

Smart manufacturing readiness in Vietnam: An assessment survey and policy implications

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Abstract:

This is an overview study of specific policies and implementation actions on smart manufacturing (SM) in Vietnam. SM is an important trend in the world, especially in the context of the Fourth Industrial Revolution (Industry 4.0). However, for a developing country like Vietnam, the right policy can help small and medium enterprises by providing a roadmap to transformation on a digital stage and according to their resources. Therefore, we conducted a survey that assesses the needs and current status of small-and medium-sized enterprises (SMEs) in Vietnam and proposes specific policies for the Government of Vietnam to develop and promote SM in our country at micro and national levels. In this research, we work to understand how economies that are similar to Vietnam, namely Indonesia and Thailand, adapt to the era of SM. This work will serve as lessons learned for developing countries implementing digital transformation in the Industry 4.0.

Keywords: industry 4.0's policy, smart manufacturing readiness, SMEs performance analysis, Vietnam's digital readiness.

Classification number: 2.3

Introduction

The impressive growth rate of Vietnam's GDP in 2019 (up by 7.02%) serves as confirmation of the efforts of businesses and people, as well as the timeliness and efficiency of solutions provided by the government. Similarly, 2019's growth rate, although lower than that of 2018, was higher than the growth rate from 2011 to 2017. Vietnam is one of the top three countries with the highest GDP growth in Asia and amongst the top 10 countries with the highest growth rate in the world in 2019. The processing and manufacturing industry continues to play a key role in growth with an increase of 11.29 thereby contributing 2.33% to the overall economic growth. However, compared

with some industrialized countries in Asia and the ASEAN-4 countries, labour productivity in the manufacturing sector in Vietnam is still low [1].

To maintain a sustainable high growth rate and narrow the gap with developed countries, Vietnam must make efforts to gain a new momentum to build a "Strong Vietnam". One fundamental solution is to implement a digital transformation that promotes SM, which will help Vietnam take the lead in the region in the Industry 4.0. With the advent of technology like big data, robotics, information and communication technology (ICT), Vietnam has a great chance to apply SM in the manufacturing sector [2, 3].

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Research questions

As a matter of fact, SM is not new in developed countries where technology has a very close relationship with manufacturing. However, in developing countries, manufacturing is still growing accustomed to utilizing high technology to evolve into a SM era. Vietnam has a huge interest in the Industry 4.0 where SM is one of the most important aspects. However, the question remains, “Is Vietnam ready for the wave of applying SM?” The answer to this question is broken down into three smaller questions that are depicted in the following sub-sections [4].

Bottom-up: for any macro situation to gain success, especially related to industrial changes, enterprises or companies are the key agents that play the most important roles. Therefore, we strive to understand if enterprises or companies have self-prepared and if they are capable of capturing the opportunities that SM brings. This idea means that the bottom base (enterprises or companies) should be well prepared to utilize any possible chances.

Top-down: once the bottom-up direction is fulfilled, the top-down direction should be in line to support. Top-down actions can be anything from government policy, easing the business environment or available standards for the economy to operate. We hope that the answer to the question, “What does the government do in order to support the application of SM in Vietnam?” helps the bottom-up direction more.

Pillars’ harmony: “What should Vietnam do in order to support SM on a pan-economy scale?” We propose three pillars in building a good environment for SM to flourish. The three pillars are: (i) research and development (R&D) activities; (ii) capability to adopt digitalization; and (iii) institutional actions from government and other government bodies. A harmonious cooperation between these pillars is required for the manufacturing sector to successfully adopt SM. Whether Vietnam achieves such a harmony is the

ultimate question to understand her readiness for SM.

Utilizing such a chance is a big question that all economic factors participating in the economy must cooperate to solve. To arrive at an answer, we outline our research in this paper as follows: methodology and research results; related experiences learned from similar countries; policy implications; conclusions and some insights about future work.

Methodology and research results

Industrial facts

Statistical background: as (APO, 2019) [5] shows, Vietnam’s GDP growth rate was quite impressive in the year 2019. Out of the growth rate of the whole economy, agriculture, forestry, and fishery sectors increased by 2.01 contributing 4.6% to the general growth, industry and construction increased by 8.9 contributing 50.4%, and finally the service sector increased by 7.3 contributing 45% to national GDP growth.

On the other hand, the growth rate of value added in the industry and construction sector was 8.85%. The industry maintained a high growth rate of 8.86%. The processing and manufacturing industry continued to play a key role in growth with an increase of 11.29 contributing 2.33%. The mining industry increased 1.29% after 3 consecutive years of decline, which contributed 0.09% to the increase in the total added value of the entire economy. The construction industry maintained growth momentum at a rate of 9.1% thereby contributing 0.66% to the general growth.

The proportion of industrial value added to the industry and construction sector is 83% of which the construction industry accounts for 17%. Among industries, the processing and manufacturing industries accounted for 56% of the total added value of the whole sector, the mining industry accounted for 26%, and the electricity and gas production and distribution sector accounted for 16%.

The processing and manufacturing sectors: in industry, the processing and manufacturing sectors employ most of the industry's labour accounting for 95%. Mining, power generation, gas, and water industries employ 1-2% of the entire work force and the rest are in other industries.

Processing and manufacturing industries continue to grow rapidly with an average growth rate of over 10.71% in the 2011-2018 periods and continued to grow by 11.29% in 2019. Labour productivity of the processing and manufacturing industries is 96.2 million VND (4.160 USD) per person per annum and the average growth rate of about 5.61% per annum in the 2011-2018 period, which increased to a relatively high level of 6.36% in the 2016-2018 period [5].

