

**GEARING UP TO**

# **INDUSTRY 4.0**



**DIGITIZATION STRATEGIES FOR SMEs**





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The Asian Productivity Organization (APO) is an intergovernmental organization committed to improving productivity in the Asia-Pacific region. Established in 1961, the APO contributes to the sustainable socioeconomic development of the region through policy advisory services, acting as a think tank, and undertaking smart initiatives in the industry, agriculture, service, and public sectors. The APO is shaping the future of the region by assisting member economies in formulating national strategies for enhanced productivity and through a range of institutional capacity building efforts, including research and centers of excellence in member countries.

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# GEARING UP TO INDUSTRY 4.0

## DIGITIZATION STRATEGIES FOR SMEs



**Gearing Up to Industry 4.0**  
Digitization Strategies for SMEs

Dr. Eva Diedrichs served as the volume editor.

First edition published in Japan  
by the Asian Productivity Organization  
1-24-1 Hongo, Bunkyo-ku  
Tokyo 113-0033, Japan  
[www.apo-tokyo.org](http://www.apo-tokyo.org)

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# FOREWORD

Industry 4.0, the rapid technological revolution driven by new-generation technologies, has fundamentally transformed the future of production systems. The integration of manufacturing with state-of-the-art ICT linked to logistics processes among different companies is one key concept behind Industry 4.0. SMEs in APO member countries face plenty of challenges to stay competitive in global value chains in the age of Industry 4.0, even though they play major roles in most APO economies. Therefore, it is imperative for SMEs to move toward digitization and leverage digital technologies to unlock opportunities for exponential growth.

As part of the initiative to help SMEs in member countries overcome the challenges posed by fast-changing digital disruptions across all sectors, the APO conducted research to assess the status, readiness, and initiatives related to Industry 4.0 for SMEs in selected APO member countries. The research report on *Gearing Up to Industry 4.0: Digitization Strategies for SMEs* pinpoints the critical components that SMEs need to take care of before they can embrace the Fourth Industrial Revolution.

Although the different economic situations of these countries led to different approaches, there are commonalities regarding the needs of SMEs in preparation for Industry 4.0 digitization, including creating awareness of its benefits to all stakeholders, access to the Internet and advanced technologies, funding of Industry 4.0 digitization initiatives for SMEs, and mobilizing for digitization and Industry 4.0.

Successful strategies for digitizing SMEs can only be followed using a multiple-stakeholder approach that includes all actors in the innovation ecosystem. That approach also involves integrating digitization strategies driven by the public sector with those in other sectors. It should also consider SMEs' level of maturity both in terms of life cycle and of expertise in digitization and management of Industry 4.0 technologies.

It is expected that this volume will provide a more complete picture of the readiness of SMEs for Industry 4.0. The report also provides useful inputs to policymakers driving government initiatives for supporting their industrial transformation process. The contributions and commitment of all the experts who participated in this research project are highly valued by the APO.

Dr. AKP Mochtan  
Secretary-General

# ACKNOWLEDGMENT

**T**his publication was produced with the contributions of various stakeholders. We would like to especially thank the various APO member countries' organizations and companies for participating in our survey and providing insightful data and inputs for the case write-ups and analyses.

We thank IMP<sup>3</sup>rove - European Innovation Management Academy, Germany for the benchmarking study comparing the IMP<sup>3</sup>rove Digital Innovation Quotient of SMEs in APO member countries and outside.

In Republic of China, we would like to thank Axel Limberg, Executive Director of German Trade Office in Taipei for promoting the benchmarking opportunity to SMEs in ROC via the organization's website as well as the country's National Association of Small & Medium Enterprises for their invaluable support.

Our appreciation also goes to the National Productivity Council of India for their support and inputs during the expert coordination meeting and data collection in India.

For Indonesia case, we thank Bambang Satrio Lelono, Director General of Training and Productivity, Ministry of Manpower; Isnarti Hasan and Ajen Kurniawan, Directorate for Productivity Development, Ministry of Manpower; Iwan Faidi, Deputy Assistant for the Improvement of Competitiveness of Cooperatives and SMEs, Coordinating Ministry for Economic Affairs; Trina Fizzanty, Indonesian Institute of Sciences; Kusetiadi Raharjo, Hexa Hydro; Beno K. Pradekso, Solusi247; and Ageng Prabowo, PT. Tesena Inovindo.

In Malaysia, we value the support of David Khor, Trade Advisor and Industry Specialist of Malaysia External Trade Development Corporation; Yew Kian Seng, Technical Business Consultant; Martin Mueller, Technical Manager of Teksoft (SEA) Sdn. Bhd.; Halimah Osman, Managing Director from Market Insights, and Wan Farid Wan Ahmad from Malaysia Productivity Corporation.

Without their contribution, this publication would not have been completed.



# EXECUTIVE SUMMARY

Industry 4.0 has become a major issue in most of the national economies as a source for significant productivity gains. As small and medium-sized enterprises (SMEs) play a major role in most of the economies, digitization strategies for them are of major interest for governments, academia, trade associations, business partners, and most importantly, for the SMEs themselves. However, most of the SMEs in developing countries still operate in a traditional manner. To cope with the workload, they hire additional workers who are rather cheap as they are not very skilled, instead of investing into automation as an investment into their future. Further, lacking skilled workers, SMEs are unable to identify and exploit opportunities for innovation. This creates another barrier to sustainable growth. Therefore, many SMEs get old before they get big.

However, the more ambitious SMEs understand the need to embrace the opportunities for sustainable growth. Their key questions are - what are the best approaches to achieve this goal and to what extent can Industry 4.0 digitization help them in remaining competitive. They need to balance the benefits that are to be expected with the necessary investments and the risks of entering into the digital world.

The Asian Productivity Organization (APO) has initiated this research project to gain an overview on the current status of Industry 4.0 Digitization Strategies for SMEs in various Asian countries. Five member states have participated in this project, including Republic of China (ROC), India, Indonesia, Malaysia, and Vietnam. National experts from these countries have summarized their view on the current initiatives related to SMEs' Industry 4.0 digitization and their impact. The different economic situation of these countries led to different approaches. However, there are commonalities regarding the needs of SMEs in preparation for Industry 4.0 digitization. They include, among others:

- Creating awareness on the benefits of Industry 4.0 digitization
- Educating all stakeholders on Industry 4.0 digitization, its benefits, and implementation
- Access to Internet and to advanced technologies relevant to Industry 4.0
- Funding of Industry 4.0 digitization initiatives at SMEs
- Mobilizing for digitization and Industry 4.0

These needs are addressed differently in the participating countries. In India, the government launched an impressive series of initiatives to enhance their economy's productivity. Most of these initiatives are in the early stages of implementation. Some of them have already started showing results and impact. Others are still in the planning phase.

In the ROC, the concept of Industry 4.0 has been adopted at a very early stage, resulting in several initiatives and concrete offerings for SMEs to gain practical experience in advanced technologies, such as automation,

robotic, etc. Several policies and programs in developing the Industry 4.0 ecosystem have been launched already. These are expected to drive digitization for Industry 4.0 in SMEs.

Indonesia's national initiative "Making Indonesia 4.0" includes five areas; namely, food and beverage (F&B), textiles, automotive, electronics, and chemicals. The objective of Industry 4.0 digitization is to regain competitiveness beyond low labor cost. Other low-labor-cost countries have gained in competitiveness based on technical and economic efficiency. Remaining in the low-tech corner will bear a two-fold risk for Indonesia - getting stuck in low productivity with low levels of skilled labor leading to limited innovation capabilities. However, on the other side, Indonesia has one of the largest labor forces in the world. This asset needs to be developed. Education will play a key role in the country's future development as well as the development of the infrastructure. Providing higher education and access to high-speed Internet across the country will require significant investment.

Compared to India and Indonesia, Malaysia's economy is more advanced. Malaysia has defined four strategic goals that the government would like to achieve with their initiatives to support Industry 4.0 digitization strategies for SMEs:

- Contribution to GDP
- Increase of productivity on national level
- Higher skilled labor force
- Increased innovation capabilities

In the process of implementing these measures, Malaysia might face challenges resulting from reservations that traditionally managed SMEs might have regarding automation and from increased unemployment of low skilled workers. Instead of taking the risk of investing in advanced technologies, SMEs might prefer to control their operational expenditures and hire additional cheap labor to carry out simple tasks, such as packaging, etc. However, once SMEs see and understand the benefits of automation, low-skilled workers will be laid off, putting pressure on the social welfare systems.

The challenges and opportunities in India are now to effectively implement and align all these initiatives. Political will has to be paired with resources and capacities to reach the key beneficiaries - the SMEs as well as other key players in the digital innovation ecosystem, such as large enterprises, regional development agencies, academia, trade associations, business advisors, etc.

Vietnam sees the opportunity to exponentially grow by implementing Industry 4.0 digitization strategies. There is a young and digitally savvy generation and there are role models for other SMEs to strive for digitally enabled business models. However as in many other developing countries, investment in education is both an opportunity to benefit from Industry 4.0 and a challenge. Funding is limited. Well-educated university graduates rather start their career in a large corporation than in a SME, or alternatively, start their own company.

The approaches and programs initiated in the five countries are complemented by a benchmarking study comparing the IMP<sup>3</sup>rove Digital Innovation Quotient of SMEs from the five countries with peers from the rest of the world. This benchmarking highlights that SMEs with a clear digital innovation strategy are usually better managed and achieve better results. It also shows the critical needs of SMEs becoming Industry 4.0 ready. Such benchmarking data will help to measure the impact of the digitization strategies designed to support SMEs to become Industry 4.0 ready. As many of the publicly funded programs are still in their launch phase, developing and initiating impact measurement is essential to ensure effectiveness of the significant investments in the countries represented in this report.

Successful strategies for digitizing SMEs will build on a multi-stakeholder approach that includes all parties in the digital innovation ecosystem as well as public sector's integrated digitization strategies that are driven by other stakeholders. It will also take into account the SMEs' level of maturity both in terms of its life cycle and expertise in digitization and Industry 4.0 advanced technologies. Flexibility and customization of the support programs will increase their impact and value for SMEs.



## CHAPTER 1

# SMEs PERSPECTIVE ON DIGITIZATION AND INDUSTRY 4.0

**Dr. Eva Diedrichs**

Managing Director










IMP<sup>3</sup>rove - European Innovation Management Academy EWIV

Digitization is the prerequisite of Industry 4.0. Although the majority of organizations have already reached a certain level of digitization in their operations, digital transformation has just begun for the majority of them. It should be noted that Industry 4.0 is a vision not only for the SMEs but also for larger companies.

Digitization is defined as the process of converting, managing and storing data, information and knowledge into a digital, computer-readable format. The benefit of digitally available data, information and knowledge is its “mobility”, easy accessibility at anytime, anywhere, by anybody with the appropriate access rights.

**FIGURE 1.1**

### APPLICATIONS ENABLED BY NEW TECHNOLOGIES [1]

|   | Technology             | Description   |
|---|------------------------|---|
|  | Big Data               | • Extremely large data sets allowing computational analysis to reveal patterns, trends, and associations. The prerequisite of Artificial Intelligence (AI).                 |
|  | Autonomous Robots      | • Development of machines that can substitute for humans, increasingly applied in tasks associated with thinking, multitasking, and fine motor skills.                      |
|  | Cloud Computing        | • The practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.           |
|  | Additive Manufacturing | • Advances in additive manufacturing, using a widening range of materials and methods; innovations include 3D (bio-)printing of different material.                         |
|  | Internet of Things     | • The use of networked sensors to remotely connect, track and manage products, systems, and grids.  |
|  | System Integration     | • The cross-company data integration based on data transfer standards.  |
|  | Simulation             | • The optimization of value networks based on real-time data from smart systems.  |
|  | Augmented Reality      | • Next-step interfaces between humans and computers, involving immersive environments, holographic readouts, and digitally produced overlays for mixed-reality experiences. |
|  | Cybersecurity          | • The need for protection of internet-connected systems, including hardware, software and data, from cyberattacks increases with the increased reliance on technologies.    |

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, 2018, WEF



Industry 4.0 is defined as the 4th industrial revolution. “After mechanization (Industry 1.0), mass production (Industry 2.0), and automation (Industry 3.0), now the “Internet of Things and services” is becoming an integral part of manufacturing. Industry 4.0 technologies have the potential to create extraordinary growth opportunities and competitive advantages... Experts forecast that businesses will be able to increase their productivity by about 30% using Industry 4.0” [2].

Industry 4.0 builds upon a number of advanced technologies that rely on data generated by digitization of things, machines, and processes.

Figure 1.1 highlights some examples of applications enabled by new technologies.

Both digitization and Industry 4.0 are expected to generate significant productivity gains as well as innovation potential. In industrialized countries, high labor cost are replaced by robots and connected machines. In developing countries, labor cost is not (yet) an issue. However, staying competitive requires firms in these countries to exploit the opportunity of leapfrogging into the Industry 4.0. This also affects SMEs as part of the value networks.

SMEs are defined differently in many countries. The European Commission defines an SME by the number of employees of up to 250 employees. Other institutions use the annual turnover as criteria to distinguish between SMEs and large companies. Key characteristics of SMEs compared to large organizations is their agility as a result from flat hierarchies, rather informal structures, and hence potentially quick decision-making. On the other side, SMEs often lack management capabilities, IT expertise, and funding. The latter leads the CEOs into the trap of avoiding risks and delaying decisions related to IT, or to decisions that are either short-sighted, or leading to an over-sized and rather expensive solution.

## CHAPTER 2

# SMEs CHALLENGES IN LIGHT OF DIGITALIZATION AND INDUSTRY 4.0

**Dr. Eva Diedrichs and Felix Fleer**

IMP<sup>3</sup>rove - European Innovation Management Academy EWIV

The challenges that SMEs face in light of Digitization and Industry 4.0 are partially a result of their specific characteristics and also a result of the significant changes taking place in many industries. SMEs have limited resources with a skill set that has been developed over time to meet current needs. Formal training in preparation for the future challenges is limited due to either lack of management focus and funding or lack of time. Often the day-to-day work has priority over other activities, such as people development. As a result, strategic focus on the integration of advanced technologies is missing as well as the management capabilities to drive the digitization for Industry 4.0. There is also a challenge to reduce the time to market new offerings and to enhance process automation for efficiency. The lack of digital capabilities and knowledge about cybersecurity prevent many SME managers from embracing digitization to become Industry 4.0 ready. Interestingly, the SMEs in the manufacturing industries seem to be more reluctant than their peers from the other industries.

