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THE GEOPOLITICAL IMPACT OF THE EMERGING TECHNOLOGIES

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In addition to the cortege of disasters generated by the SARS-CoV-2 pandemic, the current global medical crisis has also had a positive effect. More than ever, it has brought up the fundamental role played by scientific and technological research in the progress of mankind and in its defense against disruptive threats. The modern technological age of the Third Millennium has changed the human-machine relationship. Today, technologies seem to go beyond their status as a tool of power, turning into active players, who determine policies, sharpen stakes, trigger competitions. Step by step, artificial intelligence (AI), 5G, cyber security, robotics, semiconductors and microprocessors, cloud computing, cloud combat and digital networks have taken over human activities and, by extension, international geopolitical dynamics. And, all the subsequent consequences of the technological "sprint" (political, strategic, economic and social) are involving states, international organizations and private companies. The dynamics of competition and international cooperation are being transformed. This article aims to present the impact of the state-of-the-art technologies on contemporary geopolitical dynamics and, in extenso, on Romania's security.

Keywords: technology geopolitics; strategic ores; disruptive technologie; emerging technologies; artificial intelligence; Romania.

The history of mankind was written by technology. From antiquity to the present, the great civilizations and, implicitly, the great powers have developed around two pillars: geography through topography and resources (water, food, energy, minerals) and a technology that was able to ensure a strategic advantage in front of direct competitors. If geography represented the fixed, immutable pillar, the "geographical axis of history" of each nation or empire, it was technologies that made the difference. Therefore, we can say that the geo-history of humanity is, in fact, a chronicle of technological progress expressed in political and strategic terms.

It took several millennia for the mankind to get, in 1698, into the modern technological age through the pressurized steam boiler, the invention of the French physicist Denis Papin (1647-1713). And another eight decades were to pass so that English engineers Thomas Newcomen (1663-1729), in 1712, and later James Watt (1736-1819), in 1776, might be able to build the steam engine, the machine that would radically transform human society and its history, through the race for wood (beech) and coal. It did not take the same millennia for the second industrial revolution to happen. After centuries of discoveries regarding electromagnetic field and electricity, in May 1834, the Prussian engineer, Moritz von Jacobi (1801-1874), built the first rotary electric motor, opening a new "era" in the technological development of mankind and launching the race for hydrocarbons. A few decades later, in the twentieth century, mankind entered the third industrial revolution, with the invention of transistors, semiconductors and the Intel 4004 microprocessor, which brought with them industrial computerization and automation and the need for copper, germanium, platinum. Nowadays, digitization places humanity in the fourth industrial revolution, of information technology, already announcing the fifth one, the artificial intelligence. The current industrial revolution became more visible than ever in the context of the current SARS-CoV-2 pandemic, when quarantine hypertrophied the role of technology in the daily life of mankind, from the development of online commerce, to the development of e-learning tools and telemedicine.

How is geopolitical dynamics reconfigured by the current industrial revolution? How prepared is Romania for the new technological era?

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New raw materials: strategic ores

First of all, the new industrial revolutions brought up new raw materials and, implicitly, new geopolitical stakes.

Any lecture in geopolitics affirms the determining role of resources in shaping geopolitical processes. For example, in the 18th century, the pursuit for beech forests and coal brought the Habsburg Empire to the vicinity of the Black Sea, where it came into direct competition with the Ottoman Empire. In the twentieth century, the pursuit of hydrocarbons became a strategic imperative for all the great competing powers, transforming the coastal land of the continental mass of the Eastern Hemisphere, and especially the expanded Middle East, into theaters of military operations, some still active currently, such as those in Syria, Libya, Yemen, Somalia. The hydrocarbons' stake has created failed and collapsed states, cross-border migration, secessionism, poverty, underdevelopment and the emergence of ultra-conservative radical ideologies, as can be seen from the recent history of the Islamic area, the richest in these resources. Moreover, hydrocarbons have built states, such as the Persian Gulf monarchies, have created poles of regional power (e.g. Iran and Saudi Arabia), and have constituted geo-economic, geopolitical, and security formats, either state or non-state, such as the *Organization of the Petroleum Exporting Countries*[1] (OPEC) or *The International Association of Oil & Gas Producers*[2]. Hydrocarbons have become power tools, carefully played by manufacturers. This was demonstrated in 1973, after the Yom Kippur Arab-Israeli War (October 6-26, 1973), when OPEC (through Egypt, Syria and Tunisia) imposed an embargo on oil supplies to states that supported the Israelis. Or, the current gas crisis instrumented by Russian company Gazprom, based on European dependence on Russian gas. A dependence amplified by raising the interest of some European partners in Russian natural gas pipeline projects in Europe to the detriment of solutions that would have diversified gas sources and diminished dependence on Gazprom taps, such as the pipelines under the Three Seas Initiative, still on project stage[3] (BRUA, GIPL, Eastring Baltic Pipe, etc.).

