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A Need for Co-Evolution between Technological Innovations and Social Innovations

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Abstract: The 4th industrial revolution must be approached from the perspective of industrial ecosystem in order to lead to industrial reorganization facing after deindustrialization. This is because, as the characteristics of agriculture and manufacturing differ, the basic characteristics of industries related to the 4th industrial revolution differ from those of manufacturing. Differences in the way agriculture and manufacturing value is created require differences in human type, social systems, and even distribution system. That is, just as ecosystems focus on the interrelationship of organisms and their relationship with the physical environment, the industrial ecosystems to be accompanied by the 4th industrial revolution require new human beings to live in the new industrial ecosystem and new systems to support the new industrial ecosystem, with new technologies in the related fields. This paper will show that the industrial ecosystem required by the 4th industrial revolution calls for *Homo empathicus* different from *Homo economicus* of industrial society, a reciprocal economy different from the capitalist economy, and an autonomous democracy different from free democracy.

Keywords: industrial ecosystem; digital ecosystem; social innovations; *Homo empathicus*; reciprocal economy; autonomous democracy; data sharing; basic income

1. Introduction

How will the 4th industrial revolution (IR) change human society? Unless new labor-intensive tasks are created, the 4th IR will result in a catastrophe for jobs and hyper-polarization of income. That is, only the creation of new labor-intensive tasks can prevent job disasters and a drop in the proportion of labor income as a result of increasing artificial intelligence (AI) [1]. So do we have the capacity to create new labor-intensive tasks? The educational system of industrial society demonstrates a limit to the creation of labor-intensive tasks. For example, around the year 2000 in the U.S.A., the demand for cognitive tasks often associated with higher education skills underwent a reversal; that is, a strong, ongoing increase in the demand for skills in the decades leading up to 2000, and a decline in that demand in the years since 2000, even as the supply of higher education workers continues to grow [2]. As such, the ongoing 4th IR is raising new challenges for us to address.

2. What Type of Industrial Revolution Is the 4th Industrial Revolution?

Are we responding effectively to the 4th IR? Is the 4th IR similar to the 1st or the 2nd one? If the 4th IR is similar to the 2nd one, it would be able to support an industrial policy that fosters certain industries. However, if it is of the same nature as the 1st IR, we will have to consider fundamental changes in social order from the education system to the distribution system, because, as we know, the 1st IR promoted the transition to a modern industrial society. However, the 2nd IR, which took place in the late 19th century and early 20th century, only created new industries called heavy and chemical industries, and did not entail fundamental changes in the modern social order based on capitalism and democracy. Thus, it is very important to determine whether the ongoing 4th IR is similar to the 1st or

the 2nd IR. I think that the 4th IR requires a new type of humanity and social order that is completely different from the humanity or social order of industrial society. I will explain why, and at the same time I will look at what type of humanity and social order are required.

3. A Difference between the 3rd and the 4th Industrial Revolutions

The information technology (IT) revolution technically connected everything in the world. As a result, the technical conditions of building a digital ecosystem were also secured. This is the dot-com business model. However, just because everything is technically connected does not mean people are automatically connected. Some entrepreneurs with “animal spirits” had begun to devise ways to create new values by connecting people. This is the platform business model. The platform business model has made the digital ecosystem more stable. The fact that the platform business model is a more stable ecosystem than the dot-com business model is easily confirmed by Yahoo and Google’s comparison. While the former, which is vulnerable to sustainability, has declined, the latter continues to evolve into new business areas. In other words, Google continues to evolve from a search service business with the development of AI technologies and smart ventures including self-driving cars.

