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Industry 4.0.: socio-economic junctures

Abstract. The modern civilization, known as Industry 4.0., is in the midst of a new industrial revolution. It is characterised by the pervasive implementation of convergent technologies, the shift in forms of ownership, fusion of cyber-physical and social realities, endowment of machines with elements of intellect and utilisation of social media in new communication alternatives. Such major social shifts will inevitably instigate a search for new methods of interaction between people and machines in all spheres, including economy, education, industry and everyday life. Gaining awareness of technological, economic and socio-anthropological risks is the primary subject of this paper. The authors analyse various social transformation scenarios, which are fraught with tectonic shifts in the modern society: disappearance of the middle class and unqualified workers, decreasing migration of unskilled workers to Western countries and their self-isolation, and increasing potential migration of the middle class to developing countries. The paper conducts an Umwelt-analysis of both man-machine system development prospects and the danger of the technological singularity, when machines endowed with artificial intelligence may create an economic and political situation that would threaten human strategic domineering and the very existence of humankind. The authors ponder alternative paths for the evolution of humanity through supporting international consolidating megaprojects, establishing network civil society structures, building an economy of trust, releasing mankind's creative potential and spiritual values in the context of decreased industrial employment spurred on by the deployment of the digital economy, which will require a radical change in the aims and methods of education.

Keywords: Anthropotechnosphere; Socio-anthropological Risks; Digital Economy; Sharing Economy; Social Media; Umwelt; Technological Singularity; Artificial Intelligence

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Індустрія 4.0.: соціально-економічні аспекти

Анотація. Сучасна цивілізація переживає нову промислову революцію, яка дістала назву 4.0. Вона характеризується широким впровадженням конвергентних технологій, зміною форм власності, зрощенням кіберфізичної та соціальної реальностей, наділенням машин елементами інтелекту й використанням соціальних мереж для створення нових видів комунікації. Наслідком таких кардинальних соціальних зрушень стає пошук нових варіантів взаємодії людини й машини в усіх сферах, у тому числі в економіці, освіті, на виробництві, у побуті. Осмислення технологічних, економічних і соціально-антропологічних ризиків є основною темою цієї статті. Автори аналізують різні сценарії соціальних трансформацій, що можуть призвести до тектонічних зрушень у сучасному суспільстві, а саме: зникнення середнього класу та некваліфікованої робочої сили; зменшення міграції низькокваліфікованих робітників до країн Заходу та їх самоізоляція; потенційне збільшення міграції представників середнього класу до країн, що розвиваються. Авторами статті було проведено умвельт-аналіз перспектив розвитку людино-машинних систем і небезпеки технологічної сингулярності, коли машини, наділені штучним інтелектом, зможуть створити економіко-політичну ситуацію, яка загрожує стратегічному домінуванню людини та навіть самому існуванню людей. Автори розмірковують про альтернативні шляхи розвитку людства через підтримку міжнародних консолідуючих мегапроектів, формування мережевих структур громадянського суспільства, побудову економіки довіри, відкриття творчих резервів людини, а також цінностей духовного розвитку в умовах зниженої виробничої зайнятості, породженої впровадженням цифрової економіки, що потребує радикальної зміни цілей і методів системи освіти.

Ключові слова: антропотехносфера; соціально-антропологічні ризики; цифрова економіка; економіка спільної участі; соціальні мережі; умвельт; технологічна сингулярність; штучний інтелект.