This competitive environment, which dominated the twentieth century and the first decades of the current century, generated by the race for hydrocarbons, is reconfigured under the impact of emerging technologies and the need for strategic ores, the raw materials of current industrial revolutions. This has been a well-known issue at European level since 2010, when the Raw Materials Supply Group chaired by the European Commission issued the report entitled *Critical Raw Materials for EU: Report of the Ad-hoc Working Group on defining critical raw materials*[4].

This report stated that future technological development and the maintenance of European economic competitiveness depend on 41 strategic ores, of which 14 are considered critical - ”critical” meaning ”a non-fuel mineral or mineral material essential to the economic and national security, the supply chain of which is vulnerable to disruption, and that serves an essential function in the manufacturing of a product, the absence of which would have significant consequences for economy or national security”[5].

The emergence of new raw materials was later confirmed, in May 2018, by the US, through *Executive Order 13817* on *A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals*[6] (82 FR 60835). The document contained a list of 35 ores[7], considered critical for the American technological future, among which all the 14 ores nominated by Europeans in their own list are included.

In the following years, both Europeans and Americans continued to report the need for strategic ores, whose number increased to 44, these new raw materials being mentioned in strategic documents issued by specialized forums on both shores of the Atlantic[8].

The special importance of these ores is generated, both by the strategic character of the industrial, military and civil sectors, in which they are used (Annex no. 2), and by the competing, emerging powers' control over the extraction and processing of these minerals.

As it can be seen in the map in Figure 1 (and in the table in Annex no. 1), China dominates the extraction and/or processing of 29 strategic ores, representing two thirds of the total strategic critical ores globally (Figure 2). In the case of 24 of these ores, namely antimony, bismuth, cerium, dysprosium, erbium, europium, fluorspar, gadolinium, gallium, germanium, non-metallic graphite, holmium, lutetium, thulium, ytterbium, magnesium, neodymium, phosphorus, praseodymium, samarium, scandium, silicon metal, terbium and tungsten, China dominates the global market with over 65% of the market shares!

And in terms of rare earths, China has a monopoly on the entire economic chain, from extraction and processing to obtaining finished products.

Therefore, *China is the leading global producer of strategic ores which the present and future technological advance of the world depends on!*

an advantage translated in terms of state power by the ability to maintain or change the current world order. In 1992, Deng Xiaoping (1904-1997), the gray eminence behind China's transformation into today's Asian hegemon, said his country will benefit from rare earths, just as the Middle East has

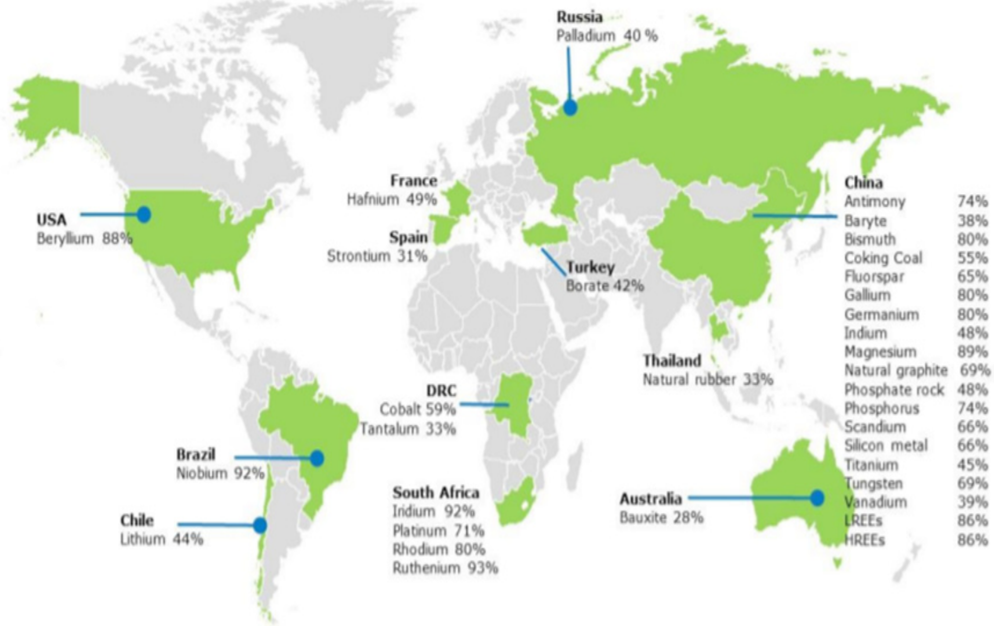

Figure 1 *Geographical distribution of strategic ore production in 2020*[9]

In turn, the US controls 88% of world beryllium production and Russia provides 40% of global palladium production.

