The Interconnected Century of Technology. How Ecosystems, Platforms, and Alliances Determine Global Innovation

Dietlmeier, Simon Frederic and Fogel, Benjamin A.

University of Cambridge, Department of Engineering, Institute for Manufacturing (IfM)

1 March 2023

The Interconnected Century of Technology

How Ecosystems, Platforms, and Alliances Determine Global Innovation

The concept of an arms race is frequently used to explain a mutual dependency in strategic armament leading towards an upwards spiral of investment in and deployment of ever newer, modern, and advanced defense systems. Today, technological innovation is creating a global "tech race", characterized by immense technological progress as well as a state of competition between industrial rivals and amongst polities. This phenomenon can be observed in many policy fields. For instance, the EU's Green Deal Industrial Plan was announced earlier this year and fully published in February; a proposal which has been commented to constitute the next step in a race of promoting clean tech manufacturing towards net-zero as reaction to the U.S. Inflation Reduction Act.

However, while governments have begun to invest extensively in emerging technologies and compete over their control, concomitant efforts to cooperatively harness technology have also begun to take shape. These developments appear to be at least partially driven by novel modes of collaboration in ecosystems and networks, accelerated due to platformization processes, as well as empowered in alliances comprising technological and industrial firms. Maintaining constant stability in the international economy against this background and a balance in the geopolitical system is dependent on multilateral responses and may require greater aspirations in tech diplomacy.

Competitive and Collaborative High-Tech Ecosystems

Companies and polities most often foster innovation in competing ecosystems. The resulting technological advancement makes it critical for politicians and policymakers alike to prevent a gap of comparative technological capabilities. At the same time, innovation also causes friction and inefficiencies between markets due to diverging rules and regulations – unless these are harmonized – and the modes of ecosystem formation and technology governance generally tend to vary by polity.

For example, while artificial intelligence (AI) can have a significant influence as general-purpose technology worldwide in all sectors, ethical considerations and regulatory risks must be addressed – preferably ex-ante and cross-border. Numerous critical or problematic AI use cases have already been identified, while even more are imaginable with the application of

ChatGPT, embedded in digital twins, or enabled in any form of immersive virtual environments like envisaged by the Metaverse. The industrial internet of things (IIoT) also has possible pitfalls. Whilst the technology promises increasing transparency about processes and generated data when developed and deployed in a platform ecosystem, additional cybersecurity measures for its safe operation are often required. And despite the prerequisite of 5G as a technology standard for achieving true Industry 4.0 capabilities in combination with AI and IIoT technologies, the strategic rivalry between East and West has motivated countries to exclude the Chinese firm Huawei from participation in tenders. A potentially superior technological offering is thus sometimes sacrificed because of strategic, ethical, or national security concerns.

New modes of collaboration between stakeholders are on the rise, as well, which not only address the manifold impacts of these developments, but also accelerate them and influence the digital transformation and business models of industrial and technological firms. These firms become more interconnected with their peripheral non-core-business environment, a process that could be initiated bottom-up by industry players, mandated top-down by policy actors, or even facilitated by independent non-profit organizations or multilateral institutions.

Bottom-Up Industrial Alliances and Consortia

A case of a bottom-up initiative, Siemens AG established the Charter of Trust in 2018 as industry consortium on the side-lines of the Munich Security Conference (MSC). The charter was formed to develop commonly agreed cyber security principles adopted by the consortium members, which are a mixture of industrial and technological firms, some of whom even direct competitors united in a common campaign. They are determined to mitigate the risk of cyber threats perpetrated by state and non-state actors. Such an effort can be supported by dedicated technologies, for example a platform that connects the community and allows for rapid information exchange between partners. This clearly provides an incentive for entities to join a consortium or platform ecosystem and may cause a competitive disadvantage for firms that remain outside.