The industry's rapid development is also reflected by rapid growth in input endowment with an average capital growth rate of 13.9% in the 2011-2015 period and 12.9% in the 2016-2018 period. Labour growth was 9.7 and 6.3%, respectively, due to the labour movement from the agricultural sector. The total factor productivity (TFP) growth rate is also quite high, about 2.4% in the 2011-2015 period and 3.9% in the 2016-2018 period. As a result, TFP's contribution to growth increased from 23.7 to 29.6% in respective periods. On average, in the period 2011-2018, increasing TFP contributed 25.9% to the industry's growth [5].

As can be seen, processing and manufacturing industries has achieved relatively encouraging growth, in both quality and quantity. However, compared with some industrialized countries in Asia and the ASEAN-4 countries, the labour productivity of the manufacturing in Vietnam is still low.

According to the Ministry of Industry and Trade of Vietnam, significant achievements in the processing and manufacturing industries in 2019 can be seen in the high growth rate, export turnover and foreign investment attraction.

Processing and manufacturing industries have always been the bright spot of the industry sector with an average growth rate of approximately 10.9% making it a driving force for growth in the economy. Major industries that contribute to the growth of the processing and manufacturing sectors include metal production (+31.7% growth), coke production, refined petroleum (24.5%), production of paper and paper products (12.1%), furniture (11.3%) and textiles (11.3%) [5].

Despite the recent stagnancy of world economy and trade, Vietnam's exports in 2019 grew by 7.8%, which is much higher than the world and regional averages. Export from processing and manufacturing industries also grew at a higher rate of 9.8%. Products with high export growth in manufacturing and processing industries such as wood and furniture, textiles, footwear, electronics, electric cables, toys, and sports equipment, etc., have significantly enhanced the position of the industry.

Industries, in general, and the processing and manufacturing industries, in particular, have also received serious interest from foreign investors. In 2019, Vietnam attracted 3,478 new projects with a total investment of nearly 31.8 billion USD. Processing and manufacturing industries accounted for the highest proportion with a total investment of 21.56 billion USD, accounting for 67.8% of total registered investment capital [5].

The year 2019 was also the first year when the manufacturing and processing industries experienced a trade surplus of approximately 100 million USD. This had proven the effectiveness of the Government's policies and solutions in recent years to promote business development, especially industrial enterprises and industrial development.

With their great contribution to the national GDP, the manufacturing sector is becoming more and more important to Vietnam's economy. There is an ongoing demand to make manufacturing smarter to contribute more to the economy. To fulfil

such demand, firms must deploy more smart tools and machines. The question is: are firms capable and ready for a new change?

Firms' awareness and preparedness

We conducted a preliminary survey on the status and the implementation of SM for 215 enterprises in the northern, central, and southern provinces of Vietnam. The survey covers the following:

Awareness on the potential benefit of SM and whether it helps (i) improve the quality of decision-making on business operation; (ii) enhance operational efficiency of production line; (iii) reduce labour costs; (iv) reduce materials waste; (v) improve product quality; (vi) increase labour productivity; (vii) better satisfy customer requirements; (viii) enhance the competitiveness and sustainable development; and (ix) strengthen market position and social image.

Difficulties and barriers to the application of SM in enterprise: most SMEs recorded obstacles and difficulties in (i) understanding the value that each application can bring to an enterprise; (ii) limited resource to invest in infrastructure required for the application of SM; (iii) lack of qualified and skilled workers to implement SM; (iv) limited awareness of leaders about SM; (v) given the relative high cost in initial investment, the benefits that SM can bring on short or medium terms may not be higher than investment costs; (vi) limited access to financial resources for investment in SM; (vii) unsupportive environment for innovation investment; and (viii) missing supportive mechanism from the government to attract investment in SM.

Policy priorities: surveyed enterprises prioritized policies according to its importance to SM promotion as follows: (i) governmental support associations and consultancy centres to help SMEs better understand the value of SM; (ii) further investment in upgrading digital-support infrastructure (especially broadband speed, internet security); (iii) human resource development

for SM application; (iv) promotion strategies for SM application in Vietnam with clear objectives for the next 5 years and a comprehensive action plan; (v) establishing a national committee on SM promotion, which consists of representatives from government, businesses, and other experts to implement the strategy outlined; (vi) providing incentives for enterprises to applying SM in business; (vii) supporting enterprises in accessing to financial resources for SM investment; and (viii) supporting SM service providers to lower the price in Vietnam's market.

Survey results from our research reveal that most industrial enterprises in Vietnam are not very ready for Industry 4.0. Among the four pillars that are relevant to the readiness for Industry 4.0, enterprises have moderate readiness for business management and productivity management and low readiness levels for the digital platform and SM pillars.

There are significant differences in the level of readiness to approach Industry 4.0 across enterprises. Larger state-owned enterprise (SOEs) firms tend to self-assess and are thus better in terms of their readiness to Industry 4.0 with higher levels of capital, equipment, scale, technology, manufacturing concentration, and technology than foreign direct investment (FDI) or private firms. They also play a pioneering role in the determination to participate in the Industry 4.0.

Interest in digital transformation and SM is mainly concentrated in manufacturing enterprises. Approximately two thirds of enterprises do not have plans to invest in digital transformation, and many of them do not know what to do. Some enterprises report to have plans to shift their investment options for factory equipment and information technology.

On the other hand, although the SMEs sector is the driving force of economic development in Vietnam (contributing 40% of GDP and accounting for more than 20% of exported value), a recent study by the Japan External Trade Organization (JETRO, 2017)

showed that SMEs in Vietnam face many barriers with the three main obstacles being: (i) lack of ability to continue access to financial resources, (ii) limited participation in domestic and international value chains, and (iii) limited business capacity. Besides, investments in technology innovation of enterprises and government spending on science research and development (about 0.2% of GDP/year) are still modest.

