

Impact of the 4th Industrial Revolution on the World Order

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Abstract: *The paper starts from two realities of the contemporary world (the unfolding of the 4th industrial revolution and the change of the world order) and attempts to evaluate to which extent the latter influences the former. After reviewing the possible impact of the 4th industrial revolution on the main factors that influence the perceived power of a state the conclusion is that while the 4th industrial revolution will bring with it numerous and complex changes, the influence on the world order will relate mostly to the nature of institutions and interactions among the key players, while the key players themselves will remain to a large extent the existing ones (USA, China, Russia, potentially India), followed at a significant distance by some European states, Japan and maybe some others. This conclusion may assist especially smaller states in defining their foreign affairs policy for the decades to come.*

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JEL classification: F02, F50, F63

Overview: world order in transition

The subject of world order is not discussed very often except in the field of the study of international relations, maybe because the world order is not changing very frequently and therefore it is assumed in the common perception to be rather perennial. This topic arises in times of significant change when there is a general perception that some fundamental aspects related to the international actors and the nature of their interactions are no longer as they used to be. The beginning of the 21st century, particularly in the aftermath of the crisis that started in 2008, is more and more characterized by such a perception of a changing world order. There are some who believe or hope that this perceived change is only temporary, there are others who are sure the change is definitive, but all agree that the Bretton Woods system that defined to a large extent the world economy after the World War II is no longer functional.

For those who still doubt that the world order has been changing as compared to the post World War II period, it is enough to notice that:

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- since 1990 the world economy is no longer bipolar (and one of the key players, the Soviet Union, is no longer present);
- the USA is no longer the only centre of power being challenged in different ways by China and, of late, often in disagreement with the European Union;
- Russia is reasserting as a significant player in certain geographical areas or in certain scientific and military domains;
- China has become the official largest creditor surpassing IMF or the World Bank (Horn, S., Reinhart, C., Trebesch, C., 2019) and succeeded to land on January 3, 2019 the first space probe on the far side of the moon (Moritsugu, K. 2019);
- India is expected to surpass as GDP Great Britain in 2019 and, attempted to become the fourth state to land a space vehicle on the moon in September 2019 (Carter, J., 2019).

In essence, the world order reflects the distribution of power among key players, based on certain rules and institutions which may be explicit or implicit. Due to its intrinsic determinants world order has a historical character because the distribution of power among key players, their rules of interaction and even the players themselves are changing after relatively long time intervals. At the same time, world order is heavily influenced by geography which determines the intensity of interactions among players and has a lot of nuances as these intensities of interactions are rather different. A certain world order, at a given historical time, is more evident in the geographical areas with strong interactions among players and more relative and less evident in the geographical areas with less intense interactions. Henry Kissinger explained this characteristic by saying: “No truly global ‘world order’ has ever existed” (Kissinger, H., 2014).

In modern times, world order has been mostly related to state power, manifested primarily as economic and military power. The past decades have added a new factor in this equation represented by science and technology or, generically speaking, knowledge. This new factor has reached an entirely new dimension together with the emergence and gradual coming of age of the 4th industrial revolution (4IR) and particularly with one of its core components, artificial intelligence (AI).

Although the last decades of the 20th century and the first decades of the 21st century have been characterized by globalization (in the sense of increasing interactions and interdependences of economic actors on a global scale) and the rise of the role of transnational corporations, from the point of view of world order **states are still the key actors** that shape to a significant extent the nature, intensity and direction of international relations and **this characteristic seems to remain valid for the foreseeable future**. A clarification is needed regarding the relation between states and transnational corporations. As economic power objectively ends by influencing political power, there is a rather strong reciprocal influence between states and transnational corporations, while in some cases the transnational corporations themselves are state owned (for instance in China, Malaysia, South Korea or Russia) or with state participation (for instance in many Western European countries where there are well known companies like Volkswagen, Enel, Deutsche Telekom, Engie, Airbus, Renault, OMV in which the respective states have between 15 and 32% of the capital) making the state-transnational corporation interaction even more evident (UNCTAD, 2017).

The power of states can be manifested within a given world order as hard power (which is coercive in its essence), soft power (which is attractive or appealing) and smart power (which is holistic, being more than a combination of the previous two), while the manifestation of power is constantly changing from one period to another due to shifts in a multitude of factors (Nye, Jr., J.S., 2011).

