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**DEFENCE INNOVATION: NEW MODELS AND
PROCUREMENT IMPLICATIONS**

The German Case

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ABSTRACT

Germany has a capable innovation ecosystem. However, there is a clear “firewall” between civilian and defence research. This expression of cultural and organisational preferences impedes its ability to access the whole range of technological innovation for military use. Government and armed forces recognize technological progress and potential military applications as a central feature of the development of the armed forces for the requirements of future warfare. Current reform efforts focus on the digital sphere and related technologies and profit from the benign financial situation of the last years. While European initiatives so far have not played a significant role, this might change if the financial situation would worsen. Given the longstanding nature of cultural and organisational inhibiting features, it is unlikely that Germany will develop and introduce radical defence innovations in the near-to-mid future.

Keywords: *Germany, procurement, Ministry of Defence, defence industry, European Defence Fund, innovation, ecosystem, future of warfare.*

INTRODUCTION

Germany has a long history of defence innovation with a successful defence industry that developed and produced iconic equipment such as the Leopard 2. However, it is not particularly known for a vibrant start-up culture, instruments generally considered to be necessary for that such as risk-seeking capital or a flexible organisational structure, especially in government and administration. Analysing the German reaction to a changing technological landscape highlights three things :

First, government and armed forces recognize the importance of actively pursuing technological progress and its potential for military applications.

Second, the armed forces are maintaining institutions for experimental exploration of new technologies while actively trying to create forums for an intensified exchange with potential new actors in the defence ecosystem.

Third, traditional cultural traits and an instable financial situation are likely to impede Germany from harnessing its full defence innovation potential.

STRATEGIC AND OPERATIONAL VIEW ON DEFENCE INNOVATION

Both German government and the armed forces (the Bundeswehr) regard defence innovation as important elements for effective and able forces. The latest German Whitebook on defence from 2016 names technological innovation “the key to securing the future”.¹ It also states that “effectively protecting and ensuring the superiority of armed forces requires constant innovation.”² Consequently, governmental R&D³ activities are seen as a key driver of innovation processes. Nevertheless, the Whitebook also recognizes that some technology areas are driven by non-state actors and beyond the traditional defence industry.⁴ In the Concept of the Federal Armed Forces, which aims to translate strategic requirements from the Whitebook into guidelines for the development of the

¹ Bundesregierung, 2016. Weissbuch 2016. Zur Sicherheitspolitik und zur Zukunft der Bundeswehr. [online] Bundesregierung. Available at: <https://www.bmvg.de/resource/blob/13708/015be272f8c0098f1537a491676bfc31/weissbuch2016-barrierefrei-data.pdf> [Accessed 04 May 2021], p.131.

² Ibid. p.131.

³ R&D in this paper subsumes R&D and R&T expenditures under the one term, even though this might deviate from the German budgetary framework.

⁴ Bundesregierung, 2016. Weissbuch 2016. Zur Sicherheitspolitik und zur Zukunft der Bundeswehr. [online] Bundesregierung. Available at: <https://www.bmvg.de/resource/blob/13708/015be272f8c0098f1537a491676bfc31/weissbuch2016-barrierefrei-data.pdf> [Accessed 04 May 2021], p.131f.

Bundeswehr, it describes itself as “striving for a high degree of agility” and “holistic innovation management”.⁵ Even though some technological innovation might come from outside the traditional defence establishment, operational visions of the armed forces and thus investment priorities are important for the direction innovation takes.⁶

Operationally, both the German army⁷ and the air force⁸ highlight certain meta-trends that will influence their future force composition and conduct of warfare. First among them are digitalisation, robotisation, automatization, and increased networking of assets. Resulting from this change, the German armed forces expect three essential characteristics in future warfare: First, an even larger importance of the network as compared to individual assets.⁹ Second, they expect the battlefield to become increasingly transparent through the further proliferation of sensors and command and control capabilities able to process the plethora of information from those.¹⁰ Third, these trends raise the question of the human role in this kind of warfare. As the battlefield becomes more transparent, more deadly and shaped by an accelerating operational speed, the use of inhabited systems and human operators becomes riskier – to their life as well as to military efficiency. Nevertheless, both services underline that humans will have to retain their function as decision-makers.¹¹

