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One Step Back, Two Steps Forward: the EU, NATO and Emerging and Disruptive Technologies

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Key Issues

- The optimal way to generate innovation in the digital age is to nurture open ecosystems and positive feedback loops between large corporations, small firms and start-ups, open-source communities and end-users.
- Rather than encouraging commercial companies to contract directly with governments, the EU and NATO would do well to incentivise the supply chain practices of prime contractors to ensure that they are both willing and able to engage with the broader civilian base.
- The EU and NATO should involve armed forces more closely in all stages of technological innovation, and should do so in more flexible and informal innovation ecosystems.

In their January 2023 Joint Declaration, the European Union (EU) and NATO have agreed to deepen cooperation on Emerging and Disruptive Technologies (EDTs). Although the recent conflicts in Libya, Syria and Ukraine indicate that emerging technologies have not revolutionised warfare, few dispute that the ability to master technologies such as Artificial Intelligence (AI), cloud computing, robotics or quantum computing could provide strategic and operational advantages in future warfare.

In recent years, the EU and NATO have launched important initiatives focusing on EDTs, such as the NATO Defence Innovation Accelerator for the North Atlantic (DIANA), the NATO Innovation Fund (NIF), the European Defence Fund (EDF) or the European Defence Innovation Scheme (EUDIS). Although distinct policy tools, when it comes to EDTs EU and NATO initiatives have two striking similarities. First, both organisations want to involve commercial companies, as many critical EDTs are increasingly of civilian origin and utilise dual-use components. Second, since industry, academia and public organisations are all important players in EU and NATO efforts, both organisations aim to develop a "triple-helix" approach to stimulating innovation in EDTs.

Many of these EU and NATO initiatives are at an early stage and it is difficult to assess their effectiveness. However, given that EU and NATO efforts in EDTs are based on similar principles, it is possible to examine whether these efforts are well designed to stimulate innovation. To do this, this Policy Brief proposes to take a step back and reflect on what is the optimal model for promoting innovation in EDTs. After taking

a step back, it proposes to take two steps forward by suggesting how best to design institutional and financial efforts to stimulate innovation in EDTs, and how to foster synergies between the EU and NATO.

Organisations and EDTs

In recent years, the EU and NATO have launched several initiatives to stimulate innovation in EDTs and, remarkably, these initiatives share some important similarities. First, they have identified a similar list of technologies: NATO's strategic documents have identified nine priority EDTs: AI, big data, autonomy, quantum technologies, biotechnology, hypersonic, space, new materials and manufacturing, energy and propulsion. The European Defence Agency (EDA) has identified six critical EDTs: AI, quantum-based technologies, robotics and autonomous weapons, big data analytics, hypersonic weapons systems and space technologies, and new advanced materials. According to the EDA's head of technology and innovation, 'no matter how you define EDTs, you end up with a pretty similar list of technologies. And that creates a good initial basis for synergies'.

EU and NATO initiatives also converge in two important respects. First, both organisations aim to increase the involvement of commercial companies, with the idea that innovation in EDTs lies outside the traditional defence industrial base. NATO has made it clear that technological innovation is 'driven by the private sector', while the EDA aims to 'explicitly involve non-traditional defence R&D communities in the generation of innovative ideas'. In this context, the EU and NATO want to support small businesses and start-ups. NATO's DIANA, structured around a network of nine accelerator sites and 63 innovation hubs across the Alliance, aims to work directly with early-stage start-ups to solve critical technology challenges. The EDF, which allocates between 4% and 8% of its budget specifically to EDTs, also places particular emphasis on the involvement of small and medium-sized enterprises (SMEs). Moreover, both NATO and the EU agree that public-led venture capital is needed to sustain innovation. NATO has launched its NIF, a multi-sovereign venture fund of €1 billion to invest in start-ups developing EDTs. The European Commission has recently proposed the EUDIS: a €2 billion fund to support innovation and entrepreneurship in key technologies. The Commission is also proposing the creation of a Defence Equity Facility to address the lack of venture capital for start-ups and SMEs developing EDTs.