As for the 4th industrial revolution, the concept has received more and more attention in the past years, being promoted among others by the World Economic Forum and its founder Klaus Schwab as a transformation **of what we do**, but also **of what we are** on a scale that has never been experienced before (Schwab, K., 2016). As Klaus Schwab statement may appear rather strong in its part mentioning that the 4th industrial revolution is changing “what we are” as human beings, maybe some examples are useful: Elon Musk announced in July 2019 that his company, Neuralink, is working for developing a brain-machine interface and it has already obtained some significant results (Hitti, N., 2019). Also, in July 2019, Facebook presented results of its project for a brain-reading computer interface (Robertson, A., 2019) while a team of researchers from the University of Massachusetts Medical School proved that they can allow infra-red vision to humans by injecting nano particles in their eyes (Waghorn, M., Curtis, S., 2019) and researches on bio-printing - 3D printing of body parts and organs are quite advanced (Kent, C., 2019).

The reason why the 4th industrial revolution is different and this difference matters for the reshaping of the world order of the 21st century is that instead of replacing the primacy of one sector of activity with another (for instance agriculture with industry as it happened with the first industrial revolution or industry with services as it happened with the second and the third industrial revolutions), the 4th industrial revolution is characterized by a fusion of “physical, biological and digital worlds” (Schwab, K., 2016) which impacts all sectors of human activity, at the same time changing its very nature and substance.

Some experts consider that the technologies of the 4th industrial revolution (such as artificial intelligence, robotics, 3D printing, 5G communications, biotechnology and genetic editing, quantum computing to name just a few) will enhance, change and replace most if not all aspects that define the economy and society of the next 50 years in such a way that will “create realities that we previously thought to be unthinkable” (Hinton, S., 2018).

In order to determine how the 4th industrial revolution may influence the world order it is useful to review the determinants of power at the state level and to adapt their content to the contemporary situation.

Generally speaking the power of states as manifested in the interaction with other states at regional, continental or global level is influenced by factors such as:

- **Quantity and quality of resources (land, natural resources, population);**
- **Capability to transform resources for economic and military purposes;**
- **Knowledge, science and technology, education;**
- **The pursuit of a state long term interests by means of diplomacy in all its formats;**
- **Capability to generate and disseminate information at a regional and global level;**
- **The richness, motivation and appeal of cultural and spiritual values.**

To this list which is rather generic and commonly used we suggest the addition of two more factors:

- Geography, in the sense of the geographical location of a state. This factor influences the availability of natural resources in a broad sense (including wind and solar light, but also rivers, seas or mountains) as well as the existing neighbouring states at a given time in history, an aspect that may be beneficial or detrimental for one's own development.
- History, in the sense of accumulated wealth and experience that may provide for a state a critical mass of expertise, capital, skills that may be useful in obtaining a favourable interaction with the rest of the world economy at a given time. From this point of view we may compare history, in favourable case, with a "savings bank" where previous knowledge, know-how, capital and beneficial relations with other key players may be accumulated from the previous historical stages. It is nonetheless true that this historical heritage may be in some cases detrimental and impose on the current generations the challenge of overcoming past liabilities and biases.

Looking at the above list one conclusion emerges: that the power of states depends at a given moment on **what resources they have** and **how they use them for achieving long term interests**. From a historical perspective it seems that the most difficult part consists in defining long term interests and pursuing them in a consistent, coherent and flexible manner over long periods of time. From this point of view it is interesting to note that a study carried out by Harvard Business Review over a period of eight years on a number of high growth companies identified *purpose* as the main driver in the long run positive evolution of the respective companies. According to the study, purpose plays two critical roles: it helps companies re-evaluate, reassess and redefine their playing field (meaning replacing or extending their focus from current competition and market to new areas where they can be among the first comers if not the first); and it helps them to redefine the value proposition (meaning that instead of competing based on current criteria, they focus on new criteria which are more holistic and long term) - (Malnight, T.W., Buche I., Dhanaraj, C., 2019).

In our opinion it is quite easy to translate this perspective from the company to the state level and stress once again the importance of defining long term interests or purpose.

How the 4th industrial revolution may influence the power of states and the world order

Although the power of states is a very complex and hard to define concept, influenced by a high number of factors, a formula has been proposed by Ray S. Cline (1977) which allows at least an approximation of it by combining tangible elements (C, E, M) with intangible ones (S, W). This formula which offers just a qualitative interpretation is presented below:

$$Pp = (C + E + M) \times (S + W), \text{ where:}$$

Pp is the perceived power of a state;

C is the critical mass related to population, resources and territory;

E is the economic capability;

M is the military capability;

S is the strategic purpose of that state;

W is the will/determination to pursue national strategies.