For the army, further problems arise from the general lack of mass on the battlefield, while the age-old task of holding territory requires precisely that mass. Dispersion vs concentration of assets becomes a critical question when the army expects battlefields to be transparent.¹² This is especially problematic if adversaries can utilise precision effects - regardless of their origin (e.g., artillery, uninhabited vehicles) - against a small number of high-value assets. The integration of uninhabited systems, open system architectures, increased networking – across domains - and enhanced mobility are some of the answers

⁵ Bundesministerium der Verteidigung, 2018. Konzeption der Bundeswehr. [online] Bundesministerium der Verteidigung. Available at: <https://www.bmvg.de/resource/blob/26544/9ceddf6df2f48ca87aa0e3ce2826348d/20180731-konzeption-der-bundeswehr-data.pdf> Accessed 04 May 2021], p.65.

⁶ See e.g. the diverging development of armed forces and services in Europe during the interwar years. Posen, B., 1984. The Sources of Military Doctrine. Cornell University Press, New York.

⁷ Autorenteam Kdo H II 1 (2), n.d. Thesenpapier I: Wie kämpfen Landstreitkräfte künftig? Kommando Heer, p.8.

⁸ Deutsche Luftwaffe, n.d. Luftmacht 2030 - Die Luftwaffe im Dienste Deutschlands. p.11.

⁹ Ibid, p.12.

¹⁰ Autorenteam Kdo H II 1 (2), n.d. Thesenpapier I - Wie kämpfen Landstreitkräfte künftig? Kommando Heer, p.15.

¹¹ Deutsche Luftwaffe, n.d. Luftmacht 2030 - Die Luftwaffe im Dienste Deutschlands. p.13. and Bundeswehr, 2019. Artificial Intelligence in Land Forces. Army Concepts and Capabilities Development Centre, p.9.

¹² Autorenteam Kdo H II 1, n.d. Thesenpapier II - Digitalisierung von Landoperationen. Kommando Heer, p.6.

to these challenges as they would enable more rapid concentration or dispersion of forces and add mass to complicate an adversary's target prioritisation.¹³

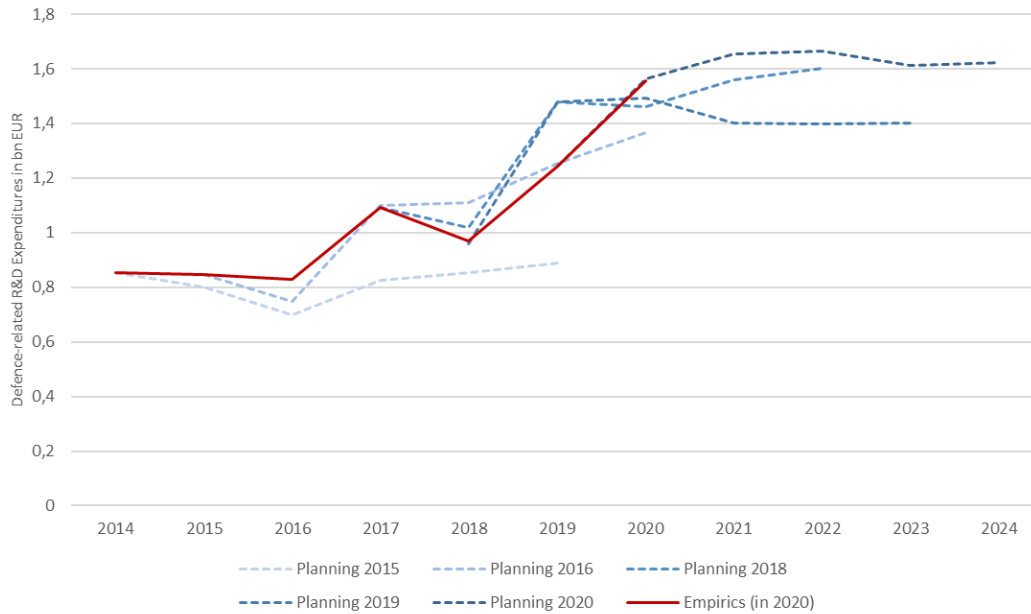
These views on future innovation challenges may even limit themselves too much to classical conflict around territory. It is reasonable to assume that conflict will focus more on infrastructures and economic relations and aims and tools. Warfare e.g. on infrastructure, cyberdomain, societies (disinformation), space become more probable. Other forms of military engagement may lie on the opposite side: stabilisation operations on spaces of limited security, i.e. the return of expeditionary operations (Auslandseinsätze).