These global players are joined by African states such as South Africa, which controls world production of platinum and platinum metals with market shares ranging from 71% to 93%, DR Congo, with huge cobalt deposits, representing 59% of global reserves as well as with coltan and tantalum, accounting for 33% of global reserves, and Guinea, with over 33% of global bauxite reserves. Or South American countries such as Brazil, which dominates 92% of global niobium production, and Chile, which provides 44% of global lithium production. States in which China is particularly present with investments and partnerships. For example, South Africa and Brazil are capacitated both in the BRICS[11] format and in bilateral strategic partnerships[12], and the other states are targeted by Beijing's investment strategies[13].

It is known that the states that dominate the production and processing of raw materials are the main beneficiaries of the industrial revolutions, benefitted from oil. Meaning that it will transform these minerals into a source of prosperity, a strategic weapon, a source of state power. The map in Figure 3 shows the European states' capacity to provide the need for strategic ores from their own production. Rarely, this capacity exceeds 1% of the need.

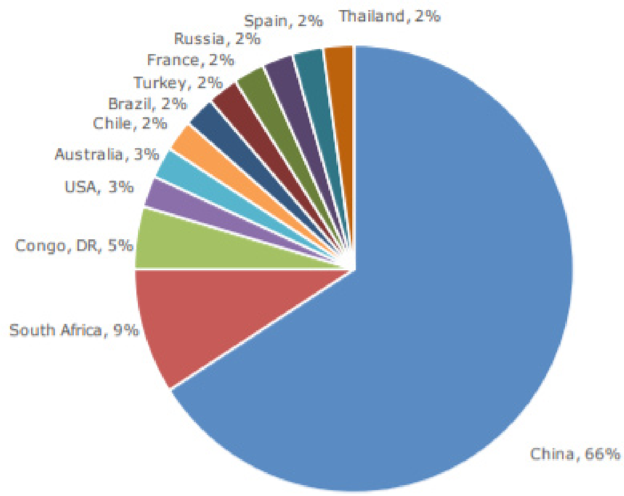

Figure 2 *Market share of the supply of critical raw materials at the level of 2020*[10]

And, we wonder how European countries will benefit from the advantages of these new technologies, as they depend on imports of raw materials from China and other competing areas? And how will China and other exporting powers use the strategic ore trump card?

In 2010 we had a first answer, when, for two months, Beijing stopped exporting rare earths to Japan, following a diplomatic dispute. The same happened when China stopped rare earth exports to the USA in 2010, amid trade frictions[15]. Decisions reminding of the Russian Federation’s energy policy toward ”recalcitrant” states in the Ponto-Baltic Isthmus region and demonstrating China’s military use of strategic ores. Obviously, the direct economic consequences suffered by the Japanese and American industries forced the governments of these states to look for alternative suppliers in areas such as Africa, India, Australia, South America and to develop submarine extraction technologies. During all this time, from 2010 to the present, there has been no major paradigm shift in the policies developed by Westerners and Japanese in these alternative areas, in which China is increasingly present and dominant, such as Sub-Saharan Africa, South America, South China Sea, Indian Ocean.

But it is not just China that owns the ”rings” of future technological domination. For example, Russia’s palladium reserves will become extremely important in the near future, as energy sources convert from carbon-based polluting technologies to ”green energy”. So are the osmium deposits of

Figure 3 *European producers of critical strategic ores*[14]

Russia and South Africa. As a result of their ability to absorb hydrogen[16], the two platinum metals will become irreplaceable in technologies based on hydrogen batteries. This situation will generate a new European dependency on Russian and South African deposits – the African state that already has a monopoly on platinum production, a raw material present either in the composition or in the manufacturing process of one-fifth of all global consumer goods[17].

Moreover, the spatial ambitions, without which no future power will be internationally relevant, will depend on Brazil’s monopoly on global production of niobium, the metal that generates the most intense and deepest magnetic fields. Being a type II superconductor, vortex generator and magnetic supercurrents generator when applying an external magnetic field, niobium is an irreplaceable raw material for space programs, super alloys, bolometers etc. American economist Jeremy Rifkin said, in 2014, that Internet technology and renewable energy, the “engines” of the third industrial revolution, heralded the end of fossil fuel dominance and of the current world order[18]. Nothing is more true and worrying, if we consider that the current Islamic area has been shaped by hydrocarbons and that states with more than 1.2 billion inhabitants, in the Middle East and Africa, mostly crushed by structural imbalances, poverty, neo-patriarchy and underdevelopment, depend largely on the oil industry. What will happen to this huge mass of people, how will the technological reconversion be achieved and how challenged will world order be? Hard to estimate. As equally difficult it will be to estimate how the ”green” technologies for energy production will coexist with the polluting ones on the global market and how this binomial will be reflected in terms of stock market stability and the stability of the financial system.

