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**Transatlantic Security Project**

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# THE FUTURE OF TRANSATLANTIC STRATEGIC SUPERIORITY

British, German, and French Perspectives

SYLVIE MATELLY, CHRISTIAN MÖLLING, AND TREVOR TAYLOR

EDITED BY MARTIN QUENCEZ



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## About the Transatlantic Security Project

GMF's Transatlantic Strategic Superiority in the 21st Century project aims to study key transatlantic perspectives on defense innovation and its implications for defense cooperation in the 21st century. The project, led by GMF's Paris office in partnership with Airbus, addresses the strategic and industrial aspects of defense innovation in the United States, France, Germany, and the United Kingdom, and fosters transatlantic dialogue on such issues.

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# INTRODUCTION

The U.S. Defense Innovation Initiative — also referred to as the Third Offset Strategy (TOS) — was announced in November 2014 to address the erosion of U.S. technological superiority and deterrence. The U.S. Department of Defense launched an ambitious innovation-based program to offset the competition from states in a long-term perspective and to “identify and invest innovative ways to sustain and advance U.S. military dominance for the 21st century.”<sup>1</sup>

When U.S. Defense Secretary Hagel announced “a game-changing third ‘offset’ strategy,”<sup>2</sup> the expression in itself highlighted the ambition of this initiative. An offset strategy is a way, through innovative technologies and operational concepts, to compensate for a military disadvantage vis-à-vis peer competitors, or to reaffirm its military primacy in a context of intense international competition. In the 1950s, the first offset strategy, part of Eisenhower’s New Look policy, aimed to overcome the superiority of the Warsaw Pact forces in conventional capabilities by investing in the nuclear arsenal. Instead of engaging in a direct — and pointless — attempt to match the numerical military power of the USSR and its allies, the United States would offset its enemy by ensuring the superiority of its nuclear deterrent. When the Soviet bloc reached near parity in the nuclear domain, a second offset strategy enabled the United States to overcome the challenge in an asymmetric way. In the 1970s and 1980s, the development of long-range precision-guided munitions, stealth technology, and new intelligence, surveillance, and reconnaissance systems, became the game-changer that guaranteed U.S. superiority. The first Gulf War and the outstanding victory of the U.S. Air Force over Saddam Hussein’s military provided a clear illustration of the implications of these investments on the battlefield.

More than 20 years after the end of the Cold War, the United States enjoys a clear dominance in the military realm. However, the rapid development of countermeasures to U.S. capabilities by state competitors — in particular China and Russia — has been identified as a threat to U.S. capacity to project power. In the early 2010s, the undermining of the power projection capacity was understood as a major issue for the future of U.S. deterrence. Driven notably by Deputy Defense Secretary Robert Work, the process leading to the announce of the Third Offset Strategy was therefore different from the first two offsets in nature — the aim was not to compensate the conventional superiority of the adversary, but to share a common goal: the United States sought for technological and operational tools to regain and maintain a strategic superiority that constitute the bedrock of U.S. deterrence worldwide.

The assessments that served as the basis for this strategy — the rapid modernization of China’s defense, emerging Russian ambitions and capabilities, the need to foster exchanges between public and commercial actors in defense innovation, the challenges of new anti-access/area-denial capacities, and the general spread of precision munitions and guided weapon systems — have remained relevant after the 2016 elections. The Trump administration, which does not use the terms TOS, continues to invest in the field of defense innovation in order to develop concrete answers to the erosion of U.S. deterrence. As the United States aims to preserve its ability to project power globally while its traditional sources of military advantage have been undermined by the maturation and proliferation of disruptive technologies, European partners must consider how this initiative may affect transatlantic military cooperation in the long run.

The launch of the U.S. Third Offset Strategy did not trigger a major reaction among European powers. Although they were aware of the long-term strategic issues that led to TOS, Europeans had other priorities for their defense policy, and could not invest

1 U.S. Secretary of Defense, “Memorandum,” November 15, 2014, <http://www.defense.gov/Portals/1/Documents/pubs/OSD013411-14.pdf>.

2 Chuck Hagel, “Secretary of Defense Speech: Reagan National Defense Forum Keynote,” U.S. Department of Defense, November 15, 2014.

politically and financially to design an ambitious response to the U.S. effort. Moreover, Washington's strategy did not offer a clear role for its allies, and left them unsure of what the United States expected from the transatlantic partnership.

A widening defense innovation gap between the United States on the one hand and European powers on the other could have detrimental implications for the future of transatlantic military cooperation. Indeed, the need to maintain a workable level of interoperability among allies cannot be overstated. Unless transatlantic coordination is reinforced, the recent U.S. initiatives could not only offset adversaries but also make its European partners more dependent and weaken their industrial and innovative assets. This requires a better understanding of the institutional and political mechanisms behind defense innovation policies on both sides of the Atlantic.

In this collection, Dr. Sylvie Matelly, Dr. Christian Mölling, and Prof. Trevor Taylor present the French, German, and British approaches to defense innovation. Considering the U.S. assessment of an erosion of conventional deterrence, the authors study the way each country defines its strategic environment and the evolution of its defense capacity. The authors also highlight the political and institutional processes that define technological innovation in their respective national defense sector, and the recent initiatives that the three main European powers have launched to address 21st century threats.

While none of these countries has aimed to propose an official response to the U.S. Defense Innovation Initiative, French, German, and British threat perceptions share many of the U.S. concerns. The need for a better integration of civilian innovation into the defense world is also underlined by the papers, although their methods and achievements differ. The global ambition of the U.S. effort is a point of transatlantic divergence: Europeans do not agree on the threats posed by China, and are forced to prioritize more short-term issues due to budget constraints.

Each country also faces its own difficulties. For France, the question of a widening technological gap with the United States reveals the complex articulation of industrial and strategic goals. While cooperation with the United States in the domain of

defense innovation is necessary in order to prevent the downgrading of the French military, a deepening of the cooperation with the United States could increase its defense dependence on U.S. capabilities and weaken its strategic autonomy. In Germany, this issue highlights the lack of awareness of the political leadership in this domain. In particular, the fact that new technologies, even if not military in nature, generate military threats, remain misunderstood by many, which hinders the prospect of a constructive collaboration between military and civilian innovation sectors. In the U.K., budget shortage and the implications of Brexit — at a time when the EU becomes more involved in capability development through the European Defense Fund — pose a problem of implementation of the industrial policy.

The United States and its European allies do not share the same global ambitions, nor do they face the same budgetary constraints. Yet, beyond these structural differences, a more fundamental divergence of approach toward defense innovation would jeopardize the mid- and long-term defense cooperation among allies. The following papers provide crucial information to understand the context in which the transatlantic dialogue on defense innovation can take place. Fostering the convergence of European approaches, while taking into account the national specificities, will be necessary to address issues such as the use of commercial technologies in the military realm, the integration of civilian personnel and talents into the defense world, the asymmetric response to peer-competitors' increasing capabilities, and the development of new operational concepts allowing for the creative use of new technologies.

# A BRITISH PERSPECTIVE

BY TREVOR TAYLOR

The British political situation in late 2017 is in an unusual state of upset. Arguments within political parties are commonplace, as are differences among ministers, but the current situation is abnormal. With the Brexit issue at center stage, the major British political parties are both internally divided on the fundamentals of the country's economic, political, and thus by implication security future. On the other hand, the defense and security community, inside and outside government, appear relatively united: To a greater or lesser extent they accept that the U.K. will leave the EU, and would prefer the minimum economic, political, and security disruption. Furthermore, whatever the political chaos of the day, external security threats require constant attention and long-term planning must continue — and it is. Emphasis on innovation has been a key component of U.K. defense planning for some years, arguably to the launch of the capability-based approach to requirements in the Smart Procurement Initiative of 1998, but with the new U.S. Defense Innovation initiative, the pressure has increased. London is keenly aware that it cannot fall behind ever more powerful and forceful adversaries, and will need more than ever to keep pace with allies as it prepares to exit the EU. Key features of the U.K. approach to innovation are the provision of (modest) state funding, a readiness to see government working with industry, and faith in the innovative capacities of small and medium-sized enterprises (SMEs).

## Reaction to the U.S. Third Offset Strategy

Behind the Third Offset Strategy (TOS) is Washington's diagnosis that Western capabilities face fundamentally novel threats that require a robust investment and renewal of forces and tools.

This assessment is taken seriously and implicitly accepted in the U.K., though there has been little public attention on the matter.

Within the defense community, however, the TOS announcement generated some concerns that a step-level change in U.S. capabilities would make it either difficult, expensive, or impossible for the U.K. to maintain the necessary interoperability to preserve its ambition to be able to deploy British forces alongside those of the United States on day one of a major state on state operation. Concerns about falling behind and out of step are, however, slightly mitigated by a series of separate procurement decisions to buy major equipment from the United States. This has been an increasing feature of British acquisition since 2003, when it was associated with the changing needs and thus urgent operational requirements of the campaigns in Iraq and Afghanistan. Purchases from the United States continued with the post-2014 commitments to the Protector (Reaper-based unmanned combat aerial vehicle), the Apache E model, the P-8A, and of course the F-35B — the U.K. relies on U.S. technology for virtually all airborne intelligence, surveillance, and reconnaissance (ISR) assets except the Thales Watchkeeper. Nonetheless, procurement is not enough and the TOS certainly influenced London's decision to maintain, and perhaps increase, its public commitment to innovation broadly defined.

