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Vietnam and the Industrial Revolution 4.0: Promoting advantages for rapid and sustainable development

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Abstract: The 4th Industrial Revolution (4IR) is capturing the ideas and changing the way we live and especially the global economy. Being driven by remarkable development of science and technology, the revolution is expected to introduce tremendous and powerful impacts on the socio-economic development of nations in different aspects. Approaches to promote the sustainable development in Vietnam coupling with the Revolution are of great concerns. This paper examines the impacts of the 4IR on Vietnam and proposing some solutions supporting the rapid and sustainable development of the country.
Keywords: Vietnam, sustainable development**,** the 4th Industrial Revolution

I. Introduction

The 4th Industrial Revolution (4IR) is currently a big trend and a top concern. It has great influences on the socio-economic and political development in every nation. 4IR is based on digital technology and integration of all smart technologies to optimize processes and production methods. Strongly supported by state-of-the-art technologies such as the Internet of Things (IoT), artificial intelligence (AI), virtual reality (VR) and Social, Mobile, Analytics and Cloud (SMAC) 4IR will completely change the way of communication, production and working, and expected to bring many opportunities and challenges for all countries including Vietnam. This article focuses on the current situations and solutions to promote its advantages towards rapid and sustainable development of the country.

II. The Fundamental Impacts Of 4ir On Sustainable Development

Mentioned since the early 1980s and defined by International Institute of Sustainable Development, sustainable development is a development that meets current needs without compromising the ability of future generations to meet their own needs [1] and it is a basic and long-term goal of many countries in the world. The content of sustainable development includes sustainable economic development, sustainable social development and environmental sustainability. The essence of sustainable development is to achieve high economic growth without damage of the environment and resources, distributing fair growth results to members of society, ensuring none are left behind in the society.

The 4IR will introduce dramatic impacts on the development of all countries in the world in both positive and negative dimensions.

2.1 Positive impacts of the 4IR

- *Creation of new momentum for rapid economic growth*

In the models of long-run economic growth, economists often refer to the concept of production function, where the output of the economy is a function dependent on production variables such as human capital, financial resources and natural resources. Recently, many models of economic growth, typically endogenous growth models, by Uzawa (1965), Lucas (1988) and Romer (1990) highlight the roles of human capital and emphasize that knowledge and education are the key motivators of economic growth. According to this model, trained people are able to use physical capital more skillfully than less trained people, thus better at improving technology or creating more efficient methods of production.

Science and technology are the leading factors in creating sustainable growth in the long run. Although corporate profits can be boosted by institutional change, infrastructure development and human capital growth. However, all of these factors are influenced by the rules of marginal productivity decreases. Consequently, growth dynamics deteriorate without technological innovation in the long term.

The 4IR is expected to create remarkable change in labor productivity as it will generate the opportunity for the establishment of a new growth model based largely on technology and innovation rather than traditional economic growth models relying on inputs such as capital, labor and natural resources. With the typical feature "small but smart", modern technology-based production models in the 4IR will be less dependent on traditional production factors such as land and labor but productivity will quickly increase based on the technology-integrated platform with no limitations of space and time. Labor productivity will be improved remarkably by new-generation robots, mobility and connectivity of billions of people and devices accessing to large databases, and multiplication of information processing capabilities.

- *Economical utilization of material*

At present, the added value of the manufacturing industry depends primarily on the processing of materials such as metals into products by applying software or control systems. However, in the future, customer demands will be collected via internet. The manufacturer will only update the software to upgrade the product. Machinery and equipments are then updated with new specifications without changing of details or parts. 3D printing technology saves materials and storage costs much more than traditional technologies. Therefore, production will be more efficient, more intelligent and more economical. Transaction methods can be implemented remotely. Wide connectivity, mobility and thousands of applications are making human life easier, more productive and more economical.

- *Opening chances for sustainable development*

Continuously technological innovation and scientific achievements shall meet the needs of economic, social and environmental developments. New technology in production is expected to replace conventional methods. Materials science introduces uses of non-toxic or less toxic, recyclable and low-waste materials in the production and consumption processes. Applications of energy science and energy saving technologies will enhance efficiency of waste treatment, replacement of mineral fuels by renewables. These efficient and less resource consumption products will help to setup environment-friendly production lines which is crucial for sustainable development. Biotechnology also creates new varieties of plants that are highly adaptable to climate change. These advances and achievements are major supporters and generating new chances for realizing sustainable development in every country.