Therefore, we can say that a first major geopolitical impact of emerging technologies is a new hierarchy of global areas relevant for the control and domination of raw material critical sources for the ongoing industrial revolutions, the Middle East being replaced by Asia-Pacific, followed by Africa and the two Americas. Or, in other words, the areas of marginality – described as such by the theorist of global areas, the American specialist in geopolitics Saul B. Cohen (1925-2021) – turn into areas of centrality in the equation of contemporary global domination. If it does not develop coherent strategies on alternative sources of African, South Asian and South American strategic ores, Europe will become increasingly irrelevant in terms of global power. Here we must mention the potential for influence lost by Romania with the withdrawal from Africa in the 1990s, a potential that could be restored, if there were a strategy and political will in this regard.

A second geopolitical impact is generated by China’s emergence as the owner of two-thirds of the global resources of strategic ores which state-of-the-art military and civilian technologies depend on. This is a status of domination that cannot be overlooked and that must be taken into account in the event of an open confrontation with Beijing.

The third impact is related to the stakes of controlling alternative strategic resources and the risk of triggering future destabilizing geopolitical processes in more or less stable areas of South America, Asia-Pacific, Africa.

And, last but not least, we must remember the great geopolitical challenge addressed to the Islamic area, perhaps the least prepared for a change of energy paradigm and for the new societal transformations induced by disruptive technologies. Extensive destabilization of this area, in the immediate vicinity of the other civilizational areas of the Afro-Eurasian continental mass, would pose a serious threat to security and stability throughout the Eastern Hemisphere.

Disruptive emerging technologies

Disruptive technology is an innovation that significantly transforms sales markets, consumer behavior, the industrial structure of a territory. Always, a disruptive technology produces major, extensive, structural changes. The term ”disruptive technologies” was introduced to the public circuit by the American economist Clayton M. Christensen (1952-2020), in the article called *The Innovator’s Dilemma*, published in 1997. Since then, the term has become a buzzword in presentations, accompanying start-up business proposals that seek to create a highly attractive product.

If we remember the thesis of Jacques Attali from his reference work *A brief history of the future*, starting with the thirteenth century (when the first technological system for food production was built) the dynamics of world economic hegemony poles was generated by the emergence of disruptive technologies against the background of economic and financial crises. Therefore, the progress of society is the direct result of the economic and technological factor. For example, says Attali, in the fourteenth century, economic hegemony migrated from Bruges (1200 - 1350) to Venice (1350 - 1500). Bruges was the place where the bourgeoisie was born through the industrialization of food production and the discovery of the built rudder. Venice was the place from where the conquest of the Orient began, through the caravels and the galleys built in its shipyards, and where the first banks, stock exchanges, trading houses, insurance companies were founded. Then, in the 16th century, economic hegemony reached Antwerp (1500 - 1560), where the mobile printing press was discovered. The mobile printing press industrialized the production of books, leading to religious reform. Later, the hegemony reached Genoa (1560 - 1620), where primary accounting through profit and loss accounts had been discovered. In the eighteenth century, economic hegemony moved to Amsterdam (1620 - 1788), the port that mass-produced the ”flueth”, the cheap and profitable ship, responsible for the great geographical discoveries. Then, in the nineteenth century, it reached London (1788 - 1890), where the force of steam and the manufacturing revolution produced structural transformations of the society. From that moment, bourgeoisie became the ruling class. This new political status-quo was followed by the separation of powers in the state, the constitutional monarchy, the market democracy, the peasant proletariat, the emergence of Marxism and the spread of colonialism.

At the beginning of the twentieth century economic hegemony left Europe, moving to the ”New World”. First, it moved to Boston (1890 - 1929), where the explosion engine and the electric motor had been discovered. These new inventions created a new product, the automobile, and a new raw material, the fuel. Then, it moved to New York (1929 - 1980), through the industrial use of the electric motor, the development of the household and audio-video equipment industry and the emancipation of women. And, finally, it reached Los Angeles (1980 - present), through the discovery of the microchip, the microprocessor, the internet, nano-technologies, space technologies and robotics[19].

Today, humanity is in the midst of economic and medical crisis. Crises over which new disruptive technologies overlap, such as e-commerce, social media platforms, GPS systems, e-learning platforms, telemedicine, cloud computing, fintech and blockchain – the technology behind Bitcoin. How close are we to the emergence of a new pole of economic hegemony? It remains to be seen.