Looking at the above formula it is obvious that the 4th industrial revolution will impact both the tangible and the intangible elements in a considerable manner. Based on extensive research of relevant sources one can say that the 4th industrial revolution is already influencing (and this influence will increase the future) the following aspects:

- How states use resources (land, labour, capital, knowledge) and what resources are used (both natural and created resources) as result of the advances in knowledge, science and technology;
- How the states educate, re-train and use labour as a key factor in capitalizing the potential of the 4th industrial revolution;
- The states' capability to transform input resources into economic and military resources, including the expansion of economic and military activities to the outer space;
- The efficiency and effectiveness of using diplomacy and foreign relations in order to redefine the spheres of influence or in order to participate in a beneficial way in the new architecture of world order;
- The capability to generate and disseminate information to the point of influencing decision making and behaviours of leaders and people.

The impact of the 4th industrial revolution on economy

One of the most obvious impacts of the 4th industrial revolution is on economy. The 4th industrial revolution already impacts and redefines many areas related to economy, from education to research and development, from engineering to management and marketing and from space exploration and computing to health care.

As economic activity is still measured by Gross Domestic Product (GDP), although there are numerous limits of this indicator, some studies tried to quantify the impact of the 4th industrial revolution on GDP at the global level. One study conducted by PriceWaterhouseCoopers (PwC) states that in 2030 global GDP could be up to 14% as compared to its 2018 value (an increase of about \$15.7 trillion), as a result of the implementation of artificial intelligence (AI) alone (PwC, 2018).

What is relevant from the perspective of the topic of this research is that, according to the PwC study, China might record an increase of 26% of its GDP until 2030 due to AI (\$7.0 trillion) while North America (mainly USA) might record an increase of 14.5% of its GDP (\$3.7 trillion), which means that these two areas will record an increase of their GDP by \$10.7 trillion or about 70% of the world impact of AI utilization. Developed Asia (except China) might record an increase of its GDP of 10.4% (\$0.9 trillion), Western Europe of 9.9% (\$1.8 trillion), Southern Europe of 11.5% (\$0.7 trillion) while the rest of the world might record an increase of its GDP of 5.6% (\$1.2 trillion).

The 4th industrial revolution may also influence the economy by **the discovery of new materials** (like graphene with applications from energy to electronics to biomedicine), **new sources of energy** that, for instance, may allow the obtaining of cheap hydrogen from oil fields (including depleted ones) and oil sands

or by converting sunlight into hydrogen using the moisture in the air, **new communication technologies** like 5G, **quantum computing** or **hypersonic aviation** with applications in the military field (La Fuente, J., 2019; Proton Technologies, 2019; Zarremba, H., 2019; Harris, S., 2018; IBM, 2019; TRT World, 2019).

Therefore the 4th industrial revolution will influence the balance of power by the differentiated increase of output (GDP) and by creating relative and temporary absolute advantages for states that obtain breakthroughs in key areas and are able to deploy them rapidly in economic and military areas.

The fourth industrial revolution impact on education and labour formation

Although many initial reactions to the advances obtained under the umbrella of the 4th industrial revolution in areas like artificial intelligence and robotics were of fear that humans would be soon replaced on a large scale, later analyses tend to favour the idea that at least in the medium to long term the humans will co-exist and co-work with artificial intelligence and robots. This idea is both more realistic and comforting but it raises a new challenge because education and formation (including through lifelong learning) will have to prepare not only the experts that will design the artificial intelligence and robots, generically speaking, but also the rest of the work force that will have to operate in rather different working environments.

In this context, according to some studies, by 2022 almost 60% of companies will significantly modify how they produce and distribute their goods and services, which means that about 54% of employees will need an adaptation and upgrade of their skills and competences. Some estimates indicate that about 35% of workforce may need training of up to 6 months, 9% of workforce will need training of 6 to 12 months, and 10% of workforce will need training of more than one year (World Economic Forum, 2018).

At the same time, even if the very pessimistic opinions of some years ago that stated that artificial intelligence and robots will eliminate in the next one or two decades almost 50% of the jobs in USA and, by extension, in the developed countries (Frey, C.B., Osborne, M.A., 2013) have been attenuated to a certain extent in more recent analyses, they still point to a probability of 50-70% of elimination of about 276 million jobs due to automation in the 32 member states of the OECD (Nedelkoska, L., Quintini, G., 2018).