FINANCIAL FRAMEWORK: R&D EXPENDITURES

In line with the total German defence expenditures, its R&D expenditures grew significantly over the past years, from 0,8 bn EUR in 2014 to 1,55 bn EUR in 2020 (as depicted in Figure 1). Even though these expenditures still fell short of the originally planned amounts between 2017 and 2019, this is important. As around 95 per cent of the R&D expenditure of the German defence industry comes from state sources, this is a remarkable influx of resources. Hardly any research activity is financed by the companies themselves, which is logical in a market whose direct and indirect (export) demand is so strongly regulated by the state. It remains to be seen to what extent COVID-19 will influence this budgetary trend. It is important to note here that military equipment exports almost never include R&D expenditures by the customer, which therefore makes this possibility of compensation for possible German reductions in R&D expenditures impossible. Even if this is the case, such investment is not necessarily compatible with a German demand or with a German or European threat assessment.

¹³ Autorenteam Kdo H II 1 (2), n.d. Thesenpapier I - Wie kämpfen Landstreitkräfte künftig? Kommando Heer, p.7.

Figure 1: Development of German MoD R&D expenditures and planning (in nominal bn EUR, 2014 - 2024)¹⁴



While parts of these expenditures are bound to specific large armament projects (e.g. the Eurofighter and its continued development), most is channelled into the German defence innovation ecosystem (See table 1, below).

Table 1: Budget for Defence research, development and testing. German MoD, 2021

Item	Budget in Mio. EUR
Defence Research and Technology	512,5
Defence development and testing	380,1
Development of the Eurofighter weapon system	280,0
Development of the MRCA fighter aircraft	160,0
Disruptive innovations in cyber security and key technologies	40,0
Future and further development of the Bundeswehr	30,0
Contribution to the German-French Research Institute St. Louis (ISL)	23,4
Military medical, psychological and other military research	2,0

¹⁴ Bundesministerium der Verteidigung, n.d., Rüstungsberichte des Bundesministeriums der Verteidigung 1-12. [online] Bundesministerium der Verteidigung, available at: <https://www.bmvg.de/de/themen/ruestung/ruestungsmanagement/ruestungsbericht> [Accessed 04 May 2021].

Development and testing, e.g. in the fields of medical services and food service	2,0
Tactical Air Defence System	2,0
Other	124,0
Total	1.555,99

Source: <https://www.bundeshaushalt.de/#/2021/soll/ausgaben/einzelplan/1404.html> (accessed: 04 May 2021)

THE GERMAN DEFENCE INNOVATION ECOSYSTEM

Innovation is multi-faceted concept. Defence innovation becomes hard to grasp in times when defence applications are fuelled by non-defence technologies. As a process, defence innovation entails not only the technology but also and often upfront to the technology the strategic innovation that aims to respond to changes in power or threat. The German defence innovation ecosystem can be displayed via two pillars: First, the institutional pillar and second the defence industrial pillar.

The institutional pillar is characterized by a multi-faceted infrastructure, a wide variety of disciplines, well-equipped research facilities and competent staff. It is dominated by (partially) state-funded research institutions, especially the Fraunhofer Group for Defence and Security¹⁵, the technical centres of the armed forces (Wehrtechnische Dienststellen), service-level institutions like the Army Concepts and Capabilities Development Centre and private defence companies.

Some universities in Germany are also performing defence-related research, foremost the Bundeswehr Universities in Hamburg and Munich.¹⁶ Others are either prevented by state law¹⁷ or by committing themselves to so-called Zivilklauseln, banning defence-related research at the university.¹⁸ This is but one example of the systematic and deliberate “firewall” between civilian and defence research as well as a traditional concern in society

¹⁵ Nelson, A.J., 2020. Innovation and Its Discontents: National Models of Military Innovation and the Dual-Use Conundrum. The Center for International and Security Studies at Maryland, p.18.

