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TODAY'S TECHNOLOGICAL INNOVATIONS FOR TOMORROW'S DEFENCE

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ABSTRACT

Globalisation has been the engine of international business and innovation since the end of the Cold War. New and more advanced forms of global outsourcing are thus very likely to emerge in the next twenty years and it is very likely that the next more advanced stage of globalisation will definitely involve all developed economies and emerging market economies in an ever more global competitive world. For European countries, the difficult strategic and economic times they face mean that they will have to become accustomed the idea of constrained defence budgets for a foreseeable future. For all European countries, budget constraints are compounded by the range of commitments defence budgets must cover. All of their commitments impose costs to which must be added the additional, exceptional costs of military interventions. All this means that defence budgets are stretched to the point of breaking. However, in many European countries, military leaders have talked openly about the lack of capacity to take on major new conflicts or challenges. In these circumstances, the funds available for R&D to shape future conflicts and future patterns of deterrence are very limited.

In reaction to the consequences on defence technologies and budgets of this quickly changing world and taking into account the need to keep a clear technological advance on possible key security challengers for the next thirty years, the United States launched in November 2014 their "Third Offset Strategy" (TOS) to bolster their conventional deterrence. The first offset strategy was developed in the 1950s when President Eisenhower emphasized nuclear deterrence to avoid the larger expenditures necessary to conventionally deter the Warsaw Pact. The second "Offset Strategy" referred to technological superiority to offset quantitative inferiority in conventional forces when compared to the ones of the Soviet Union. However, unlike the first two offset strategies, the third one could rely on commercially driven technology such as robotics, autonomously operating vehicles, guidance and control systems, visualization, biotechnology, miniaturization, advanced computing, big data analytics and additive manufacturing, which also means a real challenge to European industries to take up the gauntlet.

In such a context determined by this third offset strategy, one of the primary factors determining the future of innovation and technologies, as part of a global defence industry in a globalised system of trade, could be a widespread development of dual-use technologies that can be applied to military purposes. For Europe's defence markets and future innovations, the European Commission considers that a fragmented market hampers innovation and lead to the duplication of defence programmes and research, undermining Europe's global competitiveness and the effectiveness of the EU's Common Security and Defence Policy (CSDP), hence the European Commission's defence industrial policy to develop a competitive and innovative European Defence Technological and Industrial Base (EDTIB). Some European countries, including France, strongly support the idea of an effective European Defence Technological and Industrial Base.

Due to the challenge imposed by new models of military innovation, thisarticle focuses on the possible ways through which a new model of military innovation in the field of Defence innovation and among European defence industries and companies could be developed, based on the best possible practices taken from various European countries. National models of innovation from France, Germany and Britain could be taken as

cooperation between those European states, which actually have their own defence industrial capability, is still possible.

If successful, such a strategy would enable European countries to develop a relationship involving both cooperation and competition with American defence industries and their innovative power. In fact, one of the main challenges for a European defence community, which is absorbed by the immediate threat of terrorism and confused by the uncertainties linked to the prospect of Brexit, will be to respond and eventually to cooperate with the Americans and their "third offset strategy". And because times are hard in terms of spending, European states should start building on what they have, being realistic about their common needs and possibilities.

Globalisation has been the engine of international business and innovation since the end of the Cold War. New and more advanced forms of global outsourcing are thus very likely to emerge in the next twenty years and it is very likely that the next more advanced stage of globalisation will definitely involve all developed economies and emerging market economies in an ever more global competitive world. Due to deeply increasing costs of scientific and technological innovations, new internationally financial efforts in the fields of research & development (R&D) and research & technology (R&T) will be driven by this costly nature of advanced scientific endeavours, as well as by growing competitions from emerging power centres such as China, India or South-East Asia, competing more directly with the main current OECD economic powers such as Japan, the United States and the main European states, especially France and Britain.

If we take for granted that the phenomenon of globalisation will continue to expand, the very fast development of technologies in the civilian world will thus be essential to the emergence of cutting-edge defence systems. For European countries, the difficult strategic and economic times we are now facing mean that we will have to become accustomed the idea of constrained defence budgets for a foreseeable future. For all European countries, including Britain and France, the two nations with the strongest existing defence industrial sectors, budget constraints are compounded by the range of commitments defence budgets must cover. In addition to historic commitments to protect long standing overseas relationship from Central Africa to the Pacific ocean, European countries are committed to NATO and therefore to the precautionary defence activity being undertaken in Eastern Europe and in different ways to conflicts with Islamic militancy in its various forms from Syria to Libya. European nations are expected to provide troops and resources to support peacekeeping and humanitarian exercises for instance in West Africa in the face of the Ebola outbreak. An international presence of warships and aircraft carriers must be maintained. Military forces must develop the technical expertise necessary to counter cyber attacks on vital installations and communications systems. They have to learn how to counter insurgency from potential enemies against whom the use of conventional military force may not be viable. All of these commitments impose costs to which must be added the additional, exceptional costs of military interventions, for instance in Mali in 2014. All this means that defence budgets are stretched to the point of breaking. However, in many European countries, military leaders have talked openly about the lack of capacity to take on major new conflicts or challenges.