These findings are illustrated in the assessment of 119 SMEs (defined by number of employees with 250 or less employees) from Asian countries (47) including ROC, India, Indonesia, Malaysia, and Vietnam as well as from the Rest of the World (ROW) (72) [1]. In total 65 SMEs are active in the manufacturing sector and 54 in other industries. In this assessment strong focus was given to digital innovation as the prerequisite to successfully compete in the mid to longer term in a digitized economy. The categories in which the SMEs have been assessed include:

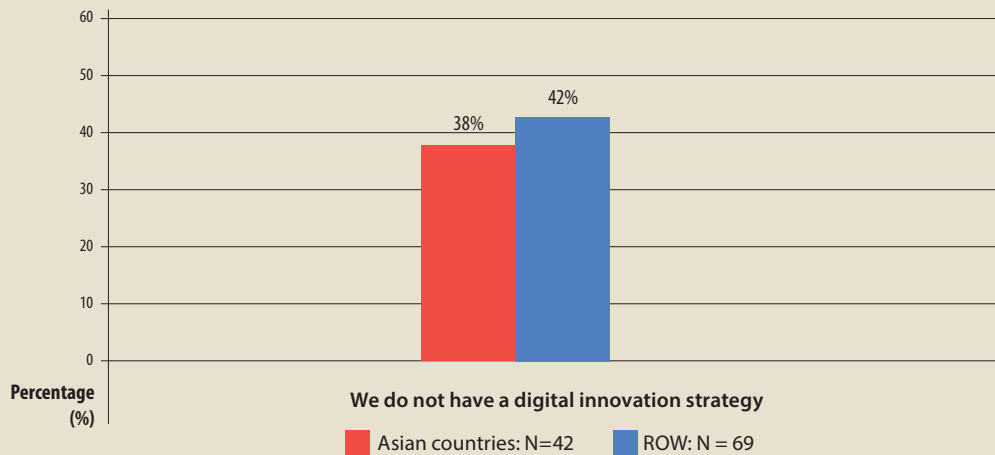
- Digital innovation strategy
- Digital business model
- Digital processes
- Digital ecosystem and culture
- Enablers for digital innovation

The SMEs performed the assessment online in 2018. They received a comprehensive benchmarking report comparing their performance to the average and the Digitization Champions.

Embracing digitization enables SMEs to develop innovative digital offerings, such as innovative digital processes and business models as well as developing innovative organizational structures and systems including cybersecurity policies.

FIGURE 2.1

## ASIAN AND ROW SMEs WITHOUT A DIGITAL INNOVATION STRATEGY



The calculation is based on companies' responses to chapter 3.1 question 4 in the DIQ: "Which of the following attributes apply regarding your digital innovation strategy?" Only companies who responded to the question have been included in the sample.

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

## The Importance of Strategic Focus for Profitable Growth

Many SMEs still lack strategic focus especially when it comes to the development of a digital innovation strategy. About 40% of the companies in Asia and in the ROW have not defined their digital innovation strategy. The share is slightly higher at 42% in ROW (Figure 2.1).

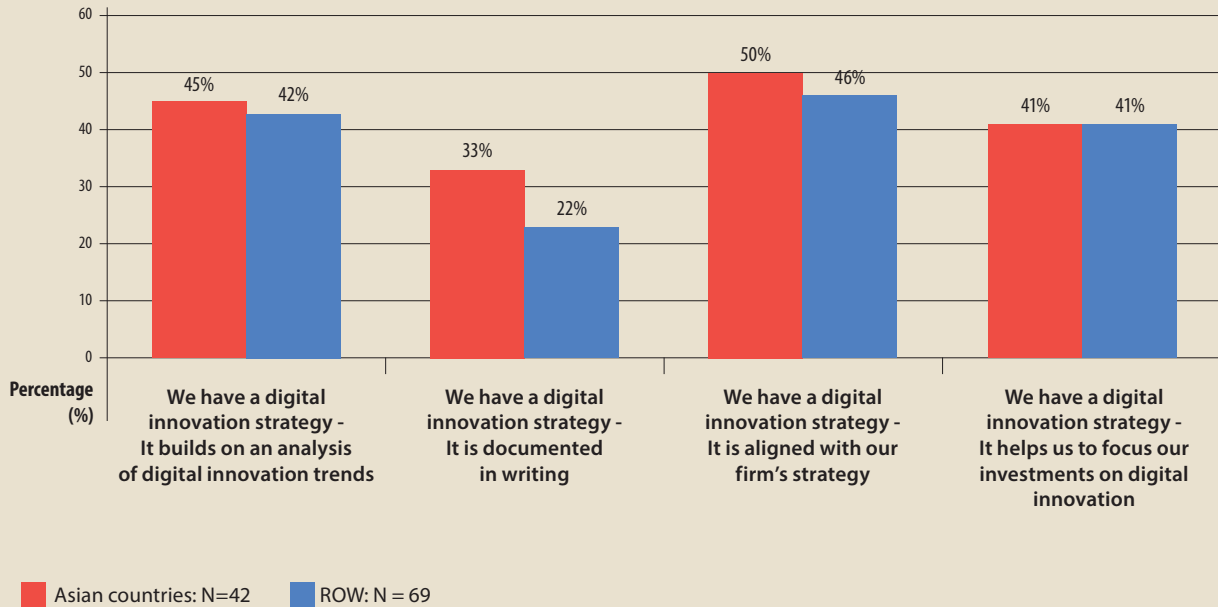
The strategic focus of companies that have digital innovation strategy is different in Asian countries compared to the SMEs in the ROW. About the same number of SMEs from Asian countries and ROW build their digital innovation strategy on the analysis of digital innovation trends (both nearly 45%). Asian SMEs also significantly outperform their peers when it comes to the documentation of their digital innovation strategy. About 33% have documented it in writing whereas only 22% of the ROW SMEs take the effort to document their digital innovation strategy in writing (Figure 2.2). This means in many SMEs only the CEO or owner of the company has an understanding about the company's digital innovation strategy. Employees do not have access to their company's digital innovation strategy if it is not documented in writing. This creates a challenge to align the organization to its strategic objectives as well as to define how each employee can contribute to the firm's strategic goals.

In the Asian SMEs sample, 50% stated that their digital innovation strategy is aligned with their firm's overall strategy. The sample from ROW reaches only 46%. In both regions, 41% focus their investment on digital innovation (Figure 2.2).

Manufacturing SMEs with a digital innovation strategy in both regions seem to be more ambitious than their peers without a digital innovation strategy. Asian manufacturing SMEs with a digital innovation strategy expect 30% compound annual growth rate (CAGR). Their Asian competitors

FIGURE 2.2

## ASIAN AND ROW SMEs ON THE CHARACTERISTIC OF THEIR DIGITAL INNOVATION STRATEGY



The calculation is based on companies' responses to chapter 3.1 question 4 in the DIQ: "Which of the following attributes apply regarding your digital innovation strategy?" Only companies who responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

without a digital innovation strategy expect only 20%. The same applies for the manufacturing SMEs from ROW. Those that have a digital innovation strategy expect 20% CAGR, whereas their competitors without a digital innovation strategy only expect 18%. This shows that Asian manufacturing SMEs overall have higher growth expectations than their ROW peers.

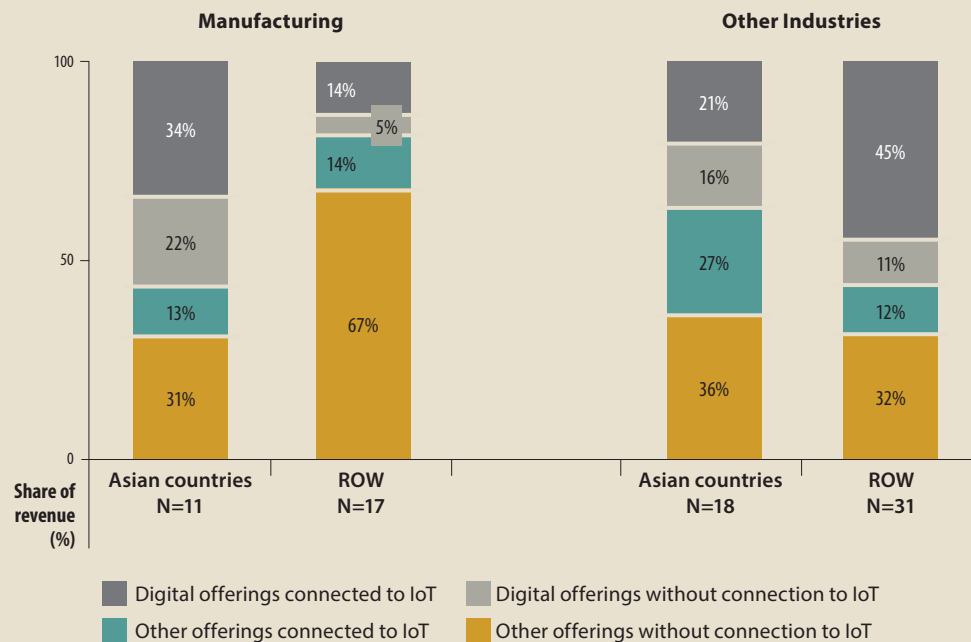
ROW SMEs in nonmanufacturing industries have the highest growth expectations. Those with a digital innovation strategy expect even 50%. Their peers without a digital innovation strategy expect less, but still 40% growth in the CAGR.

When comparing the manufacturing companies' revenue growth rate from last year to the previous year the companies from both regions with a digital innovation strategy show a significant higher growth in revenues compared to their peers who operate without. Asian manufacturing SMEs with a digital innovation strategy achieved 19% revenue growth compared to 8% of their Asian competitors. A more significant difference is seen in the manufacturing SMEs in ROW. Those with a digital innovation strategy achieved 14% revenue growth compared to only 3% of their peers that do not have a digital innovation strategy.

When analyzing the source of revenue, the Asian manufacturing industry records that 34% are generated with digital offering connected to the Internet of Things (IoT). Peers from ROW only state 14%. Accordingly, the revenues from nondigital offerings not related to IoT is much higher in ROW (67%) compared to Asia where it is only 31% (Figure 2.3).

FIGURE 2.3

## SHARE OF REVENUE BY TYPES OF OFFERING



The calculation is based on companies' responses to chapter 3.2 question 9 in the DIQ: "What share of your revenue has been generated the following categories of offerings?" Only companies who responded to the question have been included in the sample.

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

In "other industries", the revenues from digital offerings connected to IoT is much higher in ROW (45%) compared to their Asian peers (21%). However, the share of revenue from nondigital offerings not connected to IoT is similar in "other industries" in Asia (36%) and ROW (32%). This indicates there is a higher digitization of "other industries" in ROW SMEs compared to their peers in Asia (Figure 2.3).

### Lack of Management Capabilities to Innovate for Digitization and Industry 4.0 Readiness

The lack of strategic focus limits many SMEs in their development and growth, as illustrated in the figures. The lack of management capabilities are another source of constraint for the development of SMEs in the mid to long term. This is illustrated in the following section focusing on selected examples, such as the responsibility for the digital innovation agenda and the processes in the organizations, including the innovation process.

Top management plays a key role in leading the digital innovation agenda. In 55% of the Asian companies, the CEO drives the digital innovation agenda. Compared to ROW (43%), there is a gap of 12%. Where there is no clearly defined leader for this strategic topic, the companies are placed in High Risk, which comprises 25% of the ROW companies compared to 10% in the Asian sample. This exposes these organizations to the possibilities of not being able to respond to the digitization



requirements in their markets on time and with the required solutions to (re-)gain competitiveness (Figure 2.4).

## Reducing Time-to-Market for Innovation as Competitive Edge

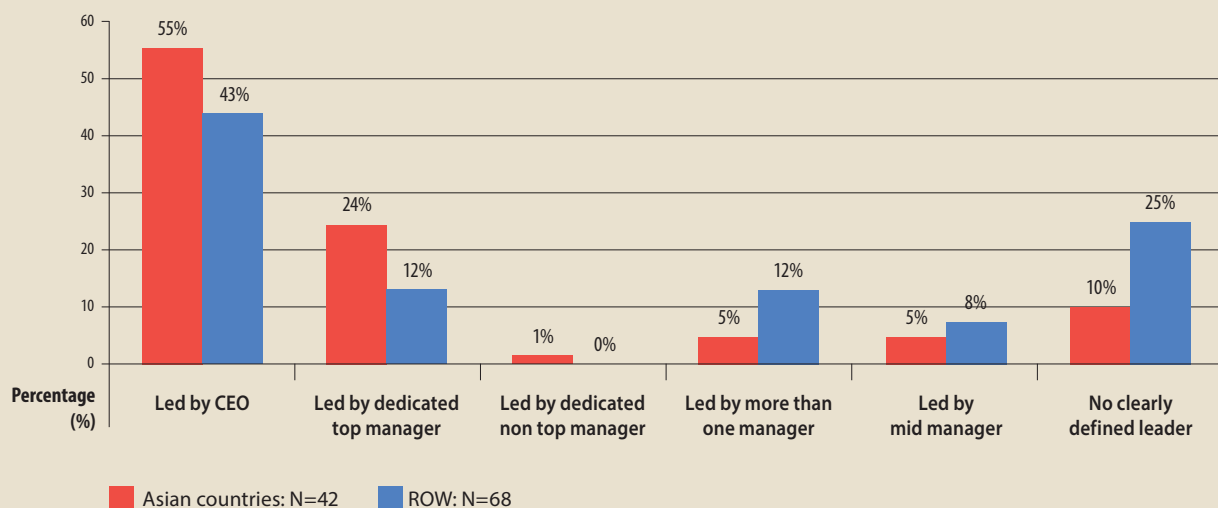
Companies achieve a competitive advantage if they manage to bring their innovations faster to the market than their competitors. They will generate revenues earlier to recover their investments on innovation. Companies from ROW are faster in their innovation processes from developing an idea to launching the new offering in the market. This applies for all types of digital and nondigital offerings whether they are related to the Internet, IoT, or not at all.