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Индустрия 4.0.: социально-экономические сопряжения

Аннотация. Современная цивилизация вовлечена в новую промышленную революцию, получившую название Индустрия 4.0. Она характеризуется повсеместным внедрением конвергентных технологий, изменением форм собственности, сращиванием киберфизической и социальной реальностей, наделением машин элементами интеллекта и использованием социальных сетей для новых вариантов коммуникации. Такие кардинальные социальные сдвиги повлекут за собой поиски новых вариантов взаимодействия человека и машины во всех сферах, в том числе в экономике, образовании, на производстве, в быту. Осмысление технологических, экономических и социально-антропологических рисков является основной темой данной статьи. Авторы анализируют различные сценарии социальных трансформаций, чреватых тектоническими изменениями современного общества: исчезновение среднего класса и неквалифицированных рабочих; снижение миграции низкоквалифицированных рабочих в страны Запада и их самоизоляция; увеличение возможной миграции среднего класса в развивающиеся страны. В статье проводится умвельт-анализ перспектив развития человеко-машинных систем и опасности технологической сингулярности, когда машины, наделенные искусственным интеллектом, могут создать экономико-политическую ситуацию, угрожающую стратегическому доминированию человека и даже самому существованию людей. Авторы размышляют об альтернативных путях развития человечества через поддержку международных консолидирующих мегапроектов, формирование сетевых структур гражданского общества, построение экономики доверия, открытие творческих резервов человека и ценностей духовного развития в условиях пониженной производственной занятости, порожденной внедрением цифровой экономики, что потребует радикального изменения целей и методов системы образования.

Ключевые слова: антропотехносфера; социально-антропологические риски; цифровая экономика; шеринг-экономика; социальные сети; умвельт; технологическая сингулярность; искусственный интеллект.

Introduction

The current state of society and the turbulent technological processes that are taking place within it are sometimes called Industry 4.0 - the fourth industrial revolution, or the Internet of Things. This concept emerged in Germany in the beginning of 2010s, and has already engaged the entire world. Hundreds of billions of dollars are being funneled towards implementing it in the USA, the European Union and China. USD 20 trillion is expected to be invested in the industrial internet by 2030, and the EU has already funded the Horizon 2020 research and innovation program in the amount of nearly EUR 80 billion between 2014 and 2020. Almost 60% of all manufacturing companies in China actively utilize Industry 4.0 technologies, while in Germany, which is the world leader in this sphere, they are applied by as much as 80% [1].

The essence of the new industrial revolution is in cutting-edge informational technologies and social media, which will allow «smart» enterprises, facilities and machines exchange real-time data over the entire span of the value chain and use intellectual networks to develop an entirely new level of self-awareness of industrial processes, which was impossible in the past [2]. As a result, the industrial environment that will emerge on the basis of artificial intelligence, Big Data and the Internet of Things (IoT) will be self-aware and able to self-predict, self-control, self-compare, self-reorganise and self-renew [3; 4]. This will allow machines that produce goods to set tasks independently and adjust operational parameters to increase quality and efficiency, which will lead, in particular, to the liberation of people from routine work and provision of exclusive goods and services to consumers at times of immediate necessity. On the other hand, it is fraught with unprecedented social upheavals, the acute problem of employment and the inevitability of the search for new planetary-scale goals and projects.

Thus, the aim of the paper is the comprehension of socio-anthropological changes related to new technological shifts in society and the economy.

The article resolves the following problems. It elucidates primary Industry 4.0 trends and related social risks, discusses prospects of social change, studies the issue of man-machine interaction through the trend from submission towards domination of artificial intelligence; tracks the

metamorphoses of socio-economic relations which engender paradoxes in the new economy.

Brief Literature Review

A review of the existing international literature on the subject allows us to conclude that the new industrial revolution (Industry 4.0) affects society and culture rapidly and deeply. The strategy of innovative growth in the context of the 21st century technological revolution is discussed in the works by V. I. Kushlin, A. I. Ageev, B. N. Kuzyk, Y. V. Yakovets. Works by A. S. Malkov, A. A. Akaev, G. G. Malinetsky examine the issues of developing a strategy for Russia's innovative development in the context of the onset of the 6th wave of innovation.

