDRP with the capability needs?

Several different options to set up the EDRP governance and management architecture can be considered, each with its drawback and benefits, from the easiest adaptation of Horizon 2020 arrangements, to the most difficult rethinking of the whole European defence programming process or even more pragmatic ad hoc solutions.

5.3.1 Adapt Horizon 2020 arrangements

Horizon 2020 legal basis and assessments are well documented as well by the Commission[69] than in recent documents ordered by the European Parliament[70]. Let's recall that the programme is ruled under an ad hoc Comitology process.

Thus, the easiest way to proceed in setting up the governance architecture of the EDRP would be to adapt the rules applying under Horizon 2020 through an ad hoc 'comitology' process.



In this scenario, Member States would be associated at the highest level (ministers or senior defence representatives) in a 'Programming committee' in charge of defining work strands through a 'Scoping paper', and to approve the results spelled out in a 'Working paper' once an 'Advisory group' (composed of representatives of relevant horizons, including industry), has been consulted. The Commission could chair the Programming committee, acting as a consensus-builder.

This process might seem attractive but we can also foresee some risks. The most important one being that all this process might give too much clout to industrial concerns and drive away the whole process from capabilities needs. For sure, the EUMC should play a more active role and thus allow the European Military Staff to have a constructive dialogue with EDA. Let us recall that Article 42.3 TEU states that EDA

[69] http://ec.europa.eu/research/horizon2020/pdf/proposals/horizon_2020_impact_assessment_report.pdf
[70] http://www.europarl.europa.eu/RegData/etudes/STUD/2014/536282/IPOL_STU(2014)536282_EN.pdf
http://www.europarl.europa.eu/RegData/etudes/STUD/2016/572678/IPOL_STU(2016)572678_EN.pdf

'shall participate in defining a European capabilities and armaments policy', not define it. If this risk proved realised, then we would have on one side a fully fledged programme with no link with the capabilities needs and on the other side a CDP, linked with the needs, but discarded because of the lack of money.

Another point is that if the Programme Committee is to be composed of high level politicians, the risk is to involve them in decisions that are not at their level might complicate the choices and open the doors to all sorts of trade offs. The same phenomenon might happen with regards the selection of the 'winners' and the 'losers' between all R&D projects. So it is crucial that every player plays the game at its best place and that the EDRP architecture to be designed does not make ministers play the role of armament engineers, nor industrials or think tankers define the 'political guidances'. A fruitful dialogue is absolutely necessary with personalities coming from all the horizons involved but might prove impossible at the highest level on a regular basis. Conversely it is essential that politicians have the first and the last say in the most important decisions and give the necessary impetus to overcome bureaucratic and nationalistic considerations at all levels.

The natural solution would be that the EDA keeps the elaboration the CDP and the EDRP funds will serve CDP's implementation. But then there will be no place for the Commission and the danger is to see the causes that have led to the present situation, produce the same effects. So it might be necessary reconsidering the whole process or, if that reveals politically impossible, find another solution.

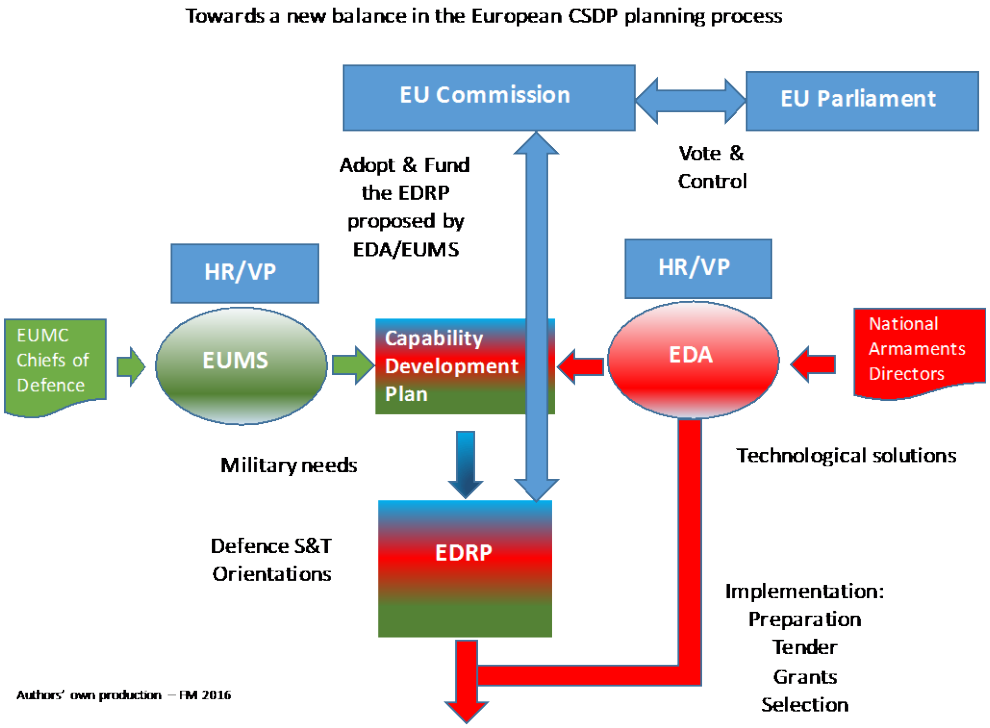
5.4 Reconsider the entire programming process

If the EDRP is to become a game changer, then the governance has to be designed around the programme and not conversely, adapting at the best existing institutions. Therefore, the logical steps should be as follow:

- Derive military needs from the 'political guidance' (defence sub-strategy or classified part of the defence sub-strategy). This should be done by EUMS under the direction of EUMC.
- Confront those needs with the technological solutions. This must be done through a dialogue between EDA technical directions and EUMS. It is a long and crucial part.
- Adopt the Capability Development Plan. On the basis of the dialogue, the CDP will be then adopted by the steering board of EDA at a qualified majority vote, according article 9.2 of the statutes.
- Work out a research strategy, which means:
    - Define the orientations
    - Translate those orientations in programmes
    - Breakdown the programmes into studies, projects and programmes
    - Launch the tenders for the studies, the projects and the programmes
    - Select them
- Parallel work out a Procurement Strategy (buy on the shelves, build, etc), submitted to Member States approval through EDA
- Apportion the targets among the Member States, submitted to Member States approval through EDA

The change in EDA governance might not lead to dramatic statutes changes. Rather, it would be a big change if only the rule of qualified majority under Article 9.2 of the Statute was applied.

The 'research strategy' will be submitted to the Commission that will adopt or amend it and finally fund it proposing the Parliament to vote the EDRP. The European Parliament would be then in measure to vote the EDPR and ultimately control the Commission through EDA.



5.4.1 Or move to more 'pragmatic' solutions

If the Member States oppose the EDA's evolving towards an authentic Capability, Research and Armament Agency, then the Union should consider the possibility of putting the new programme under the aegis of EEAS, but there is some doubt that this solution could be achieved within the current legal framework and it would be politically difficult to achieve in the current political situation. Another solution could be to consider the creation within the European Commission of a *CSDP General Directorate* and above it of a CSDP commissioner which does not requires a modification of the treaties. Certainly that might be seem as politically 'out of bounds' or over ambitious in the current context. Viewed in historical perspective it does not seem to be such a 'transformational' change and one of the greatest danger or the Union at this very moment of its history might be well the lack of ambition.

As a solution of last resort the Union should consider handling the future EDRP through a *Joint Undertaking/Joint Technology Initiative* following the SESAR pattern. This might be the easiest and best adapted solution to ensure an effective governance for EDRP. Indeed, based on the success of the JTI/ JU, and notably ECSEL and SESAR it be possible to envisage a *Publicly-led joint undertaking*, with tailor-made governance, which would associate the Member States, the European Commission, military, research associations, industrial associations, equipment manufacturers, defence clusters, European regions... The board could be chaired by the European Commission, representing the Union (like SESAR). Many solutions can be envisaged within this framework.

5.5 How to connect EDRP with armament programmes?

After decades of budget cuts, Defence industry is aspiring to more procurement programmes, not to research. However, defence R&D must precede procurement if European nations want to make the best use of their scare resources and acquire equipment of the highest quality in a relentlessly competing world. Using EDRP to finance defence industry, would be like using a screwdriver to paint a room.

Therefore, the European S&T strategy must be drawn from a reinvigorated CDP and give birth to substantial cutting-edge programmes and not 'third tier' programmes that the Member States do not want to finance. In this regard, it is regrettable that the Union is not involved in the Future Combat Aircraft System, as it is doubtful that, in the end, either France or the UK will have the capacity to finance a full-fledged programme. The same can be said about the RPAS.

Three actions should be considered.

5.5.1 Co-finance some major projects with the Member States

The first way to bridge European defence research with armament programmes would be the co-financing by the Commission and those Member States willing to bring into completion the results of common technological studies, of operational demonstrators under article 185 TFUE. The goal is to embark the final customer on board and the best way to achieve this goal is to embed the Member States in pivotal programmes for them, that will also fit in the CDP they would have contributed to define.

5.5.2 Merge EDA, OCCAR and LoI-FA

Merging EDA, OCCAR and LoI-FA is more than an 'old idea'. It was actually the original idea of the EDA's early initiators that the creation of the Agency would supersede all other existing structures[71]. At the national level, no country has ever split its procurement process between three bodies: one in charge of defining capability needs, one in charge of the research strategy, and one in charge of the procurement strategy, which is the case at European level at present. Bringing to EDA OCCAR's expertise, its know-how and experience in implementing collaborative projects could probe critical to the success of the programming process. Obviously, the merger should not lead to breaking down what works, but on the contrary to taking the best out of the two organisations. This could be done before the next MFF.

5.5.3 Enable the Union to acquire dual assets

The second idea that should be considered is the possibility for the Union itself to acquire some major equipment, as it has done through the Space policy with the acquisition of the Galileo or Copernicus satellites. For instance, it is astonishing that the property of the future MRTT fleet will be entrusted to a NATO agency and not to the Union. It may be possible to attribute this competence to the EDA, provided that the reforms proposed above are carried out. Alternatively, a dedicated structure could be created. The GOV-SATCOM project could be the second programme to be owned by the Union. MALE Drones for the surveillance of the Union's external border is another working strand that might be explored. On the same strand, recent efforts that have led to offer EDA the same fiscal incentives than the ones NATO's agencies benefit from shall be pursued.

5.6 How to involve Member States in the EDRP?

The role of the Member States in CSPD is crucial. As stated by article 42.1 (TEU): 'the performance of these tasks (CSDP) shall be undertaken using capabilities provided by the Member States'. So as long as a European army does not exist, the Member States, have to provide forces. That said, the Union can play a critical role in *supplementing* Member States' actions with tools that they lack or *complementing* their financial efforts in strategic sectors.

[71] Final report of working group VIII – Defence to the European Convention December 2002 item n° 54 http://register.consilium.europa.eu/doc/srv?l=EN&f=CV%20461%202002%20INIT item 64 – quoted in section 2.1.2.

5.6.1 Invest in the industrial sectors that are crucial for strategic autonomy

As argued earlier, one of the European Union's greatest 'added value' is bring the necessary critical mass to maintain technological sectors essential to strategic autonomy and to invest in new sectors.

It is obvious that Member States are striving to maintain a full spectrum of their most valuable and critical industries. Many examples spring to mind: optronics, radar, lasers, precision-guided munitions, advanced computing, robotics, just to name a few.

The Union can make a difference and leverage Member States' efforts. The question of whether EDRP should be 100 % EU-funded or a shared cost is secondary in a first stage. At the outset, a pragmatic approach should be followed and the bodies that will implement the programme given the latitude to decide on a case-by-case basis.

5.6.2 Help the Member States to maintain their most fragile links in their defence research ecosystem

Confronted with dwindling budgets, some Member States have had the temptation to cut the funding committed to the long term investments in order to preserve more immediate and tangible needs. In this respect, the Union's help might be decisive in two sectors: academia and SMEs.