¹⁶ See e.g. Forschungsinstitut Cyber Defence, n.d. Laufende Projekte. Universität der Bundeswehr München. Available at: <https://www.unibw.de/code/laufende-projekte> [Accessed 04 May 2021].

¹⁷ Bontrup, H., Götzke, M., 2019. Geplante Änderung des NRW-Hochschulrahmengesetzes: Kein Verständnis für ein Ende der „Zivilklausel“. [online] Deutschlandfunk. Available at: https://www.deutschlandfunk.de/geplante-aenderung-des-nrw-hochschulrahmengesetzes-kein.680.de.html?dram:article_id=449095 [Accessed 04 May 2021].

¹⁸ Klein, S., 2019. Die Friedenspflicht fällt. [online] Süddeutsche Zeitung. Available at: <https://www.sueddeutsche.de/bildung/zivilklausel-nrw-pentagon-1.4494891> [Accessed 04 May 2021].

and parts of the political landscape over defence and dual-use research. This is because 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 to German self-images as the country of ideas and engineers, whereas defence research has a seriously negative taste: It is seen by many as an activity against a peaceful world. So far, the utilisation of technologies from civilian-commercial companies in the armed forces is limited.¹⁹

Within the MoD, two divisions are specifically responsible for Innovation, Research and Development. Within the planning division, strategic foresight linked to the environment and resulting capability takes place and is also supported by the “Planungsamt der Bundeswehr”. Moreover, the Planungsamt der Bundeswehr has published several studies on innovation. These focus on specific technologies but not on innovation as an overarching perspective and its consequences for German security and its ability to defend itself.

Moreover, the armaments division is dealing with R&T. They especially manage the research planning and conduct. The objective of German defence R&T is to provide the government with the capacity to analyze and assess defence technological developments independent of project related activities. This is part German security policy and shall also place the country as part of the research landscape within Europe and NATO.

This **Ministry of Defence (BMVg)** research and technology (R&T) is based on activities in three pillars:

- > Research and development within the MoD’s own military science and technical departments.
- > As part of a pro-rata funding scheme to the Fraunhofer Association for the Promotion of Applied Research e.V. (FhG), the German Aerospace Center e.V. (DLR) as well as the Franco-German Research Institute Saint-Louis (ISL).

¹⁹ Nelson, A.J., 2020. Innovation and Its Discontents: National Models of Military Innovation and the Dual-Use Conundrum. The Center for International and Security Studies at Maryland, p.19.

> Or as part of project-funded research by awarding R&D contracts and grants to third parties within industry and private business, universities and colleges and to non-university research institutions

There is also a more or less formal coordination round on R&T which brings together the DLR, FhG and the relevant heads of department. However, this is more a working muscle than a strategic foresight body. It organizes work and coordinates the allocation of resources.

The MoD's policy division does not take visible interest in defence innovation. It does not fall into their natural area of competences to deal with long-term issues and it is rarely on the minister's agenda.

More importantly, the government is traditionally split over this matter. All mentioned statements above have to be taken with a grain of salt because the Federal Ministry of Education and Research (BMBWF) is traditionally opposed to a closer link between civilian and defence related research. The Ministry of Defence (BMVg) however stresses its commitment to defence/military research and innovation and also mentions the importance of the civilian industries in order to cope with contemporary challenges and compete internationally.²⁰ As such, in its industrial research rapport of 2015 it already sets out the importance of working with various civil organisations.

The defence industrial ecosystem in Germany is, except for Airbus and Rheinmetall, shaped by comparatively small and fragmented companies as well as SME's across the supply chain and even on the system integrator level. The duopolies in land systems (Rheinmetall and Krauss-Maffei Wegmann) and naval systems (ThyssenKrupp Marine Systems and Lürssen/German Naval Yards) are distinctly different from the national champions that formed in other European countries (e.g. Italy, the UK). Both single-domain structure as well as small size hamper the ability of these actors to independently invest in R&D and inhibits cross-domain technological innovation within companies.

²⁰ Bundesministerium der Verteidigung, 2015. Wehrwissenschaftliche Forschung Jahresbericht 2015, Bundesministerium der Verteidigung, Bonn.