Social, economic and technological aspects of the changing reality are analysed in the works by E. Agazzi, A. G. Deloitte, M. Castells, T. S. Kuhn, I. Lakatos, S. Lem, M. McLuhan, M. Mulkay, L. Mumford, M. Polanyi, K. R. Popper, P. K. Feyerabend, J. Ellul, G. Simondon and J. Baudrillard. Among the Russian authors a special mention is deserved by the works by I. Y. Alekseeva, A. A. Voronin, V. G. Gorokhov, B. I. Kudrin, N. I. Kuznetsova, N. N. Moiseev, A. P. Nazaretyan, V. S. Stepin, A. I. Rakitov, V. M. Rozin, M. A. Rozov, etc.

The concept of Industry 4.0 as the most integral project of objectification of cyber-reality is of greatest interest to R. Buritt, K. Christ, D. Buhr, H. Kagermann, L. Atzori, A. Iera and G. Morabito.

The problems of labour market transformation, emergence of new trends, such as the sharing economy, have been delineated in publications by J. Schnor, J. Horton, R. Zeckhauser, S. Fraiberger, A. Sundararajan, R. Dawson, J. Guthrie, E. Evans and R. Buritt.

According to scientists, one of the most serious and undesirable consequences for the development of human civilization, linked to the significant domination of machine intellect over human, is the technological singularity. Reflections on this process can be found in publications by D. Chalmers, V. Callaghan, J. Miller, R. Yampolskiy, S. Armstrong, A. Sandberg, J. Hughes, R. Kurzweil, H. de Garis, H. Moravec, J. Smart, P. Russell and G. Stock.

Works by W. S. Bainbridge, M. Roko, A. Toffler, U. Beck, A. Sandberg, N. Bostrom, J. Schummer, J.-F. Noubel, V. I. Arshinov, I. A. Aseeva, V. G. Budanov, E. G. Kamensky, O. A. Grimov, I. G. Moskalev, V. V. Chekletsov, S. V. Pirozhkova,

M. A. Sushchin, B. G. Yudin, P. D. Tishchenko, E. G. Grebenshchikova and others are devoted to the socio-anthropological aspects of Industry 4.0.

The present article deals with the existential risks of the modern civilization, risks caused by truly revolutionary discoveries and transformations in the economy, industry and science.

Major trends of Industry 4.0

The relevant demographic, socio-economic and technological trends primarily linked to Industry 4.0 are clearly outlined in the sociological research conducted for the International Economic Forum (January 2016) (Figure 1) [5].

The respondents emphasise that the most significant socio-economic and demographic problems are the continually changing nature of employment (44%) and the middle-class employment in emerging markets (23%). As for technological trends, the respondents place the greatest emphasis on the mobile internet and cloud computing technologies (34%), as well as on processing power and Big Data (26%).

These trends indicate the emergence of new forms of social risks. Industrial revolution 4.0 stimulates various social transformation scenarios, fraught with tectonic changes in the modern society.

In the near future we will observe the disappearance of the middle class and workplaces unskilled workers in developed countries, which has a number of consequences such as permanent absence of employment for the majority of the population, and, as a compensatory mechanism, introduction of a guaranteed universal income («feeding the people»). Such a situation involves secondary existential risks and a shift in basic values of the population of developed countries [6]. In the first phase of the 6th wave of innovation, it is already the case due to the implementation of convergent NBICS technologies and the digital economy, since humans are being replaced by 'smart machines' not only in dangerous and hazardous industries and heavy agricultural labour, but also in the field of services, which is the most prevalent source of employment in the world. For instance, in China the process of replacing blue-collar and white-collar workers in major corporations by intellectual machines has already begun, with plans for skilled professionals to be engaged in manufacturing in the Silk Belt countries, where Chinese investments are creating new workplaces and industrial enterprises.