SOEs, due to their status/starting point, have several advantages in terms of size of labour, capital, technology level, concentration, etc., compared to other types of ownership. Increasing their labour productivity, competitiveness, and willingness to undergo digital transformation are very important to ensure their role as the leading group towards Industry 4.0.

Policies toward SMEs, on the other hand, need to focus on improving the wide-spread application of technology 4.0 to improve enterprise size, capital equipment level, concentration index and technology application level, R&D capacity and skills of workers, connectivity, and spill-over.

This study found that the readiness score of the pillar of enterprise management is low. Many enterprises have advanced the implementation of labour restructuring strategies, technical standardization of the entire production chain and connection, management in their departments, applying Enterprise resource planning (ERP) models, supply chain management (SCM), and increased collection and exchange of information about the manufacturing process and products. To improve, there needs to be an upgrade in strategy toward Industry 4.0 based on the current situation of each enterprise. In addition, enterprises should prioritize technology investment and innovation, and consider upgrading or applying high-diffusion and relatively simple/low-cost technologies such as cloud technology, or digitalization.

Institutional and macro directions

On March 22, 2018, General Secretary and President Nguyen Phu Trong signed Resolution No.23-NQ/TW (Resolution No. 23) on behalf of the Political Bureau on the national industrial development policy until 2030 with a vision toward 2045. Resolution No. 23 has set an important goal for Vietnam; that it will become a modern, industrialized country by 2045. This Resolution No. 23, together with related legal documents and policies, has accelerated the internal restructuring of the industrial sector toward higher added value and smarter production. For SM, it is crucial to maintain and speed up the integration of information technology (IT) and automation in industrial manufacturing. Smart technology standards and manufacturing techniques will also need to be developed and applied across businesses. For example, as the textile, garment, and footwear industries continue their high growth trajectory, they must also participate more in high added-value-creating phases of the supply chain by deploying smart and automated manufacturing processes. The Resolution No. 23 also identify tax reduction and exemption at reasonable levels and over appropriate periods as one promotion tool to prioritize smart industries. This document also focuses on enforcing technical regulations and standards in the industrial sector to protect domestic production and consumers and smart technology standards and manufacturing techniques will be developed and issued as well.

On september 27, 2019, General Secretary and President Nguyen Phu Trong also signed Resolution No.52-NQ/TW on several guidelines and policies to actively participate in the Industry 4.0. Vietnam's government has shown determination and action in accelerating the development and adoption of science, technology, and creative innovation and they have enhanced the ability to access and participates in Industry 4.0. Resolution No.52 also states that two guidelines and six significant policies need to be implemented. They include (i)

innovating thinking and unifying perception and (ii) perfecting institutions to facilitate proactive participation in Industry 4.0 and the process of national digital transformation.

On May 4, 2017, Prime Minister Nguyen Xuan Phuc issued Directive No.16/CT-TTg on strengthening the capacity to tackle challenges posed by Industry 4.0. This Directive focuses on reviewing strategies, action plans, and proposing/formulating targeted plans and tasks to accelerate the development trend of Industry 4.0. The directive also specifies the need to develop strategies on digital transformation including smart administration, prioritizing the digital technology industry, smart agriculture, tourism, and urban areas; review and select national prioritized products with strategic competitive advantages; apply new production technologies and integrate digital technologies.

Readiness as a harmonious blend

R&D: Vietnam is a country that is in the process of industrialization, modernization, and international integration. Industry 4.0 opens many opportunities in improving technology level, improving production capacity and competition in the product chain; creating a significant change in the service business form; develop opportunities for innovative start-ups; significantly reducing transaction and transportation costs; creating attractive and potential investment opportunities in the field of digital technology and the Internet. It also an excellent opportunity for industrial manufacturing with advanced scientific and technological levels.

However, if Vietnam cannot catch up with the development pace of the world and the region, Vietnam will face challenges and negative impacts such as technological lag, manufacturing, and business decline; a surplus of skilled and low-skilled labour disrupts the traditional labour market, affecting the country's socio-economic situation; insecurity, information security, copyright

infringement, shortage of highly qualified human resources. On the other hand, there is a possibility of a wave of outdated technology from developed countries to developing and underdeveloped countries.

Because of the revolutionary changes in science and technology, it has led to a dramatic change in the structure, economic model, state, and social management systems as well as operating modes of enterprises. Industry 4.0 also presents challenges to many specific industries and fields such as requirements for technological innovation in information technology; accelerate the analysis and management of big data processing science to create new knowledge, support decision making and create competitive advantage; requirements for renewing management models, manufacturing, optimizing business models; establishing supply chains and intelligent logistics in the global value chain network and new tariff models; requirements of intellectual property management system in the digital age; higher requirements on network information safety and security.

Institutional actions: governmental actions, on June 3, 2020, the Prime Minister issued Decision No. 749/QĐ-TTg approving the “National Digital Transformation Program to 2025, with an orientation to 2030”. The program aims to bring Vietnam into the group of 50 leading E-Government Development Index (EGDI). The objective of the program is to make Vietnam a digital, stable, and prosperous country, pioneering in testing new technologies and digital models. Vietnam will focus on implementing fundamental and comprehensive reforms in governmental management and public administration activities, which then have significant impacts to production and business activities, ways of living and working of the people and build up a safe digital environment. In other words, the National Digital Transformation program aims at developing digital government, enhancing digital economy, and promoting digital society. The program also provides initial resources

for the formation of international-ranking digital businesses.