RECENT REFORMS

Both, the armed forces and the government are trying to address emerging technologies and cyber in a more targeted manner. Four new institutions are signifying this:

- The Cyber Innovation Hub (CIH) of the Bundeswehr²¹,
- the newly founded Center for Digitization and Technology Research,²²
- SPRIN-D, the Federal Agency for Disruptive Innovation²³,
- and the Cybersecurity Agency, a bi-ministerial cooperation between MoD and MoI.²⁴

While the cyber innovation hub, with a budget of roughly 10 Mio. EUR per year²⁵, focusses on progressing digitalisation in the armed forces, the Center for Digitization and Technology Research shall act as a motor for university-based digitisation and technology research in the Bundeswehr and establish a start-up incubator from the outset. This incubator aims to provide founders with a lively environment that is perceivable and activating, and that promotes the transfer of research results and business ideas into innovative start-up projects in cooperation with business and industry. Its budget is 500 Mio. EUR spread out over several years.²⁶ SPRIN-D, on the other hand, is the government's agency focussing on hard- and software civilian applications that could disrupt commercial business sectors with a budget of about 1 bn EUR for the first ten years of its

²¹ Bundeswehr, n.d. Empowering Innovation in Defence. [online] Cyber Innovation Hub. Available at: <https://www.cyberinnovationhub.de/en/> [Accessed 04 May 2021].

²² Wiegold, T., 2020. Die Bundeswehr und das Corona-Paket: Etwas mehr Klarheit – aber noch nicht bei Rüstungsprojekten. [online] Augengeradeaus.net. Available at: <https://augengeradeaus.net/2020/06/die-bundeswehr-und-das-corona-paket-etwas-mehr-klarheit-aber-noch-nicht-bei-ruestungsprojekten/comment-page-1/> [Accessed 04 May 2021].

²³ Federal Agency for Disruptive Innovation, n.d. SPRIN-D. Available at: <https://www.sprind.org/en/> [Accessed 04 May 2021].

²⁴ Deutsche Welle, 2020. Germany launches cybersecurity agency to strengthen 'digital sovereignty'. [online] Deutsche Welle. Available at: <https://www.dw.com/en/germany-launches-cybersecurity-agency-to-strengthen-digital-sovereignty/a-54529134>, [Accessed 04 May 2021].

²⁵ Rathenow, S., Vom Startup in die Kaserne: Wie Ex-Hacker Sven Weizenegger mit dem Cyber Innovation Hub der Bundeswehr hilft. [online] BusinessInsider. Available at: <https://www.businessinsider.de/wirtschaft/vom-startup-in-die-kaserne-wie-sven-weizenegger-mit-dem-cyber-innovation-hub-die-bundeswehr-digitalisieren-soll/> [Accessed 04 May 2021].

²⁶ Wiegold, T., 2020. Die Bundeswehr und das Corona-Paket: Etwas mehr Klarheit – aber noch nicht bei Rüstungsprojekten. [online] Augengeradeaus.net. Available at: <https://augengeradeaus.net/2020/06/die-bundeswehr-und-das-corona-paket-etwas-mehr-klarheit-aber-noch-nicht-bei-ruestungsprojekten/comment-page-1/> [Accessed 04 May 2021].

existence from 2019 onwards.²⁷ However, if the agency works according to the political conviction of its director, it does not venture into defence.²⁸ Lastly, the joint cybersecurity agency between MoD and MoI, aims to improve the overall governmental cyber security, is planned to receive 350 Mio. EUR between 2020 and 2023, though has run into trouble with key personnel leaving only one year after its founding.²⁹

In February 2020, the German government updated its “Strategy Paper of the Federal Government on Strengthening the Security and Defence Industry”, which defines key technologies Germany wants to procure from national suppliers. Among the eight key technologies, four are strongly related to the digital realm: security-relevant IT and communication technologies, artificial intelligence, sensors, and network-enabled operations/crypto technologies.³⁰ Most initial projects of the CIH and the Center for Digitization and Technology Research lean heavily towards digitalisation instead of other technologies. Hence, there is a particular gap for non-digital emerging technologies such as robotics and their exploration for defence use in Germany. Or at least an underlying understanding that these technologies fall in the territory of the traditional defence suppliers and their strength in other nationally defined key technologies including armoured vehicles and naval shipbuilding. It is so far unclear whether the Center for Digitization and Technology Research will be able to address this gap effectively. This shows a certain German reluctance to use all innovation available in the pursuit of military advantages.³¹

²⁷ Federal Agency for Disruptive Innovation, n.d. SPRIN-D FAQ. Available at: <https://www.sprind.org/de/faq/> [Accessed 04 May 2021].

