Torun International Studies

2023, Vol. 1, No. 18, pp. 83–101

Published online: September, 2023

DOI: http://dx.doi.org/10.12775/TIS.2023.015

Tomasz Gajewski*

0000-0003-1556-1591

EUROPEAN UNION AT THE DAWN OF TECHNOLOGICAL COLD WAR**

ABSTRACT

The purpose of the study was to construct a picture of the EU's global position in a world defined by the US-Chinese technological Cold War. Morphological analysis has been used to enable a comprehensive analysis of the relationship between the technological and social domains. Structured interviews were also used to support the analytical process. The results of the exploration showed a picture of the EU's multi-level technological weakness compared to competing powers. While the EU is not a weak entity, its future international position will depend on the creation of its own technological capabilities and on cooperation with the United States. Both lines of action are subject to multiple risks. Firstly, some aggressive technological developments (such as the plans to place microchips production in Europe) can generate more problems than diversification. Secondly, the EU must extend its work on high-tech (primarily AI) beyond the logic of market regulation and focus on their geopolitical and military dimension. It must also be ready for possible obstacles in cooperation with the United States. The alternative to this track, as the analysis shows, is the technological, and hence the political and economic peripheral status, where two technological superpowers – the United States and authoritarian China will compete. The most negative result for the EU is the status of "digital colony." The paper aspires to be a part of the effort to fill the existing void in the scientific output of Polish social sciences, regarding exploration of the geopolitical dimension of technological progress, especially its impact on EU's position in the new power distribution model, which will be the result of the rivalry between the US and China.

Keywords: European Union, United States, China, digital technology, cold war

---

* Jan Kochanowski University of Kielce, e-mail: tomasz.gajewski@ujk.edu.pl

** Research forming the basis of this article, involving study visit to European Parliament Research Service in Brussels and structured interviews with Members of European Parliament, was financed from Jan Kochanowski University grant "Technological dimension of the European Union strategic autonomy" (SUPB.RN.21.072).

1. INTRODUCTION

Meng Wanzhou, vice President of the Chinese telecommunications concern Huawei, returned to her country in 2021 after three years in Canadian arrest. In 2018, she was detained at the request of the United States authorities in connection with the tightening of Donald Trump's administration policy toward China. She has been accused of fraud and, indirectly, of violating the sanctions imposed on Iran. However, this is considered to be a sign of increasing technological rivalry between the United States and China. This rivalry is a symbol of the transformation of the global balance of power and the Middle Kingdom's desire to achieve a primacy within it. This rivalry is referred to as the "New Cold War" or "Technological Cold War" (Woo, 2020).

High technologies of strategic importance are at the heart of this competition. The President and founder of the World Economic Forum, Klaus Schwab (2016), identifies them as part of the Fourth Industrial Revolution. These include Artificial Intelligence (AI) and machine learning, automation and robotics, 5G and 6G super-fast telecommunication networks, Internet of Things, Big Data and Analytics, quantum computing and additive technologies (3D printing). In recent years, the important place in this competition is occupied by the 5G roll-out and the US and Chinese race to lead in standards setting (Pop, Hua, & Michaels, 2021). However, development of Artificial Intelligence and data are becoming the central part of global actors' attention.

The European Union has become a theater of this rivalry, both at Community and at Member State level. At the same time, the issue of 5G deployment has become an example of the weakness of the EU and its members, as well as the importance of the European market in the economic and political activities of the United States and China. The controversy that was prompted by the aggressive actions of Huawei (supported by the Chinese state apparatus) and the accompanying counteraction of the US President Donald Trump led the EU to act. The Community has taken steps to build a European identity in the field of new technologies. A multi-level strategy for development in key areas (Shaping Europe's digital future, 2020) was adopted along with initiated efforts to create "technological sovereignty." The idea of "European strategic autonomy" has been revived. Those actions are intended to serve as an actor in the ongoing global competition. The European Union is setting up regulations of high technologies use and is trying to create tangible capacities and resources in terms of resilience and economic potential. However, the effectiveness of these actions depends on overcoming the multidimensional internal crisis and achieving political coherence at least in the strategic (global) dimension of EU interests. Reflection on this complex and interesting issue is the key idea of this paper.

An analysis of the issues outlined above should be initiated with a critical review of the available literature of the subject.

2. LITERATURE REVIEW

The issue of increasing US-China rivalry is widely studied in scientific literature (i.e., Agten, 2021; Allison, 2018; Heisbourg, 2020; Hopwell, 2020; Martin, 2012; Khanna, 2019; Kissinger, 2014; Kuik, 2021; Lo, 2021; Rudolf, 2021; Sun, 2019). This is a derivative of high

rank and vibrant interest in transformations of the global balance of power and in political interest in their results.

The technological aspect of this competition is of scientific interest to researchers in international relations and security relatively recently. It relates to the surge in development of high technologies as such and the growing awareness of the immense social changes that this development generates. The political and geopolitical results of this process have already been reflected in a number of scientific publications (i.e., Diesen, 2021; Dupont, 2020; Hoffman, Bradshaw, & Taylor, 2021; Kennedy, 2020; Komiyama & Tsuchiya, 2021; Lewis, 2019; Ma, 2021; Oxford Analytica, 2021; Przychodniak, 2019; Rühlig, Seaman, & Voelsen, 2019; Toro Hardy, 2020; Walsh, 2003; Wong, 2021; Wright, 2020; Zhang, 2020).

Technological rivalry between the United States and China is, of course, the subject of a reflection of scientists from the Middle Kingdom. Among many works by Chinese scientific publishers, there are also papers that present a Chinese point of view for technological rivalry (i.e., Feng, 2020; Sun, 2019; Wu, 2020; Yang, 2021).

There are also many publications on the international scientific market which analyze the position of the European Union in a world defined by American-Chinese rivalry. In addition to the works on its political and geopolitical dimension, it is possible to get acquaint with the reflection on its technological dimension (i.e., Aho & Duffield, 2020; Biba & Wolf; Cameron, 2019; Chen, 2016; Grosse, 2014; Kaska, Beckvard, & Minárik, 2019; Lehne, 2020; Lippert & Perthes, 2020; Count, 2021; Perthes, 2021; Peterson, 2016; Pop & Grigoras, 2021; Rühlig & Björk, 2020; Santander, 2014; Simón, 2021; Simón, Desmaele, & Becker, 2021; Smith & Taussig, 2019; Starrs & Germann, 2021; Umbach, 2021; Walkowski, 2019).

A separate category of works analyzing Europe's positions in US-Chinese technology competition is represented by analyses of the prospects for building the EU's strategic autonomy (i.e., Bartels, Kelner & Optenhögel, 2017; Drent, 2018; García Pérez, 2019; Grevi, 2020; Grevi, 2021; Helwig, 2021; Howorth, 2017; Schüller & Schüler-Zhou, 2020; Terlikowski, 2021; Zieliński, 2020).