Based on the data in Figure 2.5, it seems that SMEs from ROW need longer than SMEs from Asian countries to bring their offerings to market (both digital and nondigital) connected to the Internet or IoT to market. However, when it comes to offerings without connection to Internet or IoT, SMEs from ROW seem to be faster. For the nondigital offerings, Asian SMEs take more than four months longer.

When analyzing the time-to-market in relation to who is responsible for the digital innovation agenda, the data reveal a rather heterogeneous picture (Figure 2.6). Time-to-market of digital offerings seem to take longer in Asian SMEs when the digital innovation agenda is led by the CEO, compared to Asian SMEs where there is more than one person in charge. On the other hand, Asian SMEs need less time to launch nondigital offerings when this is led by the CEO compared to the Asian SMEs where there is more than one person in charge. For the SMEs from ROW, the data show an even more heterogeneous picture. These results indicate that those who are in charge of the digital innovation strategy often lack focus on the management of the innovation process.

**FIGURE 2.4**

### RESPONSIBILITY ALLOCATED FOR LEADING THE DIGITAL INNOVATION AGENDA

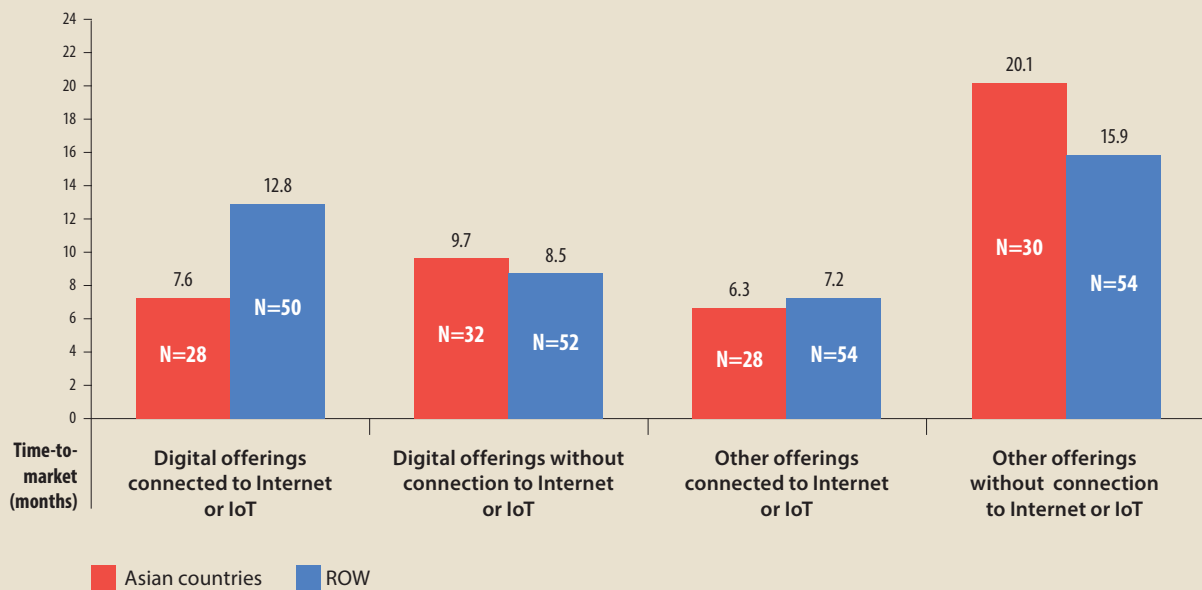


The calculation is based on companies' responses to chapter 3.4 question 2 in the DIQ: "Who is leading the digital innovation agenda in your firm?" Only companies who responded to the question have been included in the sample.

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

FIGURE 2.5

## TIME-TO-MARKET FOR DIGITAL AND NONDIGITAL INNOVATIONS BY GEOGRAPHY



The average calculation is based on companies' responses to chapter 3.3 question 2 in the DIQ: "How many does it take for your most profitable offering in each of the following categories from the beginning of the development to getting the new or significantly improved offering on sale?" Only companies which responded to the question have been included in the sample.

Source: IMP³rove - European Innovation Management Academy, August 2018

### Lack of Process Automation for Process Efficiency

Process efficiency is significantly increased by process automation. When analyzing the SMEs, overall there is still a significant potential for improvement. Measured on a Likert scale from 0 to 4, the operations from the ROW SMEs have a slightly higher degree in process automation than their peers in the Asian countries. The same applies for administrative processes, such as Finance or IT. Only in procurement and partner management the Asian companies score better than the SMEs from ROW.

The data in Figure 2.7 indicate that in most cases, there is a lower level of process automation in the manufacturing industries compared to other industries across both regions.

In the Asian sample, there is a striking difference between the manufacturing sector and "other industries". The process automation in the "other industries" is consistently more pronounced than in the manufacturing sector. The difference is most significant in "Administration IT". This low level of automation in IT should be taken into account for future support actions in Asian SMEs.

### Limited Focus on Digital Capability Development

A key driver for successful digital innovation is the involvement of the entire organization, not just the management. When analyzing the SMEs' organizational approach to digital innovation it becomes obvious that there is still room for improvement. On a Likert scale from 0 to 4 the maximum score

achieved is 2.7 (Figure 2.8). This applies for the companies in ROW for involving the entire organization to contribute to or take part in the digital innovation activities. Overall the companies from the two regions scored on a similar level.

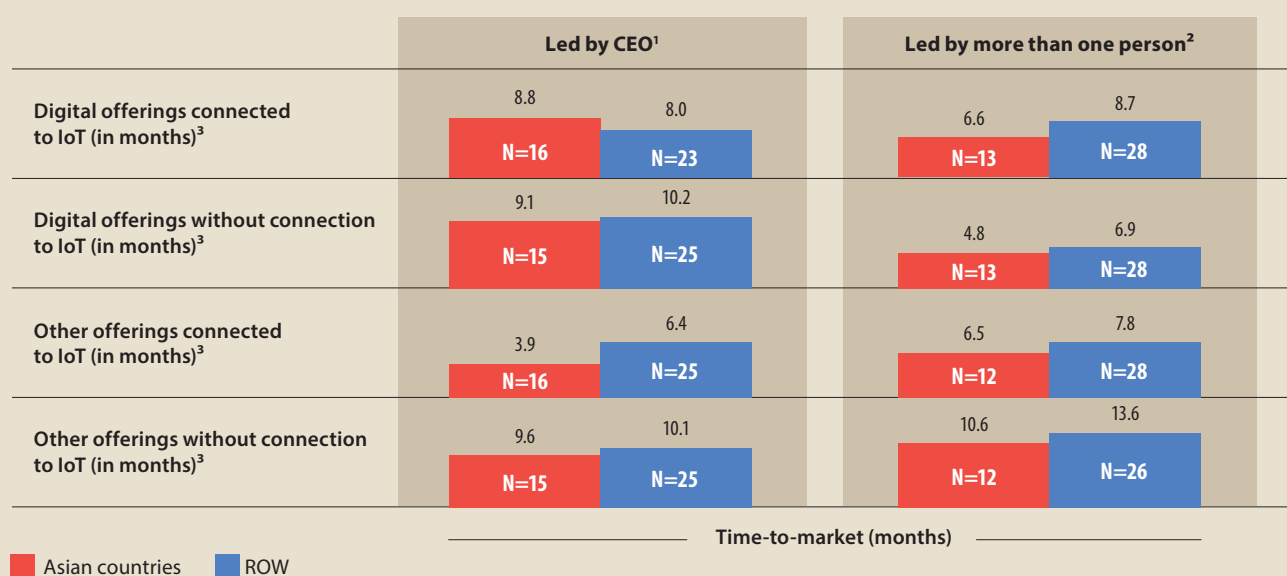
To motivate the staff to contribute to the digital innovation activities, incentives are used in many cases. About 26% of the SMEs in Asia do not offer any incentives while in ROW, the percentage is at 34% (Figure 2.9). However, overall Asian SMEs in the sample outperform their peers from the ROW in offering various types of incentives. More than 62%–72% of the Asian SMEs offer these incentives. In the ROW the percentage ranges only from 36% to a maximum of 50%.

The most often mentioned incentive is training and professional development as an investment into the employees' and company's future, followed by monetary incentives and staff recognition which can be expressed in nonmonetary ways. Time and budget to work on specific digital innovation topics will have a similar sustainable effect as training and professional development opportunities. Further, it may generate the next innovation that will secure the company's future competitiveness.

There is again a significant difference between SMEs that have a digital innovation strategy compared to those who have none. In all, 84% of the Asian SMEs and 79% of the SMEs in ROW offer their staff members incentives. As for SMEs that do not have a digital innovation strategy, the share of companies that offer incentives is much lower - only 45% in Asia and 50% in ROW (Figure 2.10).

**FIGURE 2.6**

**SMEs TIME-TO-MARKET ON CEO-LED DIGITAL INNOVATION STRATEGY AND LED BY MORE THAN ONE PERSON**



The **average** calculation is based on companies' answers to following questions:

- Chapter 3.4 question 2 "Who is leading the digital innovation agenda in your firm?" only the answer "Digital innovation agenda is led by the CEO or business owner"
- Chapter 3.4 question 2 only the answer "Digital innovation agenda is led by more than one top manager, Digital innovation agenda is led by mid-management, There is no clearly defined leader for the digital innovation agenda"
- Chapter 3.3 question 2 "How many months does it take for your most profitable offering in each of the following categories from the beginning of the development (i.e., project authorization) to getting the new or significantly improved offering on sale?"

Only companies which responded to the question have been included in the sample.

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

Offering incentives may influence the recruiting of qualified staff members. If SMEs have difficulties attracting staff members with the skill set that is required to compete in a digitized world, they either must invest in their training and skill development or they will lose in competitiveness.

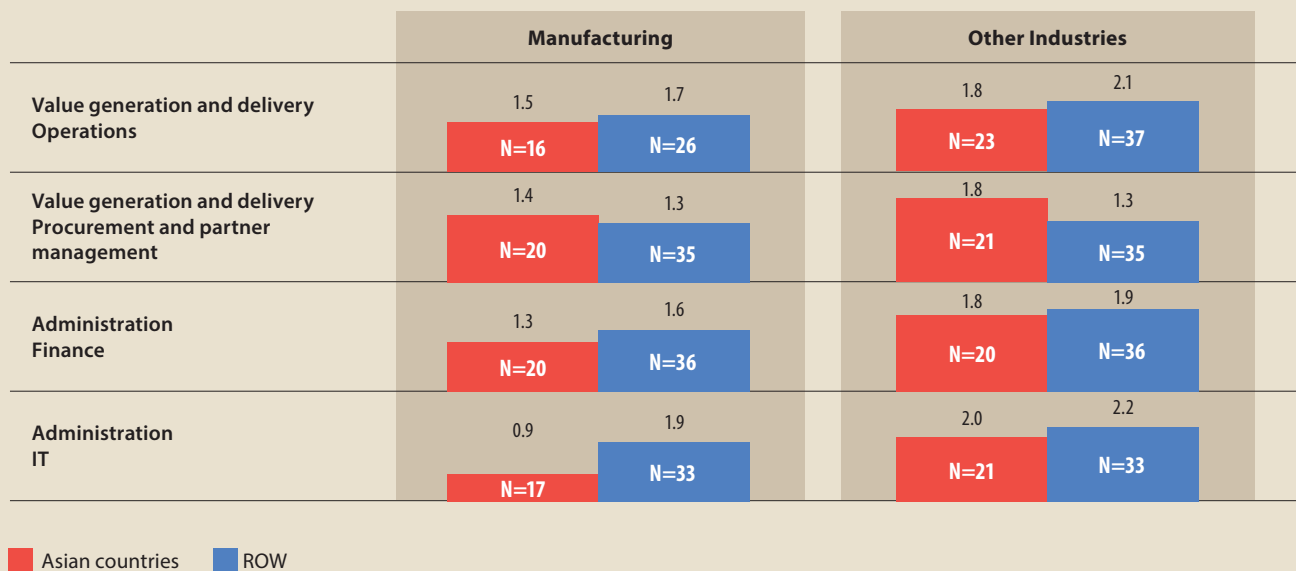
Companies are not yet fully aware of the importance of their employees' digital capabilities. On a Likert scale from 0 to 4 the maximum score is 2.9 (Figure 2.11). SMEs from ROW appear to be more advanced. This has an effect on the companies' ability to safely adopt relevant advanced technologies to enter Industry 4.0. It will also have an impact on the organization's digital risk and cybersecurity management.

Taking a closer look into the expertise in digital risk and cybersecurity management, in most cases, the SMEs from ROW seem to be more advanced than their Asian peers (Figure 2.12). It is also interesting to note that the SMEs in other industries seem to be more advanced in most cases compared to their peers in the manufacturing industries. Asia's SMEs in other industries have a slightly higher score than their peers from ROW.

In Asian manufacturing SMEs, the score is surprisingly low: 1.4 out of 4 on a Likert scale. In comparison, Asian SMEs in the other industries score 2.2 out of 4 on a Likert scale on their expertise covered in digital risk and cybersecurity management. They outperform their peers from ROW marginally.