²⁸ Baumüller, M., 2019. Wie Deutschland technologisch wieder an die Spitze will. [online] Süddeutsche Zeitung. Available at: <https://www.sueddeutsche.de/wirtschaft/agentur-fuer-sprunginnovationen-1.4528404> [Accessed 04 May 2021].

²⁹ Alvarez, S., 2021. Cyberagentur - Gesucht: Ein Kommandant fürs Neuland. [online] Wirtschaftswoche. Available at: <https://www.wiwo.de/my/politik/deutschland/cyberagentur-gesucht-ein-kommandant-fuers-neuland-/27169834.html?ticket=ST-5918417-ESHNgKEOWSbN76WzWkfu-ap3>, [Accessed 04 May 2021].

³⁰ Bundesregierung, 2020. Strategy Paper of the Federal Government on Strengthening the Security and Defence Industry. [online] Bundesministerium für Wirtschaft und Energie. Available at: <https://www.bmwi.de/Redaktion/DE/Downloads/S-T/strategiepapier-staerkung-sicherheits-und-verteidigungsindustrie-en.pdf?blob=publicationFile&v=4>, [Accessed 04 May 2021], p.3.

³¹ Nelson, A.J., 2020. Innovation and Its Discontents: National Models of Military Innovation and the Dual-Use Conundrum. The Center for International and Security Studies at Maryland, p.19.

THE EUROPEAN ANGLE

Germany is an adamant supporter of the European defence initiatives of recent years, including the European Defence Fund (EDF) and its financing instrument for R&D projects. However, this potential source of funding does not have a particularly large presence in debates about defence R&D so far. The focus especially of the more traditional German defence industrial players lies with the large multinational armament projects, especially the Future Combat Air System (FCAS) and Main Ground Combat System (MGCS). It is likely that the comparatively recent initiatives and the still quite new institutions in Germany, the Cyber Innovation Hub and the Center for Digitization and Technology Research have not yet had time to explore the full potential of e.g. support for smaller German companies wanting to work in PESCO and EDF projects. Moreover, the comparatively good financial situation of the past years contributes to a lesser incentive for companies to actively engage in such projects.

In general, Germany appears less coherent than other states in the attempt to shape the future defence industrial cooperation: It does not support a strategy and close coordination among and support to industrial and technological players by or with the Bundeswehr.

CHALLENGES AND PROBLEMS

Money is likely going to be an issue for German defence innovation in three regards:

First, in the volume of resources available to R&D. Germany will likely try to realize its constitutional goal of reaching a maximum of 0,3 percent of its GDP as new yearly national debt in 2022 (“Schuldenbremse”). Consequently, current financial planning foresees a shrinking budget for military procurement, maintenance, military infrastructure, and defence R&D from 17,2 bn EUR in 2020 to 15,9 bn EUR in 2024.³² Even though it is so far unclear how this will affect respective defence R&D sub-budgets, it certainly is no favourable environment for the retention of current spending levels.

³² Bundesministerium der Finanzen, 2020. Haushaltsaufstellung 2021 und Finanzplan des Bundes bis 2024. [online] Europäische Sicherheit und Technik. Available at: <https://esut.de/wp-content/uploads/2020/09/Regierungsentwurf-Haushalt-2021-pdf.pdf>, [Accessed 04 May 2021], p.6.

Second, the Bundeswehr will have to finance ongoing legacy programs and capabilities while refilling its force structure, thus reducing headroom for investment into new domains and technologies without painful cuts.³³ Few available resources must not necessarily be a bad thing for military innovation, as it forces armed forces to tackle tough questions and decisions.³⁴ Still, it naturally runs the danger of putting too many eggs into too few baskets, creating an unbalanced force structure or creating razor-thin forces without any sustainability.³⁵

Third, due to a lack of robust multi-year-financing instruments and regulations (like the loi de programmation militaire in France) in the German budgetary process, there is a certain insecurity for armament projects if their funding will come through decision-making processes in government and parliament. This might lead to underfunding and impede transnational cooperation, even in flagship-projects like FCAS.³⁶ While there is a debate going on for a reform to develop and implement such a multi-year budgetary planning law (Bundeswehrplanungsgesetz)³⁷, this could only happen long after the next federal elections in September 2021 and thus have no effect on the budgetary process 2021/2022.