What made this difference? A key driver of the digital ecosystem that keeps people connected is “profit sharing” [3]. Google secured data by providing people with the benefits of a search service, which enabled it to develop AI technology and enter the self-driving car business. Similarly, Apple not only generated its own revenue by offering people a chance to make money from their ideas, but also was able to produce the fancy iPhone with its great app ecosystem. The numerous platform business models that emerged in the 21st century are all based on a way of creating value through “profit sharing”. In other words, the 4th IR not only extended the connection to mobile devices, but at the same time involved the evolution of the technical network provided by the 3rd IR into a stable network between people. Just as the number of U.S. manufacturing workers plunged by more than 3.4 million before the financial crisis since 2000, the rise of the platform business model coincided with the decline of industrial society. While “rationality” has been the principle of behavior in the industrial world, “reciprocity” has emerged as a new principle of behavior in the digital ecosystem. Thus the 4th IR, represented by “hyper-connectivity,” “super-intelligence” and “hyper-convergence,” does not mean just a few technological innovations but also the social innovations demanded by the new ecosystem, given that it is the result of developing the “network” caused by the IT revolution into a stable digital ecosystem.

4. What “Smart Mobility Solutions” Mean

Major companies’ drive towards “smart mobility solution” businesses demonstrates the importance of the digital ecosystem. The challenges facing the smart mobility solution business model also show the direction of social innovations needed for the digital ecosystem. First, understanding smart mobility solutions requires understanding the smartness of mobility. The IT revolution provided a technical foundation that made it possible to connect everything. This is the emergence of the dot-com business model. However, technically possible connections do not automatically connect people. Two things had to be solved. First, we had to solve the problem of technically connecting entities while on the move, and that is about the smartness of mobile devices. Smartphones were the first step in promoting this smartness. Self-driving cars will mark the second step in smart mobile device promotions. Second, and more importantly, we have to connect people. So, when the connection of everything became technically possible, some entrepreneurs with “animal spirits” began to think that they could connect people and create value. The flagship company of this drive was Google. What is the difference between Google, which started out as a search service business, and Yahoo, then an absolute powerhouse in the search service market? Why did Yahoo decline and how has Google continued to evolve into a leader in AI technology and the self-driving car businesses? While Google was able to secure “big data” by creating an attractive platform based on “profit sharing”, Yahoo’s ecosystem, which strengthened its own interests, was on the wane. “Big data” supported the

development of AI technology, while AI technology not only strengthened the competitiveness of existing businesses such as search services, but also enabled them to make inroads into new businesses such as self-driving cars. The platform business models that emerged in the 21st century are imitations of Google's methods. For example, Apple's smartphone has become an attractive product as a result of the establishment of a sustainable app ecosystem, which was the result of realizing the spirit of "profit sharing". Apps are basically people's ideas, and Apple knew that in order to utilize more people's ideas outside than inside a company, it would be necessary to share the profits from the sale of the apps with the app developer.

Such an attractive platform becomes a key factor in connecting people or resources that others have. An attractive platform must ensure that the benefits of the platform are shared among participants and that interdependence, a key component of the ecosystem, is secured. Furthermore, in order for the digital ecosystem to become an alternative to de-industrialization, data obtained by the platform must be a new means of value and job creation. This is the meaning of "solutions" in the "smart mobility solutions" business. In other words, the final challenge for "smart mobility solutions" businesses is whether they can successfully enter the data economy. Data itself is not money or jobs. Data are compared to a kind of crude oil. As crude oil needs to be refined for use, now the ability to convert data into new values or jobs is needed. Unless this problem is resolved, AI technology and a platform monopoly could lead to a jobs catastrophe and hyper-polarization [4]. For example, the gig economy is growing fast, and platform-based independent workers are growing rapidly. The problem is that, along with the instability of the platform-based independent workers' employment, the sustainability of their work is also threatened by the development of AI technology.

5. Digital Ecosystem and Social Innovations

Technological innovations lead to new business models and raise new social problems. New business models are at odds with existing business models, and existing systems are also an obstacle to the spread of new business models. Thus, social innovations, including institutions, laws and ways of education, are necessary for technological innovations to lead to the development of new industrial ecosystems. In other words, new technologies and business models demand a new humanity, and in turn, changes in humanity involve changes in social norms and cultures, political and economic order, etc. Now let us look at the key topics of social innovation needed for the digital ecosystem.