**FIGURE 2.7**

### PROCESS AUTOMATION BY SECTOR, REGION, AND KEY BUSINESS PROCESSES

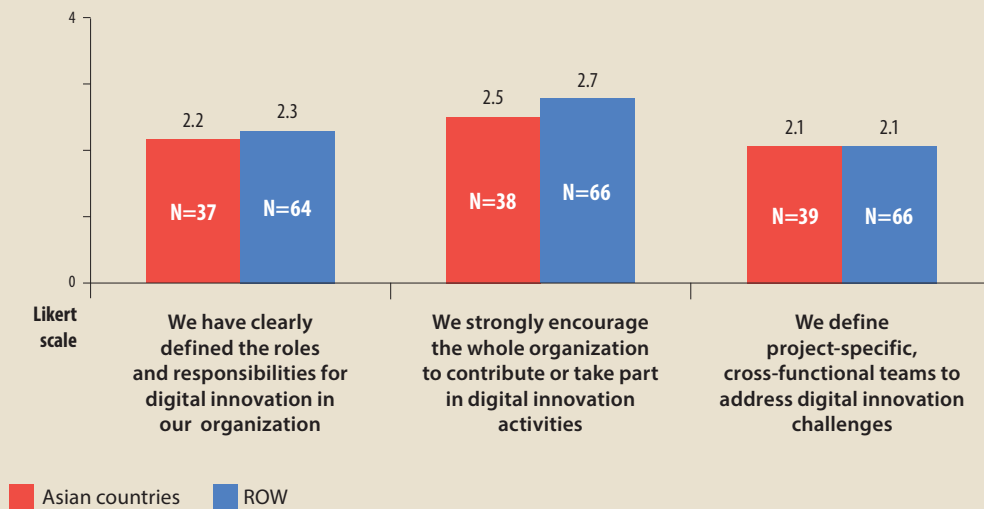


The average calculation is based on companies' responses to chapter 3.3 question 3 in the DIQ: "What degree of process automation does your firm experience today across the following functions?" The companies could select between 0 (= no process automation at all) and 4 (=full process automation). Only companies which responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

FIGURE 2.8

## ENGAGEMENT OF THE ENTIRE ORGANIZATION FOR DIGITAL INNOVATION

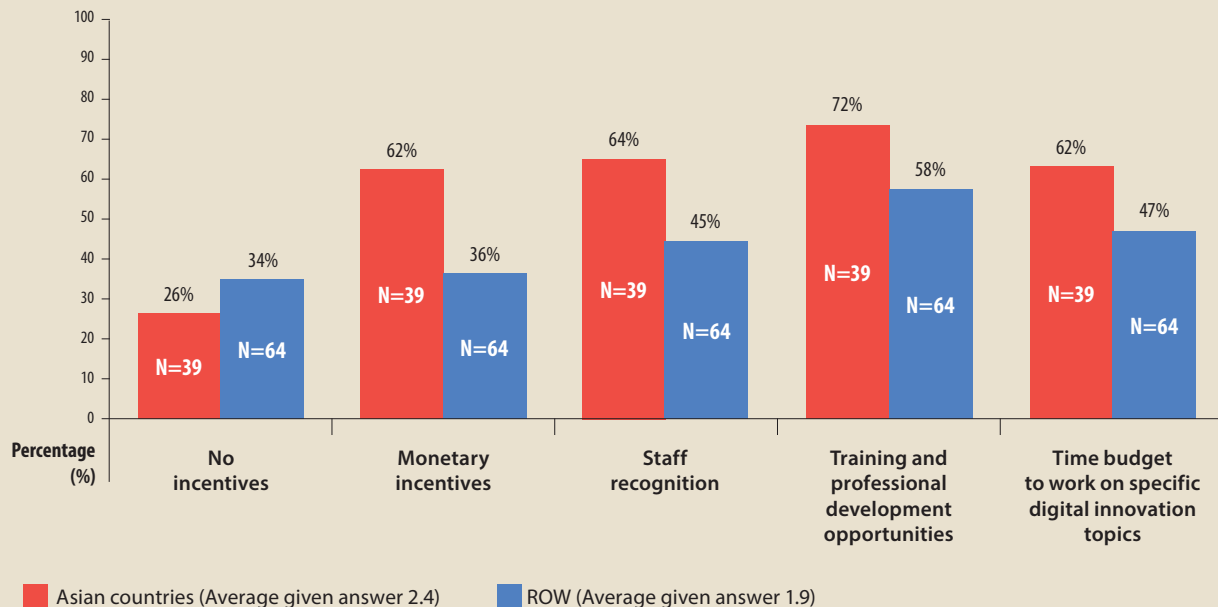


The average calculation is based on companies' responses to chapter 3.4 question 1 in the DIQ: "How do you describe the organization of digital innovation in your team?". The companies could select between 0 (=does not apply at all) and 4 (=applies to a very large extent). Only companies which responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

FIGURE 2.9

## USE OF INCENTIVES TO CONTRIBUTE TO DIGITAL INNOVATION ACTIVITIES



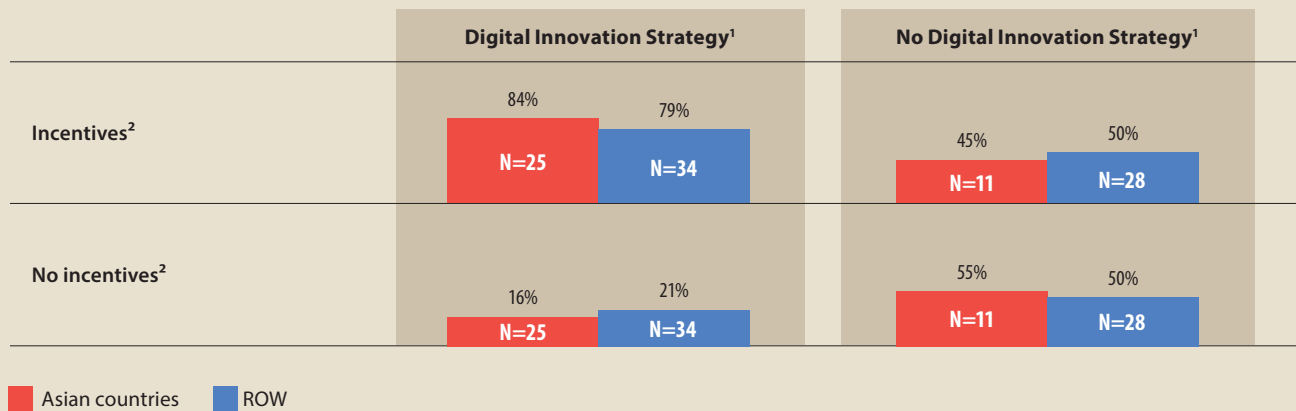
The calculation is based on companies' responses to chapter 3.4 question 7 in the DIQ: "Which of the following monetary and nonmonetary incentives for employees to contribute to digital innovation do you have in place?". Only companies which responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018



FIGURE 2.10

## RELATION BETWEEN EXISTENCE OF A DIGITAL INNOVATION STRATEGY AND INCENTIVES



The median calculation is based on companies answers to following questions:

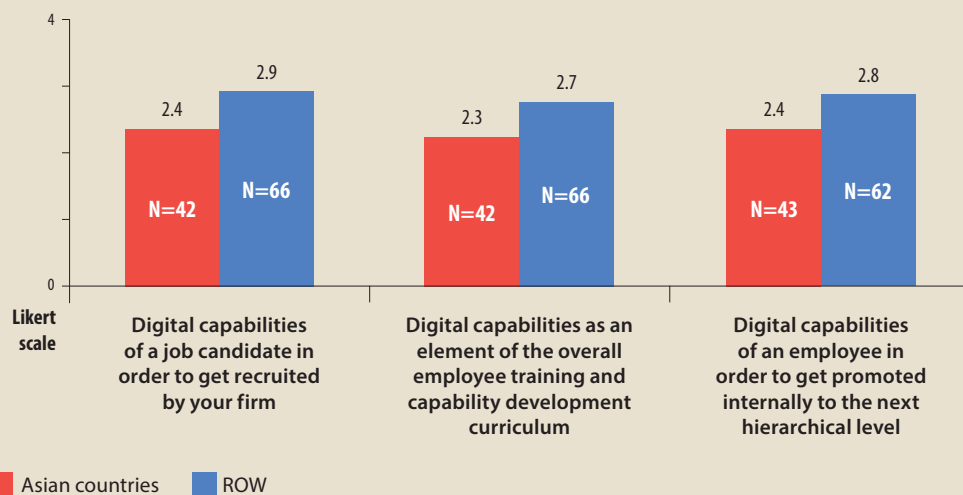
- Chapter 3.1 question 4 "Which of the following attributes apply regarding your digital innovation strategy" only the answer "digital innovation strategy or no digital innovation strategy" is included
- Chapter 3.4 question 7 "Which of the following monetary and non-monetary incentives for employees to contribute to digital innovation do you have in place?" only the answer "We do not have incentives for employees..." and "we have incentives for employees to contribute..." is included.

Only companies which responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

FIGURE 2.11

## IMPORTANCE OF EMPLOYEES' DIGITAL CAPABILITIES

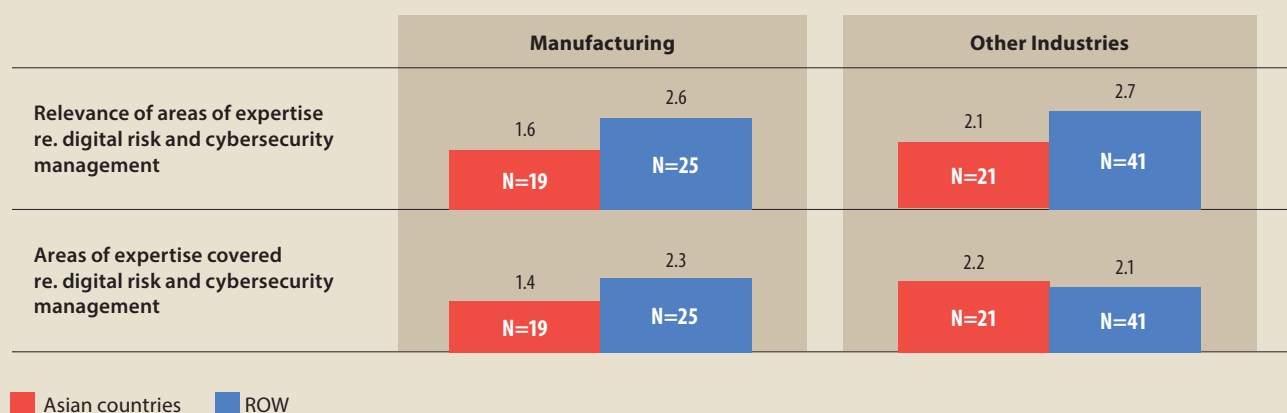


The average calculation is based on companies' responses to chapter 3.5 question 1 in the DIQ: "How important are the digital capabilities of your current or future employees in the following dimensions across your firm?". The companies could select between 0 (=irrelevant) and 4 (=vital). Only companies which responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

FIGURE 2.12

## RELEVANCE OF EMPLOYEES' CYBERSECURITY CAPABILITIES

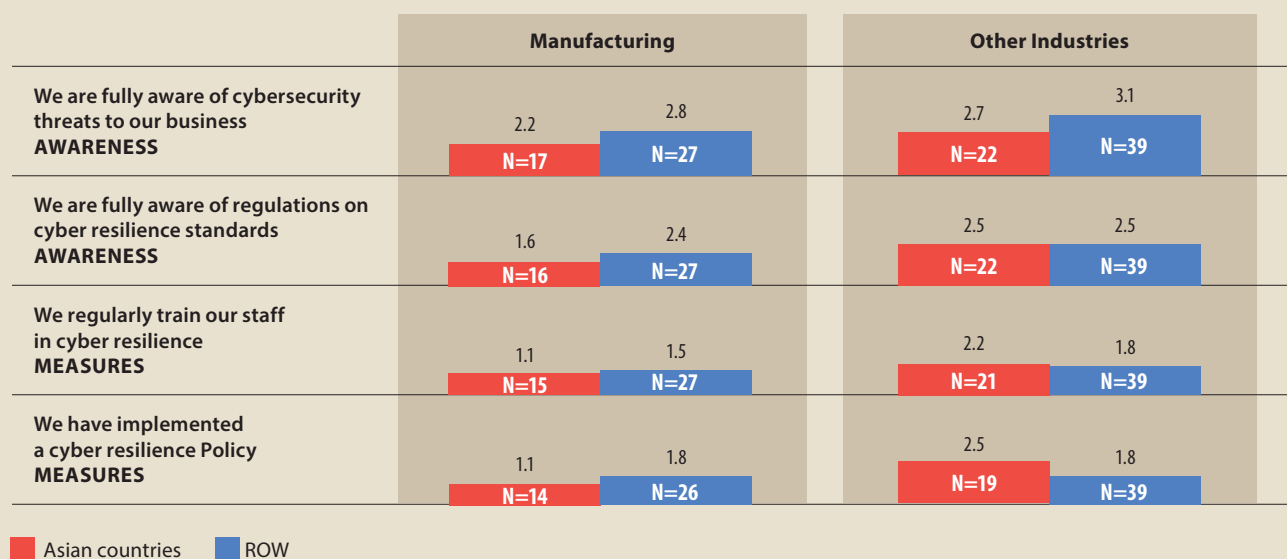


The average calculation is based on companies' responses to chapter 3.5 question 2 in the DIQ: "To what degree are the following areas of expertise relevant to you and to what extent are they covered by your firm or by external partners today?". The companies could select between 0 (=does not apply at all) and 4 (=applies to a very large extent). Only companies which responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

FIGURE 2.13

## LEVEL OF AWARENESS REGARDING CYBERSECURITY ISSUES IN MANUFACTURING AND NONMANUFACTURING COMPANIES



The average calculation is based on companies responses to chapter 3.5 question 6 in the DIQ: "To what degree do the following statements describe your firm's cyber security awareness and measures?" The companies could select between 0 (=not at all) and 4 (=to a very large extent). Only companies which responded to the question have been included in the sample.

Source: IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

The difference between SMEs from the manufacturing industries and other industries is also confirmed when it comes to cybersecurity awareness and measures (Figure 2.13). In the Asian sample the SMEs from other industries score higher than their peers in the manufacturing industries. The same applies for SMEs from ROW with the exception of the implementation of cyber resilience policy. Here SMEs from both industries in ROW seem to score on the same level (1.8 out of 4 on a Likert scale). Overall, there seems to be a rather high awareness regarding cybersecurity threats, especially in the SMEs in ROW.

Companies from ROW put more emphasis on cybersecurity than their peers from the Asian countries, as shown in Figure 2.13. They seem to be more aware of the threats and its regulations, therefore train their staff and implement a cyber resilience policy. However, there is a decline from awareness of the threats to the implementation of the resilience policy.

## Increasing the Impact of Digital Innovation Management

From a business perspective, digitization must pay off and enable sustainable and profitable growth. The following analyses provide preliminary insights that will have to be validated once the database is larger.

When comparing the SMEs' revenue spent on digital innovation projects over the last three years with their growth in revenue, there is a correlation both in Asia (0.29) as well as in ROW (0.37), although a rather low one, in Figures 2.14 and 2.15. The correlation is slightly more pronounced in ROW than in Asian countries.