The U.K. research innovation efforts detailed below could thus be interpreted as an insurance policy, aimed at leading to the U.K. having some valued niche technologies. These technologies could then secure its commercially valued access into essentially U.S. programs, which was broadly the case with the F-35.



Political developments in Washington, DC since 2014 could have changed calculations in the U.K., but at least in the field of defense, they have had only modest effect. No one can ignore the potential significance of the transatlantic relationship of a U.S. president who in the past has made U.S. support for NATO conditional on Europeans spending more. The public in Britain, too, is concerned about potential U.S. behavior, especially with regard to North Korea and Iran. But this has not fundamentally changed calculations within the British defense and security community on the importance of trying to respond to U.S. capability developments.

Though the U.K. has a long history of a collaborative (some would say dependent) relationship with the U.S. for some capabilities, London is also serious about working more closely with Europeans. This has been the consistent position from the U.K. security and defense establishment and has been underlined since the referendum result in 2016.<sup>1</sup> However, the U.K. regards national specialization in defense in Europe as a matter for each government and the U.K. is not yet ready for detailed commitments in this domain.

As for Britain's defense industry, its capacity to influence debate is issue-dependent but in general remains modest. British governments have not consistently applied a defense industrial strategy except in the niche areas of nuclear forces and complex weapons, and in general have stood by when British firms have either gone out of business or been bought by overseas firms. BAE Systems is a very large enterprise and by far the dominant U.K. defense firm, but the defense firms immediately below in terms of U.K. employees are foreign-owned.

Insofar as they seek to influence government, firms use their individual resources as well as operate through the two central industrial associations,

Aerospace, Defence, and Security (ADS)<sup>2</sup> and NDI which is the defense arm of EEF, "the manufacturers' organization."<sup>3</sup>

## Defining the Challenges

### Threat Perceptions: The Political Setting

The U.K. since 2008 has generated national security and defense documents that spell out the official perceptions of threats to U.K. security as a whole. After the Labour Government's National Security Strategy of 2008 came the Conservative–Liberal Democrat's Strategic Defence and Security Review (SDSR) of 2010. This was in turn succeeded by the Conservative Government's 2015 National Security Strategy and Strategic Defence and Security Review (NSSDSR) document. The intention was to publish such documents every five years, reflecting the

lives of (most) parliaments. However, changing international and national circumstances, including the changed U.K. financial position, led to pressures for an update to the 2015 document, (a National Security and Capability Review) in 2017.

In terms of security threats arising from human animosity (as opposed to challenges more closely associated with nature such as epidemic diseases and "natural" disasters) there is unanimity about the challenges posed by Islamic fundamentalism and terrorism. How best to deal with them is tricky but clearly, they constitute an important challenge.

The U.S. Third Offset Strategy is based on the perception of an erosion of U.S. conventional deterrence vis-à-vis potential competitors such as China, Russia, Iran, and North Korea, and from the need to find a technological answer to the spread

“ **British governments have not consistently applied a defense industrial strategy except in the niche areas of nuclear forces and complex weapons.** ”

1 Government of the United Kingdom, "Foreign Policy, Defence, and Development: A Future Partnership Paper," September 12, 2017; Patrick Wintour, "U.K. Offers to Maintain Security and Defense Cooperation with the EU," *The Guardian*, September 12, 2017.

2 See Aerospace Defence Security Space, <https://www.adsgroup.org.uk>.

3 See NDI, <https://www.eef.org.uk/ndi>.

of precision munitions around the globe. British threat perception shares many of these concerns, but remains more ambivalent toward China.

Since the invasion of Ukraine in 2014, accompanied by Russian efforts in the information and cyber domain, Russia has had once again to be regarded as a threat by London, particularly to NATO Allies and to the credibility of the Alliance. There is awareness of the need once more to deter Russia, although the door has been left open for return to a more cooperative agenda. Reflecting the limited size and capability of Russia's armed forces, the perceived threat is not of a Russian invasion of the whole of Western Europe, as was the case in the Cold War, but of Russian aspirations to intimidate vulnerable NATO Allies, most obviously the Baltic states, and even to take over limited areas of NATO territory. In addition, attention has to be paid to Russian disruption efforts in cyberspace. In terms of Russia's threat to the Baltics, the British government is relying on the presence of NATO air and land forces, with the U.K. making a significant contribution to discourage any Russian use of armed force. Privately the army is digesting the implications of Russian deep strike capabilities, the problems for the location and role of headquarters, and the need for constant movement of units and logistics, but as yet there is not the same open debate as in the United States. Moreover, in 2017 the U.K. celebrated the arrival of its long-awaited aircraft carriers, the possibility that they could be attacked by large volleys of long-range anti-ship missiles.

In regard to Iran, capabilities represent a potential threat to U.K. capabilities in the Gulf, including the Bahrain base, there is preference to keep the Iranian nuclear deal and to cope with Iran's activities in other ways.

Finally, China is presented in the 2015 NSSDR as a strategic partner with minimal attention paid to its claims in the East and South China Seas. Like other European states, the U.K. is concerned with promoting British exports to China and Chinese investment in the U.K. However, a hint of change, or perhaps of U.K. enthusiasm to support the United States, was the announcement in 2017 that the Royal Navy would send a warship to East Asia to take part in "freedom of navigation" exercises.

The value of cooperation with China has clearly been enhanced by developments in North Korea. There is awareness that the advancing nuclear weapon and missile capabilities of North Korea mean that Pyongyang is developing the capacity to hit Western Europe including the U.K., although the scenarios under which North Korea might opt to take this step are not easy to write. However, the North Korean activities clearly help to justify the U.K. nuclear deterrent. The more pressing issue concerns the U.S. responses to North Korean aspirations and activities and the potential consequences of war in the area.

### **Technological and Military Shortcomings**

The British government is reluctant to acknowledge the increasing vulnerability of some of its major platforms publicly, not least surface ships and large aircraft. After a very significant gestation period dating back to 1998, it is only now in the late stages of bringing into service its two new aircraft carriers.

Nonetheless, there is full awareness of some key elements: Russian and Chinese advances in anti-air missile technology in terms of range; Chinese progress with anti-surface ship weaponry, again speed and range; Russian advances in heavy indirect fire that will put large fixed land headquarters at risk and require dispersal and regular movement by Western land forces; Russian underwater capabilities especially relevant in and around the Baltics; and Russian and Chinese potential to disrupt the military uses of space by Western countries for surveillance, communication, navigation, and intelligence gathering. Finally, Russian, Chinese, and North Korean activities and aspirations in the cyber domain are accepted challenges that are currently dealt with on a daily basis.<sup>4</sup> In short, many British large platforms and immobile installations lack protection in the light of the advances of potential adversaries who have been seeking to deny safe access to regions adjacent to their territory. The U.K. is clearly no worse off in this regard than other European allies.

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4 See John Louth, Trevor Taylor, and Andrew Tyler, "Defence Innovation and the U.K.: Responding to the Risks Identified by the US Third Offset Strategy," RUSI, July 11, 2017.



## The U.K. Stance on Defense Innovation

For the U.K., defense innovation is a necessary response not only to identifiable future threats and adversaries' advances, but also to the innovation of partners and the support for its national defense industry. There is no doubt that the stress on innovation in defense has increased since 2014, although it is difficult to say just how much this is due to American thinking. Other contributing factors have been the rising costs associated with established defense equipment and the faith in the U.K. potential for innovation on which some Brexiters rely for a prospect of economic success after 2019.

In September 2016, the U.K. Ministry of Defence announced its new Defence Innovation Initiative (DII).<sup>5</sup> The government information release announcing the initiative summarized several strands of thought involved, including the importance of commercial-origin technology.<sup>6</sup>

A key element of guidance was the seven-point list of generic defense challenges where innovation was expected to contribute:

- Project military power against sophisticated adversaries, responding to the global proliferation of advanced capabilities aimed at reducing our reach, with innovative ways of developing, operating, and sustaining our Armed Forces.
- Deliver non-traditional and novel ways to have effect beyond traditional weapons systems against sophisticated adversaries, allowing U.K. defense enterprise to continue to offer a versatile range of options to decision makers into the future.

- Understand and take effective decisions in the information age, ensuring defense leaders have access to the best information possible to inform understanding of critical issues and enable decision-making that outpaces our adversaries.
- Adapt with agility to anticipated changes in the strategic environment, setting the organization up to better recognize the need for strategic change and exploit opportunities to respond with greater speed.
- Maintain robust strategic deterrence into the future.
- Optimize the future workforce to meet anticipated needs, finding sustainable and effective approaches to deliver the resource and skills Defence needs in the coming decades.
- Influence potential adversary choices on terms favorable to the United Kingdom, developing competitive strategies and leveraging the U.K.'s comparative advantages to dissuade adversaries from acting against U.K. interests.