Collaborative efforts can also emerge under a broader pattern of technological rivalry, driven by geoeconomic interests of countries or blocs. When Airbus announced its new Eurofighter project, Future Combat Air System (FCAS), the U.K., which had been a consortium-backing stakeholder for the previous aircraft type, decided to go ahead with its own development. Against the backdrop of Brexit, the competing Tempest consortium led by BAE Systems introduced the nowadays-called Global Combat Air Programme (GCAP). This left Airbus with the task to replace the U.K.'s technological input and investment, with an adjustment of its ecosystem and stakeholder management to find new technological partners and to concentrate on the remaining EU27 for political cooperation. A better partner management and integration of ecosystem partners could in the end decide about the comparative success of either project, which might provide the political powers supporting the consortia partners with a geostrategic advantage.

Compared to earlier defense projects, Airbus has also adopted a more transparent approach to FCAS's development and acknowledges the expected societal footprint of modern technologies, which reflects the strategic interest of the EU in ethical AI. Together with the Fraunhofer Institute for Communication, Information Processing and Ergonomics (FKIE), the independent expert board "AG Technikverantwortung FCAS" has been established as multi-stakeholder initiative. This panel considers the ramifications of applied AI technologies and should foster an increased awareness for corporate social responsibility within Airbus Defence and Space by deriving ethical and legal guidelines. The envisaged concept of FCAS as an interconnected system of a central fighter jet with remote carriers for manned-unmanned teaming motivated such an approach.

Top-Down Political Initiatives

From a political perspective, competition to develop and equip new technologies and to steer simultaneous efforts that address their policy implications has increased considerably over the past few years. This reality has spurred many policymakers and politicians across all levels of political governance and in every policy field to view innovation and technology as an integral element of geoeconomic interests that can be strengthened top-down and through policy instruments.

National technology strategies – often differentiated by individual technologies – have been drafted by governments all over the world, but many differences remain in the governance of disruptive innovation. The U.S., for instance, has a longstanding tradition with its Defense Advanced Research Projects Agency (DARPA) recognizing the strategic value of military research for civilian innovation. This synergy has led to disruptive technological advancement, in which other Western polities have lacked behind for a long time. Supranationally, the EU has only recently opted to develop resembling approaches in fostering ecosystems for disruptive innovation with its Joint European Disruptive Initiative (JEDI). The same is true nationally, such as with Germany and the foundation of its Bundesagentur für Sprunginnovationen (SPRIN-D). A path to advance European innovation capabilities in the digital sphere is Gaia-X, a European cloud platform environment and data infrastructure, which promises greater independence from U.S. offerings like Amazon AWS or Microsoft Azure. Ultimately, the initiative aligns with European efforts to pursue sovereignty or in synonymous EU jargon: "open strategic autonomy".

Control for critical supply chains involving technological input parts and raw materials like rare earth materials have become contested by the major blocs, especially since the COVID pandemic and the war in Ukraine have openly laid bare the unreliability of connected production and supply. The risk of supply chain disruptions has been especially problematic for automotive manufacturers and impacted the worldwide distribution of Ukrainian corn, which had to be renegotiated on the highest political levels. National political choices like Brexit have also exposed vulnerabilities, and from the U.K., video footage of lorry queues waiting to cross the channel was broadcasted around the world.

Manufacturing "reshoring", "nearshoring", and "friendshoring" have become popular buzzwords in policy circles; and despite today's globalized and interconnected world, the reduction of strategic dependencies is now a widely accepted political maxim. In the EU, the promotion of domestic high-tech R&D even evades otherwise rigid antitrust regulations, through state aid instruments in the form of Important Projects of Common European Interest (IPCEI) and the recently launched European Sovereignty Fund. When then President-elect von der Leyen presented the EU Commission's agenda to the European Parliament Plenary in 2019, the course was clear: "We must have mastery and ownership of key technologies in Europe. These include quantum computing, artificial intelligence, blockchain, and critical chip technologies."

