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The Orientation for Industrial Development in Revolution 4.0

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***Abstract*—** *Up to now, we have passed three major scientific and technological revolutions. First, the Industrial Revolution 1.0 (1784) was the arrival of the steam engine. Steam engines directly impact industries such as textiles, mechanical engineering, and transportation. Steam engines were introduced into cars, trains and ships, opening a new era in human history. Second, the Industrial Revolution 2.0 (1870) was when the electric motor was born, bringing civilized life, productivity increased many times compared to steam engines. Third, the industrial revolution 3.0 (1969) is when transistors, electronics, connecting the world are in contact with each other. Satellites, airplanes, computers, phones, Internet ... are the technologies that we currently enjoy. Today is the era of the 4.0 industrial revolution, which is a high-level combination of physical and digital hyperlink systems with a focus on the internet, everything connected (IoT) and artificial intelligence. Technology 4.0 will free people from intellectual work. The demonstration of Technology 4.0 is Robot Sophia, who has been granted Saudi Arabian citizenship. Sophia was created by Hong Kong-based Dr. David Hanson, the founder of Hanson Robotics, a robotics company based in Hong Kong, where he and his family moved to develop their careers, due to their low cost and high quality engineering.*

***Keywords*—** *Industry 4.0, policy, industrial revolution.*

I. INTRODUCTION

The term industrial revolution 4.0 is being mentioned a lot from the state level, to enterprises and universities, as a challenge and opportunity to develop the country. But in reality, our country is still in the industrial phase 1.0 and 2.0 - that is the period of mechanization, infrastructure, roads, bridges and airport terminals are under strong construction. Vietnam's railways are very backward, low train speed due to the narrow gauge of the railway from the French colonial period, frequent accidents due to conflicts with road traffic. Although producing electricity for a long time, we have not manufactured many types of motors, not yet produced machine tools which are the main driving force for assembly and mass production lines - a characteristic of industrial license 2.0. We can only produce small and medium-sized asynchronous motors for simple applications such as water pumps, blowers, conveyors, etc. Most of the technological and assembly lines are currently imported. foreign. Therefore, it cannot be assumed that we have completed Industrial Revolution 2.0 and it is even more unlikely that we have implemented Industrial Revolution 3.0, because the comprehensive automation of production - the characteristic of this period is far from industrial. Vietnam. While Vietnamese human resources are assessed as having an advantage in STEM subjects (Science Technology Engineering Math) - an area in which students gain knowledge of science, technology, engineering and maths productively.), but according to the World Intellectual Property Organization (WIPO) and Cornell University in 2017, Vietnam's evaluation indicators are still low. For example, in 2017 the global innovation index ranked 47/127, although it increased 12 levels compared to 2016; in terms of creative capacity, Vietnam ranked 77/100; In terms of technological innovation, Vietnam is only ranked 90/100. According to data of the Ministry of Industry and Trade, up to 61% of Vietnamese enterprises are still outside the Industrial Revolution 4.0 and 21% of businesses have just started to prepare for the first activities. Up to now, we have passed three major scientific and technological revolutions. First, the Industrial Revolution 1.0 (1784) was the arrival of the steam engine. Steam engines directly impact industries such as textiles, mechanical engineering, and transportation. Steam engines were introduced into cars, trains and ships, opening a new era in human history[1]. Second, the Industrial Revolution 2.0 (1870) was when the electric motor was born, bringing civilized life, productivity increased many times compared to steam engines. Third, the industrial revolution 3.0 (1969) is when transistors, electronics, connecting the world are in contact with each other [2]. Satellites, airplanes, computers, phones, Internet ... are the technologies that we currently enjoy[3]. Today is the era of the 4.0 industrial revolution, which is a high-level combination of physical and digital hyperlink systems with the focus on the internet, everything connected (IoT) and artificial intelligence. Technology 4.0 will free people from intellectual work[4]. The demonstration of Technology 4.0 is Robot Sophia, who has been granted Saudi Arabian citizenship. Sophia was created by Hong Kong-based Dr. David Hanson, founder of the Hanson Robotics company in Hong Kong, where he and his family moved to develop his career, because of its low cost and quality engineer team [5]. Currently, we are witnessing the Internet of Things, big data, cloud computing integrated with all smart technologies to optimize production processes and methods[6]. These fields of technology are promoting the so-called "Fourth Industrial Revolution". By being sensitive to the digital vision, the countries pioneering in Industry 4.0 are well aware of the potential for "digital transformation" in the structure of manufacturing industries, on the other hand, they also recognize the investment for Industry 4.0 will create a driving force for the economy with outstanding growth[7]. Instead of creating new industries, "digital" opportunities are driving a full transformation of today's industries[8]. In other words, Industry 4.0 renews the way it operates in business and production. However, the rate of using digital technology in businesses worldwide is still very low, specifically, over 41%