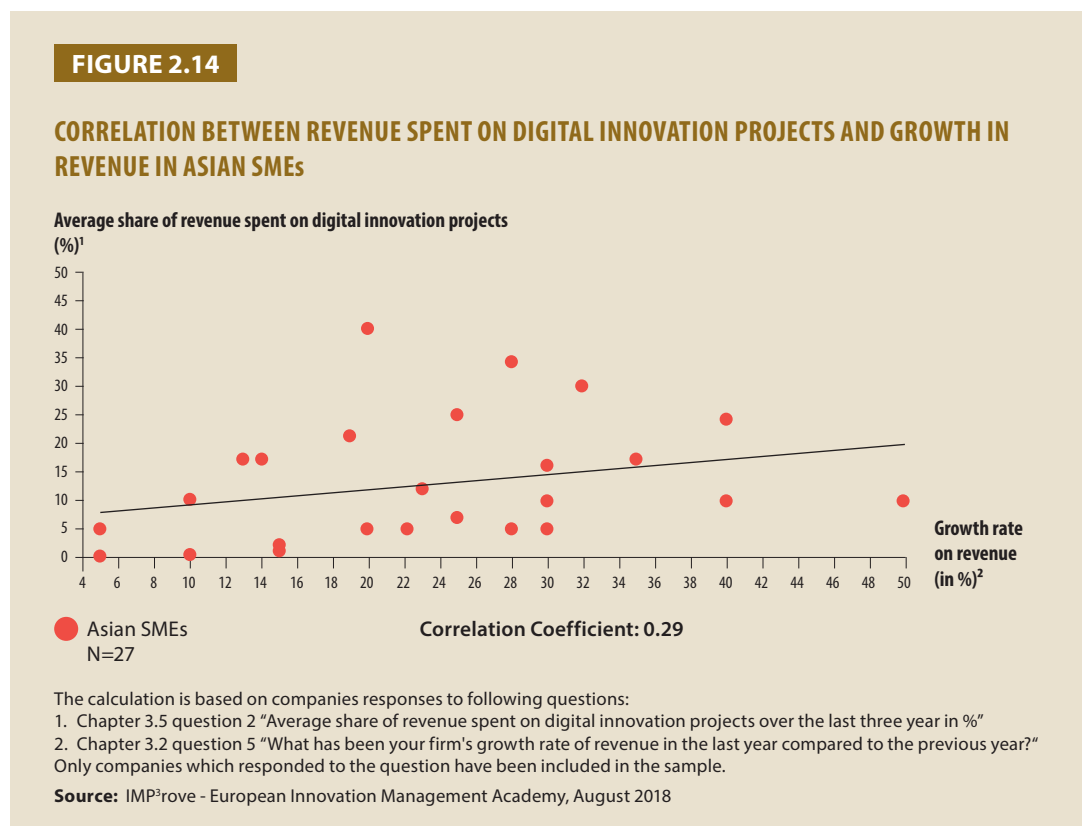
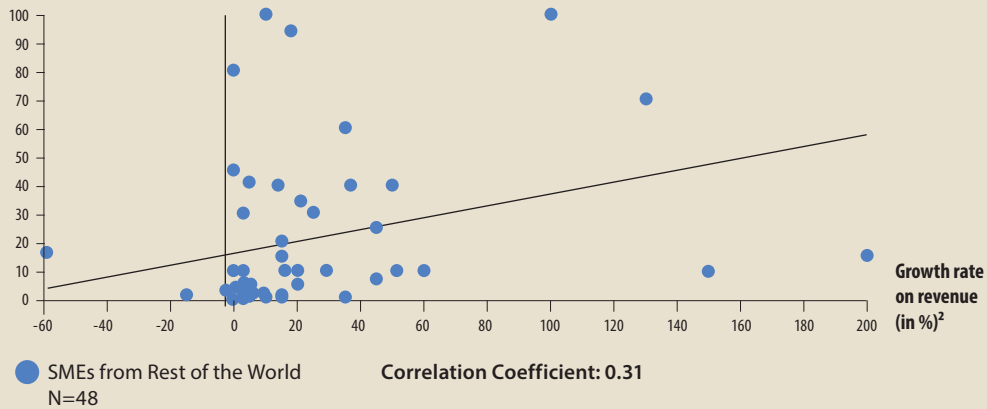


FIGURE 2.15

### CORRELATION BETWEEN REVENUE SPENT ON DIGITAL INNOVATION PROJECTS AND GROWTH IN REVENUE IN ROW SMEs

Average share of revenue spent on digital innovation projects (%)<sup>1</sup>



The values are based on companies answers to following questions:

1. Chapter 3.5 question 2 "Average share of revenue spent on digital innovation projects over the last three year in %"
2. Chapter 3.2 question 5 "What has been your firm's growth rate of revenue in the last year compared to the previous year?" is included

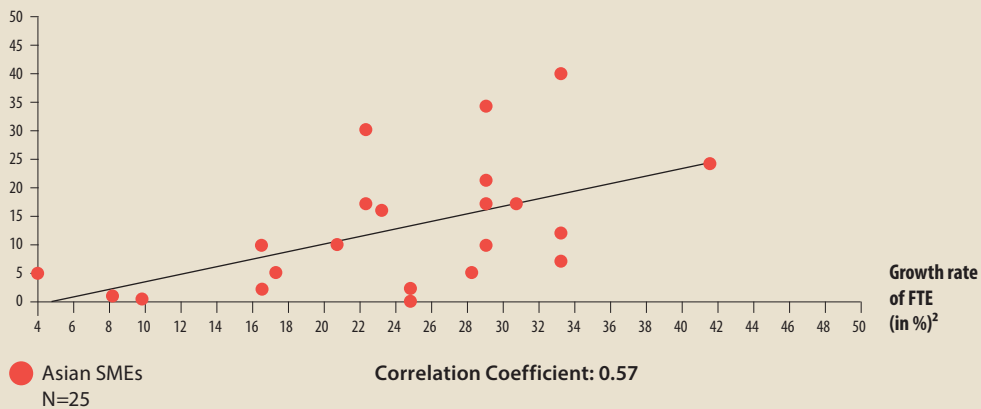
Only companies which responded the question have been included in the sample.

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

FIGURE 2.16

### LINEAR CORRELATION BETWEEN REVENUE SPENT ON DIGITAL INNOVATION PROJECTS AND GROWTH RATE IN NUMBER OF EMPLOYEES IN ASIA (MEASURED AS FULL-TIME EQUIVALENT)

Average share of revenue spent on digital innovation projects (%)<sup>1</sup>



The calculation is based on companies responses to following questions:

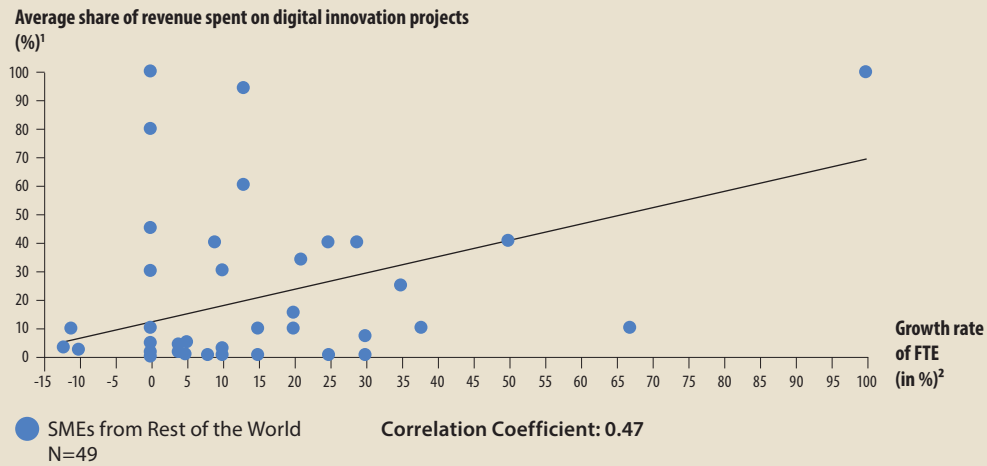
1. Chapter 3.5 question 2 "Average share of revenue spent on digital innovation projects over the last three year in %"
2. Chapter 3.2 question 8 "What has been your firm's growth rate of full-time equivalent (FTE) employees in the last year compared to the previous year?"

Only companies which responded to the question have been included in the sample.

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

**FIGURE 2.17**

### LINEAR CORRELATION BETWEEN REVENUE SPENT ON DIGITAL INNOVATION PROJECTS AND GROWTH RATE IN NUMBER OF EMPLOYEES IN ROW (MEASURED AS FULL-TIME EQUIVALENT)



The values are based on companies answers to following questions:

1. Chapter 3.5 question 2 "Average share of revenue spent on digital innovation projects over the last three year in %"
2. Chapter 3.2 question 8 "What has been your firm's growth rate of full-time equivalent (FTE) employees in the last year compared to the previous year?"

Only companies which responded to the question have been included in the sample.

**Source:** IMP<sup>3</sup>rove - European Innovation Management Academy, August 2018

There is also a positive linear correlation in the Asian SMEs between a firm's employee growth rate (measured in full-time equivalents) and average share of revenue spent on digital innovation projects over the last three years (Figures 2.16 and 2.17). This means that SMEs that have invested in digital projects experience a stronger growth rate in employees (full-time equivalent, FTEs). The correlation is more pronounced in Asian countries than in ROW.

In SMEs from ROW the digital innovation projects might be targeted to more digitization and automation rather than to expanding the work force.



## CHAPTER 3

# CRITICAL NEEDS OF SMEs BECOMING INDUSTRY 4.0 READY

**Dr. Eva Diedrichs**

Managing Director

IMP<sup>3</sup>rove - European Innovation Management Academy EWIV

With the international benchmarking on digital innovation capabilities, SMEs gain insights into their strengths and weaknesses related to digitization. Specifically, they understand the importance of digital innovation strategy and the potential profitable growth digitization offers. SMEs' digital innovation strategy will help to develop digital business models and define the level of digitization of their processes and (IT) systems. SMEs also become aware of the necessity to integrate into digital ecosystem that will provide them access to new markets. This however, requires a cultural change and new skill sets on management and operational level, including expertise in IT, advanced technologies, cybersecurity, etc. The performance measurement is a tool to monitor a company's profitable growth from digital innovation as compared to traditional measures, and as way to gain and maintain transparency in the future. It will also be an indication of growth in revenues and profit from digitization and digital business models. Transparency is important not only for the SMEs' management, but also for policy makers, consultants, intermediaries, such as trade associations, chambers of commerce, and for financial investors and academia to design their support and interventions to close the identified gaps.

Results from international benchmarking show that there is a critical need for SMEs to become Industry 4.0 ready, and must be addressed by the SMEs and external actors in the digital innovation ecosystem, including policy makers, intermediaries, business advisors, investors, academia, and, to some extent, the media. SMEs will need external support to transform to become Industry 4.0-ready and grow profitably by digitization.

## Understanding the Business Impact from Industry 4.0

Many SME owners or managers are risk averse, especially when it comes to new technologies. If they do not immediately understand the business impact from automation, 3D printing, robotics, etc., they will not invest any resources in exploring how these advanced technologies might enhance their organization's competitiveness and support their growth targets. Shortage of time and funding also limit them from attending trade shows, conferences, or the facilities of technical universities in the next town. Many SMEs are located in rural areas where it takes half a day or more to reach the closest urban area.

For SMEs in the manufacturing industries, investments in advanced technologies might be even more disruptive and costly than for their peers in other industries. For example, integrating sensors will lead to more data. However, generating business with data is not the expertise of an average manufacturing SME. This will require different skills and a different business model.

SMEs classified as digital natives do understand the impact of digitization and Industry 4.0. This group does not have to be convinced of the Industry 4.0's business impact. They need to develop their strategic management skills.

## Understanding the Benefits of a Digital Innovation Strategy

Not every SME has developed a strategy. Even less have a digital innovation strategy in place that will give the organization direction; neither an understanding of how digitally-enabled products and services will generate revenue in the future, nor the investments required to compete successfully. Traditional SME managers take a reactive and responsive approach. This ensures agility in response to immediate customer demand. However, it limits the SMEs' growth potential in disruptive markets where proactive longer-term investments in technologies and new capabilities have to be decided in advance.

To convince SME managers of developing and implementing their digital innovation strategy, they need to understand that this will give the organization focus, speed, and agility to respond to rapidly changing markets and competitive pressure. It will also educate the management and staff on ways to leverage digitization at their organization as well as on future offerings and business models. They will also learn that digital techniques for simulation and prototyping will significantly speed up their development processes. As a result, they can reduce risk and investment with a minimum viable product to test market acceptance.

## Finding the Right Approach to Digitization

Introducing digitization for Industry 4.0 readiness to SMEs has to be aligned to the SMEs' level of digitization, ambition to grow, risk taking, investment, and level of skills available in the organization. Well-managed SMEs appear to take bolder steps in digitization than those where management skills are missing, and a low-skilled work force is a constraint to change.

Experience shows that a step-wise approach to digitization in SMEs should start with a digitization "masterplan" that has been derived from the digital innovation strategy. Based on that, the necessary steps have to be defined and implemented. For example, if an SME decides to establish an online shop, it has to understand the implications to their traditional business model, the digitization of related business processes, and the skills and time required to successfully manage the transition.

## Finding the Right Partners in Support of Digitization

Traditionally managed SMEs often have long-standing relationships with their business partners. This is an opportunity to gain a deeper understanding of their partners' digitization strategies and requirements that will have an impact on the SMEs' operations. Collaborating with existing customers and supplier base on digital integration into a value chain is a must to secure the current business. Furthermore, collaborating with existing but also with new partners allows the testing of new digitally enabled solutions, to get feedback, and learn quickly. These partners may include labs at universities, large companies open to SMEs, and digital native companies who are in search of a highly innovative SME to develop a specific solution.

## Funding for Digital Innovation

The lack of funding for many SMEs is a challenge. Internal resources for investing in digitization are limited in many SMEs. Funding for digitization may sometimes pose as big a challenge as investors asking for tangible assets. The challenge also arises from nontransparency in funding opportunities and lengthy application procedures. However, in many countries public funding has increased for SMEs to become more digital and ready for Industry 4.0. Further, large companies are also investing in start-ups and SMEs in their corporate venture funds, incubators, and accelerators. Public agencies have established support services for SMEs to guide them to the most suitable funding scheme and support their application for funding.