Specifically as to how innovation should be driven, London has long believed that SMEs are a key source of valued innovation and agility. The Ministry of Defence has thus developed instruments to encourage SMEs to get involved in with defense. One such instrument is the Centre for Defence Enterprise (CDE), which was set up under the Labour Governments of pre-2010. The CDE's role was to provide small grants to SMEs to enable them to conduct specific pieces of innovative research. Because its activities were considered so successful, they have been continued, albeit with a different badge: the Defence and Security Accelerator scheme.<sup>7</sup>

Also reflecting a desire for novel solutions, the Ministry of Defence created Niteworks, a not for profit organization dating back to the pre-2010 Labour administrations where government and industry provided a few full-time people but that was largely staffed by consultants from industry assembled to work together on defined defense challenges. There are more than 170 organizations involved including Ministry of Defence, major defense

<sup>5</sup> U.K. Ministry of Defence, "Advantage Through Innovation: Defence Innovation Initiative," London, November 2016; Speech by Secretary of State Michael Fallon, "Defence Innovation Initiative" September 16, 2016.

<sup>6</sup> "Advances in technology hold enormous potential for the United Kingdom's security and prosperity whilst also posing risks as they become available to adversaries who may seek to use them against us. The global landscape has shifted with the private sector driving today's rapid pace of technological, social, and cultural change. Innovation is therefore important to maintaining our military advantage into the future. We must adapt to stay ahead and achieve our goal of maintaining strategic edge." Government of the United Kingdom, announcing the "Advantage Through Innovation Paper," September 2016.

<sup>7</sup> Government of the United Kingdom, "Defence and Security Accelerator: Terms and Conditions and Contract Guidance," December 8, 2016.

contractors, SMEs, tech specialists, consultants, and academic institutions.<sup>8</sup> Niteworks has survived and indeed increased the scale of its activities since the Conservative Party became the dominant party in government in 2010 and then the sole party in 2015.

To support innovation, but more widely to strengthen British defense industrial performance, governments since 2010 have emphasized industry-government cooperation as the way forward. Thus, Defence Growth Partnership has supplemented Niteworks with its numerous sub-groups including the Defence Solutions Centre.<sup>9</sup>

The financial center of the U.K. approach to defense innovation is a Defence Innovation Fund that should add up to £800 million over the decade from 2016. This was to be new money in addition to the floor on defense research spending set at 1.2 percent of the defense budget after 2010. Organizationally, the DII continued some existing arrangements, laid considerable stress on government and industry working together, emphasized the potential of SMEs to address key issues, and introduced some novel elements. Thus, the 2016 DII endorsed the Dual Use Technology Exploitation Programme, whose role is notably to “identify the best technologies from adjacent defense and civil sectors and ensuring they are put to dual-use through the DUTE community” and “bring together public and private investors seeking to draw on the very best emerging technologies from both sectors.”<sup>10</sup> The program was officially established in September 2015, with a confirmed Industry and Government fund of £10.3 million.

Aside from the extra money, the DII also increased the significance of the role of chief scientific advisor in the ministry,<sup>11</sup> and signalled that the defense sector was ready for the risks of failure and the disruption that a stress on innovation implied.<sup>12</sup>

The ministry’s aspiration was to create a culture across defense that was “innovative by instinct.”<sup>13</sup> In February 2017, it also announced the creation and initial membership of a Defence Innovation Advisory Panel, using people with backgrounds in areas marked by rapid innovation, including motor racing.<sup>14</sup>

## Who Are the Innovators?

Innovation is widely seen as desirable, even necessary, across all government departments. It would be difficult to focus on the precise numbers of people working on it, since in principle it should permeate the culture of government bodies including in the defense sector. The importance of innovation is manifest at exhibitions such as the International Air Tattoo at Fairford, the Farnborough International Air Show, and the Defence and Security Exhibition International (DSEI) with their specialist innovation areas.

Individual commands in the U.K. armed forces have embraced the theme of innovation, and there is particular interest in the potential for rapid innovation activities championed by the Strategic Capabilities Office (SCO) in the United States.

The army is actively searching for novel technologies, including robots, and experimenting with them in small scale exercises relevant to dismounted close combat. The multi-phase Army Warfighting Experiment 17 has been examining industrial offerings, often involving relatively low-cost and simple items such as novel ladders, stretchers, and a hoist system for easier and faster evacuation of wounded personnel from armored vehicles.

The army has also set up a Strike Experimentation Group to work out how the British Army can generate two-strike brigades useful for large-scale war fighting and yet able to move along roads for

<sup>8</sup> See Niteworks, <http://www.niteworks.net>.

<sup>9</sup> See Defence Growth Partnership, <http://www.defencegrowthpartnership.co.uk>

<sup>10</sup> See Dual-Use Technology Exploitation, “About,” <http://www.dute.co.uk/about-dute>.

<sup>11</sup> Government of the United Kingdom, “Defence Innovation Information,” updated August 10, 2017.

<sup>12</sup> “We will be open to risk, I will reward people who are inquisitive, who embrace change, and who are prepared take the fight kind of risks.” Secretary of State Michael Fallon, “Defence Innovation Initiative,” Speech, September 16, 2016.

<sup>13</sup> Ministry of Defence, “Advantage Through Innovation: the Defence Innovation Initiative,” London, November 2016, p.4.

<sup>14</sup> Government of the United Kingdom, Secretary of Defence Sir Michael Fallon, “Defence Secretary Announced World Class Innovation Panel,” Speech, February 27, 2017.

long distances. The army has been concerned with novel ways of conducting urban operations since well before the TOS.<sup>15</sup>

The Navy established an Unmanned Warrior program to explore its future use of airborne, surface, and underwater vehicles. Unmanned Warrior 2016 involved demonstrations of over 50 systems off the British coast from 40 companies and international allies.<sup>16</sup> In 2017, exercise Information Warrior, as the name indicated, focused on the exploitation and protection of information.<sup>17</sup> The Navy is also leading with the development of laser weapons.

Finally, the Defence Equipment and Support organization, which spends over 40 percent of the defense budget through contracting, has published an Innovation Strategy document that is largely focused on the organization can better facilitate the rapid introduction of technology developments into the Ministry of Defence. Its document includes six principles to assist this end:

- Help customers to shape and de-risk requirements through experimentation and pre-concept services that optimize pan-domain coherence, through life.
- Actively engage with and shape the Defence Enterprise nationally and internationally to align opportunities for innovation, and contribute to wider objectives for innovation, prosperity, and exports.
- Anticipate change through life and plan for flexibility, innovation, and capability upgrade through technology insertion.
- Identify and manage cross-cutting technical opportunities and threats appropriately across the Defence Equipment and Support portfolio delivery.

- Look for innovative ideas from any appropriate sources, and create conditions for innovation by supporting enablers and tackling barriers across all functions.
- Value and support innovation and responsible risk — and opportunity management by suitably qualified and experienced professionals.<sup>18</sup>

The innovation agenda is not only a military matter, but is within a context in which the Ministry of Defence has extensive links with other government departments dealing with wider security questions and the U.K.'s "prosperity agenda" to which the Ministry of Defence is formally committed to contribute. At the top of the heap is the Cabinet Office with its sub-Committee the National Security Council whose secretary is the prime minister's national security advisor.

On the important cyber front, the government has established the National Cyber Security Centre within the Government Communications Headquarters (GCHQ) to lead across government and indeed society as a whole.<sup>19</sup> It is the formal source of guidance and direction for all government departments. GCHQ's "home department" is the Foreign and Commonwealth Office, but it has close links with Ministry of Defence.

And given the centrality of technology in defense innovation, and the relevance of much commercial technology for defense, the ministry responsible for industry is particularly relevant. As a consequence of the Brexit vote, a separate Department for International Trade was set up and the previous Department for Business, Innovation Skills was re-organized in July 2016 to become the Department for Business, Energy, and Industrial Strategy. In a January 2017 Green Paper for comment authors argued that "we must become a more innovative economy and do more to commercialize our world leading science base to drive growth across the U.K."<sup>20</sup> In 2013, the government had identified "Eight Great Technologies" in which the U.K. had the foundation for global role (Synthetic Biology,

15 Government of the United Kingdom, "Army Conducts Largest Ever Virtual Battlefield Simulation Experiment," January 31, 2013.