In an increasingly technological society, at any time, that technology able to radically transform the market and the society can appear, regardless of the volume of start-up resources. Moreover, the great innovation is more likely to come from smaller, flexible, companies in emerging countries, than from a big company, that tends to focus on progressive improvements rather than revolutionary changes. And, as seen from the succession of global power centers described by Attali, disruptive technologies enhance the hegemonic transformation of the states that benefit from them, questioning, in the end, the *statu-quo* of the international system and the world order.

Such an innovation could become a ”black swan”, leading to an unexpected chain of consequences that require rapid adaptation, which means that systems that fail to adapt to the effects of disruptive technology may be faced with major losses. Such an innovation could be an alternative source of energy, that would effectively replace hydrocarbons, or a medical breakthrough that would cure chronic inflammation and remove entire segments of Big Pharma.

Yet, until a new economic hegemony emerges, current technologies will contribute to an even greater geopolitical and geoeconomic gap between the two ”worlds”, of rich and poor states, of rich and poor people. In this regard, it is enough to say that, currently, 592 million Africans[20], representing 42.8% of the continent’s population, do not have access to electricity. And that 2.6 billion people worldwide, representing a third of humanity, do not have access to civilized conditions of cooking[21]. The situation is far from improving in the current period, when the SARS-CoV-2 pandemic has affected global economic macro-equilibria, including in states known as major donors in financial support funds for ”third world” countries. In fact, a report by the International Monetary Fund, issued at the end of 2020, states that Africa needs $ 1.2 trillion to recover from the impact of the pandemic, and

World Bank experts say 43 million Africans are at risk of extreme poverty[22].

Therefore, the first and most important geopolitical impact of the emergence of disruptive technologies is the widening of the development gap between rich and poor countries. Thus, the rich become even richer, by concentrating wealth in a small number of technological power poles, while the poor become even poorer through an even deeper underdevelopment. An underdevelopment also amplified by a very low access to sanitation, medical services and education. On the other hand, in the world of the rich, population is decreasing and older, while in the world of the poor, population is increasing and younger. How will these two facets, demographic and economic, of the present and future world be reconciled? Most likely we will see great migration waves from the poor South to the richer North. And how will the North withstand the siege of illegal cross-border migration? Hard to anticipate. It may lead to a broad process of fragmentation of global zones and a return to the essence of the idea of state sovereignty and Westphalian order. Or, it may lead to a fundamental reconfiguration of the world order into a global governance able to manage the gaps and the security challenges generated by them. Or to other ways around.

But the development gaps are not to be found only among states. They are present even within societies. For example, in the US, about a quarter of low-income adults under $ 30,000 a year (representing 24% of the total adult population) say they do not own even a smartphone[23].

About four out of ten lower-income adults do not have broadband services at home (43%) a desktop or laptop computer (41%). Most low-income Americans do not own tablets. By comparison, each of these technologies is almost ubiquitous among adults in households earning at least $ 100,000 a year. And in April 2020, under the quarantine imposed by the pandemic, 59% of low-income American parents said they faced at least one of the three digital barriers to ensuring their children's online education, namely: the lack of reliable internet, the lack of a home computer, the lack of a smartphone to complete homework[24]. Therefore, in the context of the digitized society, *a new type of division* of the society appears, the digital one. Also, *a new indicator* appears, reflecting the accessibility to digital services. Where will this new gap lead? Most likely to an even greater social polarization and, subsequently, to a radicalization of the poor, who will feel increasingly marginalized and more unable to meet their social needs.

Therefore, a second geopolitical impact of current technologies is the deepening discrepancy between social strata, even more intense polarization of society, increasing social tensions and radicalization of poor strata, followed by increased risk of populist and extremist movements. These social phenomena are geopolitically translated into amplifying centrifugal forces that predispose to conflict, secessionism, state failure.

And, last but not least, we must remember the growing global dependence on manufacturers of subassemblies that are part of technological products. Therefore, there is not only a dependence on raw material suppliers, but also a global dependence on subassemblies manufacturers. For example, in the field of microprocessor production, the two market leaders, TSMC[25] in Taiwan and Samsung in South Korea, cover almost 75% of global production contracts[26]. TSMC is the largest global manufacturer of electronic contact chips, on which depend the productions of companies such as Apple or Huawei[27]. Moreover, the Taiwanese administration is heavily investing in technological research and, in particular, in the development of new manufacturing technologies using artificial intelligence (AI). A state policy that places the disputed island Republic, situated in the immediate vicinity of China, at the forefront of the future beneficiaries from the fifth industrial revolution. But what would happen if Taiwan and South Korea were involved in regional wars? What could be the geoeconomic impact of the total lack of semiconductors and microprocessors manufactured in the two countries? There could be only one answer – a cataclysmic impact. The global dependence on subassemblies produced in East Asia is becoming a tool of power for seemingly vulnerable nations.