The introduction of an outline of the literature of the study allows to present the methodological parameters of the analysis.

3. METHODOLOGY AND CONCEPTUAL FRAMEWORK

The author employs a research strategy that is based on scientific pragmatism. This means focusing on specific situations and their consequences. The most important element of such an approach is the liberal attitude toward the selection of specific methods, techniques, and research procedures. The essential criterion is their maximum usefulness in carrying out the research procedure. The source of this approach – as underlined by pragmatism – is the pursuance of objectives set (Crespall, 2013). Therefore, the author will use morphological analysis.

Morphological analysis is an approach developed by the Swiss astronomer Fritz Zwicky, who saw its usefulness in examining structural links not only between physical objects, but also between phenomena and ideas, regardless of their nature (Zwicky, 1969). The method can be defined as a way of examining combinations of possible relationships or configurations of phenomena, processes, and other variables (non-quantifiable), which are contained in a complex problem, and deriving generalizations from them (Ritchley, 2013). Zwicky's

approach shows that any complex socio-technological problem, which requires an integrated approach, can be examined by morphological analysis (Álvarez & Ritchley, 2015).

Building an image of the policy and economics and technologies that define the EU's position in US-Chinese competition also requires a critical analysis of available sources (from scientific publications through EU documents and analytical products to press publications). The author will also use a structured interviews technique that will enrich the analytical process.

The purpose of this paper is to construct an image of the EU's position in the intense technological Cold War between the US and China. To achieve this, a number of research questions need to be answered: What are the main areas of technological rivalry in the US-Chinese competition? What is the EU's potential in high technologies? What are the impacts of high technologies development level on EU political, social, and economic situation? How does the level of development of high technology affect the EU's global position in the context of US-Chinese rivalry?

In the light of a research problem designed as above, the author puts the following hypotheses:

- The EU does not have a robust industrial base for the development of high technologies guaranteeing global competitiveness.
- The relatively weak position in critical technologies in the context of increasing global competition creates risks to the EU's wider security and global position

The analysis of the research problem introduced above should be started by outlining the parameters of the technological Cold War between the US and China.

3.1. TECHNOLOGICAL COLD WAR

The Chinese development strategy, contained in the "Made in China 2025" document, which envisages the creation of a global technological power and a strong response by President Donald Trump's administration, can be regarded as a symbolic start to the intense technological rivalry of the two powers.

China's actions are part of the challenge to the US global leadership. The trade war that President Trump has launched against China has evolved into a rivalry for the leadership in development and implementation of core technologies – automation and robotics, 5G (with the leap in the Internet of Things in perspective), Artificial Intelligence, nanotechnology, Big Data and Analytics. These technologies are not only a source of potential economic advantages, but also of the development of the military strategic capabilities (defensive and offensive). Core technologies development will define the key parameters of state power and its position in evolving international system's architecture.

Technological rivalry has become the most important vehicle in the struggle for global primacy. The US side has consistently shut down Chinese companies' (especially Huawei and ZTE) access to critical telecommunications networks and increased own investment in the new technologies sector. The aim is not only to build potentials and resilience in the above-mentioned technologies, but also to regain control of value chains (especially in semiconductors).

This meets China's countermoves. The Middle Kingdom not only expands own high technologies sector but is offensive (politically and economically) across the markets around the world. The companies, supported by Chinese state apparatus, are striving to develop their

businesses in telecommunications markets. At the same time, China significantly restricts access to its own vibrant economy.

It should be noted that technological standards are an important area of this confrontation. Chinese "third tier" companies are producing basic equipment; at the "second tier," there are companies that create a innovative technology, develop innovation; "tier one" is occupied by entities that set standards. So far, the West has dominated this area (primarily the United States). China, however, is very active in international bodies developing technological standards. Her desire is to shape them in line with own economic and political interests (Clarke, 2021). "Breakthrough" in this field, especially in the 5G networks (but also AI and data governance) will mean building various advantages in markets defined by future technologies. These advantatages can be extensively exploited politically.

In parallel, China is trying to impose her own standards in bilateral relations (e.g., in relations with the "weaker" states participating in the Belt and Road project). Recently, China has proposed a completely new Internet protocol that would replace TCP/IP, which – according to China – becomes less and less efficient. However, it contains potentially dangerous and controversial elements, such as the "shut-up" command, which can disable the Internet for chosen user groups. The creation and application of new protocols may result in the emergence of "various Internets" – the Western Internet, "Chinternet" (or the Russian "Runet") – and its "Balkanisation" (Gross & Murgia, 2020). 5G will be the new "core" of all such projects. An entity that sets out its parameters and standards will gain not only economically and politically. It can also develop effective tools for network control and surveillance. This will translate into viable power – including military – and will be an important component of global preponderance.

Europe has become a theater of the US-Chinese technological confrontation. The expansion of state-supported Chinese companies there has faced an aggressive US response. The Old Continent, once the leader in the development and deployment of modern technologies (such as 3G networks), has been in a difficult position between an offensive, economically competitive, but politically threatening China and the US, focused on maintaining its position and close relations with traditional allies.

3.2. HIGH TECH IN THE EU

The European Union, although being a well-developed entity with institutions that have broad prerogatives and certain level of viable political power, is limited by the will and interests of the Member States. This has a negative impact on the pace of the development of high technologies and saturation of the European economy with them.

Technological development must be treated holistically – the most important technologies are interconnected, and ecosystems of various innovations are created around them. Their role in the economy will grow exponentially. The European Union is committed to stimulating the development of high technologies and to harmonizing Member States' actions. A particularly important area for EU actions in the high technologies sector is regulation of the fast-growing technologies (data governance, Article Intelligence) and giving them a legal framework that is compatible with European core values. Despite many (integrated and dispersed) technological development efforts, the EU is losing its competitive edge.

One issue that cannot be overlooked in the reflection on the development of high technologies in the EU is access to raw materials (including rare earth elements) and semiconductor

manufacturing, which are the basis for almost all technological processes. The SARS-CoV-2 pandemic led to disruptions in microchip supply chains, showing a serious vulnerability of the Community (EU's cost plan to close the semiconductor gap, 2021).

The analysis of the level of development of high technologies in the EU will be based on the three most important – as the author argues – technologies, which determine the current and projected economic and political strength of the Community – 5G, Big Data and Artificial Intelligence.

3.2.1. 5G NETWORKS

The main axis of global competition for the primacy in 5G development is the United States and China operations across the global markets. In the first phase of this rivalry, Europe was only its theater. The EU has faced a dilemma: economically attractive cooperation between Chinese companies versus traditional alliance with the United States. For some time, the EU countries have been at the center of the conflict, where both powers have resorted to exert political and economic pressure. The result of this struggle is a general move away from the unlimited admission of Chinese companies to EU's 5G networks (although some Member States have completely prevented it). This access is strictly controlled, and the intensity of US-Chinese competition has given rise to the introduction of comprehensive screening of investment procedures in the telecommunications sector (Carcy, 2021).