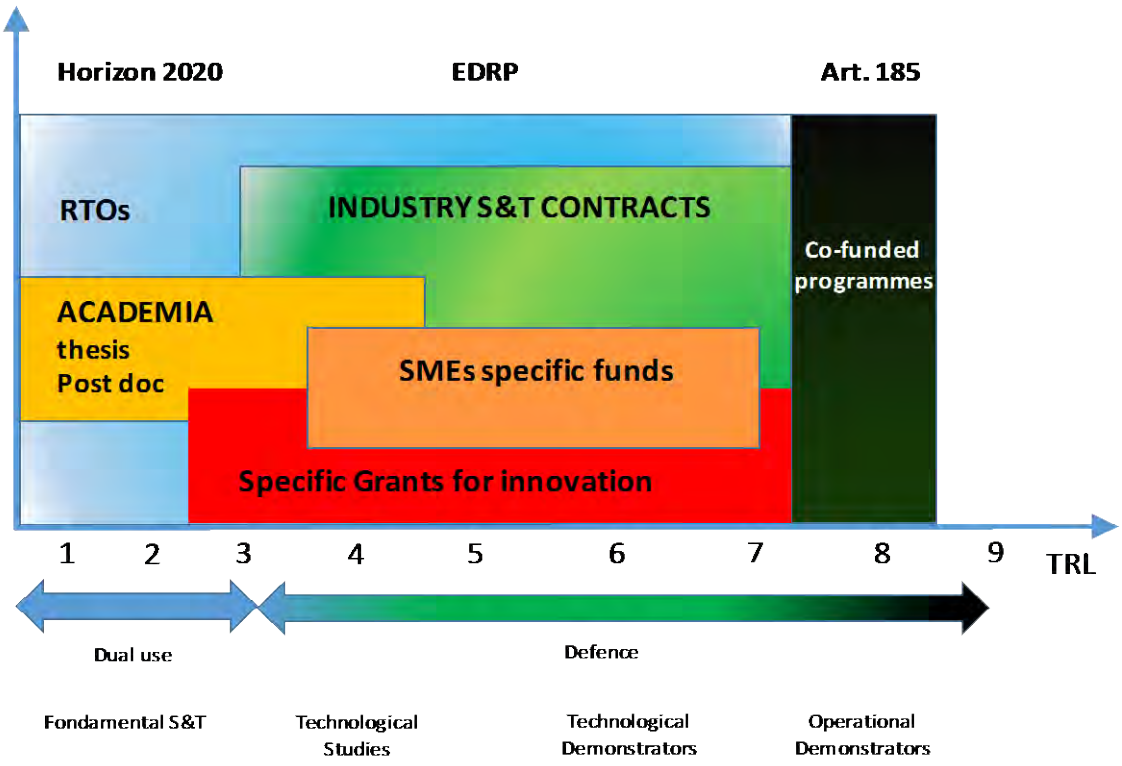
The link between academia and defence research is in Europe is too weak and it must be strengthened. That can be done with the help of RTOs which role is to mature low TRL ideas and bring them to industry, through scholarships, the creation of university chairs[72] through partnerships between the State and industry, and more broadly, by offering innovative researchers the possibility to contribute to defence through grants at European level. What is done in France by the French DGA through the 'ASTRID' [73] programme might be a good model to follow in terms of grants for innovation.

The *importance of SMEs in the field of defence is a well-documented topic*. Sustaining SMEs is not a question of ticking a box in a 'comprehensive action plan'. SMEs are vital for defence innovation and disruptive technologies. The drone revolution springs immediately to mind, just to name one example. This is the reason why some countries have technological clusters involved in the field of defence. Typical examples are in France, the Aerospace Valley in the Aquitaine region, cluster EDEN in the Provence region, the 'safe cluster' in the Rhône region[74], etc[75]; in Germany, the Ludwig Bölkow Campus near Munich, the Cluster Aerospace BavAIRia, Arbeitskreis Mittelstand (AKM) der Deutschen Gesellschaft für Wehrtechnik. Many other examples could be put forward in others Europeans countries and many SME are also members of bigger clusters such the European Aerospace Cluster Partnership[76] in Germany, or GARTEUR[77] and ACARE[78] at a European level.

A defence research programme should build on those clusters. This could be done, e.g. through specific programmes associated with simplified procedures for the funding of innovative ideas. The 'Rapid' mechanism used by the French DGA could be an inspiring model[79].

In substance, the EDRP must cover all provinces of innovation, using all available tools.

[72] France 2013 http://economie-defense.fr
[73] https://www.ixarm.com/-L-accompagnement-specifique-des,55079-
[74] http://www.aerospace-valley.com ; http://www.edencluster.com ; http://www.safecluster.com
[75] https://www.ixarm.com/-L-accompagnement-specifique-des,55079-
[76] http://www.eacp-aero.eu/index.php?id=33
[77] http://www.garteur.org
[78] http://www.acare4europe.com
[79] https://www.ixarm.com/-RAPID-



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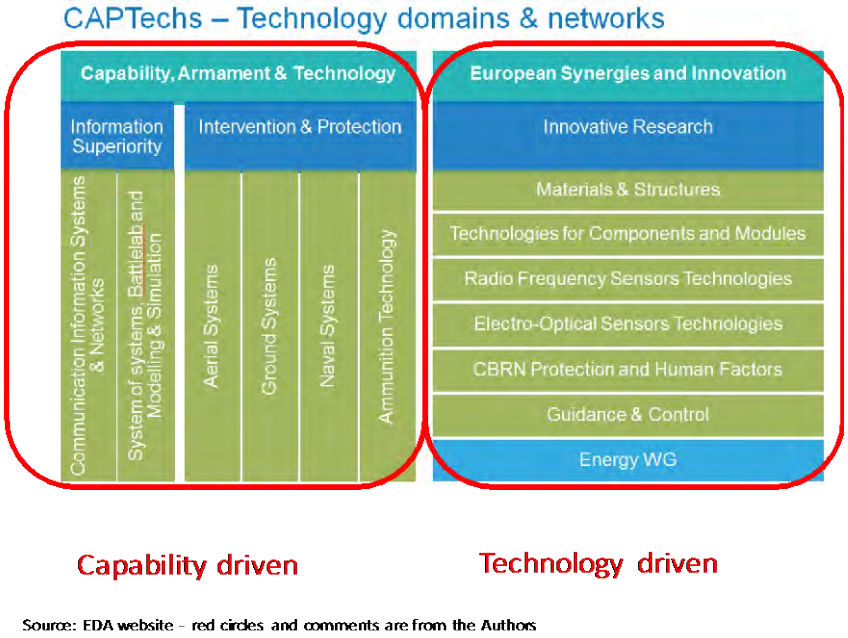
5.6.3 Make EDA a centre of excellence at the disposal of the Member States

One of the crucial abilities that Member States lack is the capacity to confront their capability needs with technological solutions, precisely because they do not invest enough in defence research. Making EDA a pole of excellence would benefit the vast majority of Member States, even the larger ones. In the past EDA has already tried to find the right recipe for confronting the analysis of the capability needs and the technological solutions. The 'captech'[80] working groups must be seen as a attempt to create a matrix between capability and technology. To some extent, this attempt is a success.

[80] A **Capability Technology group** ('CapTech') is a working group of the EDA Research & Technology Directorate dedicated to a particular technology area. The purpose of a 'CapTech' is to generate collaborative R&T Projects within its technological scope, and to support EDA participating Member States in the preparation of wider programmes.



Source: EDA website - red circles and comments are from the Authors

Yet, there is a general sense that EDA does not bring enough added value to Member States in this particular and crucial area. EDA appears to have jumped too quickly from the capability analysis to the programmes, without investing in the long and rigorous preparation phase (convergence of the needs and the solutions); it also appears not to have invested enough in building its relationship with its Member States. A degree of mistrust vis-à-vis the Agency is perceptible at present.

A major difficulty is that in order to become a centre of excellence, EDA should invest more in human resources. This has been impossible with a budget capped for six years in a row. This needs to change, whilst care has to be taken not to transform EDA into an obese body. After all, DARPA's personnel is only 219, against 125 for EDA. However, DARPA's budget is EUR 2.7 billion while EDA's is only EUR 30 million. EDA should not only be better resourced; it should probably be transformed into an entirely different organisation. The merging with OCCAR may be a good solution to increase quickly and efficiently EDA's critical size.

In addition, it is noticeable that EDA personnel are not under the general provisions of the Union civil service, which might lead to instability and thus make more difficult the hatching of a long term vision within the Agency's directions.

5.7 How to incentivise European defence industries to play the game?

European defence industries will benefit from EDRP at least in three ways:

- They will have the possibility to use the innovations and discoveries made by defence RTOs, academia, SMEs and more broadly 'innovators';
- They will be directly financed to produce technological studies or operational demonstrators;
- They will be the main producers of the military programmes that will follow up the research strategies.

At the same time, those industries seem reluctant or at least cautious towards the EDRP. There are two main reasons for this. The first is that, as funding will come from the Union, they fear the spread of their Intellectual Property Rights through other countries and then the creation of 'copy cat' companies. The second is the lack of trust with regard to confidentiality rules. Addressing those concerns in detail would go beyond the scope of the present study. However, they will have to be taken seriously into account as they buy-in from defence companies is essential to the success of EDRP.

But the main reason why Defence industries might be reluctant to buy-in is the fact that they doubt having a strong commitment to the fact that the heavy investments they will consent are followed by sound commands. In other words they must have the assurance that there will be a 'market' for their efforts and not invest their money in 'may be one day' technological ventures. That is why the previous point is crucial.

5.8 How to include EDRP within a comprehensive defence action plan?

In order to be efficient a future EDRP must be included in a comprehensive approach that encompasses all aspects of the problem and brings together elements of different policies (internal market, CSDP, research etc.) in a coherent way.

The '*European Defence Action Plan*' to be presented by the European Commission before the end of 2016 will certainly make an important contribution in this regard. In anticipation, we would like to draw attention on some aspects that we consider essentials to the success of a future European Defence Research Action Plan.

5.8.1 Connect the capability needs with the strategic planning

With regards to European defence planning, the Union has almost strategic planning instruments at its disposal (see annex 2). It already has a 'capability development plan' revised by EDA in 2014, and will soon have a 'global strategy', which is under definition under the aegis of HR/VP Federica Mogherini. What the Union does not have is a strong articulation between those strategic documents.

In terms of strengthening the European strategic path, it is crucial that once the 'global strategy' has been drawn, a 'defence sub strategy' is derived to address in detail the question of what the Union wants to be able to do militarily. This document is essential in order to give the 'political guidance' necessary to define 'the performance of (the CSDP) tasks (that) shall be undertaken using capabilities provided by the Member States' (article 42.1 TUE) and thus anchor the Capability Development plan.

On the basis of this 'defence sub strategy', a new Capability Development Plan should be drawn. Indeed, the current CDP suffers major flaws:

- it reflects a bottom-up approach in which Member States tend to put all the minor projects that they do not want to carry out at a national level;
- it is not anchored in a political document which sets the level of ambitions;
- the input of the military point of view is weak; national military staffs do not take sufficient interest in the European CDP, and the action of the EUMS is too limited;
- there is no apportioning of the burden among European countries;
- there is no review process of CSDP planning within the EU;

More broadly, a CSDP defence planning should be organised on a regular and cyclical timeline. A regular review of the European Security Strategy should be made every five years, coinciding with the beginning of a new parliamentary term and after due consultation with the European Parliament.

Within the new CSDP defence planning, the creation of an *ad hoc* 'task force' on Technology, Strategy and the Defence Industry might be considered to advise the Commission at a strategic level in drawing the defence-sub strategy on the pattern of the 'Commission du Livre blanc' in France. It might be designed on the GoP pattern.