More recently on August 31, 2020, Deputy Prime Minister Vu Duc Dam has issued Decision 1322/QD-TTg approving the national program to support enterprises to improve productivity and quality of products and goods in the 2021-2030 period. This is considered as a major national science and technology program to support enterprises in adopting technological solutions and innovations for digital transformation and SM. The ultimate goal of this program is to support enterprises to improve their productivity and quality of products and commodities (quality productivity) by applying standards, technical regulations, and advanced management systems and tools to improve productivity and quality. This will significantly contribute to the increase of the proportion of TFP in economic growth, improvement of productivity, quality, efficiency, and competitiveness of the economy. Over the period 2021-2025, the targeted harmonious ratio of national standard system to international and regional standard systems is targeted at 65% and during this time it is expected that training and qualified certifications for 600 experts will be deployed in productivity and quality at ministries, departments, cities, and enterprises. Over the period 2026-2030, the harmonious ratio of national standard system to international and regional standard systems is targeted to be approximately 70-75% with over 1000 experts having received training and qualified certification in productivity and quality and of which approximately 200 of them are certified both regionally and internationally. Besides, the program also focuses on supporting enterprises to apply standards, technical requirements, management systems, basic tools to improve productivity and quality, and promoting the application of modern management systems and tools to improve productivity and quality. Other areas of support include measures that encourage the widespread adoption of the system of finding

the origin of products, commodities, apply good agricultural practices (G.A.P), practice production of organic agriculture, and green productivity among Vietnam's enterprises. The Prime Minister also assigned the Ministry of Science and Technology as the focal point in implementing activities in the Program as well as to instruct other related ministries, departments, and local agencies to construct the plan and deploy the tasks in the program.

Ministerial actions: the Ministry of Science and Technology plays the central role in developing national standards, promoting research, application and adoption of SM technologies and solutions. On September 27, 2018, the Ministry of Science and Technology issued Decision No. 2813/QD-BKHCN approving the crucial national science and technology program to 2025: "Research support, development and technology application of industry 4.0". The program was built to accelerate applied research, and commercialization of key technologies in Industry 4.0 that Vietnam has advantages and best benefit from; and to support to pilot projects to digitalize and apply new management and business models in some critical areas. The program also prioritizes digital transformation in areas such as medicine, tourism, finance, agriculture, processing and manufacturing, education and vocational training, transport, construction, information-communication; promote research and adopting digital transformation solutions in business management; develop policies to facilitate access to finance of businesses in terms of research and development and digital technology application.

The Ministry of Industry and Trade has also implemented many activities to support enterprises to improve their capacity to participate in the Industry 4.0, towards SM, such as: providing information, guiding enterprises in the investment activities, technology innovation, digital transformation; connecting enterprises with consulting agencies, reputable technology

and solution providers; or supporting research and development activities, technology transfer amongst enterprises, and pioneering projects in a number of high-tech industrial fields.

The Ministry of Industry and Trade has supported enterprises in implementing a number of pilot projects such as: project on developing smart warehouse model; Supporting the development and application of production monitoring module for LED and electronic product lines at Rang Dong JSC (Ha Noi); online production monitoring and operating system (module for energy management and maintenance) at Saigon Beer-Alcohol-Beverage JSC; project on applying digital maps to manage and provide information on Vietnam's leather and footwear industry; the automatic control system for medicinal high extraction equipment meets Industry 4.0; QCS automatic quality monitoring system in the production of industrial packaging paper at Van Diem Paper JSC (Ha Noi), etc. In 2020, many projects with direct business participation have been launched. These include development and pilot application of production planning and management software at Pho Yen Mechanical JSC (Thai Nguyen); support a pilot model to apply innovative solutions and a smart warehouse management system at Tien Phong plastic JSC (Ha Noi); the Industrial IoT solution to build a model smart factory, applied at Massan Industrial Group (Binh Duong) and Duy Tan Mechanical (Ho Chi Minh city).

Directorate for Standards, Metrology and Quality (STAMEQ) is the governmental body under the Ministry of Science and Technology and is responsible to build a national standard system, including many SM-related standards. Up to now, there are about 500 Vietnam Standards (TCVN) relevant to production including over 200 TCVN of IT (IT infrastructure, IoT, etc.); 35 TCVN of network security (system security, information quality, network safety, risk management, etc.); 16 TCVN of automation (industrial automation, automation integration model, etc.); 5 TCVN of

robotic; 9 TCVN of smart agriculture (concept and terminology of mobile phone, standard of mobile communication, evaluation index of mobile phone, etc.); 5 TCVN of smart transportation (ITS system); over 74 TCVN of Waste control and environmental pollution control; 67 TCVN of traceability; over 30 TCVN of Advanced management systems; 70 TCVN of services (supply chain safety, assessment of supplier capacity, financial services, health services, etc.); 5 TCVN of human resource management and development, among others.

During the past two years, STAMEQ has been a pioneer in Vietnam in promoting SM in Vietnam. In early 2017, STAMEQ proposed Asia Productivity Organization (APO) to support and send SM experts to guide and train Vietnamese managers and enterprises on SM. These are among the first courses on SM in Vietnam. Since then, STAMEQ continued to send staffs, trainees, and enterprises to participate in SM training courses under the APO program to improve their knowledge. STAMEQ also established strong cooperation with Technischer Überwachungsverein (TUV SUD) Digital Service, Kilopasec (KPC), Cost Per Click (CPC), International Gemological Institute (IGI), etc. on promoting research, training, evaluation, and application of SM solutions. Some of collaboration can be mentioned as follows:

STAMEQ cooperated with TUV SUD Digital Service to conduct the first pilot assessment for 15 enterprises in SM access using SIRI. This is the first assessing tool in the world, developed by the Singapore government to promote Industry 4.0 and SM at the national and enterprise level. At the enterprise level, the set of indicators offers a 3-step assessment: technology, process/supply chain management, a practical organizational model to help manufacturers understand the concept of Industry 4.0. The assessment allows enterprise to identify status of production facilities, building an enterprises transformation roadmap and bringing sustainable development values to enterprises.