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of companies of the European Union (hereinafter referred to as the EU) have not yet applied. any advanced digital technology[9]. This is just a fact that businesses are facing challenges in the transition to digital businesses. However, reference to a recent survey of EU businesses shows that, 75% of businesses think that digital technology is an opportunity and 64% of businesses invest in digital technology that produces positive results[10].

II. POLICIES ON INDUSTRY 4.0

Assessment based on technology level: Vietnam's technology level is low. This can be seen from the fact that Vietnam's average value of high-end and high-tech products only accounts for 30% of total export value, while countries in the region are 80%, low as the Philippines also accounts for 50%. %. Evaluate the Internet of Things (IoT) level at the average level, the level of intelligent transport connectivity, 3D printing technology, advanced materials, and low renewable energy. With a low technological level, Vietnam's labor productivity is not high, only equal to 4.4% of Singapore, 17.4% of Malaysia, 35.2% of Thailand, 48.5% of the Philippines (2015). Therefore, the risk of losing jobs due to the adoption of automation in Vietnam will be very high. In this respect, Vietnam has the only advantage is that the mobile subscriber density far exceeds that of other countries in the ASEAN region. In 2017, the number of Internet users in Vietnam increased to 64 million, accounting for approximately 67% of the population. The factors of technological innovation and education are low: Vietnam's technology and innovation index is at the lowest level with 3.1 / 10 points, ranking 90/100 in technology and innovation (Technology & Innovation); ranked 92/100 in technology platform (Technology Platform); ranked 77/100 in creative capacity; ranked 70/100 in terms of human resources, 81/100 in terms of highly specialized labor; 75/100 ranking for the quality of higher education; Investment in research and development (R&D) only accounts for 0.2% of GDP, ranking 82/100 economies. Institutional quality is also low: The institutional environment is weak, showing: 1) a shortage of highly qualified labor; 2) instability in policy regulations; 3) high taxes and cumbersome tax procedures; 4) difficult and complex access to finance. The percentage of workers with high technical qualifications in the processing industry, manufacturing accounts for an average of 9% (college level or higher), while in developed countries, this rate is 40% - 60% . It is predicted that 74% of Vietnam's manufacturing and processing workers will be at high risk of being replaced by automation. This is much higher than other countries in the region, such as the Philippines (54%), Thailand (58%) and Indonesia (67%) (1).To cope with the challenges of changing from "enterprise" to "digital enterprise", most of the governments of countries have put industry 4.0 as "priority", applying policies to create favorable conditions for the public. Industry 4.0 develops on a large scale to increase productivity, increase competitiveness and improve skills to use smart technology for their workforce[11]. Industrial Revolution 4.0 (Industry 4.0), which is a high-level combination of physical and digital hyperlink systems with the focus on the internet, everything connected (IoT) and artificial intelligence. Industry 4.0 with digitalization system, aiming to liberate people from intellectual work. In this article, the author introduces: Industry 4.0 and its impact; world industrial development trend 4.0, mainly in Asia; Vietnam and the degree of digitalization[12], along with some opinions about the role of the state in promoting digitalization of manufacturing enterprises[13]. This article will point out the focus of industrial policy 4.0 in leading EU countries such as France, Germany, Netherlands, Sweden, Italy, Spain, UK and Czech Republic[14]. The author also clarifies the differences throughout the content of industrial policy 4.0 in the policy design of countries, mobilizing and using capital, implementing it has brought certain efficiency. Moreover, the authorities in these EU countries are aware of the actors involved in industrial policy 4.0, but there is a lack of systematic cooperation and exchange through regulations from government. In addition to conducting comparative analysis, this paper aims to find out lessons learned from policies for industry 4.0 to help facilitate objective and scientific perceptions in policy formulation and implementation in Vietnam in the short and long term[15]. The key points of Industry 4.0 policy are part of the overall strategic framework, reflecting Industry 4.0 priority in the EU as shown in below. In particular, France's "Industry for the Future" Scheme is linked to the "Normandie Industry" Program.