In these circumstances, the funds available for R&D to shape future conflicts and future patterns of deterrence are very limited. As a result, the prospect is that European countries could then lose more and more ground to its faster-growing Asian and American counterparts whose willingness to spend substantial amounts on each aspect of the defence sector – from research to development to manufacture and deployment is as yet relatively constrained. For the European defence community, in such a context of economic, financial and technological constraints, it thus will be of paramount importance to find new ways to invest in all the technologies and production capabilities essential to maintain our innovation, our competitiveness, and the readiness of our armed forces, thanks to brand-new defence technologies. However, innovation will itself require considerable investments. The countries involved will have to find ways of developing new technologies and financing them which are compatible with limited budgets.

In reaction to the consequences on defence technologies and budgets of this quickly changing world and taking into account the need to keep a clear technological advance on possible key security challengers for the next thirty years, the United States launched in November 2014 their "Third Offset Strategy" (TOS)[1] to bolster what they consider to be their weakened conventional deterrence when then–Secretary of Defence Chuck Hagel announced in a speech at the Reagan National Defence Forum in California a new Defence Innovation Initiative, which included this Third Offset Strategy. In a conference organized in London in September 2015 by the Royal United Services Institute for Defence and Security Studies (RUSI), the well-known think tank of the British Ministry of Defence[2], Trevor Taylor, research fellow in defence management, and U.S. Deputy Defence Secretary Bob Work insisted on the fact that "*first, potential competitors are pursuing levels of advanced weapons development that we haven't seen since the mid-1980s. Second, our attention has been rightly focused on the Middle East for the past 14 years, and post-war budget cuts have limited our own technical investments".*

The first offset strategy was developed in the 1950s when President Eisenhower emphasized nuclear deterrence to avoid the larger expenditures necessary to conventionally deter the Warsaw Pact. Then, in a second period from about 1975 to 1989, the term "Offset Strategy" referred to technological superiority to offset quantitative inferiority in conventional forces when compared to the ones of the Soviet Union. Secretary of Defense Harold Brown's "Offset Strategy" (1977/1981) emphasized new intelligence, surveillance, and reconnaissance (ISR) platforms, improvements in precision-guided weapons, stealth technology such as the F117 fighter, and space-based military communications and navigation such as the GPS (global positioning system).

However, unlike the first two offset strategies, which depended on military development, the third American strategy would rely on commercially driven technology such as robotics, autonomously operating vehicles, guidance and control systems, visualization, biotechnology, miniaturization, advanced computing, big data analytics and additive manufacturing, which also means a real challenge to European industries to take up the gauntlet.

In such a context determined by this third offset strategy, one of the primary factors determining the future of innovation and technologies, as part of a global defence industry in a globalised system of trade, could be a widespread development of dual-use technologies that can be applied to military purposes. As emphasized by former colleagues and French researchers Valérie Mérindol and David Versailles in their article published in 2010, "*dual-use policies represent now a dimension central to military R&D policies and should not be understood only as a transfer mechanism between the civilian and the military"*.

At first, this concept of dual-use came from strategic studies when there were concerns about arms proliferation through the international transfers of "dual-use products and technologies". In more recent years, this concept of dual-use technologies has been widely used much more to offer a viable solution to the technological and financial problems faced by military organizations[3], as a consequence of the so-called military technical revolution and of the changing international context favoured by fast-growing emerging powers. Indeed, dual-use technologies play an integral part in military development, but they heavily rely on the degree to which advanced dual-use technologies are both available and continuously advancing in an increasingly globalised economic system.

For Europe's defence markets and future innovations, the European Commission considers that a fragmented market hampers innovation and lead to the duplication of defence programmes and research, undermining Europe's global competitiveness and the effectiveness of the EU's Common Security and Defence Policy (CSDP). The Commission believes that reduced defence budgets and escalating development costs make it too expensive for European countries to maintain a comprehensive national defence industrial base; hence the key objective of the European Commission's defence industrial policy to develop a competitive and innovative European Defence Technological and Industrial Base (EDTIB). Many individual member states, however, remain sceptical of the concept of creating an industrial base at a European level and continue to argue for cooperation based on the development of the sector a national level and through selective bilateral initiatives. Other European countries, including France, strongly support the idea of an effective European Defence Technological and Industrial Base. In Britain, these opposite positions were confirmed by the most recent UK strategic review of defence[4] written in 2015 and by a study conducted by King's College London called "*a benefit, not a burden; the security, economic and strategic value of Britain's defence industry*"[5]. Both confirm the perceived value of a strong indigenous industrial defence base and the concern that the quality and breadth of that base is already eroding in the face of the squeeze on spending. These different approaches complicate the debate but in the end we believe that cooperation is possible in many areas even if the full-scale integration of the sector across 28 countries remains impossible. The existing elements of cooperation – for instance between the UK and France on drone technology and on some elements of nuclear technology – are encouraging indicators of what is possible. So is the much wider cooperation across many European states on counter terrorism. Faced with real and immediate challenges much is possible.

Our article focuses on the possible ways through which a new model of military innovation in the field of Defence innovation and among European defence industries and companies could be developed, based on the best possible practices taken from various European countries. This process could lead European countries to develop, by agreement, a diverse industrial base across the European Union which would meet Europe's own defence needs and would be able to compete on world markets. If successful, this would enable European countries to develop a relationship involving both cooperation and competition with American defence industries and their innovative power. This would represent a distinct improvement from the current situation where substantial elements of the European defence industrial base are little than more a "subsidiary" of American innovation and its technological might, and this last aspect could even worsen for European states and industries if the Third Offset Strategy is to succeed.