The top-down push for industrial policy is indeed most apparent in semiconductor value chains. A disputed field of technological competition since the cold war, increasing supply and production of semiconductors is nowadays the unequivocal locus of Western political initiatives seeking to keep pace with Asian producers. Even though the largest chip manufacturer by revenue (Intel) is based in the U.S. and the most important manufacturer of photolithography machines (ASML) is located in the EU, much of the productive capacity can be found in East

Asia dominated by a Taiwanese independent foundry as contract manufacturer (TSMC). The Chips Acts on both sides of the Atlantic reiterate the willingness to invest large amounts of public funding in the establishment of domestic fabrication plants. Export control mechanisms for semiconductors exercised by the U.S. in October 2022 emphasize the political desire for technological and strategic decoupling. Comparable concerns have been raised in Europe, and Germany's blocking of an M&A deal that would have allowed Chinese investors to acquire control over the German automotive supplier Elmos Semiconductor resulted from growing public pressure. Ultimately, the success or failure in securing sufficient productive capacity and redundancy in the semiconductor value chain might decide about future national security and prosperity of a polity. U.S. President Biden put it simply: "Semiconductor chips are the building blocks of the modern economy".

Stakeholder Arenas as Level Playing Field

In addition to these bottom-up and top-down examples of alliance building, collaboration, and cooperation, powerful non-profit organizations have begun to play an increasing role in nurturing innovation ecosystems. There, different types of stakeholders work together towards a shared goal, e.g. on health or sustainability topics – often coined as projects "for the good".

For instance, the COVID pandemic highlighted the importance of global partnerships in public health management of vaccine development and distribution. Due to competition between pharmaceutical companies and their shareholder obligations, working towards the common good is all too often thwarted by the prioritization of profit and distrust between industry rivals. In response, international organizations, non-profit organizations, and policy actors such as the WHO, the Bill and Melinda Gates Foundation, and the Wellcome Trust stepped in and devised the Coalition for Epidemic Preparedness Innovations (CEPI) and GAVI, the Vaccine Alliance, to advance global vaccination efforts. Of course, this requires much coordination for R&D as well as establishing new supply chain capabilities. Any such approach must naturally rely on private sector cooperation, incentivized by public funding – for instance with the COVAX Facility – and scientific grant funding provided by non-profit organizations. Multi-stakeholder alliances like CEPI and GAVI may be the best way forward to finally enable the development of a vaccine platform technology against "Disease X", following the invention of the mRNA vaccines and advancements in health tech. These initiatives provide an environment for value co-creation amongst their members and value chain partners in the form of innovation ecosystems that shorten the time-to-market for R&D considerably.

Similarly, the emergence of technologies like AI has incentivized companies to work together on global standards. Even though the four major geopolitical players – the U.S., EU, China, and Russia – tend to nurture their AI ecosystems with differing approaches to funding and ethics, industrial and technology firms have recognized the potential, but also danger from AI themselves. They have been developing firm-internal and industry-focused AI guidelines during the past years. For instance, IBM has unilaterally decided to suspend the development of facial recognition software and its provision for the U.S. government after citing privacy concerns.

Multi-stakeholder initiatives construct comparably impartial level-playing fields, where space for debate and exchange is provided. In policy fora like the High-Level Expert Group on Artificial Intelligence, the private sector provides expertise and practical input. Firms also increasingly collaborate in independent organizations like the Partnership on AI, the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems or the Rome Call for AI Ethics. A number of multi-stakeholder fora for related discussions have been formed by the World Economic Forum (WEF) and its platform initiatives such as the Center for the Fourth Industrial Revolution. As a leading agenda-setting track 1.5 diplomacy forum on security policy, most notably the MSC has its Innovation Security Board and Technology Program, whose relevance in the conference agenda has steadily increased. Other gatherings are the Business 7 (B7) and Business 20 (B20) engagement groups, which are convened by industry federations to bring together more select business interests. Despite these efforts, many initiatives meander between aspiration and actual execution. Industrial firms and technology producers have yet to prove to what extent the principles that were harmonized or even generated at these fora and the insights gained from stakeholder conferences are widely adopted and implemented in firms' value chains.

Multilateralism in the Information Age

Many points of contention amongst the world's leading actors on technological innovation, its regulation, and standardization reflect systemic differences. China's expanding sphere of economic influence, based to a large extent on the Belt and Road Initiative for infrastructure and flanked by the Regional Comprehensive Economic Partnership (RCEP) for trade, also leans on technological elements. The attempted geoeconomic counter is the G7 Build Back Better World (B3W) initiative, aiming for value-based principles. Other national and regional attempts to compete with and roll-back the wave of Chinese overseas influence and investment exist, such as the U.S. State Department's The Clean Network announced in 2020 for a U.S.-led 5G standard. The Declaration for the Future of the Internet spearheaded by the U.S. and EU last year and supported by more than 60 countries was likewise directed towards containing the influence of authoritarian governments in the information age.