Italy's "Smart factory cluster" project is built on the Italian "Roadmap for Innovation", a broader strategy on the three challenging socio-economic areas that Italy is facing, including: climate change, scarcity of resources, mechanical population growth. France and the Netherlands have clearly defined the reasons to launch policy initiatives. In France, the lack of investment and digital industry development issues are the driving force behind policy creation. In the Netherlands, by contrast, the relatively low percentage of people working in the manufacturing sector has led to a smart industry. In some countries, policy initiatives are a direct result of a national strategic framework and / or agenda. Germany's "Industrial Platform 4.0" project began as one of ten projects in the High Technology Strategy Action Plan until 2020. In the case of Spain, the Scheme is a digital part of the Industry Strengthening Program and is gradually transformed into the "Connection Industry 4.0" Scheme. Meanwhile, the Project "Launching of high value-added production" in the UK shows how the UK Government has acted in proposing policy strategies to set up a series of technology centers in industry.

In industrial policy 4.0 of EU countries, there is a big overlap in the goals and objectives they pursue. Looking at specific goals in the national strategy, most of their policies are intended to enhance the competitiveness and modernize the national industry. The most obvious is the goal to ensure the sustainable growth of the mechanical engineering industry. If fundamentally in a national policy, economic goals are often combined with social and environmental goals. Although achieving economic goals requires a difference in policies and overall goal adjustments. In the case of Spain, the cost covered by a loan depends on the scope of operation and the type of business, between the cost of 25% and 70%. France's

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"Industry for the Future" scheme combines a variety of funding tools, for example, loans and tax incentives with private investment in scientific research and technology development (R&D). Sweden's "2030 Production" scheme is heavily controlled and financed by industry to ensure industrial impact and long-term sustainability.Meanwhile, the most unique element in the UK involves providing industrial scale technology and expertise to businesses to reduce the risk of technological innovation through the establishment of seven technology centers. In this way, the centers provide a favorable environment for cooperation between industry, research and government agencies and / or between regional and national parties. In France, the foundation of the "Industry for the Future" Scheme facilitates cooperation between industrial and civil stakeholders. Meanwhile, Germany's "Industry 4.0" Scheme allows policymakers to promote leadership in industry 4.0 issues at all levels of management. On the other hand, the Italian Smart Cluster Scheme incorporates regional and national Industry 4.0 policies in line with EU guidelines [11].