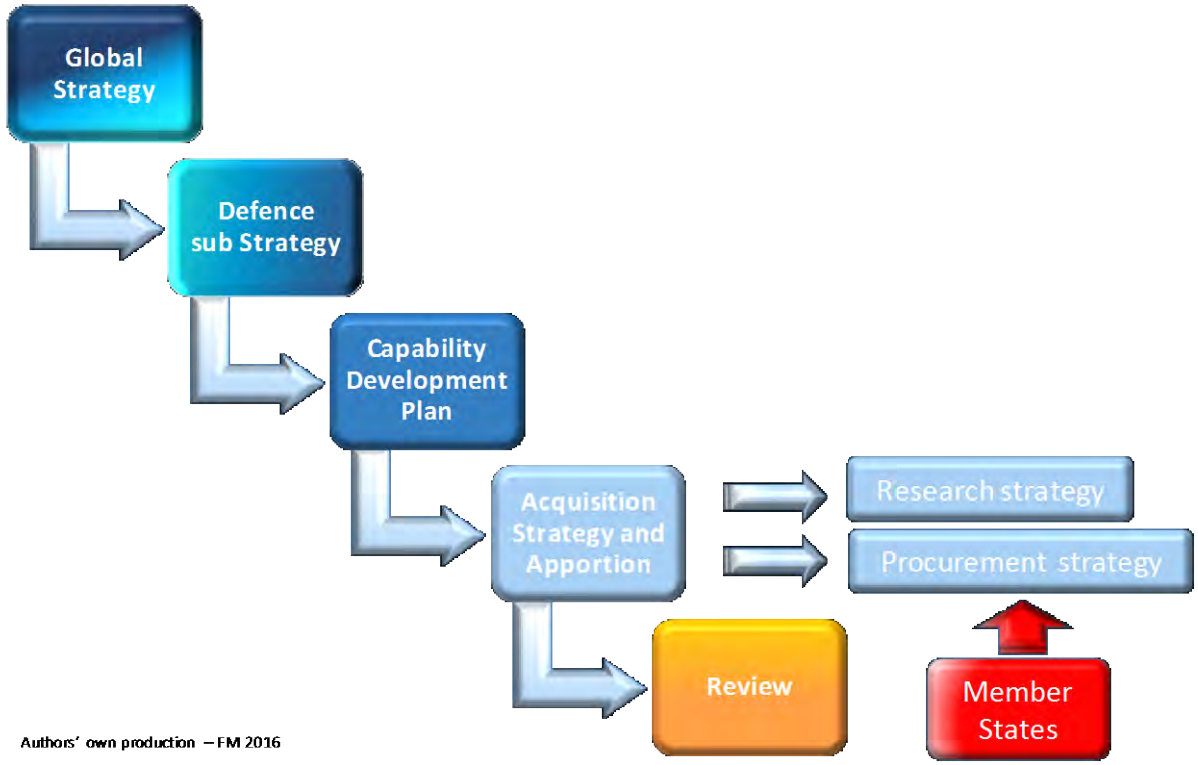
A permanent 'advisory board' including Industry should be set up in order to advise official bodies on how to break down defence research orientations into concrete programme, what is key for the success of the entire programme.

Thus the new CDP should start with the 'defence sub-strategy' in a 'top-down' approach. What is done in NATO with the 'Minimum Capability Requirements' (MCR) plan could also be done within the Union to define the CSDP capabilities. By march 2016, the new MCR will be presented. In April 2016 the review of the previous targets should be finalised and by June 2016 a new set of 'target packages' should be adopted.

Of course, the EU should coordinate with NATO. However, the risk of 'duplication' with the NATO process seems rather low. The tasks assigned to CSDP are quite different from the collective defence that shall remain the main task of NATO.

The role of the EUMS in defining the new Capability Development Plan should be reinforced in order to make sur that the military needs are really taken into account.

At the end of the road, it seems inevitable to avoid elements of specialisation in the acquisition of capabilities. The question is whether European countries prefer to specialise among themselves or with the US. Both are certainly possible, but have very different implications in terms of the degree of 'strategic autonomy' which they would enable Europe to pursue.



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5.8.2 Address all the legal aspects connected to the EDPR

The Commission has already taken action to reduce the fragmentation of the market through the 2009 defence directives (Defence Procurement and Intra-EU Transfers). This action may be pursued taking into account the implementation reports on those two directives.

One important element of the regulatory aspects connected with defence research, is the absence of definition of a European Economic operator for defence's sake. This is a very delicate matter, because of the fear of some countries to see a resurgence of protectionism, which will alter their freedom of choice. For this reason, this definition was avoided when the Defence Procurement Directive was drafted. Non-European companies may therefore bid for European procurement contracts, making the European Defence market one of the most open in the world.

The question will arise again with the EDRP: how to make sure that the corporations that will apply for the research programmes are true European companies and not shadow creations of world competitors?

The best response would be to lay down the definition of a '*European Defence Research Entity*' *(EDRE)* so as to make sure that 'European money goes for European value'. No country in the world acts differently.

Of course, all the other legal aspects like IPRs aforementioned should be addressed as well in this legal section of the EDRAP.

6 Potential benefits of an enhanced support for the defence research

6.1 Within the Union

Security threats both outside and inside Europe have had substantive effects on the European mind set on defence. Defence is not seen any more as a scarecrow, but as one of the essential ways to preserve peace. Those changes in opinion are slow, but profound. If defence matters, lonely roads are a non-starter for European countries. No European nation can stand alone in the global competition. The Union strength lies in solidarity.

Viewed in a pragmatic way, the defence research action plan might well be a smart tool to reconcile those countries who favour Europe but do not like defence and those who strongly want defence but doubt about Europe. This is why the EDRP has to be significant in size, comprehensive in scope and above all, must benefit from the best possible management and governance. Such a programme would be a good opportunity to redress incoherence in the way the EU addresses the 'D' of CSDP: strategic thinking could come before operational needs definition, and those needs before the procurement process.

But surely one of the best effect of such a programme would be to bring progressively all interests together, putting an end to the division between defence consumers and defence producers, and bridging the technological division within the Union. It is crucial to make the Union capable to act as a whole, as a proper Union, and not as the collection of national countries trying always to preserve their national interests from a body they see as alien.

The best way to reach this overarching goal is to openly discuss it. And what would be a better place to discuss political matters than a Parliament?

6.2 On the EU-NATO relationship

Viewed from NATO and at a strategic level, it has been confirmed to us that a significant defence research programme in the EU will be most welcomed, given that it would strengthen the investments in defence research made by 22 European Allies.

Initiatives in favour of European defence shall not be seen as opposed to NATO. EU and the US are rock solid allies and there is no reason for this to change because the EU would develop a defence research action plan, on the contrary. In 1995, US defence expenditure amounted to 59 % of Alliance defence expenditure. In 2015 the proportion was around 73 %. The same year, the European country which spends the most on defence, the U.K. accounted for 6.56 % only of the Alliance total

Viewed from a practical point in the context of an EDRP, NATO, mainly through its 'Science & Technology Organization (STO)' and the EU could develop their cooperation, providing opportunities to increase the leverage of the S&T investments made by the Members States (and the Union). Close relations already exist between STO and EDA staff through cross participation at important events and staff-level meetings on a regular basis, and they could be built upon.

The NATO Science & Technology Organization (STO)

The North Atlantic Council approved the NATO S&T Strategy in January 2013. In a nutshell, this Strategy encourages reinforced collaboration across organisational boundaries and fosters the sharing of scientific knowledge and technology innovation to ensure that NATO S&T fully supports Alliance core tasks as expressed in the Alliance Strategic Concept. In this regard, it is worth noting that NATO STO teams from the Centre for Maritime Research and Experimentation (CMRE) are known to have bid on Horizon 2020 tenders and on.

The NATO Science & Technology Organization (STO)

The STO plans, executes and delivers a programme of work that covers the full spectrum of defence and security related S&T. This programme contributes to capability development, supports threat mitigation, and provides advice to decision makers. The STO welcomes participants and contributors from Allied and Partner Nations, coming from government, industry, or academia. In pursuing this mission, the STO positions S&T to the strategic advantage of Nations and NATO, thereby supporting the core tasks of the Alliance.

The Science & Technology Board

The STO is governed by the Science & Technology Board (STB), a committee that comprises the senior national defence S&T managers. In addition, most NATO stakeholders in S&T are represented.

The STB is responsible for developing and maintaining the strategic guidance for S&T in NATO, promoting synergies across stakeholders while respecting their individual responsibilities and authorities. Internal to the STO, the STB oversees policies and management.

The NATO Chief Scientist

Leadership of the STO is exercised by a single authority, the NATO Chief Scientist. He chairs the STB and serves as the scientific advisor to senior NATO leadership.

He is supported in these functions by the Office of the Chief Scientist (OCS) at NATO HQ in Brussels, Belgium.

Delivering a Programme of Work Through Multinational Collaboration …

The STO delivers the largest S&T programme of work within the NATO framework. This programme is designed to promote multinational collaboration that augments each contributor's resources by leveraging the knowledge, skills, and investments made available by all contributors. It is predominantly funded by participating Nations in line with their individual objectives; to a lesser extent, it is funded by NATO directly in support to overarching Alliance objectives. The delivery of this programme rests on two pillars that are critical assets for the STO's mission success: a network of subject matter experts and a dedicated research laboratory.

… in a Network

With over 4,400 active participants per year, the STO is home to the world's largest network of defence and security scientists and engineers.

This network is structured in seven domains, each embracing a broad spectrum of scientific fields, each designed to address all militarily relevant aspects:

- Applied Vehicle Technology (AVT)
- Human Factors and Medicine (HFM)
- Information Systems Technology (IST)
- Modelling and Simulation Group (MSG)
- Systems Analysis and Studies (SAS)
- Systems Concepts and Integration (SCI)
- Sensors and Electronics Technology (SET).

For each domain, a committee of national defence S&T managers and experts is responsible to the STB for planning and executing the S&T activities it contributes to the STO programme of work.

In each domain, several hundred national subject matter experts are actively engaged in the successful execution of commonly agreed S&T activities such as joint research projects, conferences, workshops, lectures, or technology demonstrations. Every year, the STO runs well over 200 such activities.

In what is "smart defence", NATO S&T stakeholders use their own resources to generate the CPoW, and focus their efforts on Nations' and NATO's priorities, together with NATO staff.

NATO provides executive support to this network and its programme of work through the Collaboration Support Office (CSO), located in Neuilly-sur-Seine, France.

… in a Research Laboratory

The Centre for Maritime Research and Experimentation is a maritime S&T establishment particularly focussed on the underwater domain. By collaborating through the Centre and pooling the investment in infrastructure, Nations can reduce the cost of innovative work to reduce life-cycle operation costs and improve performance of downstream systems.

Using its own capabilities, infrastructure and personnel, the Centre carries out projects and experiments for its customers to deliver military-relevant, state-of-the-art, scientific research and technology development. The main customer to date is NATO, through ACT.

The projects advance the basic understanding and naval capabilities needed to operate effectively and efficiently in the maritime domain, and facilitate interoperability in future naval systems, both conceptually and in practice.

The key enablers for delivering the CMRE's programme are its vessels: the NRV Alliance and CRV Leonardo. With year-round access to the ocean and state-of-the-art scientific laboratories, satellite communications and reconfigurable deck equipment, experimentation can range from concept development through to prototype demonstration in NATO and multinational maritime exercises.

The Centre is the STO's customer-funded executive body. It is located in La Spezia, Italy and its main customer is NATO, through ACT. It is expanding its activities into other domains to meet customers' demands.

6.3 On the EU-US relationship

There is no reason to think that US RTOs or armament corporations would have anything to fear from a more active European defence research sector. In front of the 'third offset initiative', if Europe wants to be a committed ally and a true partner for the US, then it has to raise significantly its level of ambitions with regard to defence. By any measurement, the gap in State funding between the US (EUR 67 billion) and the EU (no money from the Union, EUR 8 billion from the Member States), is so wide that we cannot see the EDRP becoming an irritant in a context of the US deservedly asking for more European defence expenditure.

Problems might arise if the EU were to limit access to EDRP contracts to 'European Defence Research Entities according to a definition it might adopt, as we suggest. In this regard, it should be considered that the American defence market is highly protected by uncompromising rules and practices, as well documented during the attempted merger between BAE and EADS[81]. Indeed, its level of protection has been increasing over the years. The US has recently carried out a major reform of its procedures motivated by security considerations, but also to strengthen the attractiveness of US industry vis-à-vis European contractors. After strengthening the implementation of existing measures to control exports of sensitive goods during the first decade, from 2009 onward, the United States led a comprehensive reform of its legislation on military equipment, which entered into force in April 2013.