16 U.K. Ministry of Defence, Royal Navy, "Unmanned Warrior."

17 U.K. Ministry of Defence, Royal Navy, "Information Warrior 2017."

18 U.K. Ministry of Defence, "Defence Equipment and Support Innovation Strategy," October 2016.

19 See National Cyber Security Centre, <https://www.ncsc.gov.uk>

20 Government of the United Kingdom, "Building Our Industrial Strategy," Green Paper, February 2017.

Robotics, and Automotive Systems, Satellites, Big Data, Energy Storage, Advanced Materials, Agri-science, and Regenerative Medicine).<sup>21</sup> The 2017 document included potential areas for funded innovation challenge exercises, many of which are obviously relevant for the security sector, including:

- Smart, flexible, and clean energy technologies (such as storage, including batteries, and demand response)
- Robotics and artificial intelligence (including connected and autonomous vehicles and drones)
- Satellites and space technologies
- Leading-edge healthcare and medicine
- Manufacturing processes and materials of the future
- Bioscience and biotechnology
- Quantum technologies
- Transformative digital technologies, including supercomputing, advanced modelling, and 5G mobile network technology

However, if spending was to be used as an indicator, the amounts involved in defense innovation are quite small. Even once it builds up, the Defence Innovation fund will total only £800 million in a decade (if it is not derailed by other financial pressures). Defence has allowed research spending to fall significantly since the end of the Cold War until a floor of 1.2 percent of the defense budget (around \$450 million) was introduced after 2010. EDA data show that U.K. defense research and technology spending is around the same as that of Germany and significantly less than that of France.<sup>22</sup> The government is of course hoping to harness commercially funded advances from the civil world for defense applications. A further concerning element is the over-commitment and lack of unallocated funds in the U.K. Defence Equipment Plan, which will make it hard to restore the drastic falls in (capitalized) development spending that have taken place, not least in this millennium. Research

spending in real terms in 2014–15 was just 75 percent of its 2001–02 figures while development spending was just 44 percent of the 2001–02 level.<sup>23</sup>

## Future of Cooperation

Certainly since 1998 the established British stance has been to encourage the exploitation of technology advances for defense purposes, although it has not argued for the kind of step-level set of changes that are a mark of the U.S. Third Offset Strategy. Aware of the advances in capability of potential peer adversaries, in response to the U.S. initiative, the U.K. has reinforced its commitment to innovation and to the working together of government and the private sector that it sees as crucial.

However, cash constraints, especially since the financial crisis after 2008 and then the devaluation of the pound following the Brexit vote, have been strong and have particularly affected money for development. These constraints have been reinforced by the commitments made by the U.K. to buy a range of U.S. systems “off-the-shelf” and by the increasing costs associated with the replacement of the U.K.’s fleet of nuclear submarines.

Looking forward, the U.K. has made clear that its impending exit from the EU has not moderated its enthusiasm for European defense cooperation both in capability generation and operational activities. However, the feasibility of such cooperation depends on the identification of useful programs, the availability of funds, and the readiness of partners to work with the U.K. There is no certainty about any of these factors.

21 Government of the United Kingdom, “Eight Great Technologies,” Industrial Strategy.

22 National Defence Data 2013–2014 and 2015 (est.) of the 27 EDA Member States.

23 Trevor Taylor, “Supplementary Written Evidence to the House of Commons Defence Committee,” 2017.



# A GERMAN PERSPECTIVE

BY CHRISTIAN MÖLLING

Technological superiority is key for the West's military power. But the reality of how to maintain this superiority is changing. Instead of innovation in defense technology coming predominately from national programs linked to the military, innovation is now increasingly generated by the private sector and takes place around the globe. The competition of commercial companies for their consumers has also led to shorter innovation cycles, especially in the area of information technology, and to a geographical diversification of centers of innovation — with new hubs especially in Asia. The ability of non-Western actors to increasingly incorporate civilian innovation into defense applications has led, among other things, to the perception of a growing erosion of conventional deterrence and defense capabilities in relation to rising powers and new actors of international security.

The U.S. Department of Defense launched a major “Defense Innovation Initiative” in November 2014, also known as the “Third Offset Strategy” (TOS), which has huge implications for the U.S. allies — in particular for their governments (regarding terms of procurement and regulation) and armed forces (regarding operating and questions of interoperability). While the Trump administration may coin a different term in the future, the innovation initiative is here to stay, precisely because the thinking behind it remains valid. The way U.S. allies react to the initiative will have major implications for future interoperability between NATO countries but also for the vulnerabilities of individual NATO countries.

## Germany's Reaction: Keep Calm and Carry On

Officially launched only three years ago, TOS has had little impact so far in Germany. Individual senior officials at the Pentagon and the German defense ministry have held talks, but the topic has not trickled further down the system. There are many governmental and civil actors who recognize the importance of investing in defense-related innovation within Germany, but only in general terms. In Berlin, there is recognition that a competitive defense industry and capable military requires investing in civilian companies that develop dual-use technologies. But there are not yet any official statements or analyses that propose a way forward.

To go by government statements in recent years, one might think that Germany was on the same page as the United States and on its way to developing its answer to TOS. For example, the 2016 White Book suggested that the government was aware of the erosion of its conventional deterrence capabilities. It also states that constant innovation is needed for effective protection of armed forces and in order to maintain their superiority. In particular, it makes clear that short innovation cycles are necessary in information technology and underscores the importance of the role of civilian companies in the development of dual-use technologies. As a result, it underlines that the Bundeswehr must work more closely with new drivers of innovation such as startups and the digital sector.

The White Book also argues that it is necessary to preserve the country's own technological sovereignty by preserving key technologies and



securing military capabilities and supply. It advocates a focus on cross-departmental coordination; the prioritization of research and technology measures; targeted industrial policy and procurement by the defense ministry; and export support. A government strategy paper on strengthening the German defense industry published in 2015 highlights the need to expand funding for research, development, and innovation.

In reality, however, there is little awareness regarding the TOS among political decision-makers in Germany. Apart from some high-level officials who are conscious of its implications for Germany, no real policy changes have been made. The main reason for the lack of policy adaptation is that the majority of policymakers in Berlin do not understand that new technologies, even if not military in nature, generate military threats. Moreover, responsibilities are fragmented: There is no central authority or responsibility that can detect and assess threats that go beyond the specific area of one ministry. Instead, a variety of different security services and agencies at the federal level, plus regional authorities and coordinating bodies at state levels, are responsible for addressing such complex threats. Aside from police forces on federal and state levels, Germany also has domestic intelligence services on the federal and state levels. Moreover, the constitution strictly divides responsibilities of actors along internal and external security.

Among these actors, a broader vision of technological innovation as a key piece of broad strategy is largely missing. In particular, the danger of losing Germany's military cutting edge is portrayed in government statements and documents as a threat in operational or tactical terms rather than strategic or systemic terms. That is to say, the discussion is generally about a certain capability that would be neutralized through new developments by adversaries, or about the losing the ability to conduct a certain type of operation due to missing equipment and training. The discussion, even among the defense community, largely omits broader questions of overall strategic superiority.

Threat perception is not necessarily the key driver of innovation; nor is necessity. Germany is actually massively dependent on defense innovation. Its armed forces as a whole rely on cutting-edge technology. The alternative — taking heavy losses — is politically unacceptable. The defense industry also relies on cutting edge technology: Its business model is to generate high tech capabilities and sell them to partners who are able to pay for the quality and in turn finance the next round of innovation. But it appears that the industrial sector has not seriously taken note of the ongoing reversal in global defense innovation, meaning that civilian sources of research and innovation are becoming ever more important than the military's own efforts.

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**Germany does not seek to deter China or other actors across the full spectrum of capabilities (including nuclear) or as a single state.”**

While Germany is aware of its weaknesses in conventional capabilities, its level of ambition is not comparable with the United States. Germany does not seek to deter China or other actors across the full spectrum of capabilities (including nuclear) or as a single state. Additionally, the German armed forces are also in a degraded state: The Bundeswehr has suffered severely from two decades of underspending in maintenance, spare parts, and training, as well as from limited investment and insufficient innovation. Their primary concern is to get the current generation of equipment working again, not to generate the next generation.

The incentives for Germany to take defense innovation more seriously are likely to come less from the United States but more from Europe. Germany fully supports the EU's Global Strategy, which sees the EU as a credible security provider. This leads immediately to the question of which capabilities are needed to provide security and, to a certain degree, also against whom or what. Moreover, the idea of “strategic autonomy” — which the Global Strategy identifies as an objective — raises the bar for innovation within the EU. If the EU wants to be autonomous in strategic areas like space technology and semiconductors, it needs a strategy and a serious amount of resources to invest.

Furthermore, Germany is pursuing an ambitious defense cooperation program with France — which President Emmanuel Macron will likely push as well. Thus, Germany will come under pressure to go beyond rhetorical support for European defense. If it fails to do so, it may face harsh criticism for failing to step up — even when the security of Europe is at stake. While Germany aims to develop defense technology in cooperation with partners, these partners find working with Germany more constraining than enabling. Germany continues to be a top arms exporter in Europe, selling about as much abroad as France. However, the export of defense equipment and the development of dual-use technologies are politically highly disputed in Germany. Controversy

has even led to the postponing of a deal on infantry fighting vehicles to NATO Allies like Lithuania and halting the contribution of components to helicopters jointly produced with France in the past years. Thus, the partners who are willing to develop and export jointly with Germany may worry that they might become hostage to a volatile domestic debate. As a result, European innovation in defense and dual-use technologies may even take place without Germany. Moreover, because of the controversy around dual-use and the arms industry in general, Germany does not have the same level of synergy between civil technology and defense that other countries do. This limits the vibrancy and innovation of the national defense innovation ecosystem — despite Germany's strong and diverse technical innovation landscape.

## Germany's Defense Innovation Ecosystem

Innovation is generally understood as taking place within a system where a network of institutions in the public and private sectors interact to initiate, import, modify, and diffuse new technologies. Traditionally this ecosystem has been national. However, as the EU's role as funder and rule-setter for innovation comes into play, more incentive structures and competencies that determine the rate and direction of technological learning are becoming transnational — at least within Europe.