Additionally, there are two organisational hurdles for Germany to capture technological innovation across the whole spectrum:

First, synergetic effects from dual-use research are lost to the strict firewall between defence and civilian research. These include areas where broader areas of technology and innovation can contribute to both domains. Thus, while the intentional integration of civilian and military innovation systems make sense functionally, the ideological

³³ Roberts, p., 2020. The UK's Integrated Review Has Restarted: Are Key Questions and Assumptions Still Valid? [online] RUSI.org. Available at: <https://rusi.org/commentary/uk-integrated-review-has-restarted-are-key-questions-and-assumptions-still-valid> [Accessed 04 May 2021].

³⁴ One Example is the Wehrmacht, which largely completed doctrinal innovation before large-scale re-armament after 1934. For equipment projects see: Ricks, T. E., 2017. You want military innovation? OK, let's start by cutting the defense budget. [online] foreignpolicy.com. Available at: <https://foreignpolicy.com/2017/06/27/you-want-military-innovation-ok-lets-start-by-cutting-the-defense-budget/> [Accessed 04 May 2021].

³⁵ Depending on political preferences as seen in the "Breite vor Tiefe" Debate in Germany after 2011. See: Dickow, M., Linnenkamp, H., 2016. Breite vor Tiefe: eine Fessel deutscher Verteidigungs- und Kooperationsplanung. SWP- Aktuell 38, p.2f. Available at: https://www.swp-berlin.org/fileadmin/contents/products/aktuell/2016A38_dkw_lnk.pdf [Accessed 04 May 2021].

³⁶ Mölling, C., Schütz, T., 2020. Vorschläge für eine neue deutsche Rüstungspolitik. [online] Deutsche Gesellschaft für Auswärtige Politik. Available at https://dgap.org/sites/default/files/article_pdfs/dgap-policy%20brief-2020-23-de_0.pdf [Accessed 04 May 2021], p.2f.

³⁷ "Bundeswehr Planning Act", see e.g. BMVg. 2021. Position Paper: Reflections on the Bundeswehr of the Future. [online] bmv.g.de. Available at: <https://www.bmv.g.de/resource/blob/5029396/a83129815c00e3638302ba3630478987/20210211-dl-positionspapier-en-data.pdf> [Accessed 04 May 2021], p.5.

stumbling blocks may simply be too high. This in turn increases costs and leads to a duplication of R&D efforts, fragmented islands of knowledge, diminishes the availability of R&D resources and reduces the competitiveness of products and producers vis-à-vis competitors. These competitors are increasingly successful because they develop defence applications from both commercial and civilian technologies swiftly and with good quality.

Second, Germany's current defence innovation instruments too narrowly focus on digitalisation. While this focus on digital and cyber innovation might achieve digitalisation and networking of assets as central requirements of future forces, it falls short in other critical aspects reflected especially in the army's conception of future warfare. For example, robotics and automation are not covered or at best entrusted to traditional defence actors such as large defence companies.³⁸ The German defence ecosystem has culturally induced blind spots in emerging technologies that are not software. Moreover, it also does not seem keen on doctrine³⁹ and training reform. So far, Germany also lacks user-centric innovation concepts like Prototype Warfare in the United Kingdom.

Lastly, there are cultural and political challenges to the future of German defence innovation in certain technological areas. While political leadership currently does not massively interfere with future force planning, this model might run into problems in the future. Especially the integration of uninhabited systems and the idea of automation and (a level of) autonomy in weapon systems is a political⁴⁰ and societal⁴¹ concern in Germany. The ongoing debate on the procurement of armed uninhabited aerial systems is a first symptom of this, one in which the fear of automation is already used to prevent