Although it is China and its companies that have taken a strategic initiative in implementing the 5G networks and the market of the Middle Kingdom is one of the most dynamic in the world, the EU is not in a position to lose. According to Gartner report (2021), Swedish Ericsson is the global leader in 5G. Interestingly, a problem in relations between the EU and the United States emerges. There is a concern about the growing dependence on European technology (following the complete closure of the market for Chinese companies) in the United States. Another problematic question is the concept of development of 5G networks based on the Open Radio Access Network. The United States sees the chance to overcome the potential advantages of European companies and to engage smaller business entities along with partners from Japan and South Korea (Cerulus, 2021). The landscape after the 'repellence' of Chinese technology giant's offensive in the EU and United States is therefore fragile and potentially conflict prone. This also shows the difficulties in building a common Western front in technological rivalry with China, which in turn intensify efforts to develop their own technical standards. These steps of China are intended to give her a strategic advantage in the future.

The Chinese authorities are aware of the link between technical standards and economic position. So far, the West has dominated this area. China is active in this area in a number of standardization institutions (e.g., 3GPP) and its flagship tech company, Huawei, is the leader in the "standards-essential patents." Finnish Nokia is in the second place, but Chinese companies have extensive support from the state authorities. Chinese objectives can be classified as political or geopolitical. This situation also shows a wider problem – the EU is not institutionally strong enough to support European companies (and it is against the free market rules) in the period of intense US-Chinese competition. Similarly, there are Member States that do not have a viable political capacity to discount the economic advantages of their own companies. It should be also stressed that global rivals – the US and China – are already starting to work on 6G technology.

Super-fast telecommunications networks will form the basis for the industrial Internet of Things and stand-alone devices (medical, transport and many others) – a strong position in 5G will define new-generation industrial advantages and decide the strength of the economies. Competition is still ongoing. The EU has a solid foundation for a strong position, already with advantages over the US and China in some areas. However, the main obstacle is the lack of harmonized measures.

3.2.2. BIG DATA

The development of super-fast telecommunications networks will result in an exponential growth in data, which will expand the already existing large volumes – Big Data. This data will constitute a "fuel" for emerging new, automated industries, energy, transport, medicine and many more. Whereas this makes it necessary to create regulations which lay down the rules for acquiring and processing of data; utilization of algorithms based on Artificial Intelligence engines; exchange and storage (cloud services). In this sector, the EU has already taken the first steps to create cloud technologies (European Commission, 2021).

The size and structure of the European digital market generate data which gives an opportunity to achieve a profit of up to EUR 194 billion by 2030 (Soulava et al., 2021). The EU's potential in this area is significant. However, the most important obstacle to generating profit is the fragmented rules on the commercial use of data collected in the EU. The Community is aware of these shortcomings and is implementing the European Data Strategy (2020). The first step toward harmonization of data collection and usage rules was taken in 2021 when the *Data Governance Act* was adopted. It creates a new data management structure. It will apply to the common data spaces created by the European Commission in the health, energy, and agriculture sectors (Bertuzzi, 2021). Angelika Niebler, Member of European Parliament (Committee on Industry, Research and Energy, D-US Delegation for relations with the United States), argues, the grow of data spaces should be "organic," and the EU "should facilitate cooperation between Member States to break-up and connect national and sectoral data silos" (Interview with Angelika Niebler, 2021). The next step in EU's efforts to enhance its data market structure is to be the *Data Act*, which will regulate the way and scope of the collection and commercial use of non-personal data (Headon, 2021).

The EU is often referred to as *regulatory power*. The Community aims to create an architecture regulating the data market, which will at the same time consider the European core values and provide the foundation for global economic competitiveness. This objective is difficult to achieve despite the EU's potential as described above. However, it is challenging to overcome the growing advantages of the US and China due to different standards in these countries. The EU offers alternatives to America's techno-capitalism and China's surveillance-heavy statism (Manancourt & Lau, 2021) as ways to regulate the data market. Both powers have taken decisive actions to extend control of Big Tech companies, which even in China are perceived as a threat to the state's dominant position. The EU, with its balanced policy, which is expected to take it to the role of "digital policeman" and "standards-setter," can lose in this race. The Chinese Communist Party is already aiming to halt the outflow of data from the country and, as a result, to prevent the weakening of China's economic position. Similar thinking is presented by the US authorities. In this case, however, there is a need for cooperation with the EU, with which the US is closely economically and politically linked. However,

the EU's data potential may not be exploited due to structural inefficiencies and political and legal differences between Member States.

The economic impact of Big Data will be demonstrated by the development of Artificial Intelligence, which is the most important technology in the Fourth Industrial Revolution ecosystem.

3.2.3. ARTIFICIAL INTELLIGENCE

The report prepared by Center for Data Innovation shows that the EU is losing the race for leadership in development and implementation of Artificial Intelligence. Analysts utilized 30 metrics across categories: talent, research, development, hardware, adoption, and data. The US leads in four categories (talent, research, development, and hardware) and China in two (adoption and Data). The US obtained 44.2 points out of 100 possible. The second place is held by China with the result of 32.3 points. The European Union closed the ranking with 23.5 points. The report also considered the size of the labor force. As a result, the EU was ranked second (24.2) behind the US (58) and ahead of China (17.8). However, the authors stress that China is consistently reducing the distance between he and the US and the EU (Castro & McLiglin, 2021).

The potential of the EU, despite the distance between it and, primarily, the US, can be assessed as high. The Community is the leader in certain aspects of development research. The problem is the implementation of the results of these studies and their marketization (Nazikaitė, 2021). Even more importantly, the quality of data that feeds European AI projects is poor (Draft Report on artificial intelligence in a digital age, 2021). This is linked to a general lack of confidence in Article Intelligence in Europe. The result is the restrictions on access to data imposed by the General Data Protection Regulation (GDPR). Therefore, the AI in Europe is not able to use the data generated on the Old Continent. The EU, despite taking steps to stimulate the development of this industry, does not sufficiently free up data in the market to generate competitiveness and improve its position toward the US and China. The Data Governance Act also introduces some restrictions on access, which translates into slower progress in the AI sector. Instead, the proposals of politicians who highlight the need to modify the GDPR do not find a broad understanding.

In the case of Artificial Intelligence, the EU will attempt to define standards that are compliant with European core values. This is due to this lack of confidence in AI, which in turn is generated by the spread of black box algorithms. These are algorithms, which conduct analytical operations on data, that cannot be understood. The EU recognizes that an appropriate level of understanding is necessary (European Commission, 2018), but it is difficult to see when it actually can be achieved. At stake is the use of algorithms in, e.g., medicine or law enforcement in line with European standards and values. The question whether the EU is able to achieve the level of development of Artificial Intelligence to compete on global markets is therefore raised. In this case, the US and, above all, authoritarian China have a significant advantage. In addition to the conditions outlined above, centralized state organisms are stronger institutionally, have the causative potential and clear objectives in the ongoing competition for global primacy. EU action in a strategically important area of Artificial Intelligence is further limited by Member States' policies and interests (including those interested in developing this technology), which are at different levels of readiness for active actions in this sector (Brattberg et al., 2020). What is more, the Artificial Intelligence, if it should serve

the EU strategically, cannot be treated only as a "matter of regulation" (Interview with Axel Voss, 2021).