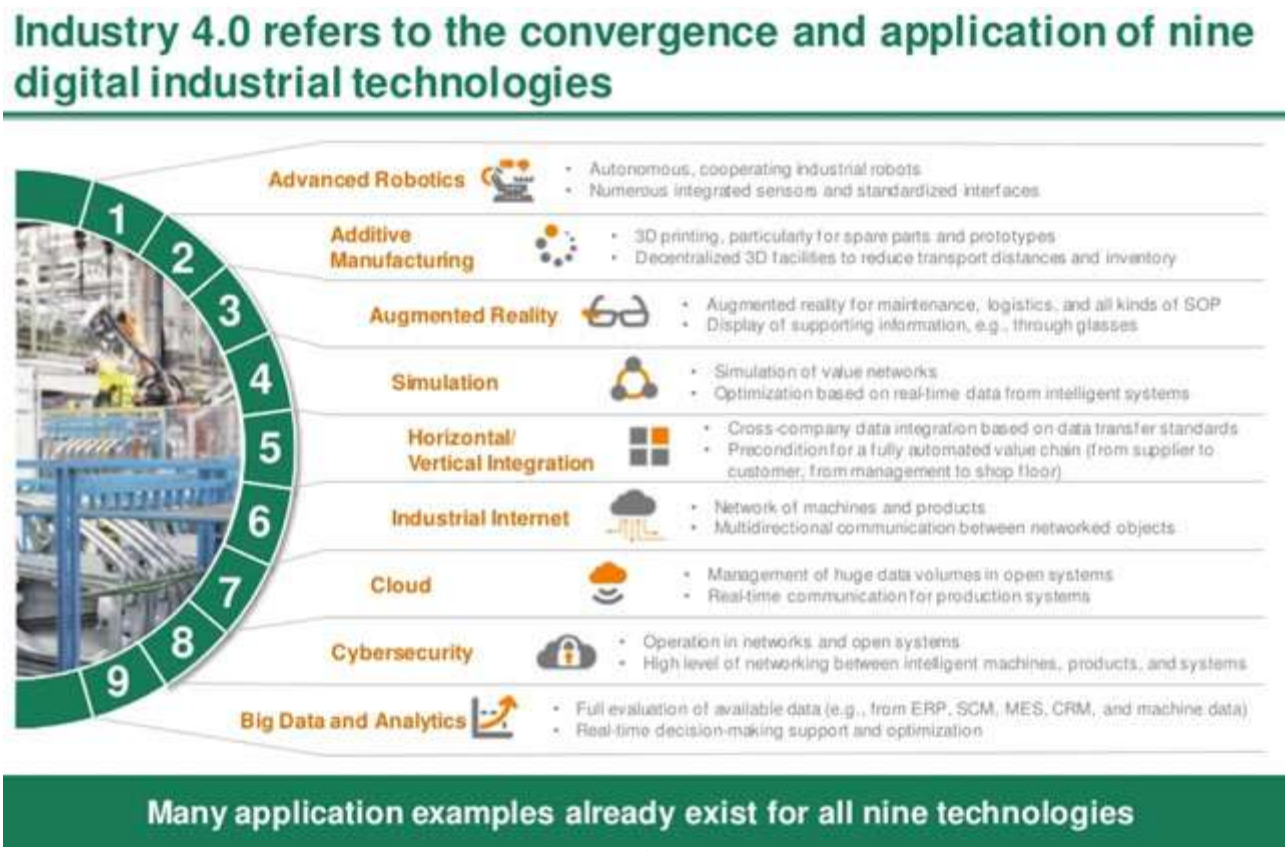

Fig. 1. Key points of Industry 4.0 policy

Although, all policies considered regarding Industry 4.0 are prioritized to accelerate the deployment and application of Industry 4.0 technologies. Only the Italian Smart Cluster Scheme focuses more on research, especially on developing new technologies to meet the challenges of creating innovation. Moreover, there is no clear technology or industry focus of national policies. While the internet of things / virtual-reality systems is the most common technology sector, it is only considered as a goal in German and French policy. At the sector and manufacturing level, specific models do not exist. This shows that the policy initiatives of the leading countries in Industry 4.0 tend to be relatively open to the application of specific 4.0 technologies or industry-specific technologies. Increasing the sustainability of production is a common area of impact targeted by Swedish and Italian initiatives. Meanwhile, Spain seeks to provide information and implementation support to companies to better exploit the opportunities provided by industry 4.0. In the Netherlands, greater flexibility in production, efficiency, cost and customer needs are the main expected impacts.

Although national industrial policies 4.0 are based primarily on public (state) financing, additional private investments are also important with significant leverage efficiency. However, the volume of leverage increase in investment between the policies under consideration is largely different. Similarly, measures adopted by policy initiatives to ensure private investment vary by type of activity. Moreover, information on private leverage is not expected to be available to all policy initiatives, hindering comparisons between policies. The UK's "High value-added production launch pad" project underwent a comprehensive review of the leverage effect of public investment. With a leverage of 17/1, "High-value manufacturing launchers" exceed the leverage of any other policy initiative, even more than many times. To a large extent, this success can be attributed to the considerable amount of income from commercial activity that the "High

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value-added production launch pad" is achieved through competitive R&D contracts. Despite the difficulties in assessing the success of policy initiatives in promoting private sector investment, it is clear that the range of measures taken varies. The two projects "Industry for the Future" and "Launching of high value-added production" have provided the most comprehensive measures. "Industry for the Future" provides tax incentives for private R&D investment.