Germany's innovation ecosystem is characterized by a multi-faceted infrastructure, a wide variety of disciplines, well-equipped research facilities, and competent talent. In all, there are more than 800 publicly-funded research institutions in Germany — universities, universities of applied sciences, non-university institutes, and federal and länder (state) institutions. The biggest are the Fraunhofer Society for the Promotion of Advanced Research, the Helmholtz Association of German Research Centres,

The Max Planck Society for the Advancement of Science, and the Gottfried Wilhelm Leibniz Science Association. There are also various research and development centers run by industry. Public and private research institutions

increasingly cooperate. Industrial and academic institutions pool their research and development activities in networks and clusters. Thus, cooperation between the private and public spheres is common practice.

However, military innovation is largely cut off from this generally well-integrated national innovation ecosystem. There is a systematic and deliberate “firewall” between civilian and defense research and long-established concern in society and parts of the political landscape over dual-use research. There is a deeply embedded perception of “good” and “bad” innovation in Germany. Civilian research is seen as contributing to the wealth of the nation and fits Germany's self-image as a country of ideas and engineers. Many Germans perceive defense research, on the other hand, as undermining a peaceful world. Some universities reject funding by the armed forces and defense industries.

More importantly, the government is also traditionally split on this issue. The defense ministry stresses its commitment to defense/military research and innovation and also mentions the importance of the civilian industries in order to cope with contemporary challenges and compete internationally. As such,

**“ Investment is not necessarily linked to a German or European demand or threat assessment.”**

in its industrial research report of 2015, it already set out the importance of working with various civil organizations. But the Ministry of Education and Research is traditionally opposed to a closer link between civilian and defense-related research.

Within the defense ministry, two divisions are responsible for innovation, research, and development. First, the ministry's planning division, supported by the Bundeswehr Office for Defense Planning, which studies the changing environment and resulting capability needs and produces reports such as the recent internal Strategic Perspective 2040. The Office for Defense Planning has also published several studies that focus on specific technologies, but not on innovation as an overarching perspective and its consequences for German security and its ability to defend itself. Second, the armaments division does its own research and technology within the defense ministry's military science and technical departments and in cooperation with the Fraunhofer Society for the Promotion of Applied Research (FhG), the German Aerospace Center (DLR), and the Franco-German Research Institute Saint-Louis, and as part of project-funded research by awarding contracts and grants to third parties within industry and private business, universities and colleges, and to non-university research institutions.

The German defense industry also conducts its own research. This is in turn guided by the priorities individual companies see in their target markets with new products and versus their competitors. Hence, investment is not necessarily linked to a German or European demand or threat assessment.

The German government also has civilian programs linked to the broader field of security, but within a definition of security that excludes the military dimension. As a result these programs are cut off from defense industry research and funded lines run parallel, rather than being combined. One example of such non-military security research is the Research for Civil Security program, the education ministry

(BMBF) made about €279 million available for 122 projects aim of improving the civil security of citizens between 2007 and February 2012. In addition, industry has contributed approximately €79 million. Research is being carried out on solutions for complex security scenarios in 48 projects in the focal areas of “protection of transport infrastructures,” “rescue and protection of people,” “protection against the failure of utility infrastructures,” and “securing supply chains.”

These projects interact with the wider network of national and international non-military projects and across disciplines, the research is sourced by a broad and open innovation system. This in turn creates not only more value for money, but also means that industry and businesses invest heavily into research and technology. Through institutionalized cooperation between industry and public research entities such as universities, the results can flow between actors.

**“ Competitors are increasingly successful because they quickly develop high-quality defense applications from both commercial and civilian technologies.”**

However, this flow excludes the defense sector. The German defense innovation ecosystem does not create synergies in the way it could. It is largely in the research and development phase that costs can be cut — especially in the digital economy. The use

for various applications of one technology developed during the research and development stages makes the duplications of effort unnecessary. Permeable borders and flows of knowledge, ideas, and people across civil and military domains and various scientific disciplines are key to more innovation. This contributes to the return of investment into innovation on a system level.

But in Germany, these synergetic effects are missing in the dual-use area — in other words, where broader areas of technology and innovation can contribute to both the civil and military domains. This in turn increases costs and leads to a duplication of research and development, fragmented islands of knowledge, and a reduction in the availability of research and development resources and the competitiveness of products and producers. Competitors are increasingly successful because they quickly develop high-quality defense applications from both commercial and

civilian technologies. These competitors are not only those states Germany is competing with on both political and industrial levels, like China or Russia, but also political partners like the United States, U.K., and France who nonetheless will seek individual economic advantage and support their industries in developing competitive products.

As the center of gravity for innovation moves quickly toward the non-military side, actors that benefit from civilian developments acquire a growing potential in technology but also in military terms. Eventually, the costs for countries like Germany to counter these developments through traditional military capabilities will increase exponentially as they are becoming evermore specialized and isolated from the civilian and commercial (innovation) world. With traditionally shrinking numbers of units but also traditionally increasing research and development costs, the costs per unit for military solutions will increase. At the same time, means of attack originating from the commercial/civilian spin-offs will become even cheaper. Thus, from the point of view of national welfare, military security solutions are becoming more expensive — and the irony is that this is happening precisely because other countries are making more effective use of dual-use applications.

A look at Germany's partners illustrates the point. France and the U.K. systematically integrate their civilian and military innovation systems and thus make an additive use of their research and development spending for overall security. Instead, Germany tends to duplicate research and development through parallel work in the civilian and military domains and thus neutralizes parts of the investment.

One area where Germany may be overcoming its dual-use aversion problem is cyber. The Cyber Command that was established by the defense ministry in 2017, which is tasked with connecting with the civilian world, could be a test case of these new ways of working. Among its first initiatives was the Cyber Innovation Hub (CIH) innovation platform. The CIH is a pilot project that aims to create a regular exchange between people from the fields of research, science, and industry in order to stimulate the development of dual-use technologies that could be used by the Bundeswehr in the future

— a mixture of an innovation agency and a tech procurement center. Together with the High-Tech Start-Up Fund (Gründerfonds), the CIH has started to invest in young, innovative technology companies that could be of value for German defense industry. For example, the High-Tech Start-Up Fund invested 600,000 euros since 2005 in young, innovative technology companies — and will provide up to €2 million in follow-up financing.

## Germany's Innovation Path Must Run Through the EU

As the system is more than the sum of its parts, risks and threats are not based on single projects and technologies but on the clever links between them. The more such technologies are of civilian origin, the more the dual-use activities of other actors have to be assessed not only in economic but in security and defense terms. In today's world we face complex threats derived from the effective use of non-military sources that consequently generate military threats. The development of artificial intelligence is one example. This is a very specific thing that is missing from Germany's awareness, and thus from Germany's strategy: the morphing of non-military tools into military threats. As an open, liberal society and one of the political and economic cornerstones of Europe, Germany needs an overarching approach to risks and threats of non-military origin. Innovation therefore needs to be assessed from an overarching perspective with regard to its consequences for German security and its ability to defend itself.

While the recent White Book correctly identified and analyzed the type of risks the country is now facing, this is not a replacement for a constant and frequent analysis of developments affecting the German economy, political system, and society. This type of analysis ought to go beyond the responsibilities of individual ministries. Precisely because individual ministries have so much influence over government policy, a horizontal body that reports to the whole cabinet is needed. Funding that is conditional on the cooperation between ministries and agencies would also create incentives to do so.

Germany abstaining from systematically harvesting dual-use technologies for its defense domain has not made the world a safer place and has not made



Germany safer either. The opposite is true: Because other actors are making more effective use of the innovation in the civilian domain for their defense application, Germany is behind the curve in two respects. First, it cannot compete, offer solutions, or be an equal partner in joint ventures. Second, Germany's adversaries can take advantage of the relative weakness of the country and its vulnerabilities.

Attempts to narrow this gap through a deeper civil-military integration of research and development networks and by fostering the exchange of results will have to overcome the distrust and fear toward dual-use technologies that is so deeply embedded in German society. Thus, while intentionally integrating the civilian and military innovation systems makes sense from a purely functional perspective, the ideological stumbling blocks may simply be too high. The other idea currently making the rounds is that of an agency based on the U.S. Defense Advanced Research Projects Agency (DARPA). This would be

a military agency but would nonetheless try to take advantage of dual-use potentials emanating from civil society.

Neither civil-military integration nor a German DARPA will be popular among German politicians. Thus, the key to a sustainable cutting-edge defense and security technology will be a narrative that raises the awareness that, in the tech world, inaction offers no protection. For example, Germany has not been spared cyber-attacks because of its large and effective cybersecurity system — quite the opposite. By failing to develop effective security responses, the German government is failing in its responsibility toward its own citizens.

The best way to move forward with more defense innovation may be through the EU. In this way, Germany is already active in the security and dual-use programs offered by the European Commission. New initiatives like the Permanent Structured Cooperation (PESCO) and the European Defence Fund (EDF) are also of such political importance

## Defense Research and Development Spending in the EU (2015)

Source: EUROSTAT, Datenbank

	Germany	France	Italy	United Kingdom	EU28 (average)
Area of Research	Amount (millions of euros)				
Civil Research and Development	25,082	13,156	8,204	11,759	897,93
Defense	820	1,017	63	2,364	4,658
<b>Total</b>	<b>25,902</b>	<b>14,173</b>	<b>8,267</b>	<b>14,124</b>	<b>94,451</b>
Defense spending as percentage of total spending	3	7	1	17	5



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that Germany will not thwart them without facing serious criticism. Once they are up and running, the initiatives will also offer opportunities for more joint research and development with preferred political partners. It would also fit with the idea of “strategic autonomy” and a more capable defense technological and industrial base.