In a nutshell, the list of equipment controlled under ITAR[82] has been completely rewritten. Export control of military equipment's that does not meet these new criteria has been transferred to EAR[83] under the

[81] http://www.publications.parliament.uk/pa/cm201213/cmselect/cmdfence/writev/bae/m03.htm see point 4
[82] International Traffic in Arms Regulations – Department of State

control of the Department of Commerce, in which a specific category called '600 Series' was created to accommodate them. Special category '9A515' was also created for the civil use of space equipment transferred from ITAR to EAR.

Until recently, ITAR discouraged European prime contractors from using US suppliers, and to some extent favoured the existence of a European supply chain. By removing the constraints posed by ITAR on very sensitive materials, the US export control reform reverses this perspective: the attractiveness of the US supply chain is increased whilst the restrictions of non re-export imposed in intra-EU transfers hamper European suppliers.

Protection of the American Defence market

Department of Defense markets like other public contracts from the US government are subject to restrictive regulations that aim to protect American socio-economic interests and to limit the participation of foreign companies. These protectionist measures can be taken by the President of the United States under the recommendation of the International Trade Commission, by Congress into law or by the Department of Defense directly through Directives or for national security needs.

The main direct restrictions on the access of foreign companies to US government procurement is related to provisions of two laws :

- The Buy American Act for public supply and construction (but not services)

- The Balance of Payment Programme), which is exclusively for public contracts for goods intended for use abroad

The Defense Department can restrict access to defense contracts to foreign exporters in the name of national security under the National Security Act 1947 and the Defense Production Act of 1950. The DoD may impose American sources for certain products or activities, particularly within the Defense Appropriation Act, the set of annual financial laws passed by Congress. To this must be added an arsenal of texts to support American industries and thus hamper competition: The Small Business Act 1953, which requires the administration to reserve SMEs / SMIs 23% of its direct federal procurement and 35 % of contracts outsourced to its industrial prime contractors. Other indirect measures hinder imports or curb foreign investment in the United States. These are related to norms, standards, complex regulations, particularly stringent safety constraints, etc. All these regulations are transposed for the Defense Department into the Defense Federal Acquisition Regulation Supplement (DFARS).

For more details see– http://www.senat.fr/rap/l10-306/l10-306.html annex 1 - French Senate - Rapport n° 306 (2010-2011) de M. Josselin de Rohan, le 15 février 2011 sur le projet de loi relatif au contrôle des importations et des exportations de matériels de guerre et de matériels assimilés, à la simplification des transferts des produits liés à la défense dans l'Union européenne et aux marchés de défense et de sécurité

Whilst remaining a committed free marketer, the European Union would be well-advised to use in the field of defence the first and most important principle in international relations: the principle of reciprocity.

[83] Export Administration Regulations – Department of Commerce

7 Conclusion

European defence research is coming close to an agonising point of no return. Its death is a silent one. Few persons will ever complain about a technological study which has not been made or a technical demonstrator that has not been launched. Whereas European defence budgets have been severely curtailed between 2006 and 2013, European R&D has decreased twice as fast, by a staggering 29 % over the same period; today it represents only EUR 8 billion per year. With 8 % of total European R&T, collaborative R&T barely exists. Three countries in Europe concentrate the defence S&T effort: France, the UK and Germany (92 % of European R&D and 86 % of R&T in 2013).

Should the trend not be reversed soon, in fifteen years, Europe will be no more than a mere customer of the US defence industry. Europe's efforts to gradually acquire greater strategic autonomy – a key aim of the CSDP – will remain vain. Shared European and US aspirations to achieve a greater balance of contributions within NATO will remain as unachievable as ever. European countries will remain legally 'sovereign' but militarily unable.

Time has come to change our stand. In 2004 EDA was created to make a difference in the quality of the European defence effort. After ten years, there is broad agreement that EDA has not 'delivered'. The responsibility, we have argued, lies primarily with the Member States, which have kept the Agency under a tight leash and largely paralysed it via a unanimous mode of decision-making. It is the time for the Union to get involved in Defence Research. If not now, later will be too late.

The Pilot Project and the Preparatory Action are heading in the right direction, but they are only test tools. This is why, no time should be lost in putting a full-fledged European Defence Research Programme on the right track. For this, the size of the programme needs to be set at a level in accordance with the Union's level of ambitions. Second, the governance of the programme should be tailored according to the aim it pursues, not just use the existing bodies as they are. Applying the qualified majority vote at the EDA Steering Board – which requires no legal change - might prove a game changer. Third, the European defence planning process should be strengthened. All the major elements are already there but they need to be articulated more strongly and coherently. Finally, the gap should be bridged between research and procurement by co-financing operational demonstrators.

Many observers will focus on the question of the size of the EDRP. However, the real question is not 'how much?' but 'what for? And 'how'? The end of financing defence research is to allow Europe to maintain and expand its 'strategic autonomy'. Increasing R&D and R&T budgets is only a 'way'. More broadly, what is at stake is to halt EU Member States' loss of military capabilities, to allow them to keep the full spectrum of capabilities, and to compensate for current weaknesses through initiatives like 'pooling & sharing'. As Javier Solana stated recently if the time to put 'more defence into the Union' is not now, then when?

A future Defence research action plan might well be the last chance to offer European countries a pragmatic, concrete and efficient way to keep their freedom of action. Its launch in itself will be a rare moment of truth: 'United we stand. Divided we fall'.

Annex 1: List of interviews

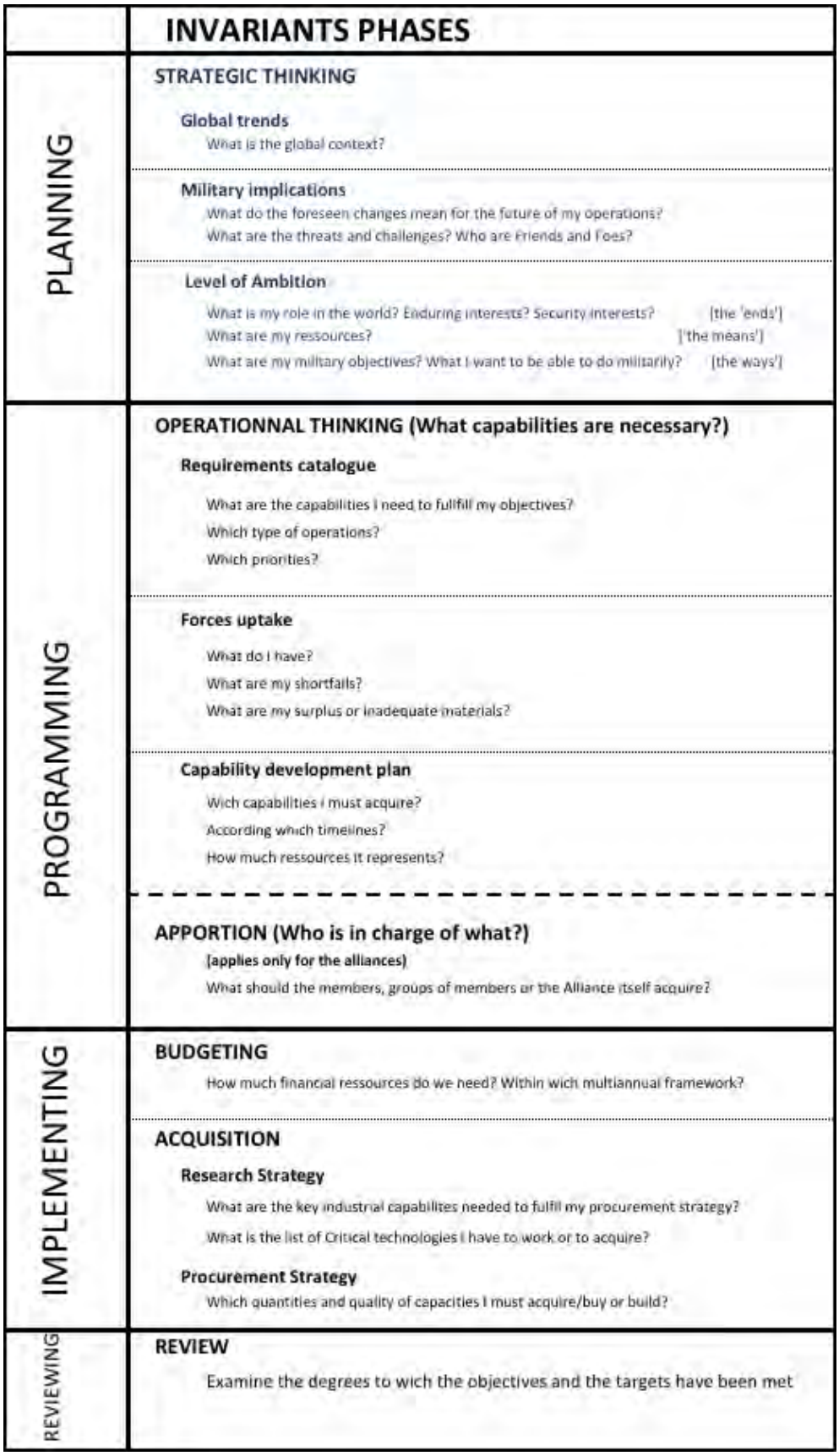
Mr. Bruno Sainjon	Chairman and CEO ONERA the French Aerospace lab	8 December 2015
Mrs Dominique Nouilhas	Director for International affairs ONERA	
Mrs Sylviane Pascal	CLORA representative – Club des organismes de recherche associés	
Mr. Denis Roger	European Defence Agency, Director for Synergies and Innovations, in charge of the Pilot Project within the EDA	16 December 2015
Michael Simm,	Policy Officer at EDA	
Mr. Philippe Brunet	Director Aerospace industry & Copernicus Internal Market, Industry, Entrepreneurship and SMEs – European Commission	16 December 2015
Mrs Apostolia Karamali	Deputy Head of Unit Space Policy and Research	
Major Gen (Proc. Corps) Jean-Luc Tinland	Armament Counsellor French Permanent Representation to the NATO and to the EU	16 December 2015
Col (Proc. Corps) Jean-Marc Edenwald	Deputy-Armament Counsellor RPFUE	
Mr. Alfredo Conte	Head of Strategic Planning Division European External Action Service (EEAS)	22 December 2015
Dr. Burkard Schmitt	Security & Defence Director ASD – Aerospace and Defence Industries Association of Europe	22 December 2015
Mr. Florian Guillermet	Executive Director SESAR Joint Undertaking	8 January 2016
Mr Tim Rowntree	Director OCCAR-EA Organisation conjointe de coopération en matière d'armement	11 January 2016

Mr Falko Fanslau	Central Office – Business Development Officer	
8th EU Space Policy Conference	Opening session	12 January 2016
Capt (N) Francesco Scialla	Defence Armaments Counsellor Attaché & NAD Representative Italian Permanent Representation to the EU	12 January 2016
M. Patrick Bellouard	Former Director OCCAR-EA Organisation conjointe de coopération en matière d'armement	12 January 2016
M. Bertrand de Cordoue	Former Research Director European Defence Agency	12 January 2016
Mr. Hans Pechan	Defence Counsellor Permanent Representation of Sweden to the EU	13 January 2016
Air Commodore Peter Round	Director for Capability, Armament and Technology – European Defence Agency	13 January 2016
Mr. Pierre Delsaux	Deputy Director-General Internal Market, Industry, Entrepreneurship and SMEs – European Commission	13 January 2016
Mr. Thierry Buttin	Policy Officer Aeronautics and Defence, Defence Aeronautic and Maritime industries	
Mr Francisco Casalduero	Defence Armaments Counsellor Permanent Representation of Spain to the EU	14 January 2016
Gen Jean-Paul Palomeros	former Supreme Allied Commander for transformation - NATO	18 January 2015
Dr Zuzana Michalcová Šutiaková	Member of the cabinet of the President of the European Council	19 January 2016