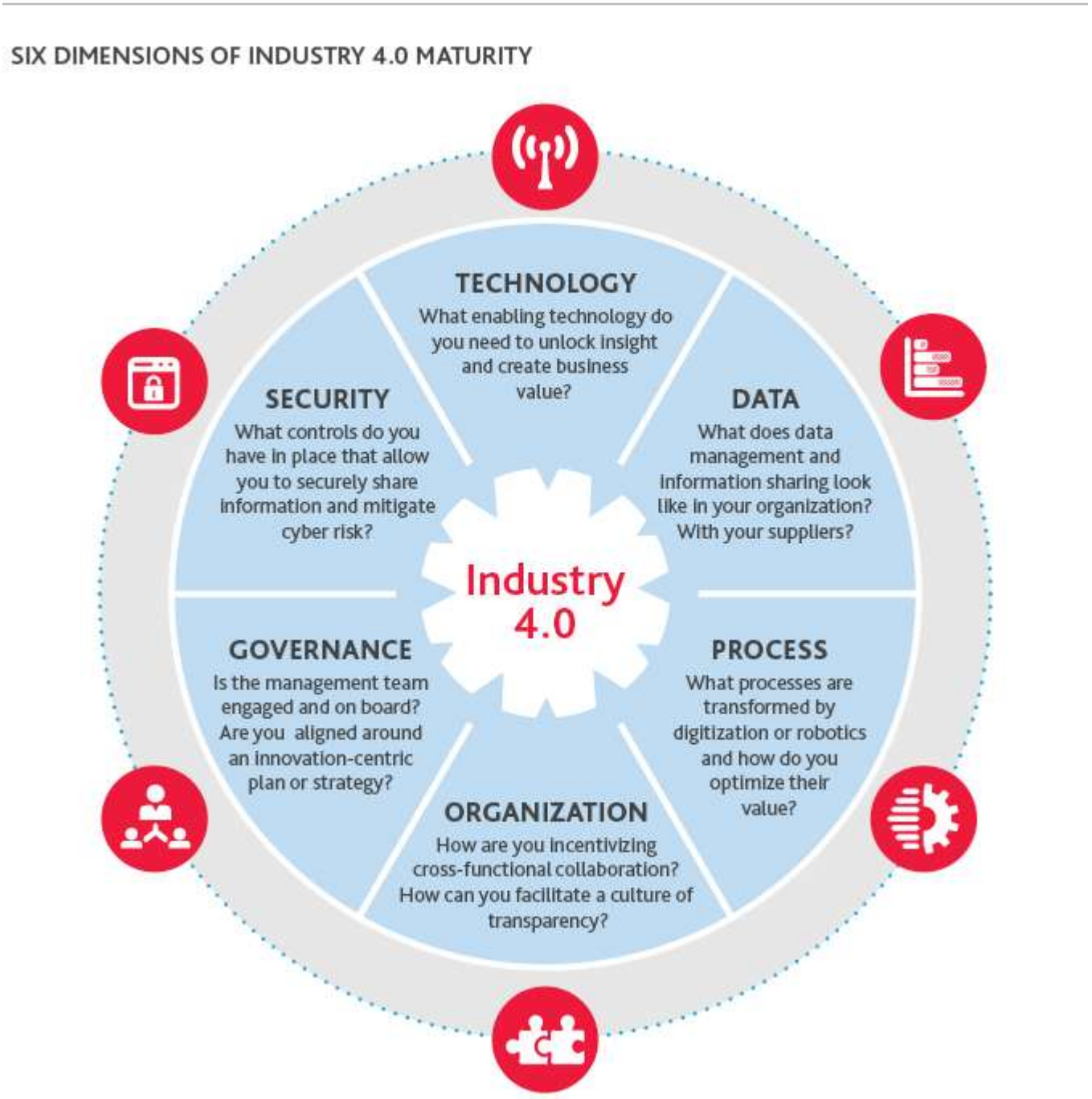

Fig. 2. Strategic technology for industry 4.0

Moreover, "High value-added production launchers" provide strategic participation with important industry partners and support programs for the participation of small and medium-sized businesses. Although, real mechanisms are in place to better ensure private investment - that is, encourage or require private investment - national policy initiatives will benefit from consideration. tighter private investment in policy design. National policies for Industry 4.0 in the EU have produced qualitative and quantitative results. The qualitative and quantitative results are incomplete for France, the