# A FRENCH PERSPECTIVE

BY SYLVIE MATELLY

The election of President Macron came as a surprise in many ways. He was a relative newcomer to the political stage, his program provided many structural reforms, and he was openly Europhile in an Eurosceptic climate. In the summer of 2017, he enacted the reforms that he had promised by launching a Strategic Review of Defense and National Security (SRDNS). Published at the end of October, it lays out the reforms for France's defense policy. However, it is difficult to argue that the SRDNS marks a break with the previous reviews: threats remain the same, alliances live on, and the will to preserve national strategic autonomy remains a central focus. On the other hand, the new president appears to take a more realistic approach to budgeting, since the recent Military Planning Law for 2019–2025 plans to increase the defense budget by €10 billion in order to reach 2 percent of GDP by 2025. For years, French defense ambitions were let down by inadequate funding — under Macron, this seems to be changing.

President Macron supports the various initiatives launched by the European Commission and EU member states on defense cooperation at the European Council in December 2016. At the same time, France is losing its closest EU defense policy ally as a result of Brexit. Its defense relationship with the United Kingdom is defined by several initiatives, including the 2010 Lancaster House Treaty. Once the U.K. officially leaves the EU, France will be the only EU country to have a permanent seat on the UN Security Council and the only EU nuclear military power.

Meanwhile, threats in the neighborhood abound, and the terrorist threat in France remains high. The evolution of the relationship with Russia and developments in the Middle East constitute other

concludes that it is imperative that necessary skills be acquired in order to minimize risks and to exploit possibilities.

The TOS also addresses the need to increase the relevant U.S. defense budgets in order to deal with the rising costs of innovation. Given the size of its defense budget in comparison to that of the United States, France is much more affected by this issue, and it is therefore necessary for it to rethink its innovation policy. The SRDNS calls for a change in the culture of the Ministry of the Armed Forces in order for it to reach out further to the civilian research centers and the private sector, including supporting national, European, and international cooperation.

The 2013 White Paper on Defense and National Security defines defense research as a priority. Following the release of the White Paper, the 2014–2019 Military Planning Law increased significantly the budget for research and development, while the French procurement agency launched a reform of its defense research. The reform was presented in 2015 under the term science and technology,<sup>3</sup> which means "science, research, technology, and innovation" and includes all the spectrum of defense research from upstream research stages to the realization of demonstrators. It has the ambition to federate private and public actors, defense, dual-use, and commercial industries to strengthen the French innovation system and develop spin-off.

As in the case of the TOS, the challenge is that the new science and technology policy has an impact not only on the technological innovations produce by the procurement agency in the next 30 years,

3 <https://www.defense.gouv.fr/english/dga/actualite/tout-savoir-sur-l-orientation-de-l-effort-de-recherche-pour-la-defense>

priorities. Finally, uncertainty about the future of the United States' engagement in European security has increased since the election of Donald Trump.

France is very attached to its alliance with the United States within NATO and beyond. "Allied but not aligned" with the United States, France has always defended its right to free speech, a tendency which has been alternately welcomed and criticized by Washington, depending on the context and administration. Strategic autonomy was and is the main objective of France's defense policy. The country has therefore always maintained military capabilities and a credible defense industry, which has been both a driver and an obstacle to industrial cooperation with the United States.

## France's Reaction

France's 2017 SRDNS is not a reaction to the United States' Third Offset Strategy (TOS), but a reaction to the same challenges that inspired the initiative. It was designed to present the threat perceptions and priorities of the new president and his government, and to reaffirm the sovereignty and strategic autonomy of France. The SRDNS therefore does not directly and explicitly refer to the TOS. However, the context in which the French armed forces operate is quite comparable to that for which the TOS was written. For example, the threat perceptions in each document are similar. Both underline the rise of cyber-threats and the proliferation of civilian technologies that can lead to new threats or to weapons development by non-states actors. In the case of France, this has led to a redeployment of the investment of the Ministry of the Armed Forces in critical technologies.

The awareness of rising threats and of their implications for defense innovation in France has coincided with the development of the TOS in the United States. Before the SRDNS was written, the French defense procurement agency (*Direction*

*Générale de l'Armement*) launched a reflection on this topic and published a science and technology policy document at the end of 2014, defining science and technology as the new denomination for Ministry of the Armed Forces research and innovation. This notion expands the spectrum of defense innovation, integrating an upstream approach with the need to better understand the geopolitical, economic, technical, and technological context. It also aims to include the public and private sectors to improve spin-offs between civilian and military research.

Several elements introduced in the 2017 SRDNS bring the French strategic analysis closer to the U.S. TOS — in particular agility, civilian innovations, and budgets. One example is the emergence of the notion of military agility, understood as the need to better adapt to a changing and ever more complex environment. The SRDNS defines the concept as "a quick and reversible adaptation to a given situation, without preventing otherwise long-term actions."<sup>1</sup> In the TOS, the same idea is used and defined as "the ability to act appropriately in a changing context and to embrace the strengths of flexibility, adaptability, and responsiveness."<sup>2</sup>

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***Introduced in the French Strategic Review, agility, civilian innovations, and budgets are elements bringing French strategic analysis closer to TOS.”***

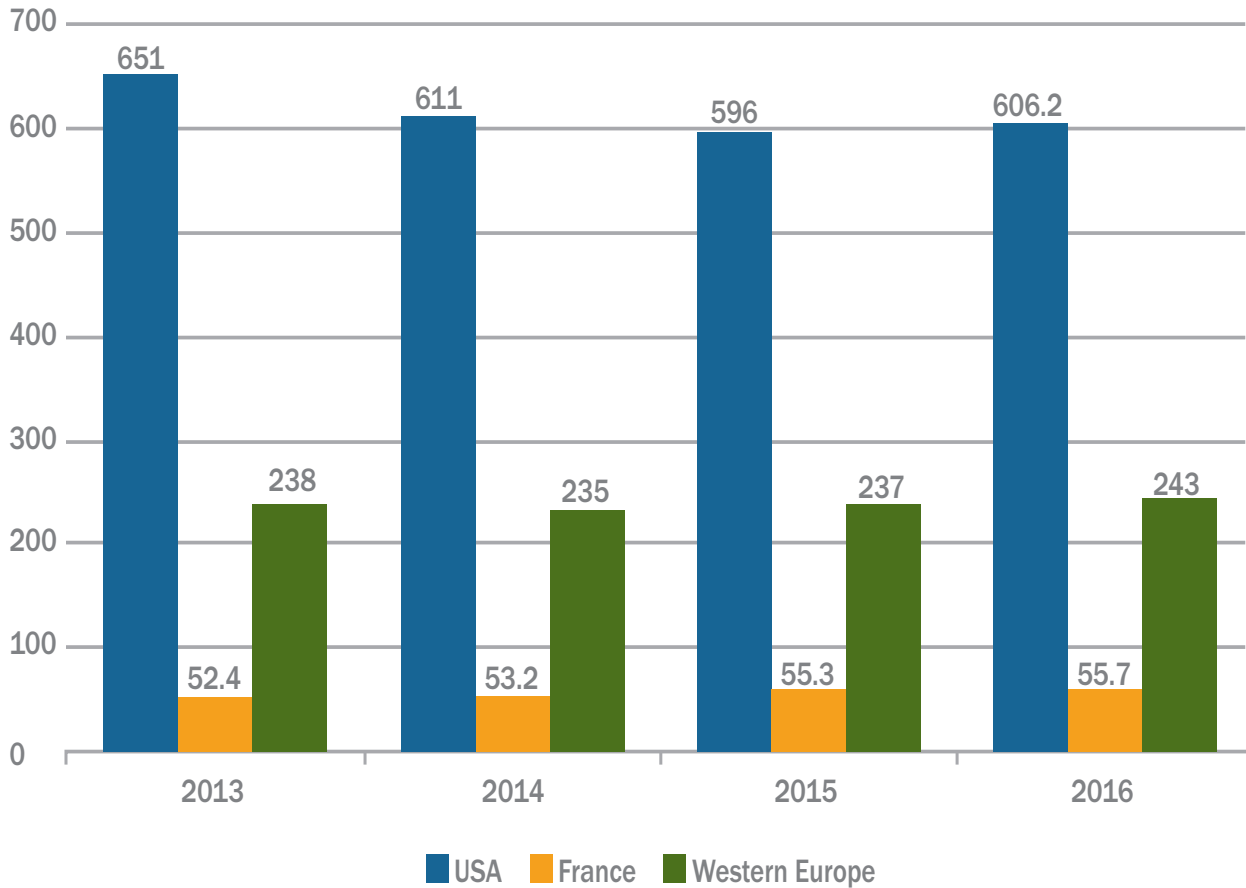
France has also reached the same conclusions as the United States concerning the dynamism of the civilian sector in generating innovations and its capacity to produce cheaper and particularly effective technologies. This may be an opportunity but also a threat, as they can

allow the military to access innovative technologies faster and at a lower cost. At the same time, they accelerate technological progress to such a degree that the military needs to innovate faster and faster to preserve its capabilities and superiority. The SRDNS

1 French Strategic Review on Defense and National Security, 2017, <http://www.defense.gouv.fr/dgris/la-dgris/evenements/revue-strategique-de-defense-et-de-securite-nationale-2017>.