## Mastering Cybersecurity

For mastering cybersecurity SMEs have two main needs. First, protecting their own organization. Second, complying with data protection regulations on national as well as international level. Limited knowledge on digital technologies combined with IT-security issues (loss of digitally stored data and intellectual property) and the risk of cyberattacks create a barrier for SME managers to take a well-informed decision on the organization's digitization.

SMEs - more than larger companies - have to rely on government activities to protect the ICT infrastructure and to develop business continuity plans. The public sector can also stimulate the training and education in cybersecurity, including developing a network of experts mandated to support SMEs in enhancing their IT protection and cybersecurity measures. These experts also contribute to raising the awareness for these digital security issues.

## CHAPTER 4

# STRATEGIES FOR DIGITIZING SMEs TO BECOME INDUSTRY 4.0 READY

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Managing Director

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Supporting SMEs in their digitization efforts to become Industry 4.0 ready requires differentiated yet coordinated support from key players in the innovation ecosystem. SMEs are in different stages of their life cycle but also in different stages of digitization for Industry 4.0 readiness. Different industries and value chains have different dynamics regarding digitization for Industry 4.0. The key stakeholders in the innovation ecosystem need to take this into account in their efforts to support and drive digitization of SMEs.

### Understanding the Different Types of SMEs and Their Needs

SMEs can be defined by their position in the life cycle of the organization: start-up, scale-up, and grown-up SMEs. Start-ups are either in the process of launching their first offering (service or product) while scale-up companies seek to grow their business by expanding their markets and/or their offerings. Grown-up SMEs have already been in business for several years, however, have not yet managed to grow into a large company.

SMEs can also be defined by their affinity to digitization: nondigital SMEs, digital explorer, digital native. Nondigital SMEs have no or only limited digital elements in their business model. Digital explorers have a partly digital business model. Digital natives are built on fully scalable digital business model(s).

When supporting these different types of SMEs in their digitization strategies, different approaches have to be taken in light of the industry and markets these SMEs are operating in. The support should address the digital and nondigital needs, such as automation, data analytics, etc., as well as funding, knowledge, management capabilities, access to market, etc. The following examples presented in Figure 4.1 will be illustrative and have to be further customized to the specific situation of each SME.

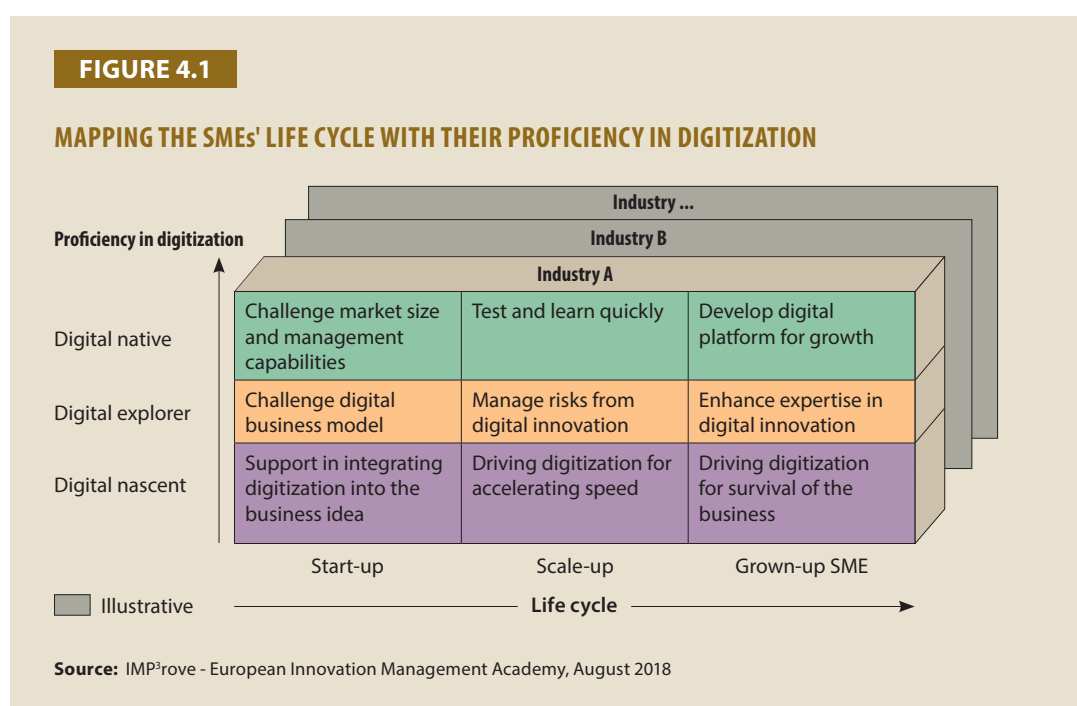
Start-ups that are still nondigital first of all will need support in integrating digitization into their business idea to have a chance to succeed in a digital world. Scale-ups that are still nondigital will need support in driving digitization for accelerating their market penetration and speeding up the growth of their customer base. Here the focus is on gaining efficiency by digitization and integrating into promising value chains for expanding the market opportunities. Grown-up SMEs that are still nondigital aiming to grow their business further, need support in driving the digitization of their organization to survive in a digital world and secure jobs for the future of the company.

Start-ups that are digital explorers will need support in challenging their idea of a digital business model. There might be others already more advanced with a similar idea, and an even broader scope of digitization. Scale-up companies that perceive themselves as digital explorers will need support in

managing the various risks when they innovate with a strong focus on digital innovations. Grown-up SMEs in the stage of digital explorer will need support in further enhancing their expertise in the specific digitization technologies that will be essential to achieve the transformation as well as the future growth targets resulting from a higher degree of digitization.

Start-ups that are digital natives will need support in developing their management capabilities to fully exploit the anticipated business potential of their innovative business idea. Once they successfully move into the scale-up phase these digital natives will need support in access to customers, markets, and further funding. Grown-up SMEs successful as digital natives will need support in developing and/or positioning themselves on digital platforms for their future growth.

The digitization dynamic may vary from industry to industry. SMEs' own industry may still be nondigital, whereas the SMEs' customers' industries are already highly digitized. This requires flexibility by the SMEs.



## Responsibilities of the Key Actors in the Digital Innovation Ecosystem

Many SMEs might not yet be fully aware of the disruptive changes from digitization affecting their business. Others lack the skills and/or funding to be able to respond to the challenges and opportunities that digitization offers. Especially in developing countries, infrastructure is a key success factor that allows SMEs to get access to advanced technologies. Last but not least, suitable funding schemes are a key issue. This leads to four key issues that need to be included in the digitization strategies for SMEs and that need to be addressed by the key stakeholders in the innovation ecosystem:

- Awareness creation
- Skill development both on strategic and operational levels to become Industry 4.0 ready, including professional management skills as well as IT and digitization skills

- Access to infrastructure, including the Internet and to advanced technologies relevant to Industry 4.0
- Access to funding as financial resources are limited in SMEs.

Table 4.1 provides an overview which can be addressed by the relevant stakeholder in the digital innovation ecosystem

TABLE 4.1

**SMEs' NEEDS AND EXAMPLES ON DIFFERENT STAKEHOLDERS' WAYS IN ADDRESSING NEEDS**

| Need  | Stakeholder   |  |  |   |  |   |   |
|---|---|--|--|---|--|---|---|
|   | SME   | Large Customer Company   | Policy Maker   | Academia  | Consultant/<br>Business Advisor  | Intermediary  | Financial Investor  |
| <b>Awareness creation</b>                           | Understanding the urgency and the benefits of digitization                                    | Share relevant Industry 4.0 strategic requirements   | Understanding the key challenges of SMEs and how to address them   | Understanding the specific digitization needs of SMEs                 | Present industry-specific international benchmarks (gaps, strengths) on SMEs' digital innovation capabilities                          | Gain transparency on gaps and challenges of SMEs' members regarding digital innovation    | Understanding the business potential from digital innovation for SMEs and the effect of available financing instruments |
| <b>Skill development</b>                            | CEO to initiate the process for gaining digital innovation capabilities                       | Share relevant Industry 4.0 strategic requirements   | Provide financial support for professional Industry 4.0 skill development  | Offer master courses on digital innovation management                 | Offer digital innovation consulting/ coaching support to SMEs  | Provide information on best practices such as digital innovation capabilities development | Validate the SMEs' digital innovation capabilities for Industry 4.0   |
| <b>Access to Internet and advanced technologies</b> | Provide computer access to all staff members  | Support integration with IT systems  | Develop access infrastructure, including rural areas and Provide financing for advanced technologies               | Provide SMEs and future staff members access to advanced technologies | Facilitate translation of digital innovation strategy into adoption of advanced technologies for Industry 4.0 and high business impact | Provide best practices in use of Internet and advanced technologies for Industry 4.0      | Provide funding for access to Internet and adoption of new technologies for Industry 4.0                                |
| <b>Access to funding</b>                            | Allocate own resources to invest into future technologies with high business impact potential | Provide innovative investment schemes for strategic SME suppliers to become Industry 4.0 ready | Facilitate access to (public) funding and tax incentives   | Funding of spin- offs, e.g. also via "in kind" contributions          | Provide overview on regional, national, and international funding schemes  | Share information on various funding schemes  | Invest in SMEs' Industry 4.0 readiness with clear strategic focus   |
| <b>Mobilizing for digitization and Industry 4.0</b> | Mobilizing staff to contribute to digital innovation projects                                 | Collaborate on digital innovation projects with SMEs   | Sponsor digital innovation awards and hubs where, e.g., SMEs use can advanced technologies on a pay-per- use basis | Showcase SMEs digitization successes in research and education        | Customize the consulting support to the specific SMEs needs with clear focus on business impact  | Provide platform for SMEs to learn from best practices and present success stories        | Provide funding for digitization and implement KPIs with focus on digital innovation success                            |

Source: IMP<sup>3</sup>rove - European Innovation Management Academy 2018

### **Awareness Creation for Opportunities and Challenges of Digital Innovation in SMEs to Become Industry 4.0 Ready**

Each actor in the digital innovation ecosystem still has to increase their own awareness concerning the digitization of SMEs for economic development and social welfare, including the awareness of SMEs for digital innovation.

More and more SMEs know that digitization is changing many industries. They might already have realized that the industry they are operating in is also affected. However, they may be unaware of the way forward: the choice of IT, advanced manufacturing technologies to invest in, and where to start. In addition, in many developing countries, especially in rural areas, the required infrastructure is not there yet, such as access to uninterrupted electricity, Internet, etc. Even if the SME has plans to move into Industry 4.0, and even with available infrastructure, financing the digitization may prove to be a major barrier. Therefore, SMEs need to become aware of the funding schemes available to capture the benefits of digitization, adopt best practices in digital innovation, and leverage on external support that will help them on their journey to Industry 4.0.

The managers of more agile and ambitious SMEs will take the initiative themselves to learn about the possibilities of digitization from media, workshops, conferences, customers, and suppliers. They may serve as role models to their staff as well as to other SMEs.

Larger companies working with SME suppliers need to become aware of their SME suppliers that have already reached a sufficient level of digitization. The level of digitization of their SME suppliers will have a major impact on their own competitiveness. Especially strategic SME suppliers will play a key role in the digitization of the entire value chain. SMEs that are considered by the larger companies as strategic supplier can use their power of negotiation to get support from their customers on the integration of their systems. On the other hand, larger companies need to be aware of their SME suppliers' constraints and challenges relating to digitization and integration into their systems. The large and complex systems used by the larger companies often are oversized and too complex for SMEs. Therefore, larger companies need to ensure the interoperability of the systems along their value chains. International initiatives, such as the Industry 4.0 platform are currently addressing this issue and working on the standardization of the systems.

Policy makers are aware of the need for SMEs' to enter into digitization. However, policy makers lack transparency on what effective support mechanisms are. Survey-based research related to SMEs' level of digitization is the source to gain transparency for policy makers. However, the challenge is to mobilize enough SMEs to take part in the survey and to get international comparison. The IMP<sup>3</sup>rove online benchmarking on SMEs' Digital Innovation Quotient provides necessary transparency for policy makers while at the same time the individual benchmarking report gives the SMEs detailed feedback on their performance and competitiveness from digital innovation. Often it is less the financial support than the development of skills and knowledge that SMEs need first before they can make an informed decision on their own digitization strategy.

Policy makers also need to be aware of policies that have a negative impact on SMEs' digitization. Regulation on eligibility of SMEs for support programs, public procurement rules, lack of investment in the country's infrastructure are just a few examples that discriminate SMEs.

Academic institutions lack awareness regarding the technical needs of SMEs in the context of digitization and effective education of students in digitization of enterprises, especially SMEs. Business schools do incorporate digital innovation management and related topics in their curriculum. However, very few focus on SMEs. And even fewer offer education programs in which local SMEs are actively



involved and provide students with practical experience and insights on what digital innovation means to an SME with limited funding as well as knowledge about the advanced technologies essential for Industry 4.0 readiness. Pioneers [1] in this area already offer courses in their master programs on innovation management that allow students to directly collaborate with SMEs to benchmark their innovation management capabilities with international peers and jointly develop a roadmap to address, e.g., the future challenges of Industry 4.0.

Consultant and business advisors that assist SMEs are usually fully aware of their clients' need for digitization and for adopting the advanced technologies to become Industry 4.0 ready. However, many of them are not aware of the tools and approaches of getting transparency on the SMEs' current performance in comparison to their peers. They are also unaware of ways to develop effective roadmaps for digitization of SMEs given their constraints regarding financing, knowledge, and management capabilities. Therefore, in some countries publicly funded capacity development programs have been launched to provide better innovation management support to SMEs [2]. SMEs receive support in assessing their strengths and weaknesses in digital innovation, analyzing their current performance, and developing an action plan to further develop their business performance. The implementation of the action plan is supported and monitored by business advisors. These programs include training and coaching of consultants and business advisors supporting SMEs in (digital) innovation management.