Netherlands, Sweden and the UK. In the "Industry for the Future" in France more than 800 corporate loans and 3,400 cases were supported, while Sweden, "Production 2030" financed 30 projects with the participation of more than 150 businesses. karma. Meanwhile, for Germany's Industry 4.0 policy initiative, outstanding qualitative results such as reducing industry divisions, transforming practical applied research and creating networks with a 150-member platform. Regardless of the important results achieved, the lack of clear short-term, medium-term or long-term goals, often means that it is unclear whether the policy goal has been achieved. The UK's "high value-added production launch pad" is once again an exception, as the initiative has set a clear goal for cyclical monitoring and evaluation. The results from the comprehensive evaluation study show that the value of innovation is 123% compared to the original goal in the period 2013-2015. This indicates that the demand for services and supports exceeds initial expectations. In addition to the overall strategy or roadmap to identify key goals and action steps, the use of proposals, working groups, in-depth consultations and steering committees with broad participation is needed. set. In a number of policy initiatives, additional initiatives have been implemented to coordinate implementation. To finalize the policy design and start implementing, consultations, stakeholder consultations and call for proposals are conducted.

In Spain, consultations with stakeholders are quite comprehensive. In the course of nearly 5 months, "Industry 4.0" has organized a series of seminars and meetings related to all participants. In addition, three major industry partners (Santander, Indra and Telefonica) helped set up strategic and governance models. In Sweden, the use of expert groups has contributed to the development of new content and suggestive comments, as well as the creation of new policy visions and proposals.

III. NATIONAL POLICIES ON INDUSTRY 4.0

A. Policy space

Firstly, in terms of investment, industry 4.0 funding comes primarily from the public and private sectors.

Secondly, in terms of orientation and policy for Industry 4.0, there is a tendency to focus on technology and infrastructure, followed by development of production skills. The notable exception to the Swedish "Production 2030" Scheme involves the participation of a national university relevant to the manufacturing sector. The scheme "Production 4.0" in the Czech Republic also shows a great orientation for production skills, especially digital skills.

Thirdly, in terms of management and implementation, most national policies on industry 4.0 have a top-down approach to design, initiate and implement policy initiatives. This means that, although other stakeholders have been consulted and contributed to the implementation of policies, governments are still in control and control. One notable exception is Sweden's "2030 production" program, where industry, academia and research groups are responsible for the design and operation of policy initiatives. The Dutch smart industry is also an exception. Smart industry is based on principles and bottom-up approach based on three pillars, with the participation of industry, universities and other research partners. The public sector plays the role of establishing and implementing core activities.

B. Industrial policy control factors 4.0

In terms of coordination capacity between the parties and between different management levels, the project "Launching of high value-added production" has established an effective mechanism to facilitate cooperation between mind, throughout the Scheme. In these forums, representatives of all collaborative centers identify technological challenges and opportunities to address by taking advantage of the centers' combined capabilities. In addition, there is a dedicated budget to support transcenter technology projects. In general, the participation of diverse parties is a strength to define national policies on industry 4.0. Collaboration with industry stakeholders / stakeholders is most often mentioned by implementing agencies as a driving force.

In some cases, the industry proactively encourages the creation of initiatives - for example in the Netherlands and France - to create incentives. Involvement of regional authorities in the application of industry 4.0 strategies at the regional level - often within the framework of smart expertise strategies - is often allowed for strong policy alignment. closer between national and regional levels. Last but not least, public authorities' initiative to promote industrial policy 4.0 is also one of the main drivers. Public dynamics can be particularly useful when industries are too isolated or fragmented to reach consensus among industry participants. For example, Germany's "Industry 4.0 Platform" shows that a large 4.0 industry platform can reduce industry segregation and improve production networks.