2.2 Negative impacts of the 4IR

The 4IR is expected to bring about huge benefits. However, for developing countries including Vietnam, the economy is much reliable on resource exploitation and cheap labor; the impact of this revolution in the early stages can be negative. Specifically, new energy or material, 3D printing will greatly affect the exploitation and usage of resources, as we will no longer rely heavily on resource extraction. The negative aspects can be foreseen as:

- *Job challenges for the unskilled employees*

Advances in technology can create risks of job losses especially on the ill-skilled people working in labor-intensive industries. This is due to the realization and applications of smart systems operated by robots which reduce the human involvement in manual activities. Those who work in the transportation, accounting, real estate or insurance will also be in job challenges. For example, manual labor in traditional textile and garment assembly and agriculture sectors will suffer the greatest impact from this revolution. Statistics show that, in the next 20 years, 70-75% of simple, manual jobs in these industries may be replaced by robots or automatic systems. As the consequences, there will be not much job availabilities for traditional workers.

This is one of the biggest challenges for Vietnam, because the labor restructuring of Vietnam is keeping at very slow pace. The Vietnamese economy is still heavily reliant on cheap labor-intensive sectors. However, in the development trend of the knowledge-based economy, skilled human resources with creative capacity are advantageous. Moreover, modern technologies sparked new revolutions in many sectors of the world economy. 4IR will challenge the "mass production" with the "batch customization" model. It can be foreseen that many laborers in agriculture, textile and garment industries, accounting, assembly and repair will face the risks of being threatened by unemployment. This people are still making up a large proportion of labor force in the country. In addition, capabilities to absorb, master, and effectively apply new technologies are being hindered by poor-skilled manpower.

It is also known that computers with artificial intelligence had defeated humans in chess and game playing. It demonstrated the power of technology but challenged well-skilled jobs as well. Intelligent devices are able to

recognize faces, voices and even compose melodies as human can. This fact is threatening millions of jobs that were thought to be difficult to be replaced.

The International Labor Organization (ILO) report shows worrying data as more than two thirds of the 9.2 million workers in the textile and footwear industries in Southeast Asia are threatened by a rapid expansion of science and technology applications. Specifically, about 86% of Vietnam's labor, 88% of Cambodia's labor forces and 64% of Indonesian labor in these industries will be heavily influenced.

- *Widening the gap between the rich and the poor in society*

The 4IR will be advantageous for people with high skills and they profit from technological strength. Therefore, the difference between the rich and the poor is getting widened. As a result, social inequality may be greater, creating a difficult gap.

III. Advantages and Disadvantages of Vietnam in the 4ir

Vietnam has the advantage of being a country with a young population and a high proportion of population accessing the Internet. There are nearly 50 million Internet users, accounting for over 53% of the population, 46.64% higher than the world average. Of these, 47.19 million have internet connection, accounting for 50% of the population. 87% of users use the internet daily.

Internet access creates the prerequisite for achieving outstanding growth in e-commerce, other sectors and socio-economic fields. According to a survey published in 2017, 48% of Internet users search for goods and services, 43% of users visited online retail stores, 39% purchased goods and services over the network. Of this, 29% of people buy goods and services online by computer and 29% buy on mobile devices. In 2016, there were 33.26 million people purchasing goods and services by e-commerce, accounting for 35% of the population. The total market value of e-commerce transactions in 2016 estimated of 1.8 billion USD, sales average e-commerce per user per year in 2016 is 55 USD [2].

These features create opportunities for Vietnam to access new technologies as well as constitute creative youth entrepreneurship movements. This opportunity has the prospect of development by the fact that large conglomerates once dominated the market for a long period being kicked off by young entrepreneurs in the field of superior technology in recent times. In fact, in the 20th century, there were many pioneers in industries such as GM, Chrysler, Kodak, Vivendi, Lotus, Sears, Motorola, Panasonic, Sony, Philips, AIG, Lehman and Nokia. For almost a decade, these businesses have disappeared in the market or are declining competitiveness. Typically, Motorola - the world's first mobile phone maker; Kodak - a maker of camera films; Nokia - just a few years ago, has rained on the market, and is now bankrupt after 100 years of development. On the contrary, there are new businesses such as Google, Amazon, Facebook, Apple, or low-level businesses such as Samsung Electronics take the lead. This is an unprecedented phenomenon in the history of economic development of the world and also a motive for aspiring young Vietnamese.