First, the digital ecosystem requires new social rights. In other words, human rights in the digital ecosystem are bound to change, as did the right to live a decent life in an industrial society. As we have seen so far, the platform business model has involved a data revolution, and as a result the economic order has begun to shift to a new phase of the data economy. The data economy means that unlike the manufacturing economy, where labor, capital and land were the three major factors of production, data has become the new important factor of production. The data economy, a key unit of the digital ecosystem, is organized by the principle of cooperation. Unlike the existing three major factors of production that characterize rivalry and exclusiveness, data, which are the raw material of the data economy, are collaborative goods that are characterized by anti-rivalry and inclusiveness. Anti-rivalry occurs when the use and/or sharing of the production of the good by one person increases the value of the good to others. Inclusiveness occurs when the value of a good increases as the number of people using and/or producing the good increases [5]. In other words, data are "collaborative goods" encompassing anti-rivalry and inclusiveness.

As a result, the more everyone shares, the more efficient the economy will be. The problem is that a platform monopoly or data monopoly is economically inefficient. Data can be used indefinitely at no cost because a data monopoly limits data usage. This is why there is a need to allow everyone to share data. In other words, the right to access data should be added to citizenship in the era of the 4th industrial revolution (as civil rights were the right to labor, the source of value creation in an industrial society).

In fact, the digital ecosystem in which creative ideas play a key role in value creation present a world of reciprocity in that digital goods (e.g., idea products) that contain creative ideas are also collaborative goods with characteristics of anti-rivalry and inclusiveness. Just as the capitalist ecosystem, a world of rationality, based on the principles of competition and private property rights is related to the nature of rivalry and exclusiveness of manufacturing products, the digital ecosystem, a world of reciprocity, based on the principle of profit sharing and cooperation, is also related to the nature of anti-rivalry and inclusiveness of data and digital goods [3]. This is why the components of the digital ecosystem are so different from those of the manufacturing ecosystem. The convergence and growing complexity of technology calls for cooperation in technology, and cooperation in technology is bound to strengthen cooperation in business relations as well. Hogeun Lim, et al. [6] demonstrate the characteristics of innovative ecosystems and mechanism through technological cooperation in the automobile industry by empirically examining them using the network ecosystem, open innovation theory and patent data on the question of “the subject, reason and type of horizontal network cooperation in technological innovation in the automotive industry”.

However, the reality reveals the problem of platform and data monopoly. This is basically the result of combining the logic of capital with the platform business model. The problem is that platform monopoly or data monopoly is economically inefficient. This is because data monopoly limits data usage, while data can be used indefinitely at no cost [4]. Thus, the right to access data should be added to citizenship in the era of the 4th industrial revolution (as civil rights stressed the right to labor, the source of value creation in an industrial society).

However, the question remains how to change the attitude of monopolistic businesses with vast amounts of data. In that it undermines economic efficiency, government intervention is justified and, as an extension, “a data tax” is proposed as a measure. Aside from the technical question of whether it is justifiable to use corporate data collected from around the world only in certain countries, the more desirable way is to motivate companies to open up access to their data on their own for the benefit of society. In other words, it is to induce the notion that voluntary data sharing is also beneficial to the company itself. The driving force behind the successful transition from a dot-com business model to a platform business model (as shown in Google’s case) was the strategy of opening up and sharing. Additionally, as the blockchain platform business model that enables transactions without a central broker, spreads, the existing centralized platform business model (e.g., centralized app business model) will inevitably lose its appeal [4].

Microsoft, once a byword for a technological walled garden, one of whose bosses called free open-source programs a “cancer”, joined a fledgling movement to liberate the world’s data on April 21st. What does this mean? It remains to be seen how transparently Microsoft will open up its data, but the move is a product of the perception that the opening up of data rather than a monopolization of data is not only a sustainable platform business model, but also helps innovation. Microsoft appears to be moving towards incorporating Linux as a central feature of its OS, which Apple already has done, but it was inevitable that it develop an open source platform. MS belatedly recognized that “innovation in the open” is inevitable to survive in the digital ecosystem. If so, the goal of data opening can also be understood as a survival response strategy through connectivity and cooperation with the outside world.