Intermediaries, such as trade associations and chambers of commerce receive feedback from their members on their challenges in digitization for Industry 4.0. Thus they are aware of their members' need for support. However, they are not aware of where to get the specific support for SMEs due to the nascent status of the digital innovation support service sector and its nontransparency. Intermediaries could and should take the role of information brokers to provide the SMEs with information on what professional support services for digitization in SMEs look like, and where to get them. On the other hand, they need to inform the support service sector about the SMEs' challenges and needs. Staff members working in the intermediary organizations therefore need to have solid technical background as well as deep knowledge of the SME members and the trends in the industries they are operating in. This might require a change in the hiring strategy of the intermediary organizations [3].

Financial investors are often unaware of the best practices in evaluating SMEs' digital innovation capabilities and the key performance indicators used to measure the value generation of digital innovation. This is especially for financial investors from the public sector who need such information to build their financing policies on measurable growth parameters to evaluate the impact of digital innovation. Proven assessment tools, international benchmarks, and measures focusing on the business impact of digitization will help monitor the return on investment in SMEs' digitization. It will also improve the understanding of the business potential from digital innovation for SMEs and the effect of the financing instruments.

### **Skill Development for Industry 4.0**

International benchmarking on digital innovation capabilities highlights the fact that SMEs with a digital innovation strategy are better managed and achieve an overall higher performance rating compared to their peers who do not have a clearly defined digital innovation strategy. Therefore, many SMEs without a digital innovation strategy need to initiate the process for developing their digital innovation strategy. Large enterprises that are SMEs' customers might require the alignment with their Industry 4.0 strategies and requirements. To increase the SME management's awareness for Industry 4.0 strategic issues, public policies have proven to be effective in two ways. Tax payers' money is effectively invested as SMEs with a clear digital innovation strategy tend to achieve better business performance. Receiving public funding for the development of the digital innovation strategy will motivate SMEs to invest management, time, and resources if it is at least cofinanced.

Academia can provide the next generation of experts that are trained in digital innovation strategy development. They can serve as innovation managers in SMEs, professional coaches, or consultants with strong background in innovation strategy development, digitization trends, and Industry 4.0 requirements formulated by large companies that are for many SMEs the preferred key customers. Intermediaries, such as trade associations, chambers of commerce, or clusters can offer information and support services to their SME members. Financial investors will evaluate the SMEs' digital innovation strategies for their focus on value creation by digitization and Industry 4.0 readiness.

Especially in Asian countries where the manufacturing sector plays a key role in economic development, support in digitization of manufacturing SMEs needs to close the gap to the development in other domestic industries as well as to the international competitors.

### **Access to Internet and Advanced Technologies Relevant to Industry 4.0**

In many developing countries access to the Internet and advanced technologies relevant to Industry 4.0 is still a challenge. Either there is no Internet available - especially in rural areas - or electricity supply is frequently interrupted. If an SME is expected to transmit data on their production output on a regular basis via the Internet to their customers and electricity is disrupted, seamless automation of processes along the value chain are jeopardized.

Large companies can support their SME suppliers and customers by providing access to advanced technologies relevant to Industry 4.0, such as 3D printing. For example, allowing the SME to print the prototype that will become a relevant part of the new machine to be manufactured by the large company creates a win-win situation. The development process for both the SME and large company will be accelerated while simultaneously time and cost also reduced.

Policy makers play a key role to develop the necessary infrastructure to secure continued electricity supply and easy access to the Internet, especially for SMEs. Already in 2015, the impact of SME online sellers in less developed areas in Europe has been highlighted [4]. Access to Internet is as critical for the manufacturing SMEs that need to become Industry 4.0 ready. If public investment is limited, public-private partnerships may overcome the financial constraints with innovative solutions that offer wireless access to the Internet, particularly in rural areas.

For access to advanced technologies relevant to Industry 4.0, policy makers can establish effective policies that will help SMEs to develop their knowledge in advanced technologies and how to integrate them into their operations. Publicly funded Digital Innovation Hubs or CoE offering Industry 4.0 technologies to SMEs to use their facilities on a pay-per-use scheme serve as training as well as a production facility. Policy makers can also design financial instruments to support SMEs in investing in these technologies.

Academia play a key role to provide SMEs the access to advanced technologies relevant to Industry 4.0. They can open labs where these technologies are developed, tested, and applied in various industries. Academia also has to ensure that their graduates equipped with state-of-the-art knowledge in these technologies and its application in an SME context. Special training programs can be offered for SME management and staff members on how to select and adopt the “right” advanced technologies relevant to Industry 4.0.

Consultants and business advisors who are specially trained and experienced to support SMEs in their digitization strategies for Industry 4.0 are expected to develop a digitization roadmap for the SMEs based on their assessment of the Digital Innovation Quotient. These consultants and business advisors

are either fully financed by publicly funded programs, or co-funded by the SME and public support programs.

Intermediaries, such as digital innovation hubs or Centers of Competence/Excellence, play a key role offering facilities where SMEs will have access to advanced technologies, e.g., process automation, robotics, or 3-D printing, to learn about best practices, and make use of these technologies for their own products or processes. Trade associations can address the specific SMEs' need for information by organizing workshops, conferences, and best practices visits.

Financial investors are expected to finance the investment for the Internet and advanced technologies that will enable the SME to put its digital innovation strategy into action and secure their future business impact, hence the financial investor's return on investment.

#### **Access to Funding as Financial Resources are Limited in SMEs**

SMEs that are already well-established should have a clear strategy on how they will invest their own resources in digital innovation projects. Our research shows that SMEs that have a higher percentage of their budget invested into longer-term innovation projects perform better than their peers that take only a short-term view [5]. When allocating financial resources (whether own or external funds), it is important to understand what problem the digital innovation project is trying to address, how many people or organizations have this problem, and how many of them are willing to pay for solving their problem. Without a digital business model for the new offering as a result of the innovation project, the reach will be limited and hence not very sustainable in a digital economy.

Large companies already invest in start-ups. Based on the insight that their own organization is too slow and not agile enough, they decided to develop their ideas for digital business models outside their established organizational structures. These start-ups funded by large companies then will collaborate with external partners to develop their digital business models. There are some examples already established in some Asian countries.

Other large companies provide financial support to their SME business partners, or they provide access to their Industry 4.0 technologies for cocreation of the next (digital) innovation.

Policy makers need to offer suitable funding schemes. Depending on the objective, the funding may aim to secure jobs by digitization of SMEs. The analysis of the IMP<sup>3</sup>rove benchmarking data has shown that investment in digital innovation projects pays off provided there is a clear strategy and effective management in place. In other countries or sectors public funding is intended to bring lagging SMEs to the first level of digitization. There are also approaches to support high-growth SMEs that have demonstrated profitable growth to get to the next level by digital innovation. Often financial resources are provided by policy makers to develop the expertise within the SME organization, facilitate the collaboration with labs or international experts who are highly experienced in the relevant advanced technology. Public funding schemes should be flexible enough in providing funds for defined digitization projects and focused enough to ensure that the funding is linked to a clear digitization strategy and its implementation.

Academia provide funding to their spin-offs or in-kind support by giving access to the Industry 4.0 relevant advanced technologies to facilitate the start-up phase of these organizations. Technical universities also play a key role in providing established SMEs in the region "in-kind contributions" by offering access to their smart factories and labs.

Consultants and business advisors may offer support in identifying the most suitable (public) funding scheme for the SMEs for their digitization initiatives. Their services to the SMEs are paid by the government.

Intermediaries, such as trade associations and chambers of commerce also play a key role as information brokers that orientate SMEs on the availability of funding schemes that would be the most suitable for their Industry 4.0 projects.

Investors, such as banks, venture capitalists, and private equities invest in SMEs' digitization initiatives. They put strong focus on the business case of the SMEs' digital innovation strategy and related digital innovation project to become Industry 4.0 ready. To get access to this kind of funding, the SMEs must demonstrate the solidity of their business case not only from a technology point of view but also from a strategic and capability perspective.

The major constraint for SMEs to become Industry 4.0 ready is often not the money but the mobilization of their organization to adopt a completely new way of operating.

### **Mobilizing for Digitization and Industry 4.0**

SMEs themselves need to mobilize their staff to become Industry 4.0 ready. In well-managed SMEs the managers explain what digitization implies for the company and each of the staff members in their respective roles. Management has to illustrate that becoming digital proficient will also mean enhancing one's own employability and being able to make a career in a digital economy. Therefore, each staff member should have the chance - and the mandate - to contribute to digital innovation in the company. This will offer the opportunity to also collaborate with external partners and learn from their experience.

Large companies know that they can benefit from collaborating with SMEs in their own attempt to innovate and grow profitably by digitization. They can test and learn quickly when experimenting with new products or services. For the SMEs such collaboration will facilitate access to labs and advanced technologies. Large companies also know that they need to mobilize their own organization to take advantage of collaboration with SMEs. In some cases, they have established separate units that are agile enough to meet the demands of SMEs and learn from the joint innovation project.

To mobilize for digitization, policy makers play a key role. Together with the business communities, academia, and media, they can launch digital innovation awards and promote digital innovation hubs, offering SMEs access to advanced technologies as a way of experimentation and testing. The key success factor here is continuity. The more often successful case examples are presented, the higher the mobilization effect will be, creating an active platform for other SMEs or entrepreneurs to learn. Innovative formats for events where digitization is the focus will attract SMEs and other key stakeholders to the digital innovation ecosystem.

Academia can showcase the successes of digitization for Industry 4.0 in SMEs through education, conferences, and publications. The presented examples will provide insight into best practices of initiating digitization for Industry 4.0 in SMEs as well as developing effective digital innovation ecosystems by integrating SMEs into the network of academic institutions.

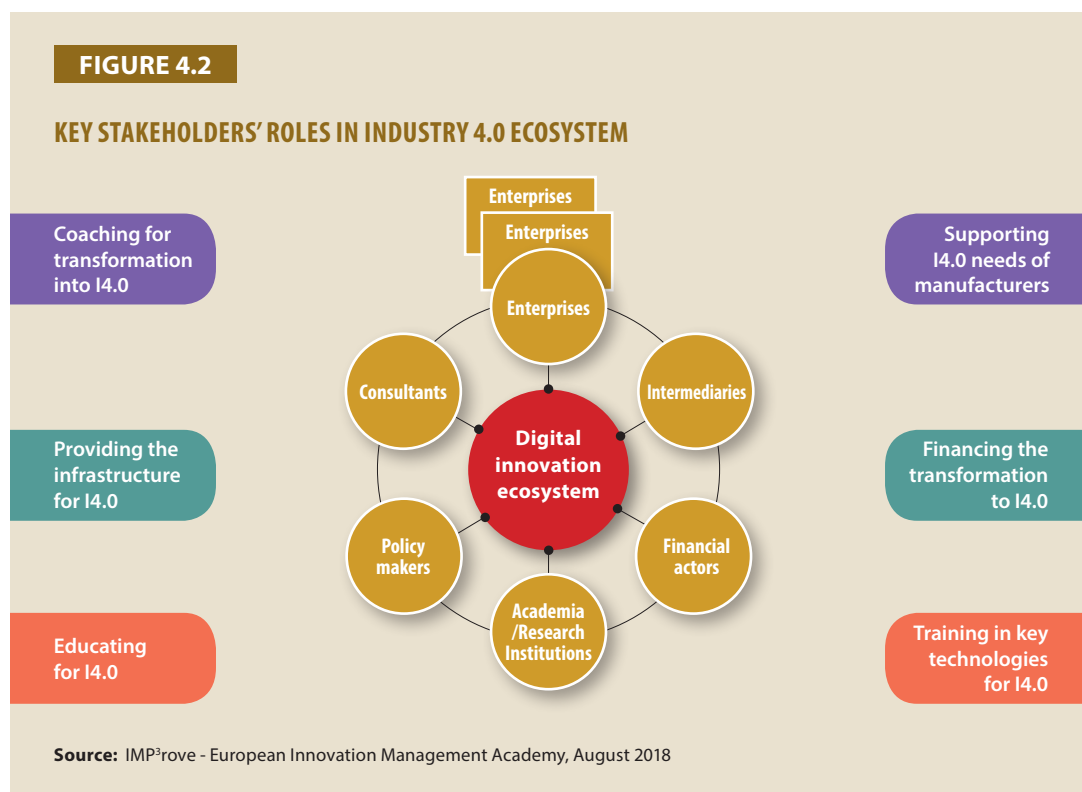
Consultants and business advisors supporting SMEs mobilize their clients best if they can:

- Provide success stories in digitization from companies the SME managers can relate to
- Base their recommendations for engaging in digitization for Industry 4.0 on their deep understanding of the SME's business and industry
- Provide a feasible plan for the SME to become Industry 4.0 ready by taking their level of ambition and their risk appetite into account

The SME manager's trust of the consultant's expertise will grow to the degree that the consultant can present a proven approach that begins with international benchmarking in digital innovation and builds on the strengths of the SME while addressing the weaknesses with concrete measures and clearly defined key performance indicators to monitor the progress in digitization.

Intermediaries, such as trade associations, regional development agencies, or chambers of commerce can mobilize SMEs with events, workshops, experience-sharing on-site visits to other SMEs and to large companies to learn from best practices, and exchange on current challenges and trends in digitization with peers.

Investors, especially public funding authorities can have a significant impact on mobilizing SMEs to get engaged in digitization and Industry 4.0 by providing targeted financial support. When clearly linked to digitization in SMEs of different development phases and integrated with the development of knowledge in digital innovation, financial support can have a sustainable impact.



## Taking a Multistakeholder Approach

The SMEs' digitization for Industry 4.0 will increase to the degree that the key players in the digital innovation ecosystem (Figure 4.2) collaborate on their activities to support the SMEs. Therefore, a solid understanding of the local, regional, and national digital innovation ecosystem is a prerequisite to design, implement, monitor, and adjust the digitization strategies for SMEs for Industry 4.0.