DUE TO THE CHALLENGE IMPOSED BY NEW MODELS OF MILITARY INNOVATION, COULD INNOVATIVE CIVILIAN COMPANIES BRING NEW INNOVATIVE SOLUTIONS TO THE MILITARY SECTOR?

Today's threats and challenges require flexible, creative solutions that would theoretically be realized through greater cooperation between public and private sectors, military and civilian ones, companies and public administrations. We recently realized that these threats and challenges were coming more and more from new industrialised countries such as China, at a time when European defence capabilities are much more being focused on organisations such as Daesh, which certainly owns the lethality and high-tech capabilities of modern weaponry they used in a frame of asymmetric tactics such as terrorism and cyber warfare. But Daesh is indeed an organization which as nothing to do with the Chinese industrial might the American Third Offset Strategy is due to counter. For European countries, countering these threats from Daesh may certainly require to adapt our industrial and technological solutions through innovations, which could leverage the capabilities that exist both inside and outside defence or civilian industries. But the very same countries are forgetting at the same time that more and more factories and key technologies are being bought by Chinese investment funds depending on key Chinese ministries such as defence or energy, ready to export recently bought European technologies to Chinese industrial complexes. One has to admit that nobody cares. European governments are much more concerned on showing how attractive they are to foreign investments such as IEF for foreign investments in France than to prepare a competitive and protective strategy for European technologies.

One has also to keep in mind that "Innovation" is a sort of buzzword for everyone nowadays in Europe, contrary to China or the United States, starting from supposed new ways of managing people in companies and public services, both in the military and civilian sectors, to real innovations in hard sciences and technologies, which indeed make our future security credible enough when being compared to our current and niggardly preoccupations of coping with low rate technological tools used in recent terrorist attacks in Europe.

It does not mean that technology is the only key or even a perfect solution to our global security problems. Indeed, as Islamic terrorists told us when they attacked in Paris, Brussels and Nice in the last few months, basically, one has to understand that European countries first need human intelligence before innovation and new technological toys our industry and military forces are keen on developing and playing with.

In fact, an efficient security system must use and mix at the same time a high level of human intelligence with technological tools in fields such as space, cybersecurity, drones or sensors, which are key to help us organizing our global defence. However, apart from human intelligence and technologies, money is in reality going to be again the determinant factor able to give us a low or a high profile to our global security system. Indeed, as quoted in their recent article[6] called "*2016 Aerospace and Defense Industry Trends*", Randy Starr, William Lay, and Chuck Marx, from Strategy& (PWC), reminded us what was exactly our current situation in which "*the aerospace and defense (A&D) industry finds itself in an increasingly challenging predicament. In recent years, military spending globally has been under immense pressure, governments around the world haven't started many significant new weapons programs, and few are on the horizon*". And

thus, industries have to find new ways to convince public authorities to adopt a new technological business model to take into account the rationalisation of defence spending and the durable scarcity of public money devoted to defence.

In a world where money is being considered as a scarce resource on the medium and long term, using innovation and technologies already developed, adopted and largely used in a civilian world is seen as a way of limiting public spending in defence sectors, without damaging too much the level of our security, especially at a time when public opinions could get the feeling that political authorities are in fact unable to counter Islamic terrorism and new asymmetric threats. And in fact, European Union's member states can't definitely match with the United States with a possible added money put on the table to cope with the Third Offset Strategy. The United States do not need it or just for non-strategic positions in new technological programs. In the best possible case, European money and contributions to any American project will be considered as subsidiary.

To confront the challenge of military innovation through innovative solutions from the civilian world is thus a process in which one has to be very cautious. Many commentators recently saw the Industry 4.0 process, also called the fourth industrial revolution, as a global panacea based on a large trend of automation and data exchange in manufacturing technologies[7]. But no one really agrees on what innovation means and what could be the main bridges between civilian and military technologies and innovations. In a recent interview given to the website *Defense Entrepreneurs Forum*, Adam Jay Harrison, a member of the *Defense Entrepreneurs Forum* and a former Director of the U.S. Army Technical Operations Support Activity, founder of Mav6, an aerospace and defence technology company, said that innovation was "*one of those non-word words that mean everything and nothing. There is no orthodoxy in the Pentagon on the definition of 'innovation' – some programs, like the Long Range Research and Development Planning Program, use it to refer to the development of game-changing, strategically significant weapons systems, while other programs, like the new DOD Defense Digital Service refer more to a process of rapidly solving complex problems*". Clearly, the Third Offset Strategy is there to limit non-orthodox positions towards innovation. The Defence Strategic Guidance (DSG) presented in November 2014 articulated ten missions the joint force must accomplish in the future. These missions include the ability to deter and defeat aggression, to project power despite anti-access/area-denial (A2/AD) challenges, and to operate effectively in cyberspace and space.

Because the rate of technological change is accelerating and considering this American Defence Strategic Guidance, one has to keep in mind that innovation is a system which can follow three different ways, as reminded by Peter Drucker[8] in 1998, the first way is systematic continuing improvement, basically close to training and experimentation. The second way is based on building tomorrow's systems using today's proven techniques and technologies; an evolutionary requirements-based R&D frequently adopted by ministries of defence in times of constraint defence budgets. The third way is innovation with a goal that makes obsolete and, to a large extent, replaces even the most successful current products and processes; something much more limited nowadays in the military industrial world.