However, Vietnam also encountered many difficulties in the 4IR.

3.1 Hard adaptation of industry structure to the technological trend of the 4IR

The 4IR will have a strong impact on some of Vietnam's major industries such as: (i) energy sector: oil & gas and electricity are suffering from long-term deflation due to changing the technology towards efficiency, energy saving, use renewable energy to help protect the environment ... (ii) garment, footwear, fine arts and handicrafts: these are the three export industries Many of Viet Nam's most inexpensive high-value labors have the highest export value but fall under the category of weakest, lowest added value in Asia. This industry will face many challenges when it cannot continue to compete with cheap labor and cannot compete with modern technology. (iii) Manufacturing industry: this is the most affected sector, as it is constantly affected by the changes in technology in the global economy, the mechanism of technology transfer through import and export.

It is the dramatic change of technology and machinery that changes the flow of international trade, re-dividing the demand for cheap labor that is used to produce for large markets. As for the electronics industry, in terms of production capacity, it is easy to see that this group is completely affected by the multinational corporations that base their production of electronic components and assembled finished products in Vietnam. Production capacities of domestic firms in this industry are increasingly narrowed or closed down by high-tech products that require continuous innovation - which domestic firms often suffer from shortages in the industry. There will be a race on technological innovation, quality and price when joining the supply chain to the world market.

3.2 Low rate of trained workers

In Viet Nam, the proportion of trained labor force remains very low. Detailed figures are shown in Table 1. In 2016, the proportion of trained labor force is only 20.9%. Of which, the proportion of workers with university education is the highest, reaching over 9.2%.

Year	Total	Vocational training	Intermediate	College degree	University degree or above
2010	14.7	3.8	3.5	1.7	5.7
2011	15.6	4.0	3.7	1.8	6.1
2012	16.8	4.7	3.7	2.0	6.4
2013	18.2	5.4	3.7	2.0	7.1
2014	18.6	4.9	3.7	2.2	7.8
2015	20.3	5.1	4.0	2.7	8.6
2016	20.9	5.0	3.9	2.8	9.2

Table 1: Proportion of trained labor force in the period 2010 – 2016 (Unit: Percentage)
Source: General Statistics Office, Ministry of Science and Technology

The 4IR with sophisticated technologies and techniques will change the traditional skills that have played an important role in the previous period as robots gradually replaced workers. The human resources training model in Vietnam is not suitable for Vietnam's current labor market due to its occupational structure. The labor force with university or higher degree in Vietnam is mainly in economics, business administration and law. Meanwhile, in order to match the trend of the 4th Industrial Revolution, Vietnam must increase the training of high technology workers, university training in high technology fields.

The quality of Vietnamese labor is still very limited, not even meeting the production requirements of the 3rd Industrial Revolution. Even comparative advantages in the international market such as textiles, leather and footwear, and labor in Vietnam are unlikely to be taken advantage of in the 4th Industrial Revolution. Workers in Vietnamese garment enterprises are stuck in the midst of fierce global competition, with cheaper labor from Cambodia, Bangladesh, Myanmar, and robots is being widely used in both developed countries and in China. Higher value production shift back to developed countries and back to China where is closer to big consumer markets, R & D centers and supplying materials and accessories centers. The most affected are the simple laborers, the less skilled because they are easily replaced by robots.

In that context, Vietnam's low level of labor and low labor productivity is considered a "bottleneck" to catch the wave of technology advancement for country's economic development. Accordingly, the advantages of cheap labor, common labor of Vietnam will be faced with fierce competition from new technologies and robots that the 4IR brings.

With unskilled labor, Vietnam will face many difficulties and challenges in absorbing and applying advanced science and technology into production and business. Therefore, in addition to increasing investment in science and technology, the Vietnamese Government will need to build and develop a contingent of highly qualified and knowledgeable workers in science and technology, be ready to absorb the advances of science into production.

Thirdly, human resources in science and technology of Vietnam are limited.

The data in the Table 2 shows that number of laborers working in the field of science and technology in Vietnam accounts for a very small share of the total labor force in the whole economy. There has been no significant increase in the size of labor in science and technology over the last five years. The share of labor in science and technology in the country's total workforce has not increased over the last five years. The Table 2 shows details of the number and labor force operating in science and technology in Vietnam.