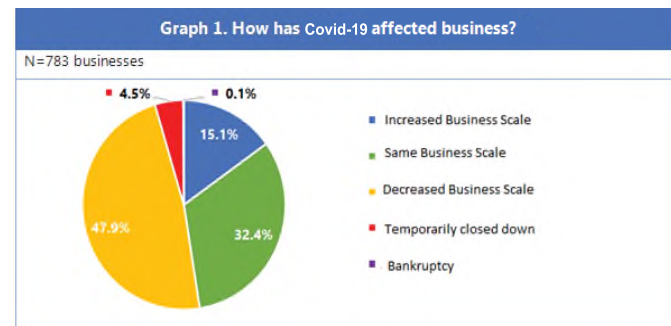
STAMEQ cooperates with CPC in implementing iBench productivity assessment solutions for Vietnamese enterprises, developing online training programs and direct training for Vietnamese enterprises on SM. STAMEQ and CPC also agreed to sign the Memorandum of Understanding (MOU) on the contents of training cooperation on SM for each industry field, each type of enterprise. Every month in 2020, STAMEQ and CPC hold online seminars on SM to connect Vietnamese and Taiwanese enterprises.

STAMEQ cooperates with KPC on SM training programs for enterprises. The two agencies have jointly established a Training Cooperation Centre located at STAMEQ to organize training courses for Vietnamese enterprises. Immediate training activities focus on the strengths of both sides such as quality control, quality assurance and improvement, productivity improvement, production management, SM, and others. In addition, this centre will provide vocational training and diploma services for enterprise employees, support start-ups and new global businesses. The establishment of this centre is expected not only to improve the productivity of Korean enterprises, but also to help improving Vietnamese enterprises by creating excellent human resources. At the same time, this is another source of support for start-ups, promoting cooperation between the two countries and promoting the competitiveness of Korean and Vietnamese enterprises.

Impact of unwanted “black swan” incidents

As of mid-July 2020, while the world’s countries were at the peak of the epidemic, many Vietnamese SMEs have almost returned to a new normal status. However, 52.5% of the 783 surveyed enterprises still reported to experience negative effects due to the pandemic. About 4.6% of enterprises had to suspend or close or dissolve their businesses. Covid-19 impacts all industries in the survey groups, led by tourism, accommodation, food, and beverage (70% of enterprises downsizing

and dissolving), wholesale and retail (59%), and services (59%). On average, the business results decreased by over 21% compared to the same period last year and business deterioration was experienced in 70% of surveyed enterprises (Fig 1).

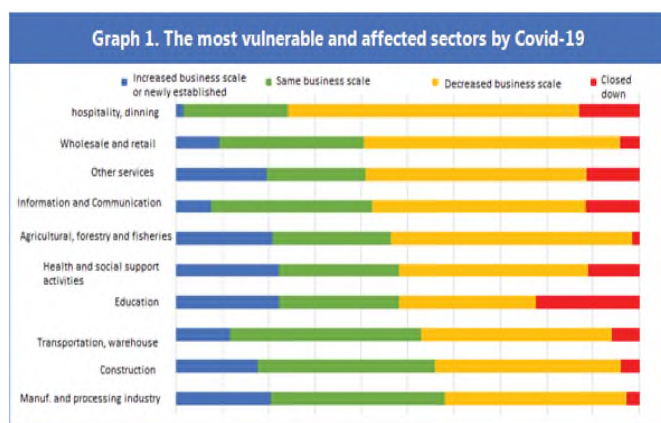


Source: Survey on SMEs in July, 2020.

Fig 1. How has Covid-19 affected to SMEs.

Survey results also show a negative picture of business performance. This is clearly engraved in the indicators related to finance, production, output market and labour resources. More than 96% of enterprises (out of a total of 783 surveyed enterprises) have difficulties in financial, production and business problems. 96.7% of enterprises have financial problems related to the failure of customers to make payments on time, enterprises cannot collect receivables when due (70.1%), high costs (27%) due to trade difficulties during the social distancing. In addition, 30.5% of enterprises said that financial difficulties lead to their inability to pay due accounts. 96.3% of enterprises have difficulty in production such as being unable or difficult to find sources of raw materials, lack of labour force due to social distancing policy and labour surplus due to reduced production scale. Regarding the business situation, the situation of customers cancelling orders, delayed payment is a common problem (90.6% of surveyed enterprises). Market demand fell sharply, greatly affecting production and business activities (88.3% of enterprises) (Fig 2).

By June-July 2020, in the “new normal” state of the whole society, the problem of underusing



Note: Businesses may have more than one sector.

Source: Survey on SMEs in July, 2020.

Fig 2. The most vulnerable and affected sectors by Covid-19.

labour resources seem to have been partly resolved compared to March 2020. Only 15.7% of enterprises (out of a total of 783 surveyed enterprises) as of June 2020 reported a change in the use of labour. The most common measures are to reduce working hours, cut wages (56.5% of businesses), and give workers temporary leave without pay (49.2%), or terminate labour contracts (37%). Enterprises with the size of 50 to 100 employees had the least negative change in labour. Smaller enterprises seemed to implement more changes in labour use. Although there are few large enterprises with negative changes in labour, this change took place, mainly due to the large number of workforces in the business.