Indeed, innovation became a nebulous term that describes all things new from mobile phones to swimwear[9], while Innovation is in reality simply anything novel and useful that one implements. As quoted in November 2014 by then US Secretary of Defence Chuck Hagel for the American Department of Defense's (DOD's), Western countries need

to adopt innovative practices and means of operating in increasingly contested environments due to the fact that "*we are entering an era where our dominance in key warfighting domains is eroding, and we must find new and creative ways to sustain, and in some areas expand, our advantages even as we deal with more limited resources*."

COULD NATIONAL MODELS OF INNOVATION TAKEN FROM FRANCE, GERMANY AND BRITAIN BE TAKEN AS EXAMPLES FOR MIXED MILITARY AND CIVILIAN INNOVATIVE SYSTEMS?

In Europe, despite continuing decreasing defence budgets, a few countries kept their national models of defence innovation, more specifically in Britain, France, Germany, and Sweden, the four last national systems of innovation (NSI) of significant scales on the European continent, though, for some limited sectors and technologies in defence, Italy, Spain, Switzerland, and Austria kept a few bits of it. However, despite the importance of defence technologies in these countries, innovation and investments are still at a low point and put European states in a position of marginalised partners inside NATO when one comes to terms with transformation, capabilities and preparation of the future[10].

Clearly, Europe states cannot afford to remain barren on defence R&D and they cannot rely on investments made decades ago. European defence investments need constant watering and without ambitious levels of R&D investment, Europe's defence technological and industrial base will eventually erode on the long term.

Considering this situation and taking into account the deep industrial and technological fragmentation inside the European Union (EU), European institutions recently tried to offer a minimum of cohesion to the 28 member states, including Britain, in a communication published in 2013, recognizing the need for a strong and less fragmented European defence industry to sustain and enhance Europe's military capabilities and the EU's autonomous action[11]. Howeverat the moment where european commission is launching an initiative to finance common R&T at the EU level with the Preparatory Action (PA) for the period 2017-2019 with in mind a real EU funded Defence Research Programme (EDRP) for the period 2021-2027 [12], there are important differences in the level of innovation activities carried out by very highly heterogeneous sub-sectors. In order to identify where there is a possibility for common European interventions to stimulate, steer or complement the defence sector's innovation activities, the sector's capacities and incentives to innovate need to be reviewed in countries where some national systems of innovation still work in the field of defence and to get innovation, if possible, from dual-use technologies.

If we look at the situation in all the European countries, there are some products that are of interest to both military and non-military users such as secure communications and surveillance technologies like unmanned aerial vehicles and sensors, there still is a large amount of difference between military and non-military products, but how European companies and states can benefit from a dual industrial system is a complete other matter. In the three examples chosen in this article, voluntarily in Europe, which are Britain, France, and Germany, the three countries with the strongest track record of investing in defence, government policies towards their defence industries are clearly of

central importance both in determining the possible fields of investment for innovations, their relationship with their European defence industry possible partners, and the level of mixed activities between military and civilian technologies, which are in fact very limited.

Due to its recent role in conflicts in Mali and Central Africa, and its new position of Europe's first arms exporter, the importance of its defence industry, the still strong position of public R&D, the role of dual-use technologies on innovation, and persistent positive public attitudes towards research and innovation, France is the first European example we have in mind, and one of the possible sources of inspiration for other European or Northern American countries in the field of defence innovation. As part of its wider strategy of taking steps to get France out of its current economic and social difficulties, following a year's work by the National Council for Industry, the French government published in May 2015 a new strategic review for France's industrial policy priorities and decided to give this programme an additional boost by adopting a new approach in the form of an "Industry of the Future" and a new logic in the form of nine industrial solutions. Though it is a non-defence strategy, it could have consequences on defence, but the link is difficult to make a proper comparison with the American Third Offset Strategy.

These priorities defined in the "Industry of the Future" stem from exhaustive analysis of growth markets throughout the world and a comprehensive evaluation of France's role in the globalization of each of these markets. The project was led by the Directorate General for Competitiveness, Industry and Services (DGCIS), now the Directorate General for Enterprise (DGE)[13], a division of the former Ministry for Industrial Renewal, in association with France's innovation clusters and sector-based strategy committees within which business leaders, employee and employer representative organizations, relevant government departments and professional federations were represented. The priorities were selected on the basis of three criteria: presence in a growth market, or one with considerable growth prospects in the global economy (1); principal reliance on technologies that France masters, their adoption throughout the economy and their development, as well as the mass-production of new industrial offerings (2); established existence of a strong position in the relevant market, with leading companies, or an academic, technological, commercial and industrial ecosystem providing the foundations of a strong position (3) [14].

There is also a more military approach of innovation going on in France and all French governments tried for the last forty years to keep it strong enough to preserve the French industrial and technological defence base, whatever happens to the defence budget. The country has been preparing its industrial future with its Defence Armaments Procurement Agency (DGA), a department of the French MOD and a strong influencer of technological defence capabilities through its direct involvement in major weapons programs, to ensure a continual access to the necessary industrial and technological base by developing strategies for research and technology, industry and cooperation; which is not at all contradictory with the document and plan explained above from the DGCIS. The DGA's work covers the entire range of technological maturity (demonstration, technology research and basic technology) and is intended to build a European technological base for defence and security. In order to do this with the necessary level of efficiency, the DGA prepares threat scenarios and defence systems in close coordination with the armed forces, imagining possible futures, anticipating threats, risks, and possible advancing technology. The DGA identifies threats that may be

encountered in the future and the technologies for responding to them. Planning provides directions for defence research and is used to prepare the plan for equipping the armed forces. It identifies the technological skills necessary for building tomorrow's military equipment and the result of these different approaches is summarised in the 30-year forecast plan called PP30[15]. A useful way of doing things and to follow what works in the United States would be to develop the links between civil and military R&D with the "Rapid funding" for civil/military SME and Astrid funding in cooperation of the French National Agency for Research (ANR).