Major Gen (BE AF) Albert Husniaux	Chief Scientist – Chairman of the Science and Technology board - NATO	19 January 2016
Ir. Drs. Nico Pos	Coordination & Outreach Officer - NATO	
Capt. (ITA NA) Alberto Ferraris	Head of Coordination & Outreach Section	
Dr Bryan Wells	Head of the Defence Science and Technology U.K. Minister of Defence Chairman of the EDA R&T Directors steering board	20 January 2016 (by phone)
Dr Rudolf Strohmeier	Deputy Director-General Research Programmes – Directorate for Research & Innovation – European Commission	20 January 2016
Mrs Clara de la Torre	Director Key enabling Technologies	
Mr Erno Vandeweert	Research programme officer – advanced materials and nanotechnologies	
Mr Michel Barnier	President Juncker's Special Adviser on European Defence and Security Policy	26 January 2016
Mr Georg Riekeles	Adviser, European Political Strategy Centre	
Mr Peter Collins	Chairman of the ASD – Aerospace and Defence Industries Association of Europe	26 January 2016
Mrs Isabelle Maelcamp d'Opstaele	ASD Defence manager	
Mr Bernd-Ulrich von Wegerer	Minister Counsellor – Head Armament Affairs – Permanent Representation of the Federal Republic of Germany at the European Union	26 January 2016
Mr Robert G. Bell	Secretary of Defense representative, Europe & Defense Advisor for the U.S. mission to NATO	27 January 2016
Mr Christopher D. Gregor	Armaments Cooperation Directorate United States Mission to NATO	
Col USAF Russel D. Driggers	Senior Military Advisor to Secretary of Defense Representative and US NATO Defence Advisor	

Mr Jorge Domecq	Chief Executive of the European Defence Agency	2 February 2016
Mr Guillaume de la Brosse	Policy Officer Strategy & Policy	
Gen Heinz Krieb	Director – Concepts and capabilities European Union Military Staff – European External Affairs Service	2 February 2016
Col Paul van der Heidjen	Head Force Capability Branch EUMS EUMS Concepts & Capability Directorate European External Affairs Service	
Mr Bert De Colvenaer	ECSEL Joint Undertaking Executive Director	9 February 2016
Mr Yves Gigase	Head of Programmes	
Mr Eric Chaboureau	Legal Adviser Legal Affairs Division EEAS	15 February 2016
Mr Stephan Marquardt	Deputy Head Legal Affairs Division	

Annex 2:
Some examples of defence planning cycles



All the drawings that follow are Authors' own production – FM/KT 2016

Due to the size of the drawings, the following acronyms will be used hereafter

* classified or partially classified

capability: is the abilty to achieve a desired effect in a specific operating environment.
This effect can delivered by either military or non military solutions
capacity: is a hardware equipment or system of hardware

ETRD: European Technology and Research Strategy
SRA: Strategic Research Agendas
FERDP: Future European Defence Research Programme
ECAP: European Capability Action Plan

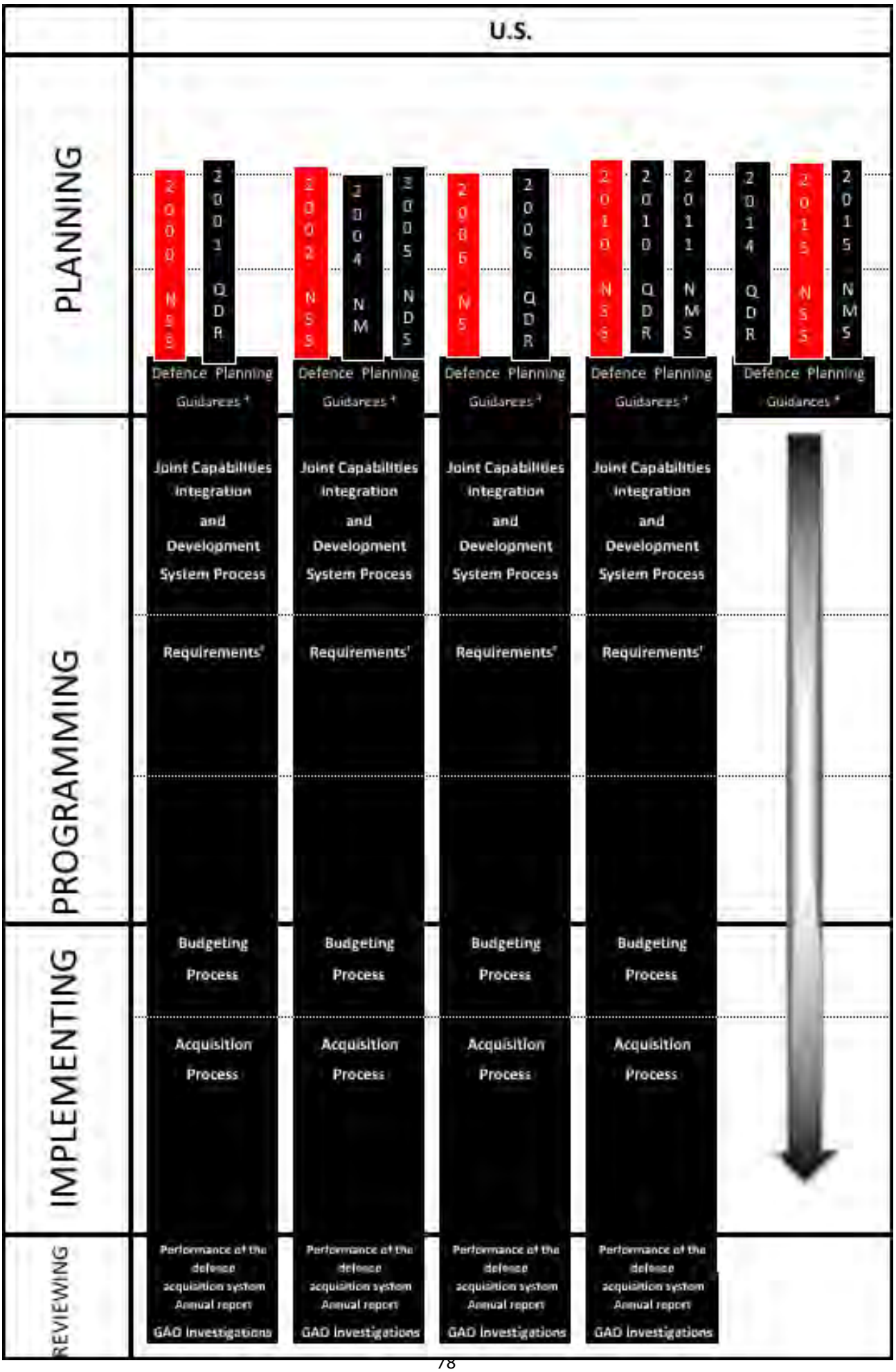
NATO RTO: Research & Technology Organization
NATO STO: Science & Technology Organization

NSS: US National Security Strategy
NDS: US National Defense Strategy
NMS: US National Military Strategy
QDR: Quadriennal Defense Review
DPG: Defense Planning Guidance
PPBE: Planning Programming Budgeting Executing
GAO: Government Accounting Office

LPM: Loi de Programmation militaire
POS: Politique et objectifs scientifiques (Scientific objectives and policy)
POST: Présentation de l'orientation de la Science et Technologie de défense
(Defense Science & Technology Orientations Presentation)
LR: Lois de règlement

SDR: Strategic Defence Review
SDR NC: Strategic Defence Review New Chapter (after 09/11)
NSS ud: National Security Strategy update
DCDC: Development, Concepts and Doctrine Center
SPI: Smart Procurement Initiative
SA: Smart Acquisition