No	Indicator	2010	2012	2013	2014	2015
1	Number of employees engaged in science and technology (thousands)	217.5	248.8	249.2	250.6	251.8
2	Percentage of labors engaged in science and technology (%)	0.4	0.5	0.5	0.5	0.5

Table 2: Number and percentage of labors working in science and technology in Vietnam in the period 2010-2015
Source: General Statistics Office, Ministry of Science and Technology

3.3 Limited financial potential for investment in science and technology, mainly from the state budget.

According to data of the General Statistics Office and the Ministry of Science and Technology, the period of 2006-2013 recorded a sharp increase of state budget spending on science and technology from 5.429 billion VND to 13.869 billion VND. In 2014, this indicator will slightly decrease and then increase again in 2015, reaching approximately 17.390 billion VND (Figure 1).

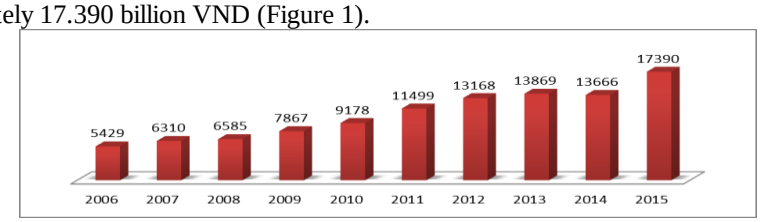

Fig 1: State budget expenditures for science and technology in the period 2006-2015 (Unit: billion VND) Source: General Statistics Office, Ministry of Science and Technology

Figure 2 shows that the state budget for science and technology has increased over the years. In the period from 2010 to 2015, state budget expenditure has nearly doubled. However, compared to total state budget expenditures and GDP, spending on state budget funds for science and technology is very modest. This is shown in Figure 2 below.

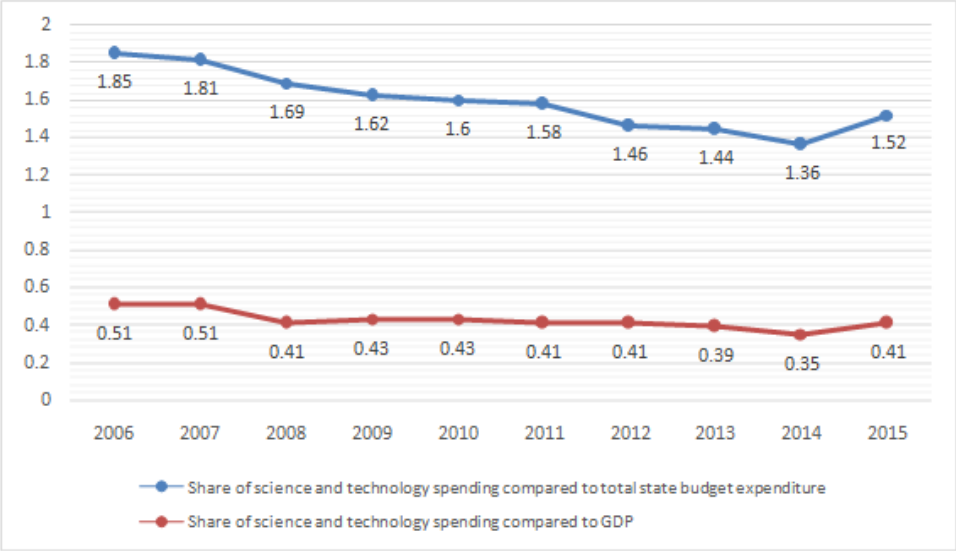

Fig 2: Proportion of state budget spent on science and technology compared to total state budget expenditure and GDP (%)
Source: General Statistics Office, Ministry of Science and Technology, Ministry of Finance

Not only accounting for a small proportion, spending from the state budget for science and technology compared to the total state budget expenditure tended to decrease from 1.85% in 2006 to only 1.36% in 2014. Meanwhile, the proportion of state budget investment in science and technology compared to GDP is also very

modest, less fluctuating, fluctuating around 0.4 - 0.5 %. That is not to mention the situation of investment spread, lack of efficiency and waste in investment projects for science and technology.

In addition, funding for science and technology activities in enterprises, which are the main production and business entities of the economy, is very limited, and lacking in strategic vision. Although most businesses are aware of the importance of science and technology with the development of enterprises but not yet turned into pressure, the driving force promoting the actual production and business activities of enterprises. Therefore, instead of using advanced technologies in business, enterprises prefer to choose technology associated with labor advantages. Meanwhile, the market of technology and science of Vietnam is formed and developed scatteredly, not to promote the desired effect on the requirements of development and application of science and technology.