C. Barriers faced in industrial policy 4.0

No specific barrier stands out as a common denominator for national industrial policies 4.0. Instead, a variety of different aspects arise. The lack of resources and ineffective participation of small and medium enterprises have challenged the implementation of policy initiatives. Like any other large-scale policy project, the state's initial budget is critical for industrial policies 4.0 to accelerate and build the capacity needed for effective functioning.

Experience shows that, although large companies are often familiar with the process of seeking financing for production, small and medium enterprises need more support to apply for funding.

D. Industry Policy 4.0 from a SWOT perspective

The SWOT analysis result of industrial development policy 4.0 shows a low level of convergence. Among the main strengths, support is given to businesses, along with agreement between policy administration levels, as well as industry co-financing. In contrast, the main weaknesses identified are closely related to barriers such as funding constraints, lack of capacity, poor planning, monitoring, and ways to engage SMEs into programs, ... These are also considered to be the main weaknesses in 4.0 industry policies. In France, there are doubts about the ability to effectively measure policy

achievements. Spain, at present, has no clear definition of goals. Meanwhile, Industry 4.0 mainly reflects potentials, expandability and transferability, new markets and international cooperation opportunities. In Sweden, the potential for expanding the scale of school production at the Nordic level provides new opportunities. Meanwhile, in Italy, the publication of a talented instrument. The new key of "Industry 4.0" will open up new opportunities for businesses. In terms of threats, the imbalance between the way of administration between levels in administrative management, along with the conflict of interests of sectors and within each industry is quite clear. Unusually, the "High value-added production launch pad" is attempting to maintain a balanced funding model, as profits have exceeded expectations. The balanced funding model is important to ensure a balance between encouraging growth and stimulating innovation in areas that are beneficial to manufacturing. The objective fact is that Industry 4.0 is gradually coming to our country. So it's time to take action. Policymakers should encourage technological innovation in association with social innovation, considering all possibilities on the supply side, as well as on the demand side. A systematic understanding of the innovation policy is needed, including strategy and implementation coordination so that production innovation can become social innovation and conversely social innovation can become innovation. manufacturing. Specifically, promoting learning and scientific research associated with enterprises so that new technologies and new knowledge can spread faster. The social innovation policy should promote interdisciplinary projects to create momentum for production innovation. Support the transfer of basic research results to application development through laboratories, smart factories with future technologies. This will encourage cooperation and prepare the basis for social innovation. The social innovation policy can support direct procurement of high-tech equipment, infrastructure development, vocational training and new career opportunities. Moreover, each Vietnamese must be understood as an opportunity for industry 4.0. Or determined to reach out to be the market leader, for example: Vietnam's cloud infrastructure, digital content market.

To enter Vietnam faster, like it or not, Industry 4.0 must still demonstrate its benefits to society. Only when developments in and around industry 4.0 lead to added value to the society; When new technologies, services and organizations are established, operate effectively in society and when social practices are "better for the people", we will realize and set the potential for industry. 4.0 has developed land. On the road to this goal, effective coordination and policies are needed.

IV. Conclusion

The fact shows that the timely and timely exploitation of challenges and opportunities of Industrial Revolution 4.0 are common ways of nations. For a developing country like Vietnam, that challenge is growing. Industry 4.0 provides us with many opportunities to improve our qualifications, production capacity and competitiveness in the global value chain, creating a major change in the sustainable business model and an opportunity for businesses creative start-up. This revolution also brings joy to developing countries, can shorten the process of industrialization by leapfrogging, leapfrogging development to higher technology. However, if there is no proper approach and catch up with the development level of the world and the region, Vietnam will face the risk of further lagging behind in technology, the labor shortage. and inequality in society. Besides, the connection and cohesion in the era of Industrial Revolution 4.0 leads to the issue of soft borders, soft power, cybersecurity and transnational high-tech crime. This requires the active response and best control to ensure sovereignty and security for people and the country.

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