Second, the EU and NATO believe that they need to leverage the links between public authorities (both governments and international organisations), the private sector and academia to stimulate innovation. NATO repeatedly mentions the "triple helix", with the idea of working more systematically with both the private sector and academia to channel efforts into EDTs. The European Commission is seeking to increase complementarity between EU programmes such as Horizon Europe and the EDF in order to exploit the dual-use potential of EDTs and the disruptive potential of space, defence and civil technologies. To this end, it is important to 'bring together all relevant stakeholders, including government, industry, academia and civil society'.

One Step Behind

It is too early to assess the effectiveness of EU and NATO efforts. However, the agendas of the EU and NATO are strikingly similar, and we can therefore simultaneously reflect on what is the optimal model for stimulating innovation in EDTs and assess the implications for the two organisations.

In the industrial age, innovation has been associated with two main models. The first is the classic model of the "vertically integrated firm" where innovation is generated internally, especially in the company's research and development (R&D) laboratories. Cases such as Bell Labs, IBM Research or Xerox PARC illustrate the ability of vertically integrated firms to channel R&D efforts on specific desired technological outcomes. The second model relates to horizontal integration. Since the 1970s, and with the advent of globalisation and increasing technological complexity, innovation has been driven by relationships between the focal firm and its suppliers, often structured in complex and layered global value chains. In technology-intensive industries, systems integrators play a key role in maintaining control of technological know-how and in defining technical specifications that are developed by specialised suppliers along the value chain.

These two models are still important today, especially

in "hard-ware driven industries". However, the EDTs mentioned in EU and NATO documents – including AI, data analytics and machine learning – are predominantly related to software advances. In the "digital and software age", innovation is mainly generated by open ecosystems and by positive "feedback loops" between large corporations, SMEs and start-ups, open-source communities and end-users. Many large technology companies – the so-called "Big Tech" firms – today create and capture value through co-creation with open-source communities and end-users to meet their evolving needs. In addition, accessing massive amounts of data in new ways (e.g. AI) and at much faster speeds (e.g. supercomputers) will facilitate feedback loops between large and small companies, start-ups, open-source communities and end-users.

Software development today is increasingly driven by the day-to-day relationships between Big Tech firms and the best practices developed by the commercially driven open-source software community. Platforms such as the Linux Foundation or GitHub are central to supporting Big Tech innovation. This makes the digital market both centralised – structured around a few large groups that compete with each other – and decentralised – dependent on widespread innovation from start-ups, open-source communities and end-users.

Cloud computing, one of the key technologies of the "Fourth Industrial Revolution", is a good example of this simultaneous process of centralisation and decentralisation. The cloud market is indeed structured around Big Tech companies such as Amazon Web Services, Microsoft Azure and Google Cloud Computing, which together control around 60% of the market. However, the innovation of these players is based on continuous feedback loops with those who own the telecommunications infrastructure, as well as with open-source communities and end-users, to continuously update their software services. Today, cloud providers work closely with the Apache Software Foundation, the Mozilla Foundation, the Eclipse Foundation and the OpenStack Foundation. Even Microsoft, traditionally resistant to open-source, has had to open its cloud structure to the Linux Foundation.

Two Steps Forward

Taking a step back and analysing the dominant way of generating innovation in the digital age allows us to take two steps forward in how best to design EU and NATO efforts in EDTs.

First, it is fair to say that innovation in the digital age means fostering innovation ecosystems and continuous feedback loops between large corporations, small companies and start-ups, open-source communities and end-users. The EU and NATO have repeatedly stated that they want to bring commercial companies on board. However, both organisations should be careful to provide the right incentives for the private sector. The industrial policy playbook based on picking winners and investing public patient capital could encourage some companies to go it alone rather than open up and find synergies with other actors in the ecosystem. Taking stock of the research on innovation in the digital age, the first objective of the EU and NATO should be to facilitate connections between large (e.g. defence prime contractors) and small firms. Rather than encouraging commercial firms to contract directly with nation states, the EU and NATO would do well to incentivise the supply-chain practices of prime contractors to ensure that they are both willing and able to engage with the broader civilian base. Prime contractors should be rewarded for effectively absorbing and integrating innovation from SMEs and start-ups. On the other hand, SMEs need access to venture capital to scale-up, but they also need incentives to partner with defence prime contractors.