Germany is clearly not on the same trend. When being compared to French or partly French defence groups such as Thales, Dassault, Safran, DCNS or Airbus, German defence industries face the prospect of consolidation as the German government tightens restrictions on arms exports. This predictable decline is based on figures in line with a concerted policy shift engineered by Economics Minister Sigmar Gabriel, who sought to substantially reduce German weapons exports since taking office in late 2013, particularly to governments in the Middle East with poor human rights records. To illustrate this point, German government approval of arms exports to Arab countries fell to €660 million in 2014 from nearly €2.1 billion in 2013. Most German defence companies could sooner or later lack the size and resources necessary to compete in international markets, despite the importance of KMW, a company making mostly highly protected wheeled and tracked vehicles, RheinMetall, ThyssenKrupp, Diehl or the German branch of the Airbus group. This situation explains why Germany is shy on having a global or even a minimal plan for defence innovation, at a time when Germany should need a clear plan for ensuring its forces have access to the most innovative technology they need to accomplish their missions. The German government tried to change it and a defence industrial strategy called "*Strategiepapier der Bundesregierung zur Stärkung der Verteidigungsindustrie in Deutschland*" was published in Berlin in July 2015 in a perspective to have a higher defence budget than France[16]. There is inside a notion of key technologies in the paper on defence industrial strategy. There is also a new white paper published last June on the subject[17], which shows a possible will to do and make things, but concrete realizations are not define in this new defence white paper.

Truly, technological hubs are strong in Germany, such as Darmstadt for software, Aachen for manufacturing, or Munich and Hamburg for aerospace, but their main benefiters are civilian industries[18] and the German trade balance, being highly positive for a long time. This last factor is indeed a living proof of the might of German industries and innovations, but it is of no help for defence innovation or possible French/German defence cooperation on technologies.

In Britain, contrary to Germany and close to France's defence industrial model, defence industrial capabilities remained strong and Britain alongside France is the only other European country that can design, manufacture, integrate, and market complete sea, land, and air-based systems, such as fixed and rotary wing aircraft, aero-engines, warships and submarines, air-to-air and air-to-surface missiles, low level air defence, field guns, or military land vehicles. Britain has an organisational system different from the French one, but its structures share globally the same goals as the French DGA does. For example, the Centre for Defence Enterprise (CDE) funds innovative research that could lead to a cost-effective capability advantage for UK armed forces and national security; the Defence Science and Technology Laboratory (DSTL) formed on 1 July 2001

ensures that innovative science and technology contribute to the defence and security of Britain.

For dual-use technologies, though most British defence companies are in fact large multi-business companies, military and civil productions are historically organizationally and physically separated. Internal technology transfer between defence and civil divisions of British companies are thus limited by security concerns and other blockades such as internal accounting and budget procedures. They do not have any incentive for interdivision knowledge sharing, a phenomenon limited to smaller suppliers where dual-use technological activities are key to survive. Being without any real synergy between civilian industries on one side, and defence industries on the other side, is a durable fact, but it does not mean for Britain that it is unable to work efficiently on defence cooperation[19].

So, if there is any possibility of seeing new defence programs and innovations to emerge in Europe in the next five years, a realistic option could be a French/British cooperation based on their key industrial defence companies. However, this option is realistic if there are a political will and a budget for it on both sides, and if Britain is in fact ready, after the Brexit option, to go on defence innovation and technologies with its traditional European partner, France. For France, this country could get an option to reinvest in defence when considering its recent successes on defence world markets. France's capability to go on with European defence cooperation could nevertheless be limited by the impact of its public debt and the lack of any financial room for manoeuvre to increase its defence budget and to offer a credible alternative to prevent its European partners to give in to the lure of American ideas on offsets.

IS COOPERATION BETWEEN THOSE EUROPEAN STATES, WHICH ACTUALLY HAVE DEFENCE INDUSTRIAL CAPABILITY AND THE WILL TO DEVELOP IT FURTHER, STILL POSSIBLE? CAN IT BE BASED ON DUAL USE TECHNOLOGIES? IS THERE A LIMIT FOR THE DEFENCE INDUSTRIAL SECTOR?

In practice however, even in the context of broad European cooperation, the research and industrial capacity to find and develop the advances required lies in a small number of countries led by France and Britain. Both have extensive experience of scientific and technical development and both have demonstrated across a number of different fields from nuclear technology to advanced aircraft and cyber technology the ability and willingness to apply knowledge for defence purposes.

The German position is different, but German firms have high levels of technical expertise and a crucial role to play in a number of areas including advanced engineering technology.

All three have successful private sector enterprises and academic institutions working on technologies, which are likely to have defence applications. The level of cooperation between these countries will be crucial in determining the success of Europe's future defences. Because of current budget constraints, the ability of all three or indeed any other European country to keep ahead of technical progress across a range of different

fields is highly doubtful. Cooperation exists already not least between Britain and France on nuclear technology, and between Britain, France and a number of other European countries on the responses to terrorism including surveillance techniques.