Draft report on artificial intelligence in a digital age (2021) states, in addition to the specific recommendations for the creation of a legal and financial environment for the development of the EU's AI, that a technological global alliance must be created. The United States is the natural partner for the EU in this case.

3.3. CAUGHT BETWEEN – EU AND US-CHINESE TECHNOLOGICAL COLD WAR

Market regulation, ethical standards and the construction of trustworthy solutions are the dominant factor in the EU's actions in the field of high technology. There is little space in Community's activities for geopolitical issues. There should be no doubt that technology is not neutral. Awareness of this is one of the driving forces of US-Chinese rivalry. Neither the EU nor the Member States are taking decisive action in the field of key technologies such as Artificial Intelligence, losing it in terms of its impact on the global balance of power. The result is EU-wide drift and inertia at the time of the increased rivalry between the US and China. This creates a number of threats to the security of the Member States and the EU as such. Although in the official documents, these states stress the importance of technology, they are lacking in determination to act in this field.

The position of the EU in the ongoing US-Chinese confrontation is therefore weak. The opportunity to neutralize some of the risks generated by this inferior position is a broad agreement with the United States, as it is proposed in abovementioned report on Artificial Intelligence. The US is a natural partner, because of the community of shared values. However, common interests are, unfortunately, increasingly difficult to define. The negative effects of presidency of Donald Trump – who scorned multilateral formats – on the US-European relations, are proving to be more difficult to overcome. This is despite the declarations by both sides to return to a close, strategic transatlantic cooperation.

However, the need for this cooperation is evident. EU-US Trade and Technology Council (TTC) was established at their summit in Brussels on 15 June 2021. It is designed to coordinate policies and approaches to "key global trade, economic and technology issues, and to deepen transatlantic trade and economic relations based on shared democratic values." Working groups have been set up in the areas of Technology standards; Climate and Clean Tech; Secure Supply Chains, Information and Communication Technology and Services (ICTS) Security and Competitiveness; Data Governance and Technology Platforms; Misuse of Technology; Threat to Security and Human Rights; Export Controls; Investment Screening; Promotion of Small- and Medium-sized Enterprises (SME); Access to and Use of Digital Tools; Global Trade Challenges (EU-US Trade and Technology Council, 2021).

American-European cooperation will not be unhindered. For instance, the renegotiation of data-flow agreements will be problematic, i.e., due to the related taxation issues of major technology companies. The strategic benefits of such cooperation for both sides are undeniable. However, the EU's structural problems and attitude can thwart effective cooperation. Speed is important in the technology-defined rivalry, not only because of the economic benefits of *first mover* status, but also because of risk mitigation and addressing threats requirements.

The abovementioned relative weakness and inertia of the EU in the ongoing US-Chinese Cold War poses threats to Community security. These threats can be divided into two categories: dependencies and vulnerabilities.

3.3.1. SUPPLY DEPENDENCIES

Dependencies have their sources in the advantage or monopoly of different entities in the development of certain technologies, manufacturing, or extraction of raw materials. The pandemic caused periodic disruptions in supply chains. From the health emergency point of view, the problem is identified by the lack of medical mask or disinfectants. However, semiconductors and raw materials were the most important goods in terms of technological rivalry. The dependence on microchip manufacturers is particularly dangerous for the undisrupted functioning of the digital economy. They are crucial in the Artificial Intelligence, smartphones and notebooks sectors, the growing industrial Internet of Things, as well as in the manufacturing of medical devices and in the automotive industry. Most of the world's production of these advanced devices is located in China, Taiwan, South Korea and the United States (EU's cost plan to close the semiconductor gap, 2021).

The value chain of this strategically important component of modern industry and economy can be disrupted for various reasons. Analysts of European Union Institute of Security Studies enumerate state fragility, economic coercion, and climate change (Fiott & Theodosopoulos, 2020). In the context of the US-Chinese Cold War, economic coercion is particularly important. It is caused by authoritarian political systems practices and economic strength. These criteria are met by China, which can use this type of instruments acting against the entire West, not just the United States. Cascading effects on the economy and, consequently, social stability in the event of disruption of microchip supplies are difficult to calculate. The risk of intentional hostile actions can be considered serious, due to the overall tensions in global relations.

The EU intends to reduce this dependency by implementing comprehensive measures, including the location of most of the value chains elements in Europe. Furthermore, the EU turns to cooperation with the United States and Asian partners – South Korea, Japan, and Taiwan (EU appeals to shared values to tempt Taiwan's chip firms, 2021). Cooperation with Taiwan in the field of semiconductors has an important geopolitical dimension and, in addition to the necessary diversification, I also create a threat of China's multi-directional retaliation. These will probably be costly projects which do not provide a clear positive result for EU's security. The EU's problem with the availability of microchips is complex. It is also due to the structure of the digital economy, which lacks large technology companies – their most important users. There is therefore an absence of market driving force for the placement of large factories in Europe (Harper, 2021). The risk of the lack of microchips on the market will therefore continue to exist indefinitely. Due to the complicated market situation in the EU and the US-Chinese competition, it will be difficult to neutralize it.

Another important EU's dependency is the limited access to critical raw materials, including the rare earth elements (REE) that are essential for the development of the digital economy. Strategically important minerals include Bauxite, beryllium, bismuth, rate, cobalt, gallium, hafnium, indium, lithium, magnesite, natural graphite, Tantalum (Critical raw Materials Resilence, 2020). The risks associated with EU dependency on foreign-supplied raw materials have increased when China began to consider using its position as a world leader in this sector in the trade war with the US in 2019. That is why the United States has started to move toward diversification (Behrmann, 2021). Similar steps have been taken by the EU (ERMA, 2020).

The Foresight study prepared by the European Commission's Joint Research Center points to the risk of supply chain disruption that may be caused only by the possible hostile action of China but to the rapidly growing demand. For instance, this is a valid case with the lithium, used in the production of batteries – China and the African countries provide 74% of the world's demand. China, on the other hand, produces 66% of the ready to use batteries. The EU is able to supply only 1% of its battery needs (Bobba et al., 2020). It has been an impulse for the intensification of the European Battery Alliance activities, but the results of the measures taken remain to be seen. Similarly, the REE – which the EU lacks – are critically important in UAVs production, operations of the automation and robotics sector and prospective additive technologies such as 3D printing (Gajewski, 2020). The risk will therefore be kept at relatively high level. Disruptions in access to raw materials threaten many sectors of the digital economy, but the functioning of the security sector, including the armed forces of the Member States, must not be overlooked in this context (Lindstrom, 2020).