2 David Walker, Deputy Assistant Secretary of the Air Force for Science, Technology and Engineering, Office of the Assistant Secretary of the Air Force for Acquisition during the Subcommittees "Emerging Threats and Capabilities (114th Congress) Hearing of 24 February 2016, in the framework of the Department of Defense Fiscal Year 2017 Science and Technology Programs: Defense Innovation to Create the Future Military Force.

## Military Expenditures by the United States, France, and Western Europe (USD, 2015)



Source: SIPRI (2017), Military expenditures database

Western European countries included: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the U.K.

but also on the entire French industrial production supporting in return the French Defense and Technological Industrial Base (DTIB). This could affect the innovation process but also the methods of acquisition, and more generally the conduct of armaments' programs.

The TOS could eventually have consequences on the level of interoperability between French and American forces, as well as on armaments or research and technology programs conducted by the U.S. Department of Defense and private American companies in partnership with European actors. As of today, however, there are so far no indications that French policy is reacting to this possibility. In this context, and as was often the case in the past, France

sees European cooperation as a way to improve both interoperability with the United States and European autonomy at the same time. Within that perspective, it largely supports the momentum for European defense cooperation since December 2016. Clearly, this includes the need to develop European security capabilities in order to become less dependent on the United States. Another important objective is to support a European security and defense policy. France has always emphasized strategic autonomy: nationally during the Cold War, and within the context of the EU since the collapse of the Soviet Union.

## Threat Perceptions

France's military is engaged in crisis theaters that are widely dispersed. It focuses mainly on the fight against terrorism at home (*Opération Sentinelle*) and abroad (in the Sahel region and the Near East). These commitments place a great deal of stress on capabilities and resources. President Macron promised new means to deal with this stress along with an increase in the military's budget in 2018, aiming to comply with NATO's threshold of 2 percent of GDP by 2025.

The 2017 SRDNS highlights the fact that the threats and risks identified in the 2013 Defense and National Security White Paper developed more rapidly and more intensely than anticipated.<sup>4</sup> Perhaps as a result, according to one government source at the time, "The president's will is to go fast, to quickly look at the strategic context, to examine our interests, to prioritize them, to define our ambitions," in a European perspective.<sup>5</sup> In the French assessment, the main threat is jihadist terrorism. According to the SRDNS, this threat is evolving, spreading to new regions, and flourishing in situations of chaos, civil wars, and fragile states.

More broadly, the SRDNS says that crises and threats are getting closer to Europe, which has experienced a return of war and use of force along its borders. The migration crisis, vulnerabilities in the Sahel-Saharan belt, and lasting destabilization in the Near and Middle East are cited as persisting threats. Moreover, threats and vulnerabilities tend to be amplified by other developments, such as climate change, organized crime, and pandemics.

Finally, the rise of mass-technologies in cyberspace and in the information field weakens societies and their security. They create growing requirements for defense and protection means to prevent and fight malicious actions and interferences, the consequences of which could be significant. The assertion of military power by several emerging countries is also

<sup>4</sup> The 2017 Strategic Review was officially introduced on October 13, 2017. It replaces the 2013 Defense White Paper. In addition, the new military planning law LINK released in February 2018, defined the means to defense and national security for the 2019-2025. <http://www.livreblancdefenseetsecurite.gouv.fr/>.

<sup>5</sup> Quoted by Sophie Louet, "La prochaine loi de programmation militaire sur les rails", Reuters, 29 juin 2017.

a notable threat. It is changing the balance of power and risk. It also feeds the logic of competition for access to natural resources and control of strategic spaces (maritime, air, exoatmospheric, and digital)

## Technology and Military Capabilities

New *modi operandi* based on the ambiguity of opponents' intentions are being developed by enemies. They use a wide range of civilian and military techniques to intimidate and destabilize people, generating higher risks of escalation. In addition, an increasing number of actors are able to acquire advanced military capacities thanks to technological developments and the diffusion of civilian technologies. These developments challenge the operational and technological superiority of Western militaries in land, sea, and air as well as in the digital

space, which is becoming an area of potential confrontation. The SRDNS underlines that this could also become the case in exoatmospheric space.

In this context, military commitments have become increasingly complex and expensive. The United States, Russia, and China focus on the development of high technologies, and the fear of a decline in European capabilities is clearly underlined by the SRDNS. Moreover, civilian technologies have the potential to proliferate, particularly in artificial intelligence, robotics, networking systems, and biotechnology. In the coming years, France's military must ensure its ability to integrate these fields to maintain its operational superiority.

In 2016, the Ministry of the Armed Forces stopped nearly 24,000 cyber-attacks. Their objectives were diverse, ranging from civilian to military. Then Minister of Defense Jean-Yves Le Drian said: "digital combat is now at the heart of all defense and security issues."<sup>6</sup> Thus, the digital space is now considered as a fifth battlespace and requires extensive coordination and complementarity between military actions and those carried out by other government services.

<sup>6</sup> Espace numérique, un nouveau champ de bataille, Dossier Grand Angle in Armées d'aujourd'hui, n° 415, Avril 2017



Characterized by the multiplicity of actors in a still underdeveloped legal framework, cyberspace is a crucial vector of new vulnerabilities. The SRDNS defines the concept of digital sovereignty as a priority issue, and calls for strengthening the previous permanent cybersecurity posture by developing offensive and defensive capabilities.

## Short-Term and Long-Term Priorities

The SRDNS has defined strategic autonomy as the primary objective for France. The military must be able to act autonomously in the fields of nuclear deterrence, territorial protection, intelligence, operations command, special operations, and the digital space. This is an amplification of the framework of strategic autonomy compared to what was defined in the 2013 White Paper. Furthermore, more than transatlantic cooperation, European cooperation must become the norm in defense research and security, unless real conflicts of interest are revealed in the long run. Targeted cooperation with other countries can also lead to interesting opportunities. Finally, in the long term, the use of civilian research will have to be optimized in order to better exploit the duality of technologies. Therefore, dialogue with civilian organizations, as well as their awareness of defense and security issues, must be reinforced considerably.

The financial resources dedicated to science and technology — including science, research, technology, and innovation — were already increased in 2016 and 2017, a trend that is likely to continue in the coming years. Investment is envisioned in fields such as hypervelocity, sensor fusion, and active stealth. It will also build on breakthroughs in civilian technologies (such as artificial intelligence, robotics and decisional autonomy, systems networking, new materials, biotechnologies) to better prepare the next generation of systems that should be capable of conferring operational superiority and be competitive in an increasingly competitive export market. After the SRDNS, a new document is expected at the end of 2018 to propose a revised policy to support innovation, identify, generate, capture, and experiment technologies.

## Organization

When he formed his government, President Macron changed the name of the Ministry of Defense to the Ministry of the Armed Forces. Some viewed this as a willingness to fully play his role of chief of the armed forces. However, this new name may reveal another objective. The concept of national defense increasingly includes new concerns (such a security, public order, social integration, and development) that are addressed by other state institutions such as the Ministries of Home Affairs, Justice, and Education. Renaming the ministry underlines the fact that it is dedicated to military affairs and is only one actor among others dealing with defense issues.

Promoting a comprehensive vision of defense and security, the 2017 SRDNS states that defense policy must focus on innovation and the digital revolution, and on introducing more agility and flexibility into the design and operational management of weapons programs. Beyond the technological dimension, defense policy should foster relationships between the defense world and other areas of research.

## Strategy

France's national defense posture is organized around five strategic functions defined by the 2013 White Paper and included in the 2017 SRDNS: deterrence, protection, knowledge and anticipation, intervention, and prevention. These will structure the identification of new defense priorities in innovation. The SRDNS identifies the following key areas in which innovation is expected to contribute.

- Human intelligence, including electromagnetic, radar, optical, digital diversifying platforms, sensors, and operating methods (manned aircraft and remotely piloted aircraft, naval units, space means).
- Capabilities to analyze an exponentially growing volume of data by improving the interconnection between different systems. A special effort will be made to increase support for intelligence analysis (big data, artificial intelligence).

- Knowledge of the exoatmospheric environment, which has become one of increasing vulnerability for command and surveillance means. The monitoring of low-orbiting objects — especially the monitoring of geostationary orbits, planned in particular within the framework of the Command and Control System for Aerospace Operations — is essential for ensuring the security of space assets and the conduct of operations.
- Early-warning capabilities to better identify ballistic threats, determine the origin of a shot, and assess the target area.
- Command and control capabilities and strategic, operational, and also tactical planning capabilities (air, naval, and ground components), including deployable modules, as well as human resources trained to take into account the multiplicity of commitments.