It's symptomatic that there is an ongoing intensive state-level legal discourse on the rights of the artificial intellect in both the USA and the EU. In the recent years, the European Parliament has repeatedly raised issues relating the legal status of devices with artificial intellect and endowing them with the status of a legal subject and corresponding rights in labour legislation. In fact, this is a direct path towards the introduction of robot labour to the market and mass layoffs of people engaged in manufacturing and service industries. The Parliament's resolution on the creation of the European Agency for Robotic Technology and Artificial Intelligence with the aim of providing integrated expertise on the issue has been passed [7]. On February 16, 2017, the European Parliament voted against the introduction of guaranteed universal income in the EU, which aimed to compensate for the impact of robotic technology deployment in the labour market. A tax on robots was also rejected by a narrow 14-vote margin. «The digital agenda in

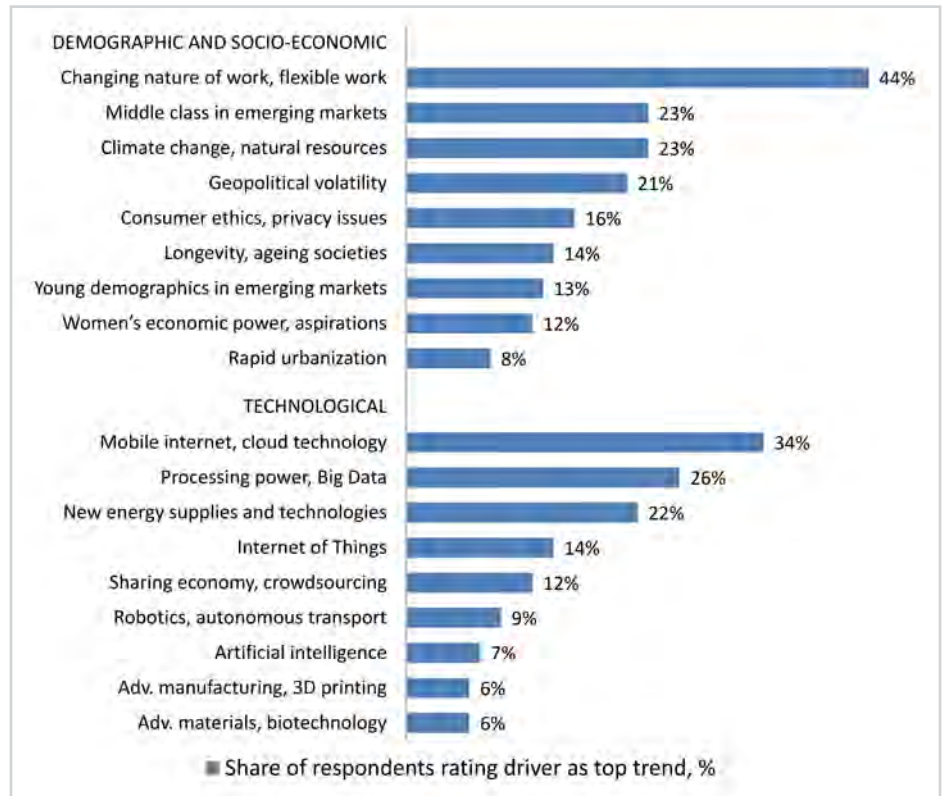


Fig. 1: Drivers of change, industries overall
Source: [5]

the EU is already very extensive, and includes cybersecurity, online commerce, Internet management, telecommunications, protection of intellectual property rights, geolocation blocking» [8].

For instance, the 2017 legislation in the USA [9] actively supports manufacturing of driverless vehicles which are entirely devoid of elements required for human drivers, such as a steering wheel. Moreover, such cars will presumably grow more numerous from year to year and are very likely to gradually replace human drivers with all the corresponding consequences - from unemployment to the prospects of self-realisation. In the US alone, it would mean the loss of employment for 10 to 30 million people. However, such incorporation of machines is, of course, justified exclusively by caring for consumers' safety and comfort. Among the consequences of the advent of «smart robots» is the potentially stimulating perfection of human beings themselves. In order to compete with or to control such machines, one needs to continuously enhance one's qualifications, possess original thinking, and apply new approaches and methods.