FFF Fähigkeitslücke und Funktionale Forderung (FFF)
Capability gap and Functionnal Requirement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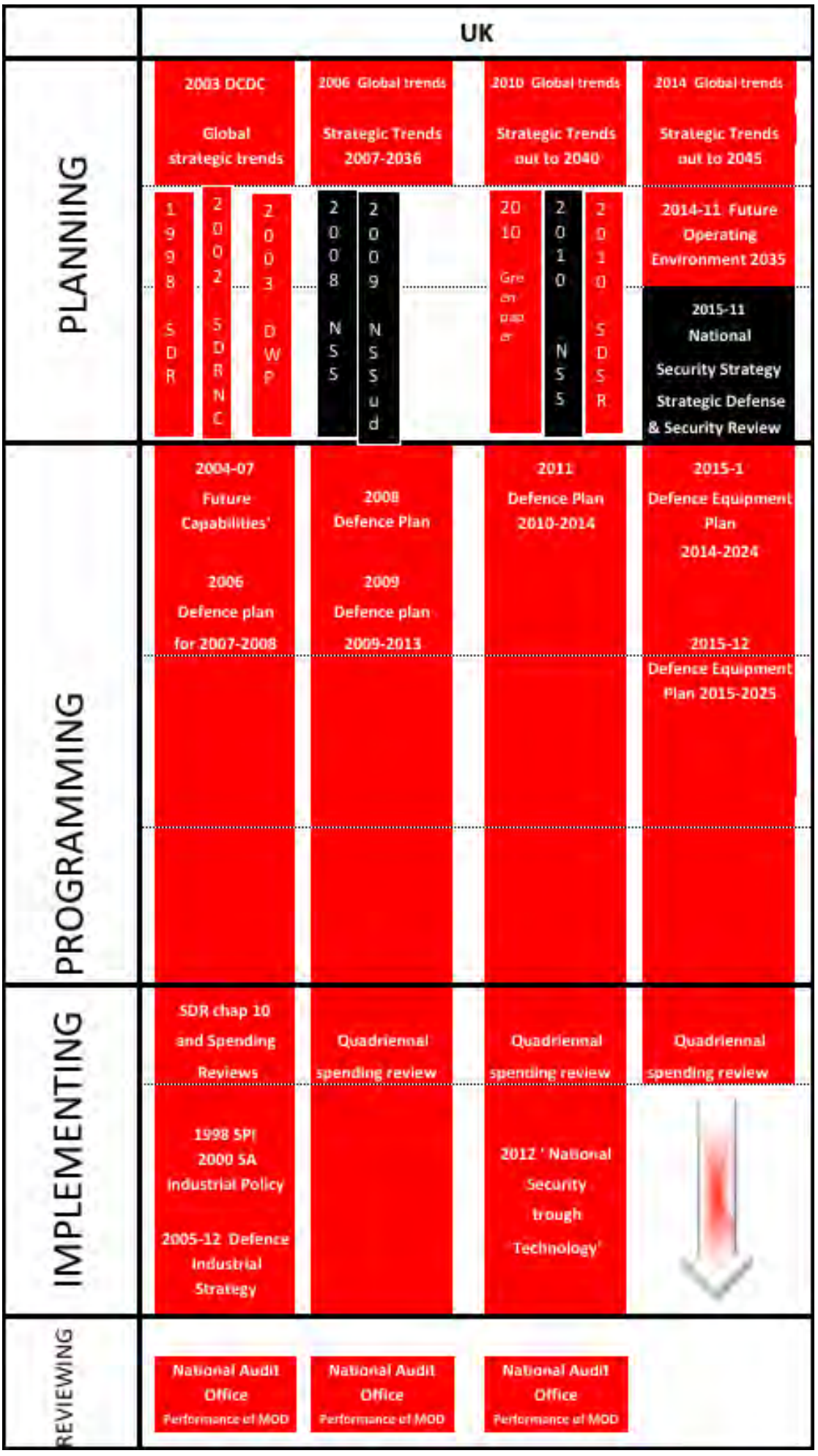
GAO investigations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1998 SDR
2002 SDRNC
2003 DWP
2008 NSS
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2010 Green paper
2010 NSS
2010 SDSR
2014-11 Future Operating Environment 2035
2015-11 National Security Strategy Strategic Defense & Security Review
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2004-07 Future Capabilities'
2006 Defence plan for 2007-2008
2008 Defence Plan
2009 Defence plan 2009-2013
2011 Defence Plan 2010-2014
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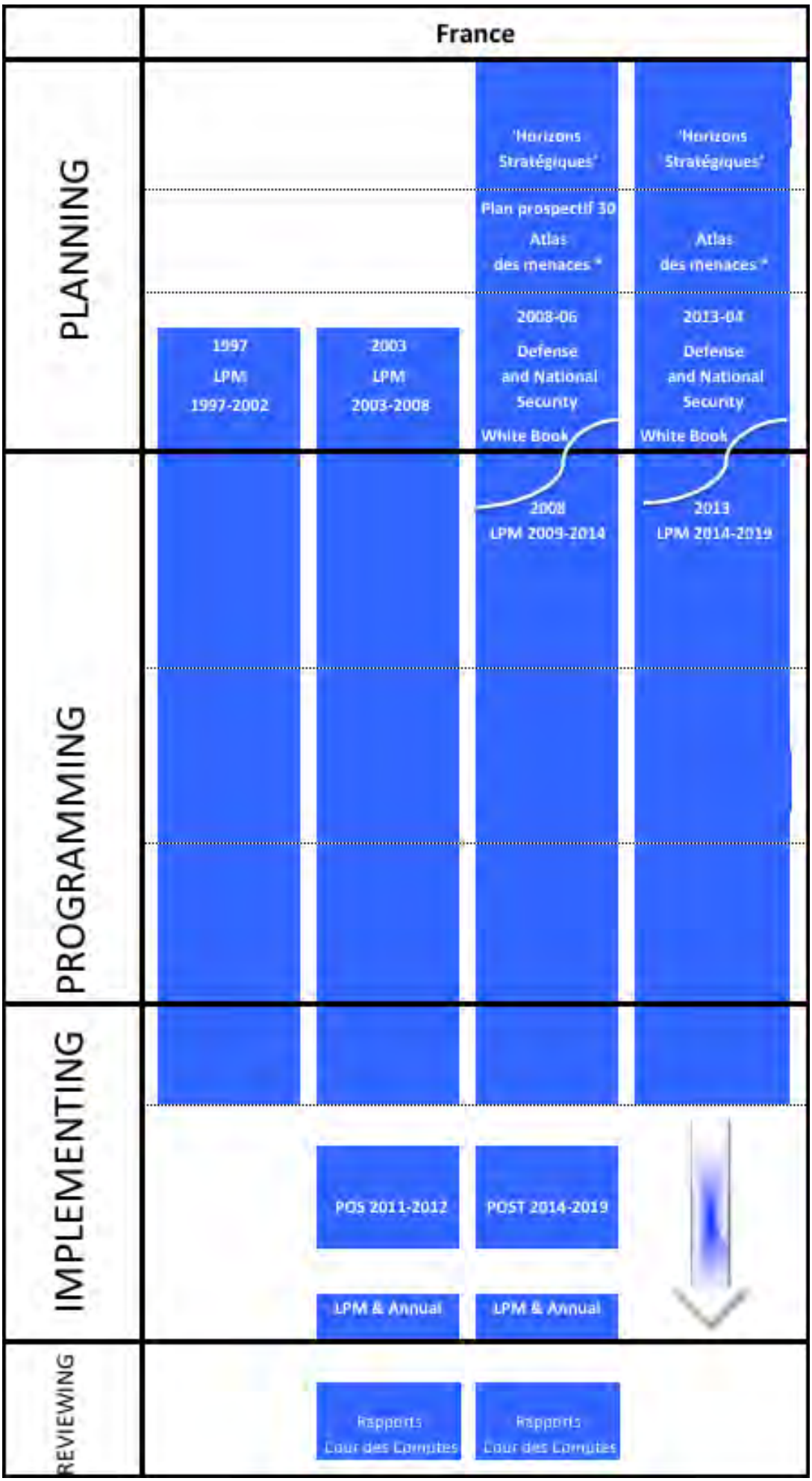
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'Horizons Stratégiques'
Atlas des menaces *
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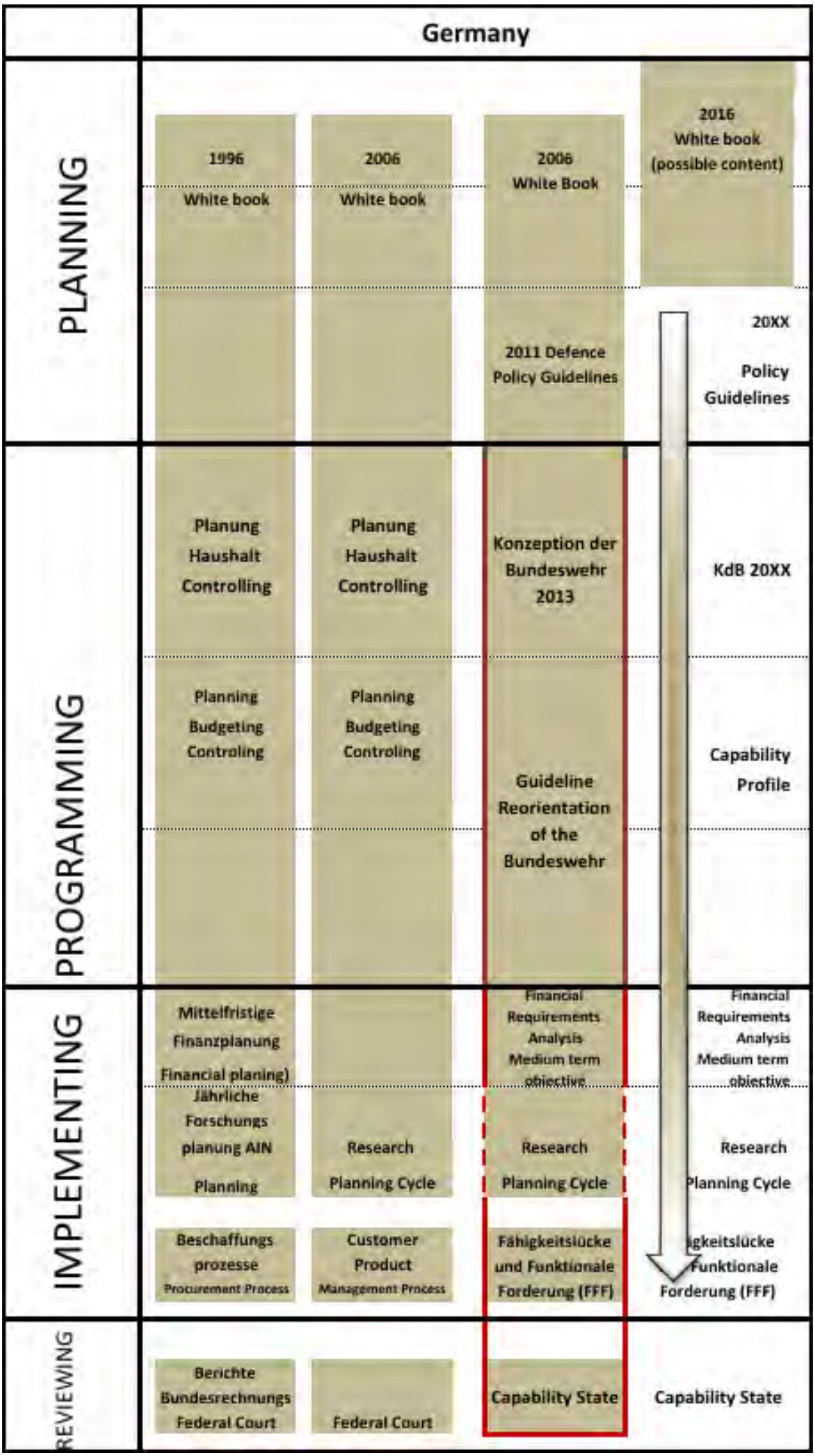
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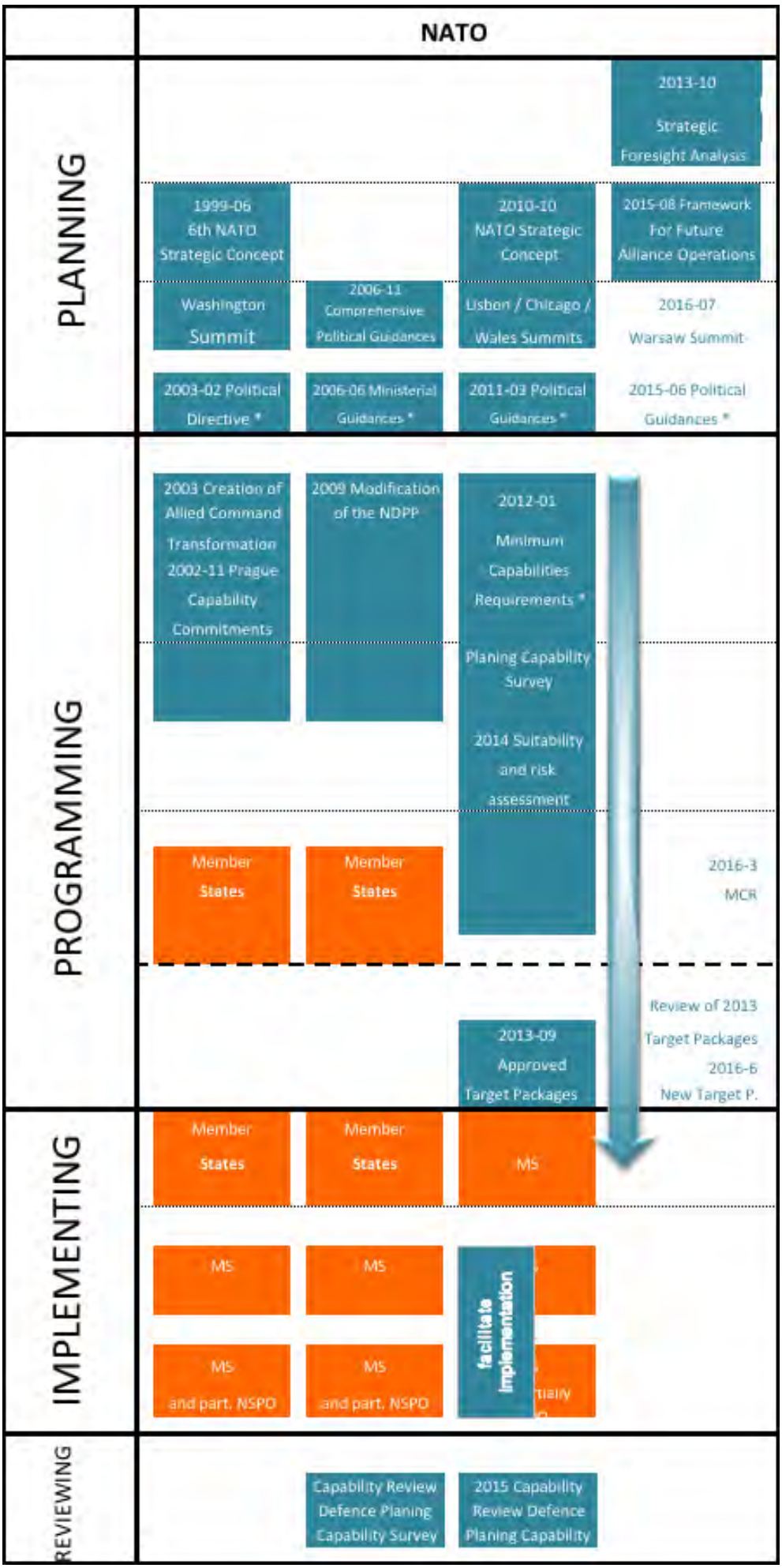
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Wales Summits
2016-07
Warsaw Summit
2003-02 Political
Directive *
2006-06 Ministerial
Guidances *
2011-03 Political
Guidances *
2015-06 Political
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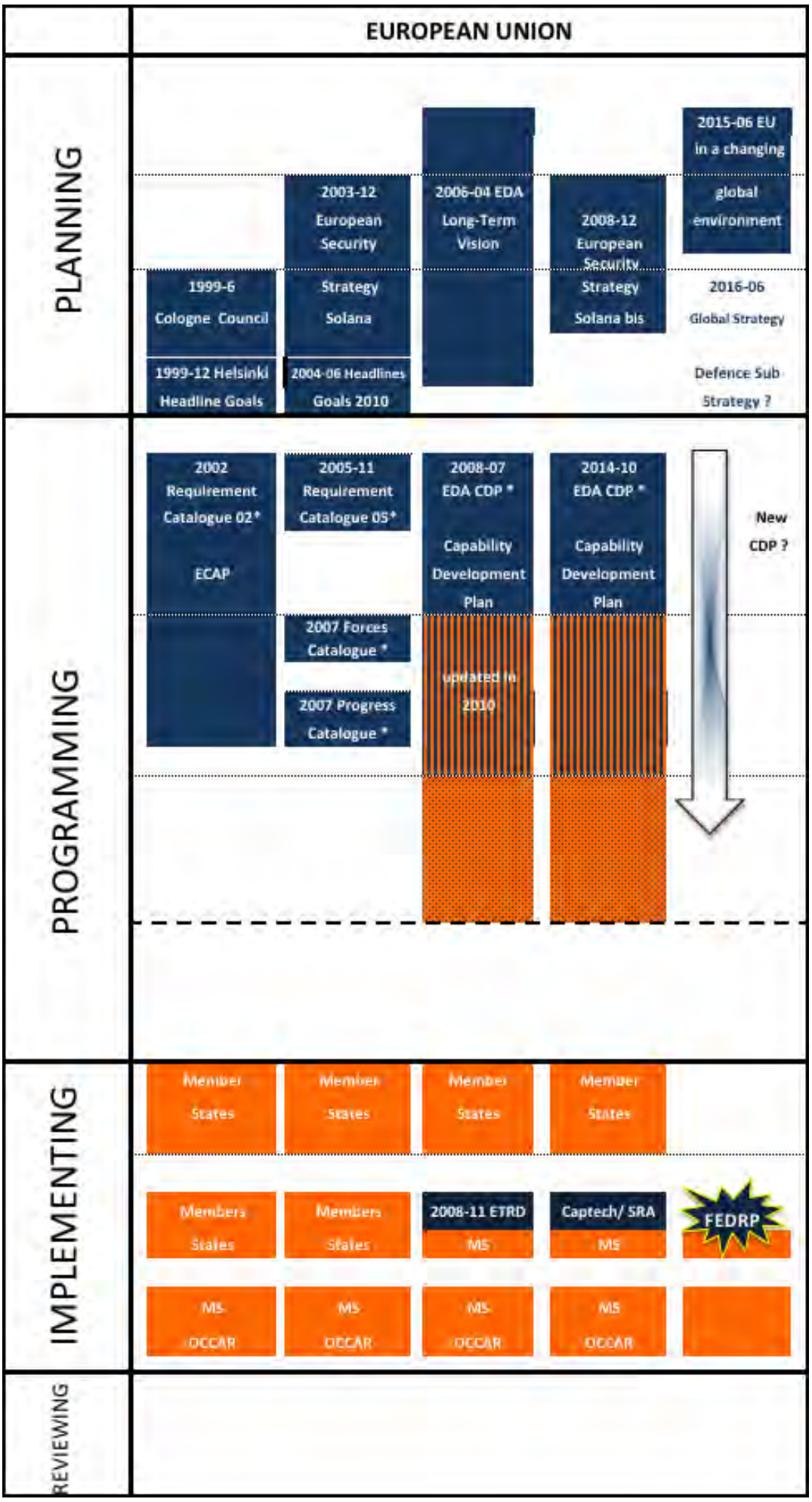
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2003-12 European Security Strategy Solana
2004-06 Headlines Goals 2010
2006-04 EDA Long-Term Vision
2008-12 European Security Strategy Solana bis
2015-06 EU in a changing global environment
2016-06 Global Strategy
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2002 Requirement Catalogue 02*
ECAP
2005-11 Requirement Catalogue 05*
2007 Forces Catalogue *
2007 Progress Catalogue *
2008-07 EDA CDP *
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updated in 2010
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Capability Development Plan
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Annex 3:
Evolution of defence expenditure in 2014-2015