## Stance on Innovation

France's defense procurement agency (*Direction Générale de l'Armement*, DGA), is responsible for innovation within the Ministry of the Armed Forces. The innovation process in defense is based on several strategic documents:

- The White Paper on Defense and National Security and the SRDNS define the guidelines as previously described.
- The 30-year Prospective Plan (PP30) is the main tool for the identification of equipment needs, and for the orientation of defense studies and research. It is developed by military staff officers and DGA engineers.
- The Research and Technology Strategic Plan is based on the major guidelines set out in the PP30. It describes the "DGA's overall action to anticipate and control those technologies that are necessary and can be used in future defense and security systems."<sup>7</sup> It develops two different approaches. First, a capacity-based one that aims to identify technological developments prior the effective launch of programs to minimize risks of

failure. Second, a more prospective one with the purpose of identifying promising technological possibilities and opportunities for future programs.

- The Policy and Scientific Objectives, published by the Mission for Research and Scientific Innovation (MRIS) of the DGA, aims to foster discussions with the scientific community. Updated every two years, it focuses on very low-maturity technologies, from basic research to early laboratory experiments. The MRIS was created to structure and reinforce the collaboration between the ministry and the academic and industrial scientific community. It is directed by the scientific adviser of the DGA.
- Research studies, defined by the ministry as "applied research and studies contributing to support and develop the Defense Technological and industrial base (DTIB) as well as the technical expertise needed by the Ministry of the Armed Forces to carry out the operations of armament."<sup>8</sup>

The report attached to the Military Planning Act 2014–2019 identifies the following priorities for these studies:

- Preparation for the renewal of the two components, — maritime and airborne — of deterrence.
- The conception of the future combat aircraft through a mutual dependency organized around the Franco-British cooperation, the processing of future developments of the Rafale fighter, self-protection and specifically military work on helicopters, the drones' insertion in air traffic within the Single European Sky Air Traffic Management Research Joint Undertaking (SESAR JU), and the increasing rationalization of the Franco-British defense industry for the renewal and renovation of missile systems.
- Submarine warfare, modular naval combat systems, operating in networks, and innovative architectures for surface vessels.
- The rise of cyber defense.

<sup>7</sup> PS R&T: Research and technology strategic plan, Direction Générale de l'Armement, Ministère de la Défense, 2009, [https://www.ixarm.com/IMG/pdf/2A4\\_PSR\\_T\\_eng.pdf](https://www.ixarm.com/IMG/pdf/2A4_PSR_T_eng.pdf)

<sup>8</sup> Finance Law Bill, Program 144 « Environment and Defense Policy », section 7-3

- The continuing efforts on the protection of vehicles, crews, and combatants, the monitoring of routes, and innovative technologies for ammunition.
- The preparation of future space programs for surveillance, observation, and communication; continued efforts on image processing, electronic warfare, exploitation and processing of intelligence data, digitization of the geophysical environment, and changes in radio navigation systems.
- The fight against remotely piloted aircraft.

In 2015, a document presenting the Orientation of Science and Technology was published by the DGA for the first time.<sup>9</sup> It supports the new definition of the objectives of the ministry in terms of innovation, the overhaul of the organization of research, and the financial means dedicated to innovation for defense and security purposes. It will be updated if substantial changes occur in policy orientation and, in any case, no later than each new Military Planning Act.

The Science and Technology concept includes:

- Research studies
- Grants to various research organizations, including for dual-use research
- Prospective and strategic studies, as they allow to anticipate major changes in the strategic context
- Operational and technical-operational studies
- Research from the Atomic Energy Commission

The Orientation of Science and Technology document defines 14 aggregates, each of which constitutes a coherent subset of defense and security science and technology that will form the framework used by the DGA to manage and stimulate innovation. They are: combat aeronautics, cybersecurity, communication and networks, information systems, intelligence and surveillance, land systems and ammunition, naval combat and underwater fighting, nuclear submarines and propulsion, ballistic missiles, missiles and bombs,

combat helicopters and transport aircraft, support for innovation, transversal skills, health and human factors, and chemical, biological, radiological, and nuclear defense.

The budget allocated by the Ministry of the Armed Forces for "Defense: Environment and Defense Policy Foresight" was €1 billion in 2016 and €1.34 billion in 2017. (The reform initiated in 2015 was also an opportunity to increase these investments.) This rise also reflects the increase in the scope of research, technological, and defense studies. The Finance Act for 2018 provides another, less significant, increase of 4.5 percent to €1.4 billion in the funds allocated to this program.

## Government Departments and Agencies

The context of geopolitical uncertainty, an ever-more dynamic civilian research sector, and the challenges of innovation for French industry and national competitiveness have pushed the DGA to widen its fields of research and to diversify the actors involved. This has been based on greater coordination and a more systematic search for synergies between public and private actors, and between civilian and military actors, as well as the development of new sources of funding. Collaborative links may be based on contractual relationships, formal partnership agreements, or the participation of defense staff in civilian research bodies and vice versa. Partnerships can be strategic (strategic analysis, orientation, evaluation) and/or operational (expertise, co-financing of projects, exchange of results, exchanges of scientists).

The 2017 SRDNS sets the following three objectives for defense innovation.

- Designing the technologies necessary for the development and evolution of systems.
- Strengthening industrial skills to carry out future programs.
- Identifying and supporting innovative small and medium-sized enterprises (SMEs) and industries as well as civilian research organizations in areas of interest for the defense and security sector.

<sup>9</sup> Document de Présentation de l'Orientation de la S&T, Période 2014-2019, Direction Générale de l'Armement, Ministère de la Défense, 2009, [https://www.ixarm.com/IMG/pdf/post\\_dga\\_2014\\_2019.pdf](https://www.ixarm.com/IMG/pdf/post_dga_2014_2019.pdf)

Facilities	RAPID*	ASTRID**	ASTRID Maturation	Unique Interministerial Fund
Who	SMEs with less than 2,000 employees	Research organizations	SMEs and research organizations	Companies
Partnership	Possibility of association with one research organization and/or one company	Possibility of association with other research organizations and/or companies	Need to involve at least one research organization and one SME, one of which may be the project leader. One of the partners must have participated in an initial ASTRID project	Need to involve at least two companies (including the project leader) and a research or training organization
Kind of Projects	Industrial research or experimental development with strong technological potential	Fundamental or industrial research	Industrial research and experimental development	Development of a new product or service with a strong innovative content. Project labeled by at least one competitive cluster
Technology Readiness Level	3 to 6	1 to 4	3 to 6	4 to 7
Maximal Amount by Project		< €300,000	< €500,000	Possibility to be funded for more than €750,000

\*Dual-use Innovation Support Regime for SMEs (RAPID - Régime d'Appui pour l'Innovation Duale)

\*\*Specific support for Research and Innovation Works (ASTRID - Accompagnement Spécifique des Travaux de Recherches et d'Innovation)

The scarcity of available funds has led the ministry to rationalize as much as possible the use of defense research and development credits, focusing on defense research and letting other public bodies or departments fund dual-use research. Finally, cooperation between the different actors is supposed to benefit strongly from military spin-

offs of dual-use research. Therefore, the DGA has institutionalized its relations with several public and private organizations: the Ministry of Education and Research, with which the DGA is involved in the development of the National Strategy for Research and Innovation; the National Research Agency (ANR), partly financed by the DGA since

its creation in 2005 and with which it manages the ASTRID (*Accompagnement Spécifique des Travaux de Recherches et d'Innovation Défense*) financing program; and the majority of French public research organizations — the National Center for Scientific Research, the Atomic Energy Commission, the National Institute for Research in Computer Science and Automation, the National Center for Space Studies, the National Office for Aerospace Studies and Research, and universities — with which the DGA has signed cooperation agreements.

The preparation of future weapons programs also requires the involvement of private actors including SMEs as well as large industrial prime contractors. Several financing mechanisms exist in which the DGA participates significantly. Each fund is dedicated to research depending on the Technology Readiness Level as explained in the table on the following page.

Finally, the DGA has been directly involved in the activities of certain competitive clusters since 2005. These are “networks of companies, higher education institutions and public or private research organizations on a same territory that aim to work in cooperation to implement local economic development and innovation.”<sup>10</sup> There are more than 70 such clusters in France. More than 50 percent of the ANR's funds for innovation is used to support projects hosted by clusters. The DGA has a leading position in nine of them and is associated with others in cooperation with the Ministry of the Economy. Finally, the DGA is also the second-largest financial contributor to the Unique Interministerial Fund, a program designed to support applied research and collaborative research and development projects (involving, for example, large companies, SMEs, and laboratories).

## Conclusion

Defense cooperation between the United States and France will remain significant as the Ministry of the Armed Forces and Department of Defense have worked closely together for years and their militaries cooperate in NATO and ad hoc operations. Through its technological and capability advantages, the United States is an essential defense partner for

France in the public and private sectors. However, cooperation in the field of defense innovation opposes two contradictory arguments. On the one hand, France's authorities as well as its research actors and companies regularly express the fear that the country would experience a serious strategic and technological downgrading if cooperation with the United States is not deepened. On the other hand, however, the prospect of weakening France's strategic autonomy by increasing its already considerable defense dependence on U.S. technologies and capabilities is also a source of concern. Finding the right balance of cooperation in order to guarantee France's security without jeopardizing its independence will be key to innovation cooperation in the future.

<sup>10</sup> Finance Law n° 2004-1484, 30 December 2004



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