Secondly, we expect a decrease in the migration of unskilled workers to Western countries and their self-isolation, which contradicts the idea of an open society and increases social stratification throughout the world. Contemporary digital technologies with elements of artificial intelligence will not leave any workplaces for the dominant majority of the planet's population in the new wave of innovation, and there is no mass employment in the forecast.

Thirdly, there will likely be an increase in the middle class migration to developing countries, where their competencies are still in demand and have not yet been replaced by artificial intelligence. The possibility of retraining everyone to engage in highly creative professions is illusory, and machines are already beginning to repair, replicate and improve themselves. Thus, mass unemployment will become all-pervailing. This problem may be resolved via a long-term transnational megaproject, such as the new Silk Road proposed by the PRC, which integrates continents into a single economic space. Megaprojects of this type may become a good platform for the interaction between people

and «smart» machines. The main point is that they carry no threat of dehumanisation for people who have lost the meaning of their lives. We can see the prototypes of such global projects in the resurrection of ideas of space exploration, preparations for Mars expeditions, generation of plans to explore the Moon, etc. Certainly, the successful implementation of such plans requires entirely different algorithms and modes of international cooperation.

Issues in man-machine interaction: from submission towards domination of the artificial intellect

The development of digital twins is one of the central achievements of the 4th wave of industrial transformation. The digital twin technology integrates the physical and virtual worlds through tying the physical object to a digital platform with the purpose of monitoring the real-time efficiency, status and productivity of the object.

For instance, within the EU, digital twins are not merely used in innovative computer simulations, or in creation and virtual testing of new medicines, but also in airplane construction, improving the design of new models, reducing certification and testing time and allowing to conduct monitoring during operation [10].

Digital twins are gradually beginning to be used in the manufacture of more consumer-oriented products. In particular, they are useful in checking the authenticity of certificates of pharmaceutical products and monitoring logistical algorithms of foodstuff deliveries. Digital twins allow us to ease the development of updated equipment models with regard to the weaknesses of the preceding ones, and are used to control the production process and to manage the lifecycle of a product - an already tested product - for the sake of testing its new versions [11].

The augmented reality technology, a derivative of digital twins, is finding its niche in education and simulator complexes. For instance, the augmented reality piano lesson program expects the user to put on specialised glasses and play on a sensor-equipped keyboard, which brings out the comments and recommendations on improving the playing quality into the player's field of vision [12].

Thus, digital twins do not completely eliminate industrial risks, but transfer the issue of risk management to an earlier technological phase - that of twin development and coding. Excessive trust in the preventive power of the algorithm may lead to far more serious consequences than traditional extensive implementation and testing of new models, which also requires a clarification of legal responsibility in cases of failure.

The issue of disappearance of private property in digital reality. The shift from products to platforms and sharing economy

Let us proceed to the discussion of the metamorphosis of socio-economic relations, which engenders paradoxes in the new economy.

A switch from products to platforms is underway, where «Uber, the world's largest taxi company, owns no vehicles. Facebook, the world's most popular media owner, creates no content. Alibaba, the most valuable retailer, has no inventory. And Airbnb, the world's largest accommodation provider, owns no real estate» [13]. A detailed analysis of these trends may be found in the work by A. Golofast [14]. Meanwhile, we will examine only one actual consequence of a life in the toils of the cyber-physical reality, namely the issue of cyber-monopolies and stratification of property. The EurActive service considers the monopolisation of data and development of black box algorithms to be the cost of anarchic cyber-freedom [15]. Giant monopolists in the digital sphere can observe a shift in people's consumption habits, use this information in their interests and manipulate it to a certain extent. [16]. «Google sees what the people are searching for, Facebook - what the people are sharing, Amazon - what they are buying» [17]. In their book «The End of Ownership: Personal Property in the Digital Age» lawyers Aaron Perzanowski and Jason Schultz call this tendency the destruction of the traditional concept of property.