Facing such challenging environment, 88% of enterprises (out of 783 surveyed enterprises) had implemented various changes in business strategy to maintain business activities. These include, but not limited to, diversifying products (77.9%), sourcing alternative materials (64.1%) and changing products to fit the market in the context of a pandemic (38.2%). 16.3% of enterprises tried to negotiate with customers and partners to delay payment and reduce rental costs. 10.1% of enterprises sought support from banks such as lowering interest rates and maintaining credit limits. 9.3% of enterprises sought for new cash

flow from loans. Cutting costs and applying for tax deferral/exemption were also two options chosen by enterprises, but with a low rate (7.2 and 5.7%, respectively). The restructuring of the organization and human resource management are reported as painful problems for most enterprises.

In this difficult context, 68% of enterprises think that policies to support SMEs were generally issued promptly and in line with the support, particularly in the three main groups of policies related to tax, finance, and credit, labour and insurance. About two-thirds of the enterprises surveyed rated these support packages as necessary.

Related experience

In this section, we spend effort on understanding how economies that are similar to Vietnam act to adapt to the era of SM. Such countries are namely Indonesia and Thailand.

Indonesia

Indonesia has an economy that is heavily dependent on manufacturing and, like Vietnam, the Indonesian government is well aware of the importance of industrialization and fostering a modern economy and has seriously worked towards that with a thorough report of the Ministry of Industry in 2018. However, the report shows some fundamental blockages such as (i) underdeveloped digital structure; (ii) absence of innovation centres; and (iii) regulation and policy roadblocks to foster cross-ministry collaborations. A common point among these blockages is that Indonesia should develop and promote technology and digitalization at a great span. Once they embrace digitalization and obtain a proper digital infrastructure, Indonesia may boost productivity and reach 150 billion USD in GDP growths (10% of GDP).

Another lesson learned from the Indonesian economy is that the number of small and micro firms outnumbers medium and large companies, however, the latter are found to dominate the former in case of value added. To solve this

situation, Indonesia must improve infrastructure in electricity, transport, trade and other logistics of which electricity infrastructure plays the most important role due to Indonesia's unique structure of several islands.

To obtain its goal of becoming the tenth-largest economy in the world, the government commits to support SM with a clear strategy and roadmap called "Making Indonesia 4.0," which embraces innovation and R&D to promote SM, especially for small and micro firms in private sectors.

Thailand

Thailand ranks the fourth highest in GDP per capita in Southeast Asia and has several similar characteristics that Vietnam may use a role model. Thailand has the second-largest economy in Southeast Asia and has an industrial sector that accounts for 35% of its GDP where the most important industrial subsector is manufacturing. With close care, Thailand soon adopted various policies to nurture and improve the manufacturing sector as the driving force for Thailand economy [5].

Like many other nations in Asia, low labour cost used to be the main aspect of competitiveness that Thailand possessed. However, movement toward the group of upper middle-income nations restricts this strength. Being aware of that, Thailand has rapidly made changes to its entire supply chain thanks to advances in sensors, machines, and IT systems. The Thai government is determined to deploy R&D applications across its industries especially toward "being smart" in the manufacturing sector. The main themes for SM in Thailand are IT-related and a largely adopted population of robots.

Policy implications

Policy implications at micro level

From the findings that most Vietnamese firms are not ready for the Industry 4.0 and a significant gap of readiness between various companies (in terms of size, capital, technology, ownership, shareholders, etc.), we believe that efforts to

improve the readiness level for Industry 4.0 of enterprises need to be an integral part of industrial development policies, business development, SOE reform, FDI attraction, among others.

In order to do that, each firm should build a process to self-assess whether it is ready and possesses enough resource to go with SM. Since Industry 4.0 is dominating, adopting SM technologies has become essential. Therefore, each firm needs a tool in order to self-assess its readiness as well as its capability to go along with SM. The authors collaborated with Dr. Yangho Park and Dr. SangSu Choi (from International Gemological Institute - IGI - Korea) and Dr. Jungyub Woo, Al Jones (National Institute of Standards and Technology) to propose a self-assessment tool as described in Fig. 3. The evaluation process is based on the following groups of issues: equipment; KPI; Labour; Management; Material Handling System; Organization, team, and personnel; Process; Standards; Technologies [6-8].

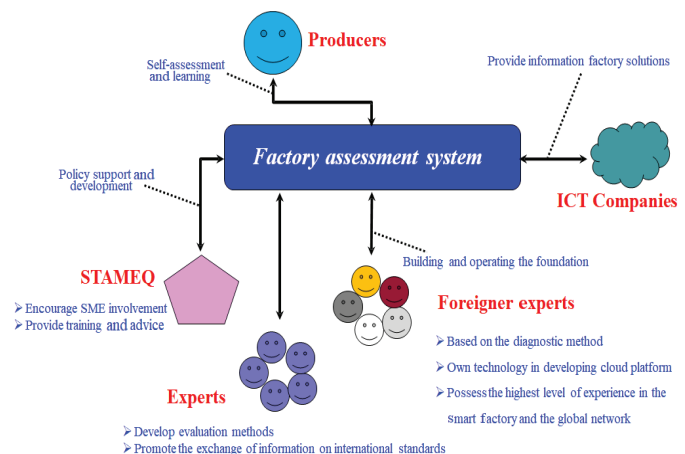


Fig. 3. The SM evaluation model.