In military and defense, strategic considerations and technological development have always been essential, but the rapid technological progress spurred by the Information Revolution has accelerated plans for modernization and adaptation of the armed forces. NATO, for instance, has initiated discussions on how to transform the organization through the NATO 2030 reflection process, alongside a new focus on emerging disruptive technologies at NATO Allied Command Transformation (ACT). The alliance has also increasingly recognized the importance of innovation in industry and supply chains through the NATO Industry Forum and has set a target of overall Technological Superiority by 2030. On a European level, the PESCO initiative's technological projects have promised closer defense cooperation to advance the defense industrial base in upcoming years. For military-technical sharing and innovation, the U.S., U.K., and Australia formed the new trilateral security partnership AUKUS, which should equip Australia with nuclear-powered submarines and jointly develops advanced military capabilities specifically geared for the Indo-Pacific. The project was formalized by a dedicated Exchange of Naval Nuclear Propulsion Information Agreement, and partners' mutual access to information in other technological areas is envisaged.

Multilateral coordination on technology is most prominently led by the United Nations – with the International Telecommunication Union (ITU) as specialized agency and additionally the UN Secretariat of the High-level Panel on Digital Cooperation. This panel has initiated extensive discussions about emerging technologies in a multi-stakeholder approach to support the attainment of the Sustainable Development Goals (SDGs). But also, regional initiatives like the ASEAN Science and Technology Network (ASTNET), which aims to connect Southeast Asian member states through a technology information network, will help lay the foundation for further diplomatic initiatives in the digital sphere.

Tech Diplomacy Overcomes Systemic Differences

The divide between business interests and geopolitics may be resolved by similar approaches taken in science and technology diplomacy. Historically, this has been a rationale in the cases of the CERN and SESAME synchrotrons, with the latter collider used as a mechanism to furthering peace and collaboration in the Middle East for the sake of technological advancement.

Space projects, especially the International Space Station (ISS), have been another success in scientific cooperation across the geopolitical blocs. So too has the space objects register administered by UNOOSA, which serves as a platform to ensure to date a transparent operation of the various satellite navigation systems. Outer space exploration is nevertheless a contested area again after the announcement of the Chinese-Russian International Lunar Research Station (ILRS) in 2021. Commercially has the competition likewise increased, not only amongst firms in the "New Space" sector, but also politically mandated due to geostrategic considerations. The EU recently announced IRIS2, its own satellite system for a resilient and sovereign communication infrastructure. And SpaceX's Starlink satellite system was repeatedly described as strategic element in the Ukraine war by military analysts. A renewed space coordination amongst the leading powers, however, could facilitate a spill-over effect that is beneficial for other policy fields and perhaps supports a peace process for Ukraine in the future.

Internally, the EU has identified a lack of strategic cooperation in cyberspace matters. To close this gap, officials introduced several concepts and initiatives including the Digital Diplomacy Network, Tech Ambassadors to represent industry interests, and a liaison office in San Francisco. These developments were interpreted as the attempt to establish an EU "Technosphere" next to the U.S. and China, that not only digitizes foreign policy, but also enhances the competitiveness of European industries. The U.S. has signaled similar intentions with the recent announcement of an Office of the Special Envoy for Critical and Emerging Technology. In addition to these individual tech diplomacy efforts by the two powers, the U.S.-EU Trade and Technology Council (TTC) has taken an increasing role in the diplomatic coordination of transatlantic technology policy, improving progress to replace the privacy shield mechanism and with potential to address further controversial issues related to technology. A large multilateral tech conference that invites other polities to participate – analogous to COP by the UNFCCC – could be a suitable forum and way forward in discussing and progressively reacting to the global implications of technological advancements.