This sort of cooperation is valuable both in sharing knowledge and in reducing the costs of research and development. The creation of single systems, for instance to monitor terrorist threats, is likely to be more effective than the development of distinct national systems which may prove to be incompatible when most needed. The events of the last year have shown the value of intelligence based on technology and data analysis in combatting the threat of Islamic or other terrorist activity within Europe itself.

Cooperation can be sensitive because it involves the pooling of knowledge and the sharing of an industrial base in a field, which has historically been a matter of strictly sovereign concern. Those challenges have to be recognised rather than evaded, but we are convinced that the combination of economic necessity and the shared interest in defending our societies in the face of exceptional threats makes the effort well justified.

The decision of the United Kingdom to leave the European Union may also appear to complicate such an agenda of cooperation. We do not believe this needs to be the case. Whatever the outcome of the Brexit negotiations, the United Kingdom will continue to share many common defence interests with its neighbours and to hold a range of technical and industrial skills which are directly relevant to the needs of Europe as a whole. There is no reason why bilateral and multilateral links should not be maintained and further developed.

In such a tricky context, the commitment to dual use is not of course a complete solution. The use of particular technologies between their civilian and military applications can vary to a very wide degree and military applications can require very specific adaptation to particular challenges. Modern military air forces could not have been developed without the prior advances in civilian aircraft design and construction. The area, up to that point, is a prime historic example of dual use in action.

But once that initial development had taken place, military aircraft evolved in quite different ways, each requiring extensive investment and specific technical expertise.

The commitment to research and development in new technology cannot simply be outsourced to the commercial side, and the additional spending required to take a commercial application and to make it relevant to the needs of the military could continue to be considerable.

In addition, there are security considerations to be borne in mind. The protection of intellectual property in civilian technology development whether in universities or private firms tends to be limited and the process of cooperation and knowledge exchange tends to be much more open than would be the case in military work.

Work for instance on advanced materials or mathematical simulations or data collection and analysis if undertaken in a private enterprise or university lab is usually the product of a diverse mix of researchers with no test of nationality and only minimal security requirements. The culture of civilian research of this type is quite different from the closed nature of much military oriented research, and in many countries and companies, this would be difficult to change. Major corporations are not bounded by national borders and seek to attract the very best staff. So do the major European research universities.

This means that knowledge developed in civilian environments cannot be kept secure to the extent which is normally required in a military environment. Developing patents is not the same as protecting core knowledge and the understanding of how it is applied. Knowledge will leak and with it the competitive advantage which comes from intellectual leadership.

This distinction between civilian and military research work extends to the industrial process of product development. The skills required in a commercial environment are not always, or indeed often, the same as those required in developing military products.

Major defence companies in Europe and elsewhere have developed through a close, often private interaction with those engaged in military activity, even if companies such as Thales or Airbus are by essence civil and military ones. A deep understanding of needs and challenges shapes specific product development. In many ways the industrial base is part of the structure of national defence even if the companies are wholly or partly privately owned.

This accumulated knowledge and capability would be hard to transfer to a civilian company focused on sales and product maximisation. There are a few examples of companies, which seek to bridge the civilian military boundary, but this is still rare and has not been highly successful. The characteristics and commercial drive of major companies shapes both their culture and their operational behaviour. Civilian companies developing advanced technology might legitimately seek global markets for their products and might find these difficult to penetrate if they were identified as the developers of military equipment for particular western countries.

The logic is that for the most advanced technologies, presumably those of the greatest value in defence terms, a distinct defence industrial sector would have to be maintained. This is already proving difficult because with limited defence budgets, the flow of new project funding is very limited. Major defence suppliers are forced into the position of relying on the development of products, which sometimes in a modified form can be sold to other governments, thereby covering the basic costs of the equipment, which home governments want to buy. Much time and political capital is then devoted to selling such products.

As an example, the French Dassault privately owned company decided, with the support of the French government, not to cooperate on a new common European fighter and started the Rafale project in the mid-80s. It was presented till now as a blocker of any common European aircraft cooperation, but if you want more cooperation in Europe, even on R&D, one has to recognize that we all must clarify these questions of key national technologies before doing anything. As basis for cooperation were very unclear, the French government dragged the go-it-alone attitude from Dassault and chose not to join a pan-European project to replace the "European fighter aircraft" that Britain, Germany, Italy, and Spain began developing in 1985. With the support of French national authorities, Dassault stubbornly refused to join, preferring to concentrate on developing the Mirage's successor, the Rafale fighter. In fact, this position was indeed possible due to the fact that Dassault made France for a long time the world's third-biggest arms exporter with its Mirage fighters. Things changed when world arms markets started shrinking in the 90s of the late century, but it was too late to re-orientate that policy. It also showed that national positions on key strategic military projects cannot be orientated on a too broad and multinational basis, due to the fact that it is often too complicated to settle and too hard to share industrial benefits on a fair basis. Indeed, key technologies are still to be protected on a national level.

Therefore, dual use is part of the solution but far from simple or the complete answer to the challenge of matching the need for continued high level research and development of the technology which will shape the future and provide the defence which is necessary in the face of evolving challenges.

Additional responses are needed if this basic challenge is to be met. Is a transatlantic level a possible response and is there a will on both sides, European States from one side and the United States on the other side, to play a fair game?