Specifically, planning to break through “data opening” to make “solutions” is the last step in the process of “smart mobility solutions”. When data is opened, no one can predict how people will use it, and we might possibly experience a “great innovation explosion”. It is likely to be the starting point for the emergence of a kind of “thinking ecosystem”. Of course, even if data is opened, the data economy can be a source of new growth and could lessen polarization when the source of new growth is supported by data utilization capabilities. We need to nurture a new humanity for the digital ecosystem we have described earlier, and we have no choice but to emphasize once again the need for an education revolution.

Second, the data economy requires a new distribution system in that the good ideas that play an important role in the data economy do not come in proportion to working hours as in industrial societies. The provision of basic income is presented as a distribution system that addresses the weakening of the proportionality between working hours and value creation. In industrial society, labor and leisure were separated because working hours were an important criterion in production and income. As a result, in economics, labor is time for others, so it reduces utility and is rewarded with wage income. Leisure, on the other hand, increases utility because it is time for oneself, but reduces the opportunity to earn wage income.

In the data economy, however, creative ideas play an important role in value creation. In other words, uniform tasks and formal decisions are made by computers today. In this era, the most important technology people need to have becomes creativity. However, creative ideas do not have a one-on-one proportional relationship with working hours (like the products of manufactured products), but come from free time such as leisure or play, not from the labor process. For example, when you look at the process of designing a product, as designers take a walk and get inspiration from nature, ideas come from free time rather than from offices. These creative ideas do not come in proportion to the input of working hours, so income allocation based on the input of working hours is unrealistic.

One solution to this problem is basic income. In other words, given basic income, people can choose what they are most satisfied with as well as their high-paying jobs. The biggest obstacle to introducing basic income is the gap in perceptions among generations. For example, the older generation, whose ideology of the industrial society has been embodied, has a strong perception that not working is shameful. As a result, they think that unconditional basic income makes people lazy. However, they miss two things. First, with technological development and innovation, the amount of human labor needed for the production process is getting smaller and smaller. Second, people with less working hours and more free time want to do socially valuable work. Jinhyo Joseph Yun, et al. [7] show that reflective basic income with permissionless open innovation, capital fluidity, a sharing economy, and a platform tax can motivate open innovation dynamics and arrive at a method by which an entrepreneurial state can conquer the growth limits of capitalism.

Further, people become creative when they have more free time. So the basic obstacle to the introduction of basic income stems from the clash between the 20th century values of paying a reasonable price for physical efforts and the 21st century ideal of value creation based on creative ideas.

Third, economic players in the digital ecosystem are bound to be different from those in the manufacturing-oriented industrial ecosystem. This is the same logic as the difference between creatures of the Nile ecosystem and the Sahara Desert ecosystem. The human of industrial society was the individualistic economic man, the so-called *Homo economicus*. However, *Homo economicus*, who seeks to maximize his own interests independently, is not suitable for a digital ecosystem that creates value by linking other people's resources through profit sharing. This is the reason that the so-called 4C (creativity, critical thinking, communication and collaboration) is often mentioned as the core competency of 21st century learners.

Homo empathicus best represents a human being with 4C capabilities. This is why Rifkin [8] argues that *Homo sapiens* is giving way to *Homo empathicus*. *Homo empathicus*, the man of the world of connectivity and the data economy era, specifically refers to a human being with "associability" which is the ability to connect thoughts and minds with each other. A human being with associability is not only involved in the formation of various kinds of human and social relationships, but also has the ability to propose and actively organize them according to his needs and ideas.

The question is whether we can create 4C capabilities through the educational methods of industrial society. For example, acquiring explicit knowledge, one of the educational goals of industrial society, is useless in the era of the 4th industrial revolution. Some problems of present education can be seen in the trend of job changes since the 1970s in the U.S. With de-industrialization in the late 1970s, repetitive and formalized manual jobs began to reduce, and from the mid-1990s, repetitive and formalized cognitive jobs began to decrease due to the IT revolution [9]. It should also be noted that

since the early 2000s, there has been a gradual decline in non-repeating and atypical cognitive tasks (e.g., managerial, professional jobs) and even atypical physical jobs since around 2010. The former is related to the proliferation of platform business models, which are “employment-lite business models,” while the latter is related to the explosion of artificial intelligence (AI) technology. As such, it is clear that industrial society’s educational system will worsen the job situation. This is why the urgency of an education revolution is raised.