Therefore, a third geopolitical impact of high technologies refers to their new status of *tools of power with exceptional defensive value* – through global dependence on subassemblies producers and through technological advancement. On one side, a collapse of the main subassemblies producers could lead to the collapse of global production chains of entire industries, with incalculable geoeconomic and geopolitical consequences that could end up in hegemonic wars. On the other side, the technological advancement brings prosperity and creates the premises for maximizing state power. And, last but not least, technological dependencies can configure alliances, coalitions, security architectures, meant to preserve the status quo and to provide the security of technological zones with maximum geoeconomic and geopolitical importance. So, in the current global technological environment, technological status should be treated as an independent source and tool of power in any specific, professional, analysis.

Modern warfare in the age of artificial intelligence

Also, the current industrial revolutions left their mark on the way war is waged, perhaps the oldest way of *doing politics by other means*[28]. In this regard, the American analyst Harlan Ullman, theorist of the *massive attack of disruption (MAD) concept*, believes that the war of the future will be waged by these disruptive attacks. MAD are included into the *shock and awe* doctrine, by which the opponent's will to fight is paralyzed by the overwhelming magnitude of the attack. These massive disruptive attacks, described by Ullman as ”the fifth knight of the Apocalypse” are generated by seven major disruptive forces: government failure, climate change, cyberspace, social networking, drones, terrorism and explosive indebtedness[29]. Forces that are targeting societal vulnerabilities and are acting synergistically through mutual empowerment, having a massive impact on the population. Forces acting on the ”fabric” of interests and dependencies created by the interconnections of globalized, hyper-technological society. Forces that are terrifying precisely through the multitude of effects, on the domino principle, generated by the interference among technology, power diffusion and de-structuring of the Westphalian states[30].

The modern warfare, of the fifth generation, is a confrontation of the extended, interconnected and interdependent digital networks, which ensure in real time the collection and transmission of data, the detection and the evaluation of the impact, the transmission of the command; of combat-clouds that allow the extraction and addition of data by digitally activating key combat platforms; of multi-field combat tactics in the five synergistic operational areas – land, sea, air, space and cybernetics; of fusion – warfare, through the vulnerabilities generated by the command and control war, such as additional information flows, software incompatibilities and intrinsic vulnerabilities to attack and deception.

All these new facets of war are the result of the last industrial revolutions' technologies and bring with them a new and frightening challenge. If regarding the competition for critical raw materials, a state may or may not choose to join the race for resources and, regarding the technological advancement, it may try or not to align itself with emerging technological powers, in terms of warfare, the access to the state-of-the-art technology and artificial intelligence makes the difference between survival and annihilation.

What does this mean in terms of security and geopolitics?

First of all, the idea of collective security and alliances, the only formulas by which states can be able to withstand the current technological sprint.

Secondly, a potential sliding towards a ”techno-civilizational” global order, made by technological nomoses, meaning global technological regions. This new global configuration of technological nomoses attracts a large number of international actors, united by common interests, principles and values and, in case of confrontation, huge battlefields, massive forces engaged in battle, massive destructions and huge costs[31].

Third, a new world order dictated by technological powers, which will be the future hegemons of the planet. A new world order which can take the current hegemonies out of the game, if they will not be able to keep up with the technological advance. A new world order which can bring to the fore other hegemonies – states or alliances.

Instead of concluding: what is the geopolitical impact of these emerging technologies for Romania?

In the last 30 years, Romania has lost at all the levels of technological power.

Romania left the African continent, where it was an active geostrategic player and where it could have used the capital of influence created with great financial efforts during the Communist time. The same foreign policy was also practiced in South America and South Asia, other ”third world” zones where Romania was player before 1989. Today, that capital of influence could have turned into a tool of power, given the future race for strategic ores in Africa, Asia and South America.

In terms of scientific research, Romania is experiencing a worrying decline, due to the lack of a strategy aimed at aligning the country’s technological status to the average of Western states. In 2021, Romania was ranked 48th out of 132 states worldwide by the *Global Innovation Index ranking*. The ranking included states from conflict-ridden or underdeveloped areas of Africa, Asia and South America. Even so, this medium-leading position was the result, rather, of infrastructure (electrification, sanitation, transport infrastructure) and economic performance, than of human capital and research itself – where it ranks 76th in the partial ranking. Or based on the degree of sophistication of the market – where Romania is placed in position 76. Or based on the creativity – where it is in position 72[32]. Therefore, Romania’s position in the mentioned ranking does not reflect in any way a performance, not even mediocre, in the field of scientific research, if we look at the worrying 76th position, in the second half of the ranking.