For the SM, enterprises need to focus on integrating IT equipping to the production process. Collecting and analysing data will be beneficial to optimize production or product development, and support sales and marketing. In the SM pillar, data collection and analysis are also critical to increase the efficiency of planning, monitoring, adjusting, and optimizing their business and production processes. At the same time, it is necessary to

integrate infrastructure, machines, and equipment with IT systems to automate the process of adjusting processes in a timely and flexible manner.

Enterprises also need to promote external system integration and automated processes to improve the digital transformation infrastructure. Industry 4.0 related skills of workers in each enterprise will also need to be upgrade. This can be done not only with the efforts of individual enterprises, but also through policies to facilitate linkages with leading enterprises, universities, vocational training centres or other professional organizations.

However, it should be noted that (i) inter-connected devices/systems/products require and large-scale investments and this imply high risks. (ii) Not all enterprises need to fully implement SM in their business depending on the impact of Industry 4.0 on the production and business process, enterprises may determine the appropriate level of participation. For example, SMEs may choose to utilize advanced technologies with low cost and wide applicability such as cloud computing technology.

Policy implications at national level

Although SMEs are a driving force to the economy, Vietnam seems to be lagged in supporting such firms, especially a standardized approach for firms to identify and prepare themselves to be fully adaptive to Industry 4.0. Policies to educate and promote the application of modern technology, improving R&D capacity and training skills for employees are not only decisive factors for enterprises to develop, improve productivity and competitiveness but also provide enterprises with the foundation for Industry 4.0. Solutions should be given to building an “innovation network” among all parties (state, enterprises, academia, social organizations, and investors) to promote technology adoption and innovation. Innovation at business level will also be critical in achieving industrial development goals, enhancing productivity and competitiveness and integrate Vietnam more to the global value chains.

To support enterprises to deploy SM, the formation and development of SM ecosystem is critical. The author proposes the SM ecosystem includes government agencies, policy makers, consulting organizations, training institutions, financial institutions, solution consulting units, international organizations, etc (Fig. 4).

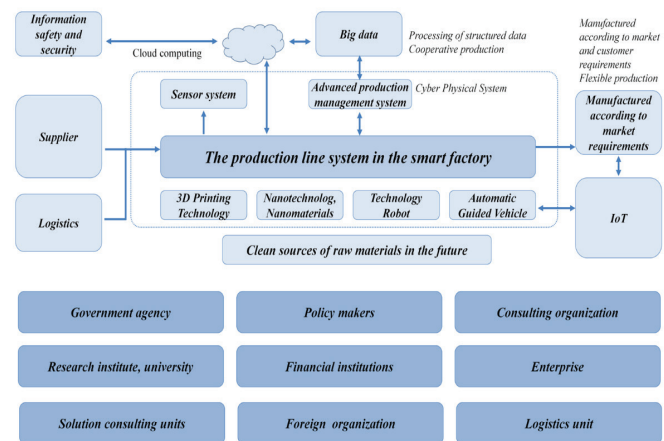


Fig. 4. The SM ecosystem.

The authors urge policy makers to focus on the main role of promulgating regulations policy to promote SM-related activities such as: institutional reform; legal policies; mechanism for research and testing of sand-box; financial mechanism; mechanism for training high-quality human resources for SM; mechanism to encourage the use and connection of data to ensure safety and security; mechanisms to promote enterprises to join the supply chain; financial, tax and investment incentive policies and regimes.

SM consulting organizations: conduct consulting activities on productivity, productivity boosting solutions and digital transformation. Vietnamese enterprises are at a relatively low level of awareness and capability to SM, so consulting organizations need to focus on consulting activities on standard systems and basic productivity tools such as quality management systems ISO 9001; Environmental management system ISO 14000; Food safety management system ISO 22000; Energy management system ISO 50001; Occupational health and safety system ISO 45001; Risk management according to ISO 31000; MFCA; quality control tools; Production line

balance (Heijunka); Anti-mistakes (Poka Yoke); Quick change over; 5S; Intuitive management; KPI; TPM; LEAN; Lean 6 Sigma... On the basis of these systems, SM consulting organizations will continue to support enterprises to deploy digital transformation solutions and SM to improve productivity.

Training organizations: to implement SM training activities for enterprises. First of all, training organizations need to focus on increasing the awareness of enterprises on Industry 4.0, digital transformation, and SM, especially for enterprises leaders. Training organizations should also focus on training on SM standards issues. STAMEQ is expected to announce the standard framework for SM in early 2021. This will be an important direction for training organizations to deploy

training courses to support enterprises on SM standards. ISA 95 or IEC 62264 set of standards is the basic and most important set of standards that need to focus on training Vietnamese enterprises to deploy SM. In addition, STAMEQ also cooperates with KPC and CPC to organize intensive training courses on SM for Vietnamese enterprises.