Fifth, changes in the way values are created and the advent of a new type of humanity inevitably lead to changes in social culture, economic order, democracy, etc. Specifically, this calls for the spread of a culture in which differences and diversity are respected as sources of value; the spread of a reciprocal economy in which cooperation and sharing are not limited to consumption and production but also encompass the realm of distribution, and the evolution of autonomous democracy beyond free democracy (the 1st democracy) and people’s democracy (the 2nd democracy). For example, if the blockchain platform and social innovation are combined, productivity might develop rapidly and it will ensure a wide range of people have the least income and minimum purpose [10]. Here, “purpose” means the opportunity to establish relationships with others through work and make socially meaningful contributions. This is also related to the fundamental changes in the distribution system previously introduced, in contrast to the fragmented individual’s life in an industrial society, where only one has to do well. In the world of connectivity, the more social interactions there are, the more innovations there are. However, interaction in a society where everyone has the same color cannot create innovations. In other words, both interaction and cooperation are meaningless among humans with no difference in color or personality. The ability to propose and actively organize according to one’s needs and ideas is “creativity” or “critical thinking”; that is, the ability to find problems. Therefore, a “human with associability” is a man of relationship formation and creativity potential. In other words, he is a man with 4C capabilities.

Next, a change in democracy is inevitable. It is difficult to express cooperation and reciprocity in a liberal democratic system that “domains” “selfish individuals” by majority vote. Alexis de Tocqueville, who wrote *Democracy in America* (1835), said early on that in order for democracy to be more than just public domination, there must be a spirit of democratic mutual assistance (beyond liberal democracy that leads to excessive individualism, promotes passive attitudes toward the nation, and fosters political indifference). In other words, a new cooperative democracy is needed to revive the original spirit of democracy that de Tocqueville had long ago seen.

The problem is that in order for cooperation to take root in everyday life, it must solve the “dilemma of collective action”. This is because individuals tend to free ride to pursue their own private interests when they take collective action to pursue common interests. The free-rider problem can be solved only when the voluntary cooperation efforts of the members are supported. In order to solve the “dilemma of collective action,” it is necessary to reconstruct democracy as a political system that adapts to *Homo autonomus* (autonomous man) in that it has no choice but to resolve individualism, restrictions on personal freedom, and the individual sense of responsibility as a member of a community. Fortunately, in a world of digital ecosystems and connections where cooperation, networking and continuation of relationships are in line with the maximization of individual interests, there is little chance that the “problem of free rides” will arise, making it impossible for sustainment of cooperation and relationships. In other words, if cooperation is stopped, the potential benefits of opportunistic attitudes will be extinguished, so cooperation will inevitably be established as a rule and a norm.

Liberal democracy, characterized by individualism, exclusive ownership and hierarchy, is not a suitable background for the world of platform economy and connectivity, which characterize interest sharing and cooperation. Individualism, the cultural foundation of liberal democracy, makes voluntary participation difficult. It is also difficult to sustain a liberal democratic world order based on the monocentric worldview, given that the world of connectivity (which characterizes the integration effect and the contagion effect) requires the coexistence of humans and animals, humans and nature, the state

and the nation, the rich and the poor, etc. Indeed, there have been calls for stronger transnational cooperation since the financial crisis or the eurozone crisis, but home-centered logic has deepened, making it difficult for the global economy to recover and raising uncertainties. Just as American liberal democracy is not ashamed of racism, structured inequality, and foreign military intervention at the expense of countless lives for the benefit of multinational corporations, today's liberal world order is nothing but an unstable systemization which is maintained by force. I use the term "an unstable systemization" to mean "a system of control that does not work, or is destructive".