In the hyper-technological society of the future, the alignment to and the technological supremacy will constitute criteria of hierarchy and evaluation in the real-political decision-making process. Why would anyone consume time and resources to support, protect or ally with a third-world technological state, geopolitically positioned in the gray-zone of the Ponto-Baltic Isthmus, on the edge of Europe’s ancient empires? Or, in other words, for how long will the benefits of such support/alliance outweigh the costs of ensuring the security of a technologically underdeveloped state? What would be those attractive resources that could recommend it for such support or how important will its geostrategic position be in the context of such an international fluid environment?

On the other hand, all the issues discussed above can turn into challenges to Romania’s national security, from the race for strategic minerals and the risk of destabilizing the entire Islamic zone under the impact of a new global energy paradigm, to massive illegal cross-border migration and disruptive technologies of the fifth-generation war. A modern war which is no longer a matter of anticipation, already being waged in Transcaucasia between Azerbaijanis and Armenian separatists from Nagorno-Karabakh in September-November 2020. Security challenges that risk tipping the balance between centrifugal and centripetal forces acting on the national territory, a balance resulting in the maintenance of the statu-quo.

Therefore, in the post-pandemic technological society, Romania’s future can only be a technological one! Such a future involves developing a strategy to recalibrate the education and research system to the new challenges of the era of artificial intelligence and high technologies. A strategy where the cyber component (cyberwarfare, cyber-defence, cyber-education) will play a fundamental role. And, very importantly, a strategy for financing and developing technological and fundamental research platforms, that will attract researchers from the country, the diaspora and the neighboring areas.

NOTES:

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10 *Ibidem.*

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Annex no. 1

TYPES OF STRATEGIC ORES AND THEIR MAIN GLOBAL PRODUCERS BY 2020[33]

	Mineral	Stage	Main global producer	Market share		Mineral	Stage	Main global producer	Market share
1	Antimony	E	China	74%	23	Magnesium	P	China	89%
2	Barium	E	China	38%	24	Natural graphite	E	China	69%
3	Bauxite	E	Australia	28%	25	Natural rubber	E	Thailand	33%
4	Beryllium	E	USA	88%	26	Neodymium	E	China	86%
5	Bismuth	P	China	80%	27	Niobium	P	Brazil	92%
6	Borate	E	Turkey	42%	28	Palladium	P	Russia	40%
7	Cerium	E	China	86%	29	Phosphates	E	China	48%
8	Cobalt	E	D.R. Congo	59%	30	Phosphor	P	China	74%
9	Coke	E	China	55%	31	Platina	P	South Africa	71%
10	Dysprosium	E	China	86%	32	Praseodymium	E	China	86%
11	Erbium	E	China	86%	33	Rhodium	P	South Africa	80%
12	Europium	E	China	86%	34	Ruthenium	P	Africa de Sud	93%
13	Fluorspar	E	China	65%	35	Samarium	E	China	86%
14	Gadolinium	E	China	86%	36	Scandium	P	China	66%
15	Gallium	P	China	80%	37	Metallic silicon	P	China	66%
16	Germanium	P	China	80%	38	Tantalum	E	D.R. Congo	33%
17	Hafnium	P	France	49%	39	Terbium	E	China	86%
18	Ho, Tm, Lu, Yb	E	China	86%	40	Titanium	P	China	45%
19	Indium	P	China	48%	41	Tungsten	P	China	69%
20	Iridium	P	South Africa	92%	42	Vanadium	E	China	39%
21	Lanthanum	E	China	86%	43	Yttrium	E	China	86%
22	Lithium	P	Chile	44%	44	Strontium	E	Spain	31%
Legend									
Stage	E = extraction; P = processing								
Heavy Rare Earths	dysprosium, erbium, europium, gadolinium, holmium (Ho), lutetium (Lu), terbium, thulium (Tm), ytterbium (Yb), yttrium								
Light Rare Earths	cerium, lanthanum, neodymium, praseodymium, samarium								
Platinum Metals	iridium, palladium, platinum, rhodium, ruthenium								

Annex no. 2

INDUSTRIAL APPLICATIONS OF STRATEGIC ORES

As I presented in the volume entitled *Uncomfortable Analyzes*, published in 2020, at the Military Publishing House:

• Platinum has a wide use, both in the military and in the civilian industry. It is mainly used in the car manufacturing industry, to obtain automotive catalytic converters designed to reduce carbon emissions (also called ”environmental metal”), but also to obtain fuel cells with platinum catalysts for submarines, ships, vehicles, aeronautical turbines[34], etc.

• Palladium is used as a cheaper substitute for platinum in the production of catalytic converters[35], in research on cold fusion and for creating alternative energy sources on the model of low-energy nuclear reactions (LENR), as a result of its ability to absorb hydrogen[36].