Solution providers: to support enterprises to build and apply IT solutions in Vietnamese enterprises. Solution providers can help to integrate existing machinery and equipment systems with new systems invested by enterprises. They can also provide solutions that help connect enterprises in the supply chain and help connect Vietnamese with international market. Currently, commonly used IT solutions include Enterprise Resource Planning (ERP), Customer Relationship Management (CRM),

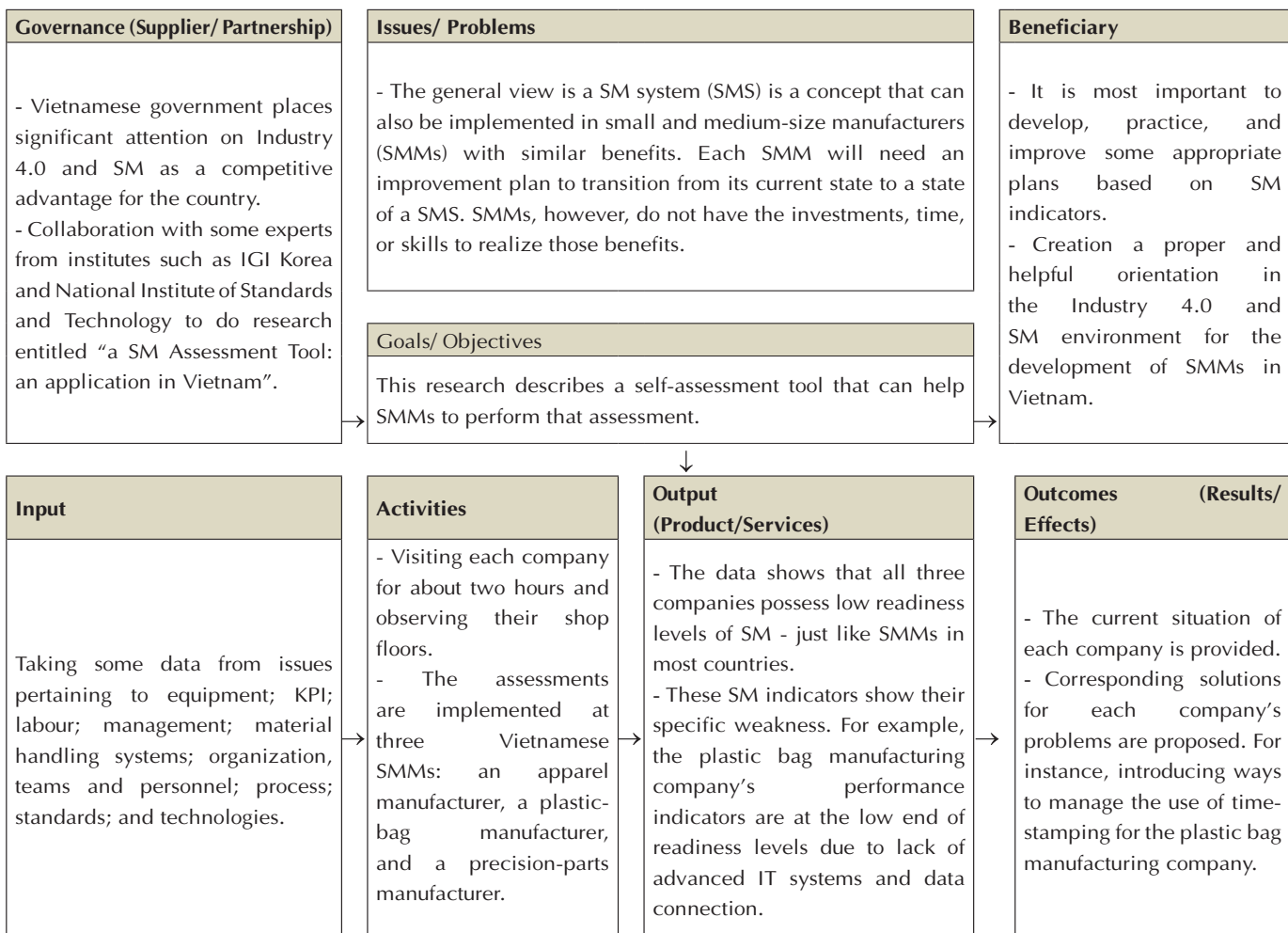


Fig. 5. Policy modelling canvas of the Industry 4.0 Policy in Vietnam.

SCM, Product Life Management (PLM)...

International organizations: APO is the most important international organization helping Vietnamese SMEs approach digital transformation and SM. APO's annual training programs on SM play a very important role for Vietnamese enterprises. Besides, STAMEQ cooperated to train with CPC on SM; establishing training centres for SM and innovation with KPC; cooperating with TUD SUV on evaluation and construction of SM roadmap for Vietnamese enterprises. STAMEQ continues to strengthen cooperation with international SM enterprises and corporations such as: Avantech, Igi, Malik, Csiro...

Policies toward SMEs need to focus on improving the wide-spread application of technology 4.0 to improve enterprises' size, capital equipment level, concentration index and technology application level, R&D capacity and skills of workers, connectivity and spill-over.

As a country with the population of "golden ages", Vietnam has a huge advantage in luring resources from the world as the people are quick learners, especially for new technologies in ICT and manufacturing. Therefore, Vietnam government and agencies should adopt policies that foster high-technology educational and vocational trainings that meet industrial needs.

Policy Modelling Canvas

We summarized the Policy Modelling Canvas of Industry 4.0 Policy in Vietnam (see Fig. 5).

Using this canvas, different elements of the Vietnamese economy (i.e., government, firms) can effectively interact and produce good [5].

Conclusions

In this paper, we thoroughly mapped out an understanding of the capability of some Vietnamese companies to catch up with the wave of Industry 4.0 to propose some policy implications that Vietnam may adopt in order to facilitate the application of SM in the manufacturing sector. Our findings show that most Vietnamese firms are not ready for the adoption of SM. However, this situation can be mitigated with the appearance of a

standardized framework to help firms self-identify the gap between their current status with SM and preparation for embracing SM. Besides this, we proposed a framework to make the cooperation between policy makers and firms harmonious.

The focus of this research is a survey of enterprises' view and awareness of SM although there is a lack of observation of real-life SM since its application is still in its infancy in Vietnam. Therefore, we aim future works at collecting observed data and the realization of our framework and application of the canvas to real life activities.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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