The risks arising from the dependence on commodities and raw materials are multiplied by the increasing US-Chinese competition, which drives demand, leading to temporary supply constraints. They may be caused by objective factors (consequences of climate change, epidemics, or other crises) or by the intended actions of competing powers. The situation is even more difficult as China, one of the parties to the Cold War, has a very strong position in the production of equipment and extraction of raw materials. The United States is working to strengthen her position in both microchips production and the diversification of raw materials supply.

Despite the general focus on strengthening transatlantic cooperation to balance China's growing power, the US can improve its position in the areas described above at the expense of the EU. It was President Donald Trump's policy that contributed to the crisis in the supply of equipment and raw materials from China (EU unveils strategy, 2021). The EU must therefore be ready to adapt to US policy changes after the next presidential elections. There should be awareness of the possible situation where EU-US cooperation will be *de facto* a structured dependence on the US partner. The result would be the "vulnerability" of the EU in the event of fluctuations in the US political line. Although it is difficult to deny the validity of the argument that the issue of a firm course toward China is not a matter of political struggle in the United States (Interview with Radosław Sikorski, 2021), the risk of a disruption in transatlantic relations should not be ignored. It is obvious, that China is not an alternative.

The EU, in turn, sets itself ambitious objectives to reduce the risks described above. However, the success of these measures depends to a large extent on the attitude of the Member States and cohesion of the European integration project.

3.3.2. CRITICAL VULNERABILITIES

The reliance on external (primarily non-democratic) equipment suppliers, which will underpin the functioning of the European digital economy, will create considerable vulnerabilities. Their catalog is broad, and its overall analysis goes beyond the framework of this paper. The main risks stemming from technological competition or, more specifically, the ineffectiveness of EU's action are threats to 5G networks architecture; risks to the security of submarine cables; reliance on technology standards imposed by other entities; cyber threats to European infrastructure, military offensive, and defensive capabilities, and finally threats to democratic processes such as disinformation and computational propaganda.

As mentioned above, the technological rivalry between the United States and China must be considered within the framework of the geopolitical struggle for global preponderance. The controversy surrounding the 5G architecture development in Europe and the participation of Chinese companies has made European decision-makers aware of the sensitivity of telecommunications systems. Unrestricted access by state-supported Chinese companies to major networks of Member States and the EU as such creates a risk of penetration of critical infrastructure systems, i.e., banking, transport, energy, civil and special communication sectors. It also creates a vulnerability for the industrial Internet of Things and modern medical devices that will grow around 5G networks. What is more, the reliance on external suppliers increases the risk of cyber-attacks of various kinds sponsored by states. The prospect of "trading of the access" to sensitive networks is also conceivable, depending on specific political interests.

There is also a threat of mass data acquisition that Europeans leave on the network as part of the growing digital footprint. In a context of increasing US-Chinese rivalry and growing role of Big Data (large data volumes are sometimes referred to as oil equivalent) in the world economy, both sides of the conflict can treat Europe not only as a theater of confrontation. The EU market can also be exploited by stronger actors to generate economic power.

The issue of submarine cable security is also critically important, though it is often overlooked. It is estimated, that 97% of global Internet traffic and financial transactions of USD 10 trillion per day (Franke & Torreblanca, 2021, p. 6) flows through underwater lines. American and Chinese companies invest heavily in this sector, providing submarine cables serving EU Member States, e.g., in the Mediterranean (Marseille becomes focus of US-China submarine cable battle, 2020). This creates a risk of penetration of the Middle East and North Africa digital economies and weakening of the EU's position there. The deliberate paralysis or the physical damage of submarine cables with potentially catastrophic consequences cannot be omitted.

Access to networks and data also creates the possibility of influencing political processes and forcing political or economic decisions, that are beneficiary for the competing powers. The development of Artificial Intelligence-based instruments for analyzing large data volumes and for psychometric profiling provides a wide array of influence avenues on political preferences and consumer behavior. The strategic use of such instruments cannot be excluded, as is the case with the actions of Cambridge Analytica in the United States Presidential elections and the United Kingdom referendum campaign.

Another threat is the forced compliance with technological standards imposed by other actors, especially in the field of Artificial Intelligence. Unless the EU is able to successfully push its own, it will have to adapt to other standards that are often inconsistent with European values. They may be created by authoritarian China or by the United States, where the perception of the privacy and social dimension of technology is different. The adoption of US or Chinese standards will also mean giving rival powers almost unlimited access to the European market.

Article Intelligence as such – even more than other technologies – must also be considered in geopolitical terms. Work on ethical dimensions of Artificial Intelligence is undoubtedly a purposeful task and can make the European digital market particularly attractive globally. However, ignoring AI as the most important technology for offensive and defensive military capabilities creates wide range of threats itself.

Both the United States and China openly identify AI as a key technology for military use. If the EU is unable to stimulate the development of military-oriented AI, it will create security risks and reduce its potential. The capabilities that will create "weaponized" AI will be more powerful than the previously known systems. Their effectiveness will be defined by the increasing dependence of public and private institutions and ordinary citizens on networked devices and networks as such. AI will be one of the most important determinants of the power of actors operating in the international system (Sajduk, 2019). The consequences of the lack of highly developed capabilities in this realm will lead the EU and the Member States (unable to build high-level capacity on their own) to become a passive member of the new power distribution model, which will be defined by the results of the US-Chinese technological Cold War.

4. CONCLUSIONS

According to the results of the study, currently the EU does not have a solid industrial base for the development of high technologies and for building of a competitive position on the global stage. This translates into a relatively inferior position in strategically important technologies, especially when compared to the US and China. This results in a generally weak global position of the EU.

The first connotation can be confusing – the EU is not a weak entity. However, the conditions and pace of development, set by the US and China's Cold War technological rivalry, show that the EU, operating slowly and facing many constraints on the part of the Member States, is increasingly falling behind them. While the EU is intensifying efforts to make up for this distance, structural conditions can thwart them. Dependencies on the external sources of supply of key goods and raw materials can make these efforts even more complicated. Remedy for these problems may, in turn, prove as painful as the problems themselves (as with the plans to transfer microchips production to EU territory).

Divisions within the EU can create vulnerabilities in telecommunications networks or submarine cables. This in turn will weaken the security of European information infrastructure and will result in threats not only for the European economy, but also for EU citizens and democratic systems.

The EU rightfully positions itself as a leader in setting technology standards (primarily in the data sector and AI). However, if the military and geopolitical dimensions of these technologies are ignored and this component is neglected, the EU will not develop the ability to enforce its standards. This conclusion is appropriate for an understanding of the international situation defined by the realism and power politics. This is the result of changes in the global balance of power – technological rivalry between the US and China is their driving force. Its effect will determine the parameters of the international situation in all dimensions.