The three tables that follow have been established thanks to NATO providing downloadable tables with full figures[84] and the help of NATO staff who provided us with the exchange rates and GDP figures they used to produce their own tables.

The first table provides the evolution of defence expenditure for all NATO countries, but conversely to NATO we have inflated the 2014 current figures (and not deflated the 2015 current figures), in order to show the amounts as 2015 prices. Doing so, it appears that EDA countries still reduced their defence expenditure as a whole by 0.82 % in real terms, although 14 countries out of 21 increased their expenditure. Therefore, the defence expenditure measured as a percentage of GDP for all EDA countries fall slightly from 1.48 % to 1.46 %. Measured in current terms and largely due to exchange rate variations[85], defence expenditure for those countries felt from USD 245 billion to USD 213 billion.

The second table shows the evolution of defence equipment, under the same methodological provisions. It seems interesting to note that the decrease in equipment for EDA's countries has been less substantial than for overall defence expenditure. Nevertheless, due to the fact that we are unable to breakdown the 'equipment' figure provided by NATO between 'major equipment' and associated R&D, it is difficult to get an accurate picture with regards R&D. The increase of the percentage of defence equipment in total defence expenditure from 16.9 % up to 19.4 % is mainly due to the decrease in overall defence expenditure and not to a real effort to increase equipment expenditure.

The third table provides the same findings as in the picture page 48, for the year 2015. Thus it appears that if EDA countries were to respect the commitments they undertook at the Wales summit, they should increase their expenditure as a whole by USD 87 billion per year from the current level, and thus their equipment expenditure by USD 24.5 billion. Due to exchange rate variations, this means EUR 77.7 billion and EUR 21.9 billion respectively. It is interesting to note that the 'burden sharing' between Europe (26 %) and North America (74 %) has never been so imbalanced. This imbalance is even more important if we focus on 'equipment': 21 % against 79 %.

[84] http://www.nato.int/SGReport/pr-2016-11-def-exp-tables_e.xlsx

[85] We used as average conversion rate the same rates than the ones used by NATO *i.e.* in 2014: €1 for $1.326 and in 2015 €1 for $1.119.

	Def expenditures in billion USD			Variation in %	Def expenditures in % of GDP		GDP in current prices and exchange rates in billion USD		
	2014 (current)	2014 (constant*)	2015	(constant)	2014	2015	2014	2015	%
Belgium	5,2	4,5	4,2	- 5,8	0,97	0,90	532	456	-14,2
Bulgaria	0,7	0,6	0,6	- 6,7	1,32	1,20	57	50	-12,4
Croatia	0,8	0,7	0,7	- 1,0	1,41	1,38	57	50	-13,5
Czech Rep.	2,0	1,7	1,8	+ 5,6	0,96	0,97	205	186	-9,5
Estonia	0,5	0,4	0,5	+ 7,3	1,93	2,04	26	23	-13,5
France	52,0	44,2	43,9	- 0,9	1,84	1,80	2 829	2 433	-14,0
Germany	46,1	39,6	39,7	+ 0,3	1,19	1,18	3 868	3 382	-12,6
Greece	5,2	4,3	4,8	+ 10,1	2,20	2,46	237	194	-18,2
Hungary	1,2	1,0	1,0	+ 0,3	0,87	0,85	138	120	-13,3
Italy	24,4	20,9	18,3	- 12,4	1,09	0,95	2 142	1 828	-14,7
Latvia	0,3	0,2	0,3	+ 15,6	0,94	1,06	31	27	-13,0
Lithuania	0,4	0,4	0,5	+ 31,9	0,88	1,14	48	42	-14,1
Luxembourg	0,3	0,2	0,3	+ 25,3	0,39	0,47	65	58	-10,2
Netherlands	10,3	8,7	9,0	+ 2,6	1,15	1,16	879	760	-13,5
Poland	10,1	8,6	10,5	+ 21,7	1,85	2,18	545	482	-11,6
Portugal	3,0	2,6	2,8	+ 8,6	1,30	1,39	230	200	-13,1
Romania	2,7	2,3	2,5	+ 10,0	1,35	1,44	199	176	-11,5
Slovakia	1,0	0,8	1,0	+ 16,6	0,99	1,12	100	87	-12,9
Slovenia	0,5	0,4	0,4	- 0,4	0,98	0,95	49	43	-12,9
Spain	12,6	10,7	10,8	+ 1,0	0,91	0,89	1 381	1 210	-12,4
UK	65,8	61,9	59,7	- 3,5	2,20	2,07	2 990	2 878	-3,8
EDA countries	**245,3**	**214,9**	**213,1**	**- 0,82**	**1,48**	**1,46**	**16 612**	**14 685**	**-11,6**
Denmark	4,1	3,5	3,5	+ 2,3	1,17	1,18	342	301	-12,1
Norway	7,3	6,1	6,0	- 0,3	1,52	1,49	500	401	-19,8
Albanie	0,2	0,1	0,1	- 11,8	1,35	1,16	13	11	-13,9
Turkey	13,6	11,6	11,9	+ 2,5	1,70	1,69	798	706	-11,5
NATO - Europe	**270,4**	**235,6**	**234,8**	**-0,3**	**1,47**	**1,43**	**18 266**	**16 104**	**-11,8**
Canada	18,2	15,8	15,8	-0,2	1,02	1,00	1 785,4	1 571,5	-12,0
US	654,3	663,1	649,9	-2,0	3,79	3,62	17 348,1	17 943,9	3,4
North America	**672,4**	**678,9**	**665,7**	**-1,94**			**19 133,5**	**19 515,3**	**2,0**
NATO	**942,8**	**915,2**	**900,5**	**-1,60**	**2,51**	**2,42**	**37 399**	**35 620**	**-4,8**

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* constant 2015 prices and 2015 constant exchange rates

	Def equipment (R&D + maj. Equip) billion USD			Variation in %	Equipment expenditure as % of Defence expenditure	
	2014 (current)	2014 (constant*)	2015	(constant)	2014	2015
Belgium	0,18	0,18	0,17	- 5,8	3,5	4,0
Bulgaria	0,01	0,02	0,02	- 6,7	1,0	3,2
Croatia	0,06	0,07	0,07	- 1,0	7,3	10,5
Czech Rep.	0,13	0,14	0,15	+ 5,6	6,5	8,3
Estonia	0,11	0,06	0,06	= 7,3	22,1	12,8
France	12,87	11,08	10,98	- 0,9	24,7	25,0
Germany	5,97	5,29	5,30	+ 0,3	12,9	13,3
Greece	0,43	0,76	0,84	+ 10,1	8,2	17,6
Hungary	0,09	0,11	0,11	= 0,3	7,8	10,9
Italy	2,73	2,61	2,29	- 12,4	11,2	12,5
Latvia	0,02	0,03	0,03	+ 15,6	7,5	10,3
Lithuania	0,06	0,07	0,10	+ 31,9	14,1	20,1
Luxembourg	0,06	0,08	0,10	+ 25,3	22,6	35,3
Netherlands	1,10	1,37	1,41	= 2,6	10,7	15,7
Poland	1,90	2,68	3,26	+ 21,7	18,8	31,1
Portugal	0,25	0,23	0,25	+ 8,6	8,4	8,8
Romania	0,42	0,34	0,37	+ 10,0	15,8	14,6
Slovakia	0,11	0,15	0,18	+ 16,6	11,1	18,0
Slovenia	0,00	0,00	0,00	- 0,4	0,7	0,8
Spain	1,70	1,67	1,69	+ 1,0	13,5	15,6
UK	13,33	14,49	13,98	- 3,5	20,2	23,4
EDA countries	**41,54**	**41,43**	**41,36**	**- 0,18**	**16,9**	**19,4**
Denmark	0,45	0,45	0,46	= 2,3	11,0	13,1
Norway	1,55	1,37	1,37	- 0,3	21,2	22,7
Albanie	0,03	0,01	0,01	- 11,8	16,6	8,9
Turkey	3,41	3,03	3,10	+ 2,5	25,1	26,0
NATO - Europe	**46,98**	**46,30**	**46,30**	**0,0**	**17,4**	**19,7**
Canada	2,4	2,5	2,5	5,9	13,0	15,9
US	169,8	173,3	169,8	0,0	26,0	26,1
North America	**172,2**	**175,8**	**172,3**	**5,9**	**-96,6**	**0,0**
NATO	**219,2**	**221,9**	**218,6**	**-0,2**	**23,2**	**24,3**