³⁸ Three of four tested UGV systems coming from traditional suppliers. Geiger, W., Hoffmann, L., 2021. Cargo Mule – unbemannte Bodenfahrzeuge für die Infanterie. [online] Soldat & Technik. Available at: <https://soldat-und-technik.de/2021/01/mobilitaet/24935/cargo-mule-unbemannte-bodenfahrzeuge-fuer-die-infanterie/> [Accessed 04 May 2021]

³⁹ "Leading by mission, winning and keeping the initiative, trust in well-trained military leaders and subordinates and thus the possibility of delegating responsibility, will remain constant key factors for military success. Under the framework conditions of the information age, new capabilities will be obtained through horizontal communication, but also increasingly exposed to old threats (micro-management through information permeability)." Hence, at least the Germany Army simply continues its existing doctrinal orientation, assuming it will be equally valuable in the changing battlefield. Autorenteam Kdo H II 1 (2), n.d. Thesenpapier I - Wie kämpfen Landstreitkräfte künftig? Kommando Heer, p.7.

⁴⁰ Federal Foreign Office, 2019. "Doing nothing isn't an option." Rethinking arms control. Available at: <https://www.auswaertiges-amt.de/en/aussenpolitik/themen/abruestung/uebersicht-konvalles-node/rethinking-arms-control/2199924> [Accessed 04 May 2021].

⁴¹ See e.g. "Campaign to stop killer robots", n.d. Available at: <https://www.stopkillerrobots.org/> [Accessed 04 May 2021].

procurement and, consequently, R&D in the future.⁴² Even though the armed forces stress the importance of human decision-making ("human-in-the-loop"), any autonomy or high degree of automation will likely lead to extensive debate. Hence, a potential misalignment between military visions and means of future warfare and political support for further research into certain aspects of them might arise. Attempts to narrow this gap will fight an uphill battle against the distrust and fear vis-à-vis dual use that is so deeply embedded in the society and political practice.

CONCLUSION

While recognizing the importance of technological innovation and especially innovation taking place outside of the framework of traditional defence suppliers, Germany struggles to overcome longstanding cultural and organisational inhibitors that prevent it from harnessing its full technological potential. This also hampers the establishment of user-centric innovation models as is partly done in the armed forces of allies, in particular with Prototype Warfare in the UK. So far, the German armed forces are also quiet on the wider implications of a changing character of conflict, which they actively analyse, on things like training and doctrine. Moreover, the institutional reform efforts like the creation of the CIH have not had notable effects on overall procurement procedures.

Politically, there is the risk of a clash between societally and politically acceptable defence innovation (and use of technologies and products in the armed forces) and future warfare visions by armed forces (and industry). This steers innovation in certain directions, which will have to be checked against those of allies with an eye towards potential problems for interoperability in the future. Mitigating instruments like the FCAS ethics commission⁴³ are a uniquely German outcome of this civil-military tension. This might also affect future multinational armament cooperation as well as doctrinal coherence within EU and NATO in particular. Lastly, such a potential divergence from European partners will complicate the harmonization of innovation policies. "Uploading" the R&D of controversial

⁴² Käppner, J., 2021. Worum es bei der Debatte um bewaffnete Drohnen geht. [online] Süddeutsche Zeitung. Available at: <https://www.sueddeutsche.de/politik/drohnen-bundeswehr-spd-1.5160969> [Accessed 04 May 2021].

⁴³ Janes, 2020. Airbus launches ethics panel for FCAS/SCAF technologies. [online] Janes. Available at: <https://www.janes.com/defence-news/news-detail/2020/05/14/e265af84-7eb0-465e-b6dd-2bd518cbd0a8> [Accessed 04 May 2021].

technologies and applications to the EU-level might be a work-around for Germany, though this in turn entails the danger of blaming Brussels for investing in R&D for technologies that are considered morally and ethically questionable in Germany.

In the autumn of 2021, Germany will have its next federal election, which is likely to bring a new coalition into the government. The most important requirements for supporting defence innovation are resources and strategic patience. Retaining or increasing defence spending, including R&D spending, is a prerequisite for future Germany defence innovation. At the same time, recent reforms require strategic patience before they will bear fruits. Even though innovation is said to accelerate, building ecosystems and changing organizational and cultural attitudes takes time. ■

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Policy Paper

DEFENCE INNOVATION: NEW MODELS AND PROCUREMENT IMPLICATIONS

The German Case

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ARES GROUP

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

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