[2992 Words]

Biographical Notes

Simon F. Dietlmeier is a PhD Candidate in Engineering at Sidney Sussex College with the Ecosystems, Platforms & Strategy Research Team of the University of Cambridge's Institute for Manufacturing (IfM). His research is funded by an EPSRC Doctoral Studentship of the School of Technology and with a Doctoral Scholarship of Konrad Adenauer Foundation (KAS). There he is a member of the Doctoral College "Social Market Economy". He received multiple other awards and scholarships. Simon has professional work and internship experience in industry with Siemens, Airbus, and BMW; as well as in policy with the Munich Security Conference (MSC), the Federal Foreign Office, the Federal Ministry of Finance, and the Bavarian Parliament. He relaunched and scaled-up the TUM Speakers Series as Chairman and established the Advisory Board as its Co-Chair. Having been selected in DLD Media's "50 for Future" class of 2020, his work was shortlisted for The Charlemagne Prize Fellowship 2022. Simon co-founded the G7-75 Years Marshall Plan Young Transatlantic Leaders Initiative, and he is a Global Shaper of the World Economic Forum's Community.

Benjamin Fogel is a Senior Consultant with the Logistics Management Institute, where he advises the U.S. Department of Defense on security cooperation. His research interest is in alliance-building and emerging technologies. He has experience at the United Nations, the European Parliament, the U.S Department of Justice, and NATO Allied Air Command at Ramstein Air Base in Germany. Named a U.S. Presidential Management Fellow (PMF) finalist for the class of 2023 and a GLOBSEC Young Leader for the 2022 Bratislava Forum, Benjamin was also a Junior Ambassador to the 2020 Munich Security Conference, and a Fellow at the Penn Program for Democracy, Citizenship, and Constitutionalism. In 2013, he coordinated the production and publishing of the "Global Go To Think Tank Index Report". Benjamin is a graduate of Johns Hopkins University, School of Advanced International Studies (SAIS), with a MA in Strategy, Cybersecurity, and Intelligence. He received his BA at the University of Pennsylvania, where he studied transatlantic history and mitigating cognitive biases in political risk forecasting as a member of the dean's list.

List of Publications

Simon F. Dietlmeier

Dietlmeier, S. F., Floetgen, R. J., Bock, J., & Urmetzer, F. (2022). IoT for Rail Transportation: The Case of Railigent. *Proceedings of the 2022 IEEE International Conference on Big Data*, Osaka, Japan.

Dietlmeier, S. F., Floetgen, R. J., Bock, J., & Urmetzer, F. (2022). Conceptualizing IIoT Platform Ecosystem Verticalization. *Proceedings of the IEEE 8th World Forum on Internet of Things*, Yokohama, Japan.

Dietlmeier, S. F. (2018). Brexit – A Shattering Event or Unremarkable Episode for Private Equity Activity? [online], Seminar Paper. Available at SSRN.

Benjamin Fogel

"Qué dice la nueva Estrategia de Seguridad Nacional de Biden sobre América Latina." *InfoeBae*. November 2022.

"Russian use of Iranian Kamikaze Drones in Ukraine." *ABC (Australian Broadcasting Corporation; Radio)*. October 2022.

"Ukraine and the Weaponization of Commercial Drones." *Modern War Institute (Military Academy West Point)*. August 2022.

"The implications of Russia-Ukraine War for Colombia and Venezuela." *Grupo Mejor Así | Visión Colombia*. February 2022.

"The next frontier in drone warfare? A Soviet-era crop duster." *Bulletin of Atomic Scientists*. February 2021.

"Keeping grounded: Mitigating militarization and building trust in space." *Munich Security Conference*. January 2020.

"Implementing the Lisbon Treaty provisions and its effect on CSDP." *Brussels: EPRS Briefing*. June 2018.

"The European Council's 'rolling agenda' on European Defense Cooperation." *Brussels: EPRS Briefing*. June 2018.

"US counter-terrorism since 9/11: Trends under the Trump administration." *Brussels: EPRS Briefing*. May 2018.

Contact

Simon F. Dietlmeier
PhD Candidate

Institute for Manufacturing (IfM)
University of Cambridge
Alan Reece Building
17 Charles Babbage Rd
Cambridge, CB3 0FS
United Kingdom

Phone: +49 151 19417611
Email: sfd37@cam.ac.uk