It is becoming illegal to alter the device with the aim of satisfying the consumer's needs without the manufacturer's consent. Soon, perhaps, there will no longer be a possibility of uncontrollable transfer of a device into the property of another person due to permanent personal subscriptions. All of this means that you can no longer «own» an electronic device in the traditional sense of the word.

On the other hand, the previously palpable objects, such as music albums and off-the-shelf software, are disappearing off the store shelves. They are being substituted by subscriptions to services that allow access to materials for a limited time at a fixed rate. Thus, the concept of temporary access is gaining primary significance instead of the concept of property [17].

Traditional business is being replaced by platforms, for example, movie theaters are being replaced by streaming media services. In this manner, digital-era property becomes a layered cake, where the top and bottom layers belong to the consumer, and the filling - to the manufacturer. As for the platforms that list third-party goods and services, they do not carry the charge of unfair competition. However, they do raise the issue of fair taxation and mandatory quality control of listed goods and services [18]. For instance, the Uber platform in Moscow was acquired by the Yandex-taxi platform, which, in the Russian realities, is the platform that creates a space of greater trust and service quality: vehicle and driver certification, a lower risk of criminal incidents, greater legal responsibility. Although in the EU member states the criteria are probably just as stringent for Uber. It is unlikely that platforms like Yandex-taxi or Uber may be classified as a component of sharing economy, which is essentially built upon joint usage principles - open networks, open enterprises, exchange of services and joint use of industrial assets [19]. Meanwhile, most scientists agree that the difference between the traditional economy and the sharing economy is not merely in the commercial/non-commercial dichotomy. The primary issue is the fact that the latter wins on a peer-to-peer basis due to the absence of intermediaries, establishing credible contacts between people who are not personally acquainted, decision-making based on people's reviews and social media ratings. It is no accident that the sharing economy is also called the economy of trust.

Conclusion

Examining the strategic global consequences of the Industry 4.0 industrial revolution, it's impossible not to mention the second transformation of the techno-anthroposphere. R. Kurzweil, an inventor, futurologist and philosopher of science, has forecasted the emergence of an artificial intellect, which is similar to human intellect, by 2030, whereas most scientists acquiesce that it will occur by the 2050s. This process received the name of technological singularity [20; 21], which is defined as the time when artificial intelligence becomes commensurable with human intelligence and exceeds it (passes all Turing tests), being entirely impervious to people and spinning off into an uncontrollable evolution mode. We can observe these trends now, but as early as 1965 I. J. Good wrote the following in his article «Speculations concerning the first ultra intelligent machine»: «Let an ultra intelligent machine be defined as a machine that can far surpass all the intellectual activities of any man, however clever. Since the design of machines is one of these intellectual activities, an ultra intelligent machine could design even better machines; there would then unquestionably be an «intelligence explosion», and the intelligence of man would be left far behind» [20].

At first glance, it seems possible to limit the development of AI, just as the issue with human cloning was resolved through prohibitions based on the global socio-technological and bioethical expertise. However, the advantages of economic and military use of artificial intellect are currently so great that the rivals are unlikely to forego its further development. We believe that technologies in education, management, forecasting and decision-making that engage quantum-like forms of coherent collective

consciousness, which are now being embraced at crowdsourcing platforms, should become a compensatory security mechanism in the struggle with AI domination on the edge of technological singularity. Here is where new Umwelts, in J. Uexküll's terminology, emerge. Today we can speak of four hybridly coexisting Umwelt-worlds - the techno-world of machines, the neuro-world of virtual reality, the myth-world of culture and the network-world of social media, platforms and IoT (crowdsourcing and

crowdfunding) [22]. Of course, the nature-Umwelt, suppressed by humankind, also needs a mention. The Umwelt-analysis conducted by the authors proves the vital necessity of a shift of the economy towards new forms of communication between humans, machines and hybrid forms, joint-access digital economy, electronic forms of democracy, permanent educational processes, establishment of the value of personal growth and common activities in the context of declining employment.

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