ARE A REAL DIALOGUE AND A PRACTICAL COOPERATION AT A TRANSATLANTIC LEVEL BETWEEN EUROPEANS AND AMERICANS ON MILITARY INNOVATION STILL POSSIBLE IN A CONTEXT OF A THIRD OFFSET STRATEGY?

As we just saw, there is a time when defence policy is facing a series of profound challenges. It is thus understandable that less visible developments are liable to be overlooked or neglected. On both sides of the Atlantic Ocean, a series of visible challenges dominates the debate on defence both within Governments, within the military and within the defence industry. One has to keep in mind that the first challenge is the increased risk of terrorism spreading from the Middle East into the streets of European cities today and maybe American ones tomorrow. That risk has evolved and becoming more threatening as radicalisation has reached into "home grown" communities. There is also the increased threat of assertive actions by Russia, particularly in areas which were once parts of the Soviet Union. China's emergence as a serious military power continues as do its challenges to neighbours, especially in the South China Sea and to the United States, although its long strategic ambitions remain unclear. And on top of all that there is the emergence of cyber as a new dimension of conflict and challenge. Each of these threats poses risks to Western societies and economies, which cannot be dealt with by the use of conventional forces alone.

As in Europe, this accumulation of risks also poses a harsh challenge to American budget, which is also already overstretched. Better than in Europe, economic growth has been moderate for most of the last decade, putting inevitable pressures on public spending. The response to the new risks listed above, and to the needs of conventional forces which in many cases find themselves stretched and threadbare in terms of even basic equipment, will be expensive for the Americans, leave apart Europe where it is not even on any credible agenda. Thus, it can be no surprise that NATO has struggled to get member states to deliver on their commitments to spend two per cent of GDP on defence.

Given this context it is not surprising that the development of serious new ideas on defence thinking have received little or no attention. That neglect, especially in Europe, is regrettable because such rethinking especially as expressed in the American Third Offset Strategy could reshape the defence environment and could leave Europe at a serious and growing disadvantage in a complex and dangerous world. It is in fact very unlikely that any transatlantic cooperation could be settled in such a context when the third offset strategy portfolio is already focusing on militarily useful artificial

intelligence, directed energy weapons, and autonomous aircraft and ships, far from what is being done in Europe.

But, again, this phenomenon is not especially new. The United States developed for a long time the right tools for the right policy. For approximately fifty years, the *Defense Advanced Research Projects Agency* (DARPA) played a leading role in turning innovations in technology into new military capabilities. In fact, most military and many civilian systems today can trace their origins to funding from DARPA. These include the Internet (ARPANET), high-speed microelectronics, stealth and satellite technologies, unmanned vehicles, and a wide variety of new materials.

One has to keep in mind again that the aim of the Third Offset Strategy initiative, if Chuck Hagel is rightfully quoted, is "*to use innovation to advance the US' military superiority in the 21st century*" and to give the US "*comparative advantage in power projection over the coming decades*". Instead of the gradualist approach of continuous improvement, the aim of the strategy is to deliver a step change in capability through significant and enduring investment. The initiative covers not just R&D, but also leadership development, operational thinking and the relationship between defence and business. The scope is wide, but the broad statements are backed up in most areas by impressive details, most of which flows from a major study by Robert Martinage from the Centre for Strategic and Budgetary assessments, an independent think tank which focuses on the need for forces to be able to compete and win when operating in areas of medium and high risk - the areas which he believes will be the location of much future conflict[20].

The challenge for a European defence community, which is absorbed by the immediate threat of terrorism and confused by the uncertainties linked to the prospect of Brexit and the vulnerability and weakness of the European Commission, is how to respond and how eventually to cooperate with the Americans. Can Europe keep pace with the envisaged technical and structural changes, which are already underway in the US[21]? Can Europe whether through the European Union or more focused coalitions develop its own version of a strategic response to the new challenges of our time? Is there a sufficient awareness of Europe's common defence interests to override long standing and historically driven difference of approach when it comes to the use of the force and the role of external intervention as a part of the defence of peace and prosperity? Can European nations, including the reluctant Europeans of the U.K, subsume their individual national interests sufficient to cooperate at the industrial level?

Or is Europe destined to remain weak in defence terms, divided and secondary in technical and industrial terms to the US and potentially China? Just to give some idea of the scale of European under-investment, the European Defence Agency's 27 participating member states spent €37.5bn on R&D/R&T in 2013, while the U.S. Department of Defence's R&D budget in the same year was approximately €102bn.

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CONCLUSIONS

So, what could be the European answer to the present situation, which is in fact quite bleak? Our main point leads to one inexorable conclusion, which is that the sort of industrial cooperation which is necessary for the time being should be achieved by the UK and France, the only last two European countries to keep a capability to work together on key technologies, despite the existence of the German documents recently published and quoted above to do things on defence technologies, but which in fact suffer from reluctance for defence topics in Germany. We know this will never be total cooperation because the UK and France are sovereign states with different interests who will always want some national capability of their own. That should be accepted because anything else is unrealistic. Cooperation between France and the UK would not harm anyway the rest of Europe and we think it should create capabilities, which everyone could use, and a balance against total US dominance.

We also consider the idea of a pan-European industrial sector as definitely unworkable. Nevertheless, there is great scope for building on the cooperation we have already by identifying three or four areas where we could work together without too much difficulty. There are possible areas better for this such as cybersecurity, helicopters and space, but surveillance and counter terrorism seem to be the areas where needs and skills and experience come together well for European countries.