Therefore a challenge that arises from the above aspects is that either way (due to jobs losses or due to the changing of the nature of jobs), due to the effects of the 4th industrial revolution a huge number of people will need training, re-skilling and up-skilling at the same time. What type of logistics will be needed for such a huge effort, where the teachers will be coming from and who will pay for this unprecedented exercise?

Being so comprehensive in its areas of manifestation, the 4th industrial revolution impacts education and labour formation in multiple ways:

- **What to study? Besides traditional knowledge new fields of study emerge and the graduates of tomorrow will have to be able to live and work in a different environment characterized by climate change, new materials, new plants and animals obtained by genetic engineering, new communication**

technologies, new sources of energy, new forms of human interaction and the list may continue.

- **How to study? Traditional forms of interaction between teacher and student may be more and more complemented or even replaced by customized teaching based on artificial intelligence where the teaching process is adapted to each individual, the teaching process may use augmented reality and virtual reality, distance learning may become more frequently used.**

- **When to study? Due to the significant changes determined by the fourth industrial revolution but also by other phenomena such as climate change the traditional forms of education will be more and more complemented by Life Long Learning while the increase of the duration of active age may bring to the education process a new category of students over 50 or even 60 years old.**

In order to evaluate the impact of the 4th industrial revolution on education and formation of labour, we estimate that the states that define strategies for the preparation and adaptation of their work force to the new environment may have a better chance of capitalizing on the opportunities determined by the new technologies and knowledge and, at the same time, to minimize the losses of jobs and social tensions they may incur.

At the same time, the states that not only have defined an education and formation strategy for the 21st century but also employ the technologies of the 4th industrial revolution in the process are at an advantage. For the moment, China is the most advanced in the large scale deployment of AI based education that already enrolls tens of millions of students in extra-curricular, tutoring programs, digital learning platforms or normal classrooms; at the same time, in the US there is a growing interest for the use of AI in education, numerous foundations, universities and industrialists supporting this approach (Hao, K., 2019). Other countries are at best experimenting with different approaches but are still far from a large scale implementation.

The 4th industrial revolution impact on the military sector

The history of humankind is so rife with the military dimension that ignoring it would leave any analysis incomplete. And the contemporary period is nothing but a proof of that. Therefore when discussing the world order the military sector represents a significant element.

By its comprehensive nature, the 4th industrial revolutions is both supported/financed by the military sector and, by its results, a supporter of the military dimension. Due to its disruptive nature, the 4th industrial revolution is not bringing to the military more of the same, but rather entirely new dimensions such as hypersonic weapons, quantum encryption and communications, nanotechnologies, genetic engineering, a new space race with a military component, the use of robots in the military field, including the much debated possibility of the emergence of lethal autonomous weapons.

From this point of view in recent years the key actors that are very present on the military scientific arena are the USA, Russia and a more and more prominent China, an emerging India and, to a certain distance, other countries like United Kingdom, France, Israel, Japan and others.

As the 4th industrial revolution represents on a historical scale a new beginning, this creates the opportunity for key players to enter a new race for

securing favourable positions in a redefined architecture of world order. It is very likely that, as in previous periods (such as the two World Wars and the periods that followed them), the development of science and technology will be accelerated by military research and some of the results will arrive later in the consumer use.

The impact of artificial intelligence on the world order

Although artificial intelligence represents just one of the components of the 4th industrial revolution, it seems that it has the most significant impact on the weakening of the existing international institutions and rules of interactions among states that have been widely accepted in the previous decades. The impact of different applications of artificial intelligence on decision making, behaviour and actions of individuals or institutions is so significant because it is massive (that is present on a large scale) and very different. A recent case proved that individuals and institutions are simply not prepared for the type of interaction or data usage as it happened in the Facebook - Cambridge Analytica scandal where personal data of millions of people had been used for political advertising purposes without their consent (Gartenberg, C., 2019).

Research carried out by experts of World Economic Forum (Pauwels, E., 2018) pointed out that artificial intelligence affects the existing world order through a number of mechanisms, namely:

- **the degradation and/or relativization of truth** by the widespread use of fake news that are more and more extremely difficult to distinguish from reality. This may create a climate of confusion, mistrust and misguidance that can affect multiple areas (economic, social, political, and military).
- **precision surveillance** that combine vast networks of video cameras with facial recognition software and big data analytics allowing states to monitor the location and behaviour of entire populations or, on a more benign level, allowing companies to measure emotions and reactions in order to determine consumer or employee behaviour.
- **global competition for big data** referring to entire populations in order to process it through AI based algorithms. Such data can be used for commercial, medical, political and military purposes and may lead to cyber races, cyber colonization or cyber wars.