Ongoing processes will create conditions for so-called "digital trench warfare," where two main "gravity centers" – the United States and China – are surrounded by technological barriers ("Balkanization of Internet"). Like in the Cold War of the second half of the 20th century, the global peripheries will be the theater of this rivalry. This time, it will not be so much a geopolitical periphery but technological peripheries. Where will the EU be then? The answer to this question depends on many factors, above all on the capacity of the EU itself and the strategic awareness of the Member States.

It is natural for the EU to strengthen its own capabilities and to work closely with the US. It may be assumed that the EU's starting position in the technological race – as indicated in this analysis – is too weak to think in real terms about generating global advantages. The risk of another isolationist or unilateral turn in United States global policy should not be overlooked in this context too. However, the close alliance with the US is the only way to maintain and strengthen the EU's position in the new global balance of power, where one of the leading actors will be technologically advanced, authoritarian China. The alternative – at best – is the status of technological and, consequently, also political and economic peripheries. In the worst case – a "digital colony."

REFERENCES

A European strategy for data. (2020, February 19). EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1593073685620&uri=CELEX%3A52020DC0066

Agten, S. (2021). The Great Decoupling and a New Cold War. In S. Agten (Ed.), *Adventures in the Chinese Economy: 16 Years from the Inside* (pp. 219–237). https://doi.org/10.1007/978-981-16-1167-4_12. Palgrave Macmillan.

Aho, B., & Duffield, R. (2020). Beyond Surveillance Capitalism: Privacy, Regulation and Big Data in Europe and China. *Economy and Society*, *49*(2), 187–212. https://doi.org/10.1080/03085147.2019.1690275

Allen, J. R., Hodges, F. B., & Lindley-French, J. (2021). *Future War and the Defence of Europe*. Oxford University Press.

Allison, G. (2018). *Skazani na wojnę. Czy Ameryka i Chiny unikną pułapki Tukidydesa*. Pascal.

Álvarez, A., & Ritchley, T. (2015). Applications of General Morphological Analysis from Engineering Design to Policy Analysis. *Acta Morphologica Generalis*, *4*(1).

Bartels, H.-P., Kellner, A. M., & Optenhögel, U. (Eds.). (2017). *Strategic Autonomy and the Defence of Europe. On the Road to European Army?* Dietz Verlag.

Behrmann, E. (2021, September 30). *EU Makes $2 Billion Push to Curb Reliance on China's Rare Earths*. Bloomberg. https://www.bloomberg.com/news/articles/2021-09-30/eu-makes-2-billion-push-to-curb-reliance-on-china-s-rare-earths

Bertuzzi, L. (2021, December 1). *Data Governance: New EU Law For Data-Sharing Adopted*. Euractiv. https://www.euractiv.com/section/digital/news/data-governance-new-eu-law-for-data-sharing-adopted/

Biba, S., & Wolf, R. (Eds.). (2021). *Europe in an Era of Growing Sino-American Competition: Coping with an Unstable Triangle*. Routledge.

Bobba, S., Carrara, S., Huisman, J., Mathieux, F., & Pavel, C. (2020). *Critical Raw Materials for Strategic Technologies and Sectors in the EU*. European Commission Joint Research Centre.

Brattberg, E., Csernatoni, R., & Rugova, V. (2020). *Europe and AI: Leading, Lagging Behind, or Carving Its Own Way?* Carnegie Endowment for International Peace.

Cameron, F. (2019). *The European Union's New Rival – China*. GIGA Focus Asien, 7. GIGA German Institute of Global and Area Studies – Leibniz-Institut für Globale und Regionale Studien, Institut für Asien-Studien.

Carcy, L. (2021). *The New EU Screening Mechanism for Foreign Direct Investments When The EU Takes Back Control*. Colleger of Europe.

Castro, D., & McLouglin, M. (2021). *Who Is Winning The AI Race: China, The EU, or The United States?* Center fo Data Innovation.

Cerulus, L. (2021, November 30). *Cracks Appear in West's 5G Strategy After Huawei*. Politico. https://www.politico.eu/article/us-europe-5g-strategy-huawei/

Chen, Z. (2016). China, The European Union and the Fragile World Order. *Journal of Common Market Studies*, *54*(4), 775–792. https://doi.org/10.1111/jcms.12383

Clarke, L. (2021, June 15). *Echnical Standards-Setting Is Shaping up to Be the Next China-US Showdown*. Techmonitor. https://techmonitor.ai/technology/technical-standards-setting-shaping-up-next-china-us-showdown

Creswell, J. M. (2013). *Research Design: Qualitative, Quantitative, and Mixed Method Approaches*. Sage Publications.

Diesen, G. (2021). *Great Power Politics in the Fourth Industrial Revolution: The Geoeconomics of Technological Sovereignty*. Bloomsbury.

Drent, M. (2018). *European Strategic Autonomy: Going It Alone?* Clingendael Institute.

Dupont, A. (2020). *Mitigating the New Cold War: Managing US-China Trade, Techn and Geopolitical Conflict*. Center for Independent Studies.

Ericsson named a Leader in the 2021 Gartner Magic Quadrant for 5G Network Infrastructure for Communications Service Providers report. (2021, February 2021). Ercisson. https://www.ericsson.com/en/press-releases/2021/2/ericsson-named-a-leader-in-the-2021-gartner-magic-quadrant-for-5g-network-infrastructure-for-communications-service-providers-report

ERMA. (2020, September 3). European Raw Materials Alliance. https://erma.eu/about-us/

EU Appeals to Shared Values to Tempt Taiwan's Chip Firms. (2021, October 14). Reuters. https://www.reuters.com/technology/eu-appeals-shared-values-tempt-taiwans-chip-firms-2021-10-14/

EU Unveils Strategy to Reduce Dependency on China. (2021, May 18). Economist Intelligence Unit. https://www.eiu.com/n/eu-unveils-strategy-to-reduce-dependency-on-china/

EU-US Trade and Technology Council: Commission Launches Consultation Platform for Stakeholder's Involvement to Shape Transatlantic Cooperation. (2021, October 18). European Commission. https://ec.europa.eu/commission/presscorner/detail/en/IP_21_5308

EU's Costly Plan to Close the Semiconductor Gap. (2021, October 4). Financial Times. https://www.ft.com/content/a016f686-791f-4a3f-9e7a-c6389896862b

European Commission. (2018, January). *USA-China-EU Plans for AI: Where Do We Stand?* Digital Transformation Monitor. https://ati.ec.europa.eu/sites/default/files/2020-07/USA-China-EU%20plans%20for%20AI%20-%20where%20do%20we%20stand%20%28v5%29.pdf

European Commission (2020). *Critical Raw Materials Resilience: Charting a Path Towards Greater Security and Sustainability*. European Commission.