We don't think Brexit will affect this line of thinking. Truly, existing cooperation is not managed through the European Union and future cooperation could involve other European Union's member states and companies without being a European Union project. Brussels might not like this approach but they don't really have an alternative to offer.

Times are hard in terms of spending, but the needs are growing. Therefore we should build on what we have, being realistic about the limits but ambitious in terms of the common needs. It seems both constructive and useful as a contribution to the debate. ■

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[1] An offset is a way of compensating a disadvantage, particularly in a military competition. Rather than match an opponent in non-favourable competitions, changing the competition to more favourable footing enables to defend oneself at acceptable cost. An offset strategy consequently seeks to deliberately change an unattractive competition to one more advantageous for the implementer. In this way, an offset strategy is a type of competitive strategy that seeks to maintain advantage over potential adversaries over long periods of time.

[2] See their website: https://rusi.org/event/robert-work-united-states-deputy-secretary-defense-third-offset-strategy-and-americas-allies

[3] The think tank *Friends of Europe* presented in Autumn 2015 a discussion paper called *dual-use technologies in the European Union, prospects for the future*, to concrete ways of making dual-use technologies a major asset to Europe's economy. See: http://www.friendsofeurope.org/media/uploads/2015/09/FoE-Dual-use-Discussion-paper-WEB.pdf

[4] See: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/478933/52309_Cm_9161_NSS_SD_Review_web_only.pdf

[5] See: http://www.kcl.ac.uk/sspp/policy-institute/publications/A-benefit-not-a-burden.pdf

[6] See: http://www.strategyand.pwc.com/perspectives/2016-aerospace-and-defense-industry-trends

[7] See for example "*How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective"* by Malte Brettel, Niklas Friederichsen, Michael Keller, and Marius Rosenberg published in 2014. http://www.waset.org/publications/9997144

[8] See Peter F. Drucker. 1998. *Management's new paradigms.* Forbes (October 5): pp. 152–177.

[9] The Rand Corporation tried to give us a clearer view on innovation and what it means in a report called *Innovation Models, enabling new defence solutions and enhanced benefits from science and technology*, published in March 2015. See: http://www.rand.org/pubs/research_reports/RR840.html The British MOD commissioned RAND Europe to conduct this study on innovation models and to make recommendations on changes the MOD could make.

[10] "European defence research, the case for an EU funded defence R&T programme, Group of personalities, EUISS, february 2016

See the report from the European Defence Agency published in 2013 on "*the development of a European defence technological and industrial base*": http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/433838/EXPO-SEDE_ET(2013)433838_EN.pdf

See national defence data 2013-2014 and 2015 of the 27 EDA member states, European Defence Agency june 2016

[11] See the Communication from the Commission of the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions towards a more competitive and efficient defence and security sector /* COM/2013/0542 final */ http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52013DC0542

[12]- "European defence research, the case for an EU funded defence R&T programme, Group of personalities, EUISS, february 2016

- The futire of Defence research, European Parliament 2016, http://www.europarl.europa.eu/RegData/etudes/STUD/2016/535003/EXPO_STU(2016)535003_EN.pdf

[13] See their website: http://www.entreprises.gouv.fr/dge/home?language=en-gb

[14]See: http://www.entreprises.gouv.fr/files/files/directions_services/secteurs-professionnels/industrie/nfi/NFI-anglais.pdf

[15] The 30-year forecast plan - or PP30 as it is known in France - is intended as a guide in the preparation of weapons programmes. In particular, it identifies key factors and risks arising from operational and technological step changes. This technical-operational approach should be backed up by a forward-looking analysis of the international strategic environment.

[16] See the document: http://www.bmwi.de/BMWi/Redaktion/PDF/S-T/strategiepapier-bundesregierung-staerkung-verteidigungsindustrie-deutschland,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf

[17] German white paper on German security policy and the future of the Bundeswehr, https://www.bmvg.de/portal/a/bmvg/en

[18] Germany has got Fraunhofer, which is Europe's largest application-oriented research organization. Their research efforts are geared to health, security, communication, energy and the environment. See: https://www.fraunhofer.de/en/.html

[19] However, key defence players can play on duality. As an example, in May 2014, DSTL presented a number of research projects at the "Quantum Timing, Navigation and Sensing Showcase" at the National Physical Laboratory to bring to market the science behind the world's most accurate atomic clocks, but the immediate benefits for British defence are in fact limited.

[20] See his report on the Third Offset Strategy: http://www.csbaonline.org/wp-content/uploads/2014/10/Offset-Strategy-Web.pdf

[21] See on defence cooperation and budgets in Europe the report published in January 2016 with the main European think tanks (RUSI, IRIS, IAI, FOI, etc.): http://www.iai.it/sites/default/files/pma_report.pdf

#10

Policy Paper

TODAY'S TECHNOLOGICAL INNOVATIONS FOR TOMORROW'S DEFENCE

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ARES GROUP

The Armament Industry European Research Group (Ares Group) was created in 2016 by The French Institute for International and Strategic Affairs (Iris), who coordinates the Group. The aim of the Ares Group, a high-level network of security and defence specialists across Europe, is to provide a forum to the European armament community, bringing together top defence industrial policy specialists, to encourage fresh strategic thinking in the field, develop innovative policy proposals and conduct studies for public and private actors.

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