The response and adaptation to this new environment is difficult both at the national and international levels because all the institutions that exist at this levels have been established a long time ago, some of them being more than a century old.

Some politicians and experts are aware of these developments and their related risks and they try to incorporate these new technologies in the foreign affairs and diplomacy areas. Already artificial intelligence is a **topic to be discussed in diplomatic circles** (including its implications on economy and business; security; democracy, human rights, ethics), a **new environment where foreign affairs is extending its activities** and a **tool for diplomacy** used for a better understanding of various circumstances and implications of foreign affairs decisions (DiploFoundation, 2019).

As it happened with all major discoveries (for instance nuclear power or the transistor), artificial intelligence may have a dual impact on governance on all levels: it may provide very powerful analytic instruments based on myriad of sensors and big data processing, but, at the same time, it may be instrumental in

fuelling distrust and sowing confusion by the control and distortion of mass-media, social networks and vital data bases.

Conclusions

In retrospect all industrial revolutions have had an impact on world order, either **consolidating that order** (like the 1st industrial revolution that consolidated the position of the United Kingdom as the major world centre of power or the 3rd industrial revolution that consolidated the position of United States as the major world centre of power) or **challenging that order** (like the 2nd industrial revolution that marked the gradual replacement of Great Britain by the United States as a major centre of power or the 4th industrial revolution that marks the challenging of the pre-eminence position of the United States and its gradual replacement with a dynamic multi-polar world).

From a pragmatic point of view, the 4th industrial revolution acts as an amplifier for both beneficial and detrimental effects, a characteristic that requires much more prudence and patience than it has been manifested until now. In essence, the 4th industrial revolution will significantly influence:

- the economy on a local and global scale, with a lot of positive implications but also with the risk of enhancing inequality and the development gaps between groups of countries as well as within countries;
- the international stability and peace by potentially increasing the risk of different types of wars (from trade wars, to cold wars, hybrid wars and cyber wars) due to the emergence of entirely new types of weapons or instruments that can be used for destabilizing, weakening or controlling the adversaries);
- democracy and traditional ethical values by the potential to influence the decision making process of vast masses of people, affecting their perception of reality and their ability to manifest their free will. In this respect, Noah Yuval Harari has warned against the risk that with a better knowledge of biology and more computing power human beings can be hacked/controlled by governments and corporations by predicting their choices and redefining their feelings (Harari, N.Y., 2018).

In our opinion, capitalizing the positive effects of the 4th industrial revolution and minimizing the negative ones will depend substantially on human resources (it seems that once again the human beings represents the most precious capital).

How the human resources will be educated and trained during the lifelong learning process will influence the ability to use the knowledge available nowadays and will further enhance science and technology through continuous research. In theory, the options for a better education and use of the human resources are available to all states, but in reality the states are rather different in their capability to follow such paths.

From the perspective of 2019 it seems that the benefits of the 4th industrial revolution will not be equally distributed and the maturity of this revolution may bring with it inequality both internally and internationally (Laudicina, P.A., et al, 2018; McKinsey Global Institute, 2018).

From this perspective, there are two states that seem more advanced in developing and deploying the technologies of the 4th industrial revolution, namely the USA and China. A second group of states, such as Russia (which has a

particular situation with an asymmetry between the economic and the scientific levels of development), Great Britain, Germany, France, Israel, Japan, Canada, South Korea and some others seem to be well positioned due to highly developed education, research and industrial sectors. Even much smaller states, such as Finland, Sweden or Singapore may be well positioned, because they have highly developed education, research and industrial sectors. A third group of states, such as India, Italy or Malaysia have a certain potential to capitalize the benefits of the 4th industrial revolution, possessing strengths in certain sectors but somehow lacking the coherent and consistent approaches at state level that can be found in the first two categories. The fourth group of states includes the rest of the world that is lacking both significant current strengths in education, research and development and industrial sectors and coherent and consistent strategies regarding the 4th industrial revolution.

In our opinion, particularly the states that belong to the fourth group will have to focus on the systematic development of their human resources in order to be able to make use of the technologies specific to the 4th industrial revolution. Even if they cannot be leaders of innovation, the fact that they will be able to employ the new technologies may give them some advantages and the potential for increases of productivity. At the same time, this group of countries will have to develop a better understanding of the emerging architecture of the world power in order to position themselves in the most beneficial manner in relation to established or emerging poles of power.

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