IV. Some Solutions for Promoting Advantages, Overcoming Difficulties towards Rapid and Sustainable Development of Vietnam in the 4ir

The recent economic growth model of Vietnam is increasingly exposed to many constraints such as environmental pollution, depletion of resources and social unrest. In addition, the complexity of climate change creates many difficulties and threats to the stability of the economy of the country. Therefore, the 4IR is an opportunity for Vietnam closer to advances in science and technology, which is the key to Vietnam's rapid and sustainable economic development.

The solutions are proposed as follows:

4. 1 Solutions for promoting advantages

- Completing the legal environment for the development of the science and technology market in the direction of integrating and building a legal environment for the development of new business lines in Vietnam, which is beginning to emerge from the industrial revolution. The state needs to create favorable conditions for the environment for enterprises to have access, participation and application of advanced technologies.
- Developing and implementing a program to support the integration of the 4IR in Vietnam, especially small and medium enterprises. A dynamic private sector can create strong demand and absorb advanced knowledge for value-added goods and higher competitiveness in the domestic and international markets. Businesses can then become more effectively engaged in global value chains, playing a leading role in the local value chains and industrial clusters.

4.2 Some solutions for overcoming difficulties

4.2.1 State management innovation serves the innovation system

- Establishing the government of integrity, implementing efficient public services to facilitate development. The relationship between state and business should be seen as partnership, with support and interaction. The operation of the State management system should be renovated, building responsible administrations and minimizing the negative impacts of group interests. It is also necessary to improve the quality of business support services.
- Formulating a comprehensive economic strategy, clearly defining the fields, industries with comparative advantages, key production branches and national products of Vietnam. This is quite a difficult task that Vietnam has not completed for many years. Because strategy is the foundation to realize policies, appropriate ones will guide private businesses to invest in human resources, finance and technology. Priorities should be put on public investment in infrastructure development in line with improving internet connectivity, extending its coverage, speeding up access and lowering the cost of utilization.
- Completing the legal documents related to science and technology, regulations on high technology and venture investment. The State should focus on speeding up the process of strengthening the information technology platform, evaluation criteria for Research, Development and Innovation (R&D&I). In parallel, information technology innovation should be transparent, fostering the precise evaluation of scientific research results, the socio-economic and geopolitical benefits. Regarding the capital market, long-term market, development of venture capital funds associated with technology and innovation should be accelerated.

4.2.2 Empowering of human resources for innovation.

- Creativity and innovation are keys for any successful organizations. They are knowledge-based and must be built-up through education and training. Science - Technology – Engineering – Math (STEM) should be incorporated to school curriculums to foster creative thinking for students. National education and training system should be adapted and improved to generate capable work-force to master the 4IR.
- Selection, nurturing and investment for talents at all ages should be done appropriately with focus on science and technology. This approach will create a well-prepared human resource to master the 4IR.
- Prioritized national investment should be put on socio-economic development oriented research activities in universities and research institutions.
- Supporting policies should encourage business start-ups taking the universities, research institutes as a focal point of innovation.

4.2.3 Key role of enterprises in the innovation process

- National policies should favor manufacturing enterprises to innovate their production. Then enterprises will boost potential R&D&I initiatives or projects. They will become the heart of square collaboration between government, universities/research institutions, investors and enterprises.
- Innovation activities of Vietnamese enterprises can be financed by the National Scientific and Technological Development Fund, the National Technological Innovation Fund or venture capital funds. So far the outcome from these activities is still modest compare to the investments and requirements for innovation. The targeted beneficiaries and set of criteria need to be assessed and selected carefully with the goals of effectiveness and fairness.
- Domestic and international enterprises collaboration should be promoted by industry policies to support start-ups and those operating effectively on technology development and application and supporting industries associated with global value chains.

V. Conclusion

Vietnam has achieved impressive achievements in economic and social development. Economic development has helped raise incomes and reduce poverty, bringing better lives for many people. But the current situation is that the country's GDP growth has slowed down in the international context and less active. Previous growth sources are declining while increasing the risk of falling into the "middle income trap". The 4IR is an indispensable global trend, providing great opportunities to promote rapid and sustainable development in Vietnam.

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