> **"Innovation in the digital age is in part at odds with the dominant mode of innovation in the defence industry."**

The EU and NATO need to do more to foster innovation ecosystems and to promote opportunities for large

and small companies to meet. The EDF provides financial incentives to involve SMEs, but the issue is not so much bringing large and small together as bringing the right large and small together to find innovative synergies. Additional funding could be given to prime contractors who involve the same small companies in several projects, or who commit to directly funding small companies' R&D in specific technology niches. Prime contractors such as Airbus and Dassault may have the programme for the next-generation fighter jet, and a start-up can partner with them on the aircraft's data processing to get a foot in the door. As far as NATO is concerned, it is essential that the DIANA framework works in close synergy with the NIF, so that prime contractors can recognise and progressively absorb (e.g. through DIANA accelerator sites) the innovation generated by small firms (e.g. supported by the NIF). Incidentally, some of the well-known problems associated with the private sector's reluctance to contract with burdensome defence-related administrative procedures can be alleviated by encouraging large-small partnerships.

Second, the EU and NATO should involve end-users (i.e. involving armed forces more closely in every step of technological innovation). Users are at the centre of defining and solving problems in the digital age, sometimes actively contributing to the development of new solutions. The relationship between end-users and technology developers is particularly important for EU and NATO efforts in EDTs, as they need to exploit breakthroughs in science and engineering and integrate them with existing military technologies and doctrines. Indeed, technologies developed for civilian applications are not easily transferred to the military domain but need to be modified by specialised suppliers and integrated by end-users. There are already some successful examples of end-user involvement: the F-16's FalconView software suite was developed by an organic user community. Continuous feedback loops between the United States' (US) Air Force, Lockheed Martin and the Red Hat open-source community led to the development of the F-4 software.

The EU and NATO should develop a systematic two-way exchange between private companies – both large and small – and their armed forces. Both organisations repeatedly refer to the "triple helix" interactions between government, industry and academia, but the armed forces are the key actors to be involved in any EDT efforts. Traditionally, the armed forces have been involved in some formal steps of the development of military platforms, but the EU and NATO now need to systematically involve end-users in more flexible and informal innovation ecosystems. NATO's DIANA explicitly mentions the involvement of end-users in its mission, but it is not yet clear how their role will be implemented. In the European context, end-user involvement is more complex, if only because some of the European EDT initiatives – such as the EDF – have an industrial policy rather than a defence policy basis. Greater involvement of the EU Military Committee or military personnel seconded to the EDA in the selection of EDF projects or in the EUDIS could ensure greater synergy between technological and military needs. The systematic involvement of end-users could also promote greater synergy between the EU and NATO: for example, the DIANA accelerator sites, which will involve end-users, could also be made available for EU-funded projects.

Conclusions

The EU and NATO agendas on EDTs have a difficult task ahead. Innovation in the digital age is in part at odds with the dominant mode of innovation in the defence industry. Defence is organised around a predominantly closed ecosystem, dominated by privileged relationships between procurement agencies and system integrators, and top-down control of critical technologies. Today, we need new ways of designing incentives to stimulate innovation in EDTs. A good starting point for addressing these challenges can be to incentivise prime contractors to partner with SMEs and start-ups, and to structurally involve end-users in every step of technological innovation.

The one step back, two steps forward approach of this Policy Brief also suggests new ways to promote synergy between the EU and NATO. Both organisations repeatedly mention the need for venture capital, accepting the fact that many start-ups investing in EDTs will inevitably fail, but that the few that succeed will offset the losses. Following the example of "private venture capital", the EU and NATO should have the possibility to invest in different and competing consortia, but also sometimes to support the same consortium – with different shares. Accepting some competition in the short-term will be beneficial in the long-term.

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