On the other hand, people's democracy (a communist political system) pursues equality, but relies on control, planning and orders for its means. As a result, weakening of individual spontaneity (motivation inducement) has accompanied the limiting of personal freedom and efficiency has been reduced and creativity weakened. We saw universal human rights and real equality as impossible under private property, which legalized the structure of exploitation and institutionalized inequality. This is the background of banning all private ownership of important means of production in the name of the common ownership of the entire people and institutionalizing state ownership. As a result, the state distributed the daily necessities needed by the people and provided virtually free education and medical services, but the lack of autonomy and motivation in the rigid planned economy resulted in stagnant production motivation and little productivity, decreased the quality of goods or services supplied free of charge, and limited the diversity of social demand. It showed that the way the economy operates could not meet the needs of the public as long as it is dictatorial. Moreover, corruption has become widespread over time due to the excessive concentration of power.

Above all, it was historically self-evident that the centralized decision-making system, the real consequence of the people's democracy, was forced to reveal its limitations amid the strengthening trend of pluralization and decentralization. In other words, the class struggle inevitably resulted in the dictatorship of the proletariat and set the inevitable nature of the state, which is forced to take only the form of revolutionary proletarian dictatorship, as a transitional form to implement communism, but did not understand the failure that the monopoly of power would result in. The excuse that the monopoly of power developed in reality was different from one they intended was just ignoring the reality that "proletarian dictatorship" was bound to end up as just another dictatorship. Of course, they would want to claim that since the etymology of democracy is "demokratia", which combines "demos", which means people or majority, and "kratia", which means dictatorship, the dictatorship of the people is democracy, and that since there is still a difference between the dictatorship of the proletariat that Marx talked about and Stalinism, a state capitalism in which the proletariat has no power and is exploited by the state, a proletarian dictatorship is still possible. Even those who emphasize this difference, however, will not deny the fact that the proletarian dictatorship itself has concentrated power in the state, and as a result, it cannot escape the problem of power concentration. The reason the people's democracy results in the concentration of power is because it is difficult to achieve the public interests without controlling individual freedom. Basically, they have a distrust of an individual's "autonomous" capability. In other words, people's democracy is not suitable for the framework of social norms and governance in the era of the 3rd and 4th industrial revolutions, where dispersion, sharing and cooperation are keywords.

As such, free democracy (the 1st democracy) and people's democracy (the 2nd democracy), which are the projects of modern industrial society, cannot fundamentally solve the dilemma of collective action, an obstacle to cooperation which is the operating principle of both the world of connectivity and the digital ecosystem (platform economy). In addition, democracy, the principle of social organization and social management, needs to be upgraded in order for each individual to plan their own life on their own, to actually organize life according to their own plans, and to create cooperation with others. Then, shouldn't democracy, which responds to a world of connectivity and a reciprocal economy, be an "autonomous democracy" that uses autonomy and cooperation as the operating principles of society and economy? This is because autonomous democracy can guarantee individual self-reliance, overcome individualism, and achieve harmony between community benefits

and individual benefits. In that self-regulation is the ultimate direction of freedom, and cooperation is the ultimate direction of control, autonomous democracy is the 3rd democracy that goes beyond liberal democracy (the 1st democracy) or people's democracy (the 2nd democracy), and is a complete form of democracy [4].

In a platform economy, “autonomy” emerges as a keyword due to concerns about data monopoly and the negative consequences that would arise if third-party forces for certification and verification were concentrated in one place. Indeed, many consider “autonomous protocol” for certification and verification an integral part of a comprehensive and democratic digital future. Here, the “autonomous protocol” means communication rules used to exchange information and data between computers. However, this is in the same context as the autonomous capability of platform participants. In addition, the various processes of bureaucratic administration will be simplified by the introduction of algorithms, while the transparency of administrative information will also be enhanced as information on the needs and desires of people is actively communicated amid active full-scale connectivity. While it is self-evident that such decentralized individual value judgments will significantly change the pattern of economic evolution and human social development, the problem is that a new framework for governance needs to be drawn up and an upgrade of democracy is inevitable.

6. Concluding Remarks

Most societies tend to think that ongoing innovations can continue within the capitalist social order. However, technological innovations related to the 4th industrial revolution are fundamentally different from those that created capitalist social order or industrial society. Technological innovations related to the 4th industrial revolution require social innovations that conform to the new social order in that they aim for a new economic ecosystem called the digital ecosystem. Social innovations include a new humanity, new civil rights, a new distribution system and economic order and an upgraded democracy.

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