European Commission. (2021, July 21). *Commission launches alliances for microelectronics and cloud technologies*. Shaping Europe's digital future. https://ec.europa.eu/newsroom/dae/redirection/document/78362

Feng, S. (2020). Cyclical Globalizationand China's Strategic Options. *China Quarterly of International Strategic Studies*, *6*(3), 355–370. https://dx.doi.org/10.1142/S2377740020500207

Fiott, D., & Theodosopoulos, V. (2020). *Sovereigny Over Supply?* European Union Institute of Security Studies.

Franke, U., & Torreblanca, J. I. (2021). *Geo-Tech Politics: Why Technology Shapes European Power*. European Council on Foreign Relations.

Gajewski, T. (2020). Druk 3D jako technologia zakłócająca w systemie międzynarodowym. *Annales UMCS. Sectio K*, *27*(1), 43–64. http://dx.doi.org/10.17951/k.2020.27.1.43-64

García Pérez, R. (2019). Strategic Autonomy of the European Union. In *The Routledge Handbook of European Security Law and Policy* (pp. 81–95). Routledge.

Grevi, G. (2020). *Fostering Europe's Strategic Autonomy. A question of purpose and action*. European Policy Centre – Konrad Adenauer Stiftung.

Grevi, G. (2021). Europe's Strategic Autonomy and the Partnership Approach. In P. Gieg, T. Lowinger, M. Pietzko, A. Zürn, U. S. Bava, & G. Müller-Brandeck-Bocquet (Eds.), *EU-India Relations The Strategic Partnership in the Light of the European Union Global Strategy* (pp. 19–31). Springer International Publishing.

Gross, A., & Murgia, M. (2020, March 27). *China and Huawei Propose Reinvention of the Internet*. Financial Tims. https://www.ft.com/content/c78be2cf-a1a1-40b1-8ab7-904d7095e0f2

Grosse, T. G. (2014). Geoeconomic Relations Between the EU and China: The Lessons from the EU Weapon Embargo and from Galileo. *Geopolitics*, *19*(1), 40–65. https://doi.org/10.1080/14650045.2013.789864

Harper, J. (2021, April 29). *The EU's Microchip Dilemma: Too Little or Too Late?* Deutsche Welle. https://www.dw.com/en/the-eus-microchip-dilemma-too-little-or-too-late/a-57367537

Headon, T. (2021, December 9). *Data Act: Summary Report on Public Consultation*. Lexology. https://www.lexology.com/library/detail.aspx?g=88907ef5-edac-4ce2-a994-233aea64948e

Heisbourg, F. 8.-1. (2020). NATO 4.0: The Atlantic Alliance and the Rise of China. *Survival*, *62*(2), 83–102. https://doi.org/10.1080/00396338.2020.1739950

Helwig, N. (2021). *EU Strategic Autonomy. A Reality Check for Europe's Global Agenda*. Finnish Institute of International Affairs.

Hoffman, S., Bradshaw, S., & Taylor, E. (2019, August 22). Great Power Rivalries in 5G Technology Markets. In C. A. Crocker, F. Osler Hampson, & P. Aall (Eds.), *Diplomacy and the Future of World Order* (pp. 241–272). Georgtown University Press.

Hopwell, K. (2020). *Clash of Powers: US-China Rivalry in Global Trade Governance*. Cambridge University Press.

Howorth, J. (2017a). *Strategic Autonomy and EU-NATO Cooperation: Squaring the Circle*. Egmont Royal Institute for International Relations.

Interview with Aexl Voss, MEP. (2021, December 2). Technological Dimension of EU's Strategic Autonomy.

Interview with Angelika Niebler, MEP. (2021, December 23). Technological Dimension of EU's Strategic Autonomy.

Intreview with Radosław Skorski, MEP (2021, December 17). Technological dimension of EU's strategic autonomy.

Kaska, K., Beckvard, H., & Minárik, T. (2019). *Huawei, 5G and China as a Security Threat*. NATO Cooperative Cyber Defence Centre of Excellence.

Kennedy, S. (2020). *China's Uneven High-Tech Drive. Implications for the United States*. Center for Strategic and International Studies.

Khanna, P. (2019). *The Future Is Asian: Global Order in the Twenty-First Century*. Orion Publishing Group.

Kissinger, H. (2014). *O Chinach*. Wydawnictwo Czarne.

Knutsen, B. O. (2016). European Defence Research in Crisis? The Way Towards Strategic Autonomy. *Global Affairs*, *2*(3), 287–295, https://doi.org/10.1080/23340460.2016.1219152

Komiyama, K., & Tsuchiya, M. (2021, April). The Triadic Conflict That Lies Ahead in the U.S.-China Tech Confrontation. *Asia Policy*, *16*(2), 43–55. https://doi.org/10.1353/asp.2021.0016

Kuik, C.-C. (2021). The Twin Chessboards of US-China Rivalry: Impact on the Geostrategic Supply and Demand in Post-Pandemic Asia. *Asian Perspective*, *45*(1), 157–176. https://doi.org/10.1353/apr.0.0010

Lehne, S. (2020). *How the EU Can Survive in a Geopolitical Age*. Carnegie Endowment for International Peace.

Lewis, J. A. (2019). *Emerging Technologies and Managing the Risk of Tech Transfer to China*. Center for Strategic and International Studies.

Lindstrom, G. (2020). What if… A Country Restricted Access to Rare Earth Elements? In F. Gaub (Ed.), *What if…? 14 futures for 2024* (pp. 67–73). European Union Institute for Security Studies.

Lippert, B., & Perthes, V. (2020, April). Strategic Rivalry Between United States and China: Causes, Tragectories, and Implications for Europe. *SWP Research Paper*, *4*. https://doi.org/10.18449/2020RP04

Lo, C. (2021). *China's Global Disruption. Myths and Reality*. Emerald Publishing Limited. https://doi.org/10.1108/9781800437944

Ma, W. (2021). *The Digital War: How China's Tech Power Shapes the Future of AI, Blockchain and Cyberspace*. John Wiley & Sons.

Manancourt, V., & Lau, S. (2021, August 6). *Europe Was The World's Great Tech Enforcer. Not Anymore*. Politico. https://www.politico.eu/article/eu-big-tech-enforcer-us-china-gdpr-privacy-competition-apple-google-facebook-amazon/

Marseille Becomes Focus of US-China Submarine Cable Battle. (2020, December 2). Intelligence Online. https://www.intelligenceonline.com/grey-areas/2020/12/02/marseille-becomes-focus-of-us-china-submarine-cable-battle,109624883-art

Martin, J. (2012). *When China Rules the World: The End of the Western World and the Birth of a New Global Order*. Penguin Books.

Modlicz, C. (2021). *China, the USA and Technological Supremacy in Europe*. Routledge.