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* constant 2015 prices and 2015 constant exchange rates

2015	Defence expenditure		Equipment expenditure (R&D + major equipment)		Wales Summit Agreed defence expenditure at 2 % (minimum) of GDP			Wales Summit Investment exp. at 20 % (min) of new def. Exp.		
In current prices	1 as % of GDP	2 USD Millions	3 as % of Def. Exp	USD Millions	as % of GDP	USD Millions	Effort to match the commitment	as % of Def. Exp	USD Millions	Effort to match the commitment
Belgium	**0,90**	4 206	**3,97**	167	2,0	9 315	**+ 5 109**	20,0	1 863	**+ 1 696**
Bulgaria	**1,20**	599	**3,24**	19	2,0	994	**+ 395**	20,0	199	**+ 179**
Croatia	**1,38**	682	**10,54**	72	2,0	990	**+ 308**	20,0	198	**+ 126**
Czech Rep.	**0,97**	1 809	**8,31**	150	2,0	3 714	**+ 1 905**	20,0	743	**+ 592**
Estonia	**2,04**	467	**12,82**	60	2,0	467	**0**	20,0	93	**+ 34**
France	**1,80**	43 864	**25,04**	10 982	2,0	48 666	**+ 4 803**	25,0	12 185	**+ 1 202**
Germany	**1,18**	39 743	**13,35**	5 305	2,0	67 639	**+ 27 896**	20,0	13 528	**+ 8 223**
Greece	**2,46**	4 773	**17,62**	841	2,5	4 773	**0**	20,0	955	**+ 114**
Hungary	**0,85**	1 021	**10,87**	111	2,0	2 398	**+ 1 377**	20,0	480	**+ 369**
Italy	**0,95**	18 271	**12,52**	2 287	2,0	38 627	**+ 20 356**	20,0	7 725	**+ 5 438**
Latvia	**1,06**	288	**10,34**	30	2,0	545	**+ 257**	20,0	109	**+ 79**
Lithuania	**1,14**	476	**20,09**	96	2,0	831	**+ 355**	20,1	167	**+ 71**
Luxembourg	**0,47**	276	**35,32**	97	2,0	1 164	**+ 888**	35,3	411	**+ 314**
Netherlands	**1,16**	8 952	**15,74**	1 409	2,0	15 453	**+ 6 501**	20,0	3 091	**+ 1 682**
Poland	**2,18**	10 496	**31,07**	3 261	2,2	10 496	**0**	31,1	3 261	**0**
Portugal	**1,39**	2 788	**8,81**	246	2,0	4 001	**+ 1 213**	20,0	800	**+ 555**
Romania	**1,44**	2 532	**14,60**	370	2,0	3 524	**+ 992**	20,0	705	**+ 335**
Slovakia	**1,12**	981	**18,01**	177	2,0	1 746	**+ 764**	20,0	349	**+ 172**
Slovenia	**0,95**	411	**0,78**	3	2,0	862	**+ 451**	20,0	172	**+ 169**
Spain	**0,89**	10 816	**15,63**	1 690	2,0	24 205	**+ 13 388**	20,0	4 841	**+ 3 151**
UK	**2,07**	59 699	**23,42**	13 983	2,1	59 699	**0**	23,4	13 983	**0**
EDA countries		**213 149**	**19,40**	**41 355**		**300 109**	**+ 86 960**	**21,9**	**65 858**	**+ 24 502**
Denmark	**1,18**	3 535	**13,08**	462	2,0	5 995	+ 2 460	20,0	1 199	+ 737
Norway	**1,49**	6 034	**22,72**	1 371	2,0	8 074	+ 2 040	22,7	1 834	+ 463
Albanie	**1,16**	132	**8,92**	12	2,0	228	+ 96	20,0	46	+ 34
Turkey	**1,69**	11 935	**25,99**	3 102	2,0	14 125	+ 2 191	26,0	3 672	+ 569
NATO - Euro	**1,43**	**234 785**	**19,72**	**46 302**		**328 531**	**+ 93 746**	**22,1**	**72 608**	**26 306**
Canada	**1,00**	15 757	**15,89**	2 504	2,0	31 429	**+ 15 672**	20,0	6 286	**+ 3 782**
US	3,62	649 931	26,13	169 839	3,62	649 931	0	26,13	169 839	+ 0
North America	**3,37**	**665 688**		**172 343**		**681 360**			**176 125**	
NATO	**2,42**	**900 473**	**24,28**	**218 645**		**1 009 891**	**+ 109 419**	**24,6**	**248 733**	**+ 30 088**
NATO - EDA in %		**23,67**		**18,91**		**29,71**			**26,48**	
NATO - Europe in %		**26,07**		**21,18**		**32,53**			**29,19**	
NATO - North Am in %		**73,93**		**78,82**		**67,47**			**70,81**	

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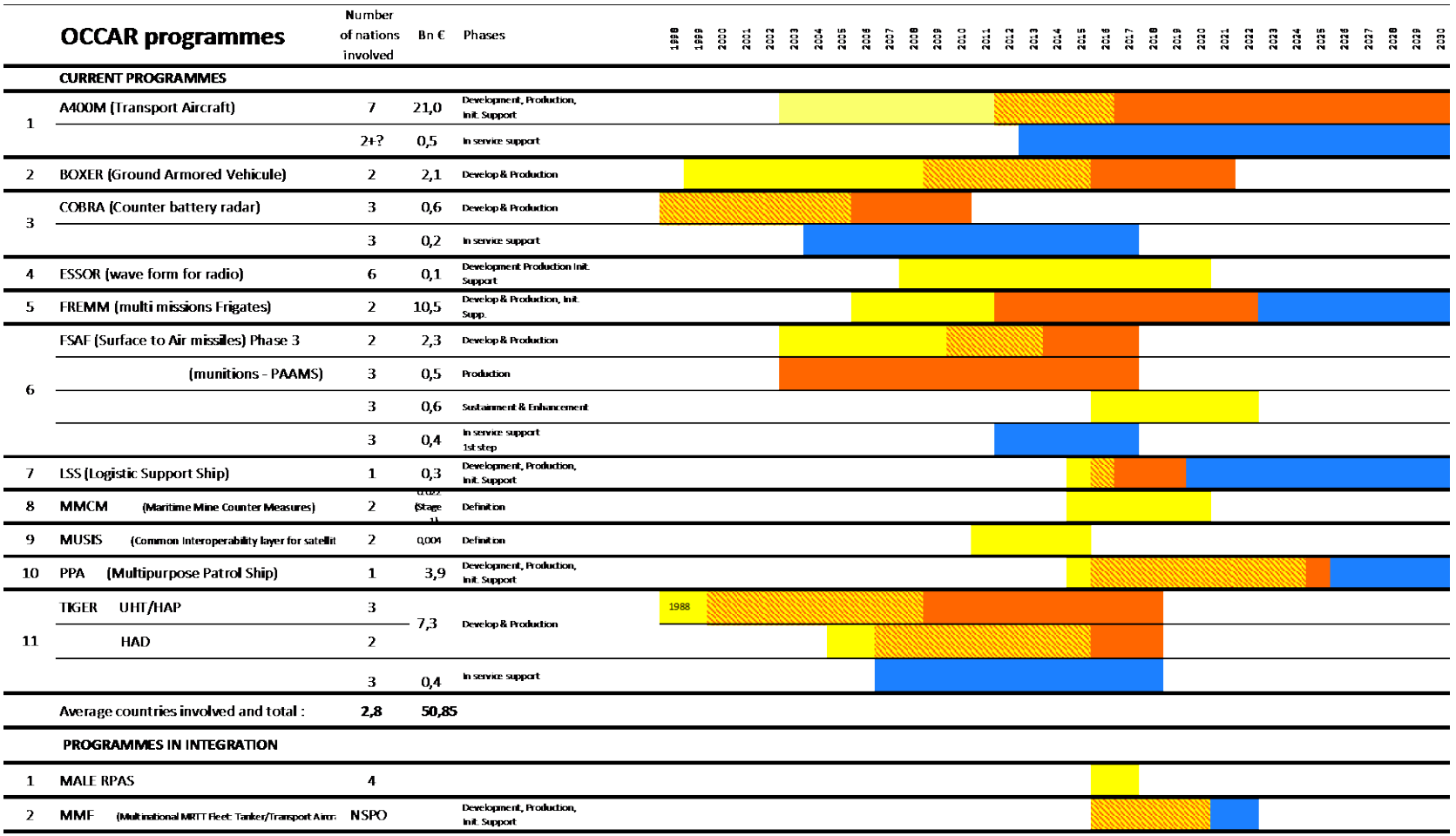
Column 1 from NATO download 'defence expenditures of NATO countries(2008-2015) table 3
column 2 from table 2
column 3 from table 6 a
All others columns are deducted from the three previous ones

Annex 4:
Abbreviations and acronyms

CDP	Capability Development Plan
CSDP	Common Security and Defence Policy
DARPA	Defence Advanced Research Projects Agency
DG	Directorate General
DoD	Department of Defense (U.S.)
ECSEL	Electronic Components and Systems for European Leadership
EDA	European Defence Agency
EDRP	European Defence Research Programme
EUISS	European Union Institute for Security Studies
EUR	Euro
GDP	Gross Domestic Product
GoP	Group of Personalities
IPR	Intellectual Property Rights
ITAR	International Traffic in Arms Regulations
JTI	Joint Technology Initiative
JU	Joint Undertaking
LoI	Letter of Intent
MFF	Multiannual Financial Framework
MoD	Ministry of Defence
NATO	North Atlantic Treaty Organisation
OCCAR	Organisation Conjointe de Coopération en matière d'armement
PA	Preparatory Action
PP	Pilot Project
R&D	Research and Development
R&T	Research and Technology
S&T	Science and Technology
RTO	Research Technology Organisation
SME	Small and Medium Enterprise
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
TRL	Technological Readiness Level
UK	United Kingdom
US	United States of America
USD	United States Dollar

Annex 5: OCCAR programmes

	OCCAR programmes	Number of nations involved	Bn €	Phases
	CURRENT PROGRAMMES			
1	A400M (Transport Aircraft)	7	21,0	Development, Production, Init. Support
		2+?	0,5	In service support
2	BOXER (Ground Armored Vehicule)	2	2,1	Develop & Production
3	COBRA (Counter battery radar)	3	0,6	Develop & Production
		3	0,2	In service support
4	ESSOR (wave form for radio)	6	0,1	Development Production Init. Support
5	FREMM (multi missions Frigates)	2	10,5	Develop & Production, Init. Supp.
6	FSAF (Surface to Air missiles) Phase 3	2	2,3	Develop & Production
	(munitions - PAAMS)	3	0,5	Production
		3	0,6	Sustainment & Enhancement
		3	0,4	In service support 1st step
7	LSS (Logistic Support Ship)	1	0,3	Development, Production, Init. Support
8	MMCM (Maritime Mine Counter Measures)	2	d:0,2 (Stage	Definition
9	MUSIS (Common Interoperability layer for satellit	2	0,004	Definition
10	PPA (Multipurpose Patrol Ship)	1	3,9	Development, Production, Init. Support
11	TIGER UHT/HAP	3	7,3	Develop & Production
	HAD	2		
		3	0,4	In service support
	Average countries involved and total :	**2,8**	**50,85**	
	PROGRAMMES IN INTEGRATION			
1	MALE RPAS	4		
2	MMF (Multinational MRTT Fleet: Tanker/Transport Aircr	NSPO		Development, Production, Init. Support



Source: restated figures drawn from OCCAR 2015 business plan: http://www.occar.int/media/raw/OCCAR_Businessplan_2015_WEB.pdf
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