• Rhodium is used in the production of catalytic converters for diesel engines (where it cannot be replaced)[37].

• Ruthenium is used in the I.T. industry and electronics, in the production of hard disks and superconductors[38], etc.

• The main industrial application of Antimony is the production of fire-proof equipment, where it is the basic and irreplaceable raw material[39].

• Beryllium is used in the production of thermonuclear weapons, neutron sources for particle accelerators, CANDU reactors, in special alloys used in the production of aircraft, satellites, spacecraft, missiles; in the production of large mirrors for meteorological satellites and small mirrors for military optical guidance systems and fire control systems, space telescopes, solar panels; in the production of naval or terrestrial demining systems, high power radars, tools for high power microwave generating systems, semiconductors[40], etc.

• Cobalt is used in the military industry, in the manufacture of Cobalt-based nuclear weapons, high-strength permanent magnets for the military industry; of special alloys for the aerospace industry, medicine (prostheses), jewelry (platinum alloy), pigments for glassware, ceramics, radioisotopes for medicinal purposes[41], etc.

• Gallium (mainly extracted from bauxite and sphalerite) stabilizes plutonium, being used I confectioning the core of nuclear bombs[42]. It is mainly used in the production of optoelectronic devices, semiconductors and light emitting diodes L.E.D, integrated circuits used in the military industry, I.T. and telecommunications[43], etc.

• Germanium is used in the production of infrared optical fibers used in the defence industry in the manufacture of ballistic guidance systems, sighting systems and in the civil industry in the production of night vision systems, infrared spectroscopes, infrared detectors, optoelectronic devices, catalytic polymerization in the process of obtaining nanofibers in other chemical processes[44], etc.

• Indium is used in the production of metal alloys used in cryogenic and highly vacuum applications, in the electronics and electrical industry: touch-screens, LCDs, flat-screens, semiconductors, computer monitors, solar panels, batteries, superconductors, LEDs[45], etc.

• The main uses of Magnesium are in the military industry, in the production of warheads, incendiary bombs, pyrotechnic devices, missiles, in the aerospace industry (light aluminum-magnesium alloys), the pharmaceutical industry[46], etc.

• Niobium is used in the production of special steels (niobium increases the strength of steel) the automotive industry, the construction of gas pipelines, in the production of superalloys for the aerospace industry (engines for rockets and aircraft, gas turbines, rocket subassemblies, combustion systems, turbo systems)[47], space programs (Apollo, Gemini), in the production of superconductors for nuclear magnetic resonance medical equipment, particle accelerators, FLASH lasers, bolometers for detecting electromagnetic radiation in the THz frequency band used in the construction of high power telescopes[48], etc.

• The main areas of use of Tantalum are the manufacture of cutting tools, furnaces for furnaces, lenses for digital cameras, mobile telephony, glasses; Surface Acoustic Wave filters for mobile telephony, television, audio-video equipment[49], etc.

• Tungsten is used in the manufacture of glass-metal gaskets, filaments for electric lamps, cathode ray tubes, electric ovens, fluorescent lighting, X-ray lenses; when obtaining special alloys for rockets, oil, mining, metallurgy, special paints, lubricants for high temperatures (500° C)[50], etc.

• Fluorspar is used in the chemical industry, to obtain Hydrofluoric Acid used in the production of refrigerants, foaming agents, chemicals based on carbon fluoride and fluoride, in the metallurgical industry to obtain iron, steel and other metals, extracts impurities of sulfur and phosphorus from ores and increases the fluidity of slag, in the optical industry in the production of lenses for microscopes, telescopes, video cameras including for the spectrum of ultraviolet radiation[51], etc.

• Natural Graphite is used in the manufacture of refractory bricks, refractory crucibles, furnace liners, in the production of batteries (lithium-ion, zinc-carbon) and batteries for portable electronics (laptops, tablets, mobile phones, portable CD-players), in the production of special steels, the production of brake linings where it replaces asbestos (carcinogenic), lubricants[52], etc.

• Rare earths (REM), represented by Lanthanum, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, Lutetium to which Scandium and Yttrium are added, have as main application military production of permanent magnets based on Samarium-Cobalt and Neodymium-Iron-Bromine.

Neodymium-based magnets, the most powerful permanent magnets, are essential in the production of offensive and defensive weapon systems. Samarium-based magnets are essential in the production of ballistic guidance systems, intelligent bombs and aeronautical components. Magnets based on Terbium, Gadolinium, Neodymium, Dysprosium are fundamental components in the production of generators for wind turbines, electrical and electronic components, in the I.T., telecommunications and satellite communications industries. Dysprosium is vital for ensuring the permanence of magnetism at very high temperatures[53].