Naujokaitytė, G. (2021, September 21). *EU Faces Major Barriers to Deploying Artificial Intelligence*. Science Business. https://sciencebusiness.net/news/eu-faces-major-barriers-deploying-artificial-intelligence

Oxford Analytica. (2021). Tech Risks Shape Chinese and Western National Security. *Expert Briefings*. https://doi.org/10.1108/OXAN-DB260678

Perthes, V. (2021). Dimensions of Rivalry: China, the United States, and Europe. *China International Strategy Review*, *3*, 56–65. https://doi.org/10.1007/s42533-021-00065-z

Peterson, J. (2016). Choosing Europe or Choosing TTIP?: The European Union and the Transatlantic Trade and Investment Partnership. *European Foreign Affairs Review*, *3*, 383–401.

Pop, A., & Grigoras, R. (2021, January). Towards a Bifurcated Future in the US-China relationship: What Is in it for the EU? *Futures*, *125*, 102634. http://dx.doi.org/10.1016/j.futures.2020.102634

Pop, V., Hua, S., & Michaels, D. (2021, February 8). From Lightbulbs to 5G, China Battles West for Control of Vital Technology Standards. *The Wall Street Journal*. https://www.wsj.com/articles/from-lightbulbs-to-5g-china-battles-west-for-control-of-vital-technology-standards-11612722698

Przychodniak, M. (2019). China and the Challenges of the Fourth Industrial Revolution: Value Chains, 5G, and Emerging Markets. *PISM Policy Paper*, *171*(1), 2–12.

Ritchley, T. (2013). *General Morphological Analysis. A general method for non-quantified modelling*. Swedish Morphological Society. http://swemorph.com/pdf/gma.pdf

Rudolf, P. (2021). The Sino-American World Conflict. *Survival*, *62*(2), 87–114. https://doi.org/10.1080/00396338.2021.1905980

Rühlig, T., & Björk, M. (2020). *What to Make of the Huawei Debate? 5G Network Security and Technology Dependency in Europe*. The Swedish Institute of International Affairs.

Rühlig, T., Seaman, J., & Voelsen, D. (2019). *5G and the US-China Tech Rivalry – A Test for Europe's Future in the Digital Age: How Can Europe Shift Back from Back Foot to Front Foot?* Stiftung Wissenschaft und Politik -SWP- Deutsches Institut für Internationale Politik und Sicherheit. https://doi.org/10.18449/2019C29

Sajduk, B. (2019). Theoretical Premises of the Impact of Artificial Intelligence on the International Relations and Security. *The Copernicus Journal of Political Studies*, *2*, 157–180. https://doi.org/10.12775/CJPS.2019.017

Santander, S. (2014). The EU and the Shifts of Power in the International Order: Challenges and Responses. *European Foreign Affairs Review*, *19*(1), 65–82.

Schüller, M., & Schüler-Zhou, Y. (2020). *United States-China Decoupling: Time for European Tech Sovereignty*. Hamburg: GIGA German Institute of Global and Area Studies – Leibniz-Institut für Globale und Regionale Studien, Institut für Asien-Studien.

Schwab, K. (2016). *The Fourth Industrial Revolution*. Penguin.

Shaping Europe's digital future. (2020). European Commission. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/shaping-europe-digital-future_en

Simón, L. (2021). *Subject and Object: Europe in Sino-American Competition*. EUI Robert Schuman Centre.

Simón, L., Desmaele, L., & Becker, J. (2021, Spring). Europe as a Secondary Theater? Competition with China and the Future of America's European Strategy. *Strategic Studies Quarterly*, *15*(1), 90–115.

Smith, J., & Taussig, T. (2019, September/October). The Old World and the Middle Kingdom. *Foreign Affairs*, *98*(5), 112–125.

Soulava, B., Cameron, H., & Ying, V. (2021). *Data Rules for Machine Learning: How Europe Can Unlock the Potential While Mitigating the Risks*. Atlantic Council.

Special Committee on Artificial Intelligence in a Digital Age (repporteur: Axel Voss). (2021). *Draft Report on Artificial Intelligence in a Digital Age (2020/2266(INI))*. European Parliament.

Starrs, S. K., & Germann, J. (2021, September). Responding to the China Challenge in Techno-nationalism: Divergence Between Germany and The United States. *Development and Change*, *52*(5), 1122–1146. https://doi.org/10.1111/dech.12683

Sun, H. (2019). U.S.-China Tech War. Impacts and Porspects. *China Quarterly of International Strategic Studies*, *5*(2), 197–212. https://dx.doi.org/10.1142/S237774001950012X

Terlikowski, M. (2021). *European Strategic Autonomy and Third Countries: The Defence Industrial Dimension*. GLOBSEC Policy Institute.

Toro Hardy, A. (2020). *The Technological Contest Between China and The United States* [GLO Discussion Paper, No. 521]. Global Labor Organization (GLO).

Umbach, F. (2021). EU-China Relations at a Crossroads: Decoupling or a European "Sinatra Doctrine." *East Asian Policy*, *13*(1), 47–64. https://doi.org/10.1142/S1793930521000040

Walkowski, M. (2019). Between the United States and the People's Republic of China. The Dilemma of The European Union's Negotiation Position in the Context of the Accelerated Technological Development of the PRC. *Rocznik Integracji Europejskiej*, 311–325. https://doi.org/10.14746/rie.2019.13.22

Walsh, K. (2003). *Foreign High-Tech R&D in China. Risks, Rewards, and Implications for U.S.-CHINA Relations*. The Henry L. Stimson Center.

Wong, P. (2021). *Techno-Geopolitics: U.S.-China Tech War and the Practice of Digital Statecraft*. Routledge. https://doi.org/10.4324/9781003047100

Woo, S. (2020, October 22). The U.S. vs. China: The High Cost of the Technology Cold War. *The Wall Street Journal*. https://www.wsj.com/articles/the-u-s-vs-china-the-high-cost-of-the-technology-cold-war-11603397438

Wright, N. D. (Ed.). (2020). *Artificial Intelligence, China, Russia, and the Global Order Technological, Political, Global, and Creative Perspectives*. Air University Press.

Wu, X. (2020). Technology, Power, and Uncontrolled Great Power Strategic Competition Between China and The United States. *China International Strategy Review*, *2*, 99–119. https://doi.org/10.1007/s42533-020-00040-0

Yang, Y. (2021). The New Cold War: America's New Approach to Sino-American relations. *China International Strategy Review*, *3*, 20–33. https://doi.org/10.1007/s42533-021-00071-1

Zhang, K. H. (2020). Industrial Policy and Technology Innovation under The US Trade War against China. *The Chinese Economy*, *53*(5), 363–373. https://doi.org/10.1080/10971475.2020.1730553

Zieliński, T. (2020). Strategic Autonomy of the European Union in Security and Defence. *Lithuanian Annual Strategic Review*, *18*(1), 5–22. https://doi.org/10.47459/lasr.2020.18.1

Zwicky, F. (1969). *Discovery, Invention, Research – Through the Morphological Approach*. The Macmillian Company.