The interdependency of the various stakeholders in the digital innovation ecosystem recommends a multistakeholder approach for the digitization strategy of SMEs. Government policies, especially their systematic implementation, will be the basis for an effective development of the required Industry 4.0 infrastructure and capabilities. However, these policies need to reflect on the following:

- Current stage of infrastructure development
- Absorption capacity of enterprises, especially SMEs to adopt advanced technologies for Industry 4.0
- Level of digitization in the various industries' value networks, and the driving forces there for further digitization
- Level of knowledge in the technologies driving Industry 4.0, and common understanding of how Industry 4.0 should be adopted
- Financial resources (both public and private)
- Capacity to mobilize and align the key stakeholders in the digital innovation ecosystem(s)

Large high-tech companies and OEMs define the required level of digitization for their first, second, and third tier supplier, and those in turn put pressure on their suppliers including the SMEs in their networks. Skilled workers educated and trained in digitization and advanced technologies for Industry 4.0 need to be either recruited or developed based on re- and up-skilling initiatives. This task needs to be driven by academia, training facilities that are easy for SMEs to access, higher education institutions, and to some extent, by consultants and business advisors. Publicly funded digital innovation hubs will help SMEs to apply advanced technologies for Industry 4.0 for their specific products and markets.

### Digitization Strategies for SMEs Driven by the Government - Selected Case Examples

Digitization strategies for SMEs by the public sector have taken very different approaches depending on the public sector's strategic intent, the level of IT proficiency at SMEs, the industry sectors in focus, and the size of the SMEs. Most of the public sector's initiatives either aim at awareness creation, providing access to knowledge and technologies, piloting the digital transformation in SMEs, or financing SMEs' digitization project.

#### (Inter-)National Awards for Best Practice Awareness Creation

Initiated by the government, the national awards should highlight best practices in adopting advanced technologies for Industry 4.0 in SMEs. The selection criteria for the winners should include lessons learned in selecting the digitization approach, in adopting and integrating the new technologies into the SME's organization, the SME's transformation journey toward Industry 4.0, and the business impact already achieved. Presenting the winners and their success stories should be scalable and of interest for many other SMEs. The message conveyed should clearly highlight that digitization is inevitable, and it is rewarding for the SME and the employees.

DIGITALEUROPE comprising almost 40 trade associations launched the DIGITALEUROPE SME Award to highlight the importance of SMEs in the digital ecosystems. Each of the trade associations were asked to nominate one of their members for the European award. SMEs from different European countries were nominated.

#### Providing Learning Experience for SMEs

For SMEs it is essential to understand how advanced technologies relevant to Industry 4.0 work, the benefits offered, and the application within their operations. Therefore, many governments, e.g., India, are now establishing CoE where these technologies are available. The cases compiled there are presented to show how these technologies are applied in the manufacturing industry. In some countries these CoEs or Digital Innovation Hubs (DIH) also offer a kind of “contract manufacturing” solution for SMEs in the form of a “technology as a service” model. For example, SMEs can book capacity of a 3D printer at the DIH for their products. The DIH staff will then manufacture and deliver the prototype, the parts, or products to the SME. This allows small companies to leverage advanced technologies at reasonable costs.

#### Developing Formal Training Curricula for Industry 4.0

Ministries of Education need to redefine the curricula on vocational and higher education to adjust them to the requirements of Industry 4.0. New job profiles demand for more focus on IT skills, data analytics, etc. Graduates, therefore, should have sufficient knowledge and practical experience in the advanced technologies needed by SMEs to become Industry 4.0 ready.

There should be at least two different levels of formal training: the academic level and the vocational level with similar requirement, however, much more practice oriented. I4.0 best practices are assimilated in education curriculum that feature advanced technologies with high development dynamics taught toward the end of the students’ formal education. This ensures that the graduates have the (academic) institution with the latest knowledge in the area.

Engineers, scientists, professionals in education, representatives from various industries, and the SMEs have to define what knowledge the graduates should acquire to ensure high employability of the next generation of staff members. Special support programs for female and minority students will secure diversity in this field right from the beginning. In-house training programs developed within large companies could be opened to selected staff members from SME suppliers. This will create a triple win situation for the large company, the SME, and the employee.

#### Funding Highly Qualified Experts at SMEs

Apart from lack of funding many SMEs suffer from lack of access to skilled labor, expertise, and knowledge. Therefore, public programs can combine both support in funding and in access to knowledge. For example, the European Commission has funded highly visionary SMEs that work on a rather radical idea in their industry but could not find an expert to further develop this radical idea. The funding included the recruiting of an expert from a field relevant to the project - usually a young PhD graduate with a background in science or engineering from any part of the world, salary for the expert for 12 months to further develop the idea, the training of the expert in innovation management including four off-site seminars, web sessions, and online coaching by IMP<sup>3</sup>rove - European Innovation Management Academy, an internationally acknowledged innovation management service provider.



The objectives of this program were:

- Providing SMEs with expertise in the area in which they wanted to innovate
- Internationalization of the SMEs as the expert had to come from a foreign country
- Knowledge transfer in the area of the innovative idea but also in the area of innovation management that the expert (PhD graduate) was expected to apply within the SME
- Education of the PhD graduate in innovation management to facilitate his/her transition from academia to the business world

#### Online Training Platforms

To reach SMEs in remote areas, governments initiate online training platforms that will give SMEs access to knowledge in digitization and Industry 4.0 technologies. The impact of these electronic training platforms increases if they are combined with personal expert support. The content for these platforms comes from academia, the Industry 4.0 CoE, or DIHs, but may also come from trade associations, large organizations, and consultants. The success of these electronic training platforms is dependent on its animation as well as the value and practical experience it offers to SMEs of varying sizes and industries.

#### Developing a Network of Digitization and Industry 4.0 Business Advisors for SMEs

The impact of initiatives significantly increases if there are well-trained business advisors who have profound understanding of the SMEs' challenges and constraints. The training of these business advisors should not only focus on technologies but also on innovation management issues. For example, adopting process automation in an SMEs should clearly be linked to a compelling business case demonstrating that the SME will be able to achieve a significant return on their investment and increased competitiveness. Experience shows that there are not many experts that combine deep knowledge of technologies with profound business acumen and innovation management expertise. Continued training of business advisors will ensure a common "language" in the network and maintain high quality and reputation of the experts' support services.

The members of this network of highly qualified and trained business advisors may be employed by trade associations, regional development agencies, consultancies specialized on SME support, or by a national agency that is mandated to develop the country's SME sector.

#### Removing Issues Related to Data Security and Data Protection

For SMEs and their customers data security and data protection is a key concern. Hence, public institutions need to provide for effective regulations that are easy for SMEs to comply with. Here policies may help by facilitating the SMEs' access to professional support and legal advice. This support can also be offered online by the public authorities in countries where access to Internet is available in all regions and in remote areas.

#### Digitization Strategies for SMEs Driven by Other Stakeholders in the Digital Innovation Ecosystem - Selected Examples

Universities, research centers, and also large organizations are offering training, coaching, and peer learning with the focus on SMEs' needs.

### Combining Practical and Academic Education

OEMs have already developed training programs for re- and up-skilling their staff members in Industry 4.0-related technologies. In some countries these programs also include training and exchange at the (technical) university nearby. The objective of this exchange is to bring the practical experience developed in the company and absorb the academic knowledge for adoption in the company. Selected staff members of SME suppliers could take part in this exchange to provide their perspective and sometimes more pragmatic technical solution.

### Vocational Training in Industry 4.0 Relevant Technologies

Industry 4.0 in many developing countries could become a catalyst for better vocational training in advanced technologies. Formal apprenticeships for graduates from secondary school will develop the knowledge in advanced technologies and how they can be used in practice - especially in SMEs. Such vocational training with a clearly defined curriculum - combining formal education at a vocational training center and practical training at the company (e.g., SME) - should be completed with a formal and widely acknowledged exam that will increase the employability of the successful candidate within any company. The formal exam will include the proof of the candidate's practical experience gained during the training-on-the-job in the company. The apprentice can serve as a source of reference during his/her apprenticeship for the SME when applying the knowledge gained at the vocational training center.

## Measuring the Impact of Digitization Strategies for SMEs

Especially for digitization strategies that are publicly funded there should be clear measures defined how, when, and with which objectives the impact of these programs and policies are measured. The following performance criteria may be applied in the required combination:

- SMEs reached
- Increase of employment
- Increase of skills in digitization and Industry 4.0-related subjects across the entire digital innovation ecosystem
- Increase on people re- and up-skilled for Industry 4.0
- Development of digital business models by SMEs and their contribution to the profitable growth of the SMEs
- Increase of SMEs internationalization as an indicator for increased competitiveness and connectivity
- Increase of SMEs that managed to move from start-up to scale-up, scale-up to grown-up, and grown-up to large company in a defined period of time
- Return on investment by large companies that invested in the digitization of SMEs
- Number of disruptive digital business models and technologies that changed the established markets and value networks, and created jobs

- Number of successful collaborations, such as academia and SMEs that led to new digital opportunities (business models, products, services)
- Number of supported companies that received an international award for digital innovation
- Growth in foreign direct investment in Industry 4.0-related industries, technologies, or value chains

It is recommended that pilot programs and particularly large national programs are accompanied by impact measurement projects. This will allow adjustment of pilot programs in due time, save taxpayers' money, and accelerate SMEs' Industry 4.0 readiness. The impact measurement project should be designed together with the digitization policies. This will help to i) sharpen the focus of policies, while simultaneously ii) reach consensus on the objectives of the digitization policy, and iii) allow for timely adjustments of the programs.

It will also help to manage expectations of key stakeholders, both the public sector and within the SME communities.

A key prerequisite for a sober evaluation of the digitization support programs is the SMEs' assessment regarding their digital innovation capabilities to embrace Industry 4.0 before and after they receive the support. The assessment results, such as the IMP<sup>3</sup>rove DIQ benchmarking report will give the management a detailed view on their competitiveness in a digital world. At the same time, local, regional, and national funding agencies gain insights into the local SMEs gaps to become Industry 4.0 ready. Based on these data public programs can be better tailored to close these gaps.

## EXAMPLES FROM SELECTED COUNTRIES

In the context of the research project funded by the APO, the National Productivity Organizations for ROC, India, Indonesia, Malaysia, and Vietnam have contributed their view on Industry 4.0 Digitization Strategies for SMEs, demonstrating the diversity of approaches in their respective countries. These examples illustrate two things:

- These countries are aware of the opportunities from Industry 4.0 digitization
- Developing Industry 4.0 digitization strategies is a challenge. Implementing them is a greater challenge. This takes time, continuity, passion by all key stakeholders, and very often, innovative solutions to make things happen

Although many of the initiatives are in the early stages, they show strong interest to capture the opportunity for economic development via Industry 4.0 digitization.

## CHAPTER 5

# REPUBLIC OF CHINA

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### **Executive Summary: Vision of Industry 4.0 Digitization Strategies for SMEs in Republic of China (ROC)**

To implement Industry 4.0 technology or digitization in an SME requires much effort to overcome many obstacles, such as connecting machines with various communication protocols, allocating funding and resourcing, dealing with cybersecurity issues, etc. Not every SME need to be fully digitized. An SME should examine its own technological capability and financial outlook to have a clear goal and plan to implement technologies of digitization. In ROC, the government provides SMEs many incentives and programs to help them become digitized. An SME should choose the ones that are the most suitable for it to become digitized. As long as an SME knows how to deal with and take advantage of the digitization results, it can definitely benefit from digitization. As different SMEs have varying characteristics, it is difficult to give SMEs more specific advice and guidance on digitization.

### **Current Situation for Industry 4.0 for SMEs in ROC**

About 10% of total SMEs in ROC are in the manufacturing sector. These SMEs should be the first to be affected by Industry 4.0. However, most of them are not ready for Industry 4.0, and their digitization level is low. The challenges that they face are described in the following segments.

### **Overview of the SMEs in ROC**

#### **Definition of SME in ROC**

According to the Small and Medium Enterprise Administration, Ministry of Economic Affairs of the ROC, the definition of SME is as follows:

- In the sectors of manufacturing, construction, mining, and other quarrying enterprises, paid-in capital must be less than TWD80 million (around USD2.7 million), or the number of regular employees must not exceed 200.
- In the other sectors, sales must be less than TWD100 million (around USD3.3 million) for the previous year or the number of regular employees must not exceed 100.

#### **Current Status of SMEs in ROC**

According to the 2017 whitepaper published by the Ministry of Economics, ROC [1], the number of Taiwanese SMEs in 2016 was about 1,408,313, accounting for 97.73% of the total number of entrepreneurs. With an increase of 24,332, the annual growth rate was 1.76% (Table 5.1). Of these, 1,123,729 SMEs (79.79%) were engaged in the service sector, 273,204 SMEs (19.40%) in the industry

sector, and the remaining in the agriculture sector (Table 5.2). SMEs are not good at international marketing and global distribution. Therefore, they mainly turn to service-demand markets. The breakdown of the sectors sees 48.44% of the SMEs are in wholesale and retail business, 10.71% in the accommodation and food business, and 10.17% in manufacturing (Figure 5.1). Although manufacturing businesses only total 10.17% of the total SMEs, the sales amount for the manufacturing business is 34.6% (Figure 5.1). Clearly, the averaged contribution to the sales amount for the manufacturing SMEs is much larger than that for the other businesses, and these manufacturing SMEs may be greatly affected by Industry 4.0.

In 2016, the sales of SMEs in ROC was approximately TWD11.76 trillion, with an annual growth rate of -0.33% (Table 5.1). Among them, domestic sales were approximately TWD10.34 trillion with an annual growth rate of 0.15%. On the other hand, the sales amount for large enterprises is approximately TWD26.55 trillion, of which TWD18.51 trillion is domestic sales. The decline in domestic sales for large-sized enterprises is -1.73%. It shows that SMEs are more dependent on the domestic market than on the global market.

TABLE 5.1

#### NUMBER OF BUSINESSES, SALES AMOUNT, DOMESTIC SALES, EXPORT SALES, AND NUMBER OF EMPLOYEES IN 2016

| 2016 Business Statistics    |                |            |                   |
|-----------------------------|----------------|------------|-------------------|
| Indicator/Scale             | All Enterprise | SMEs       | Large Enterprises |
| <b>Number of Businesses</b> | 1,440,958      | 1,408,313  | 32,645            |
| - Percentage                | 100.00         | 97.73      | 2.27              |
| - Annual Growth Rate        | 1.71           | 1.76       | -0.34             |
| <b>Sales Amount</b>         | 38,312,769     | 11,764,677 | 26,548,091        |
| - Percentage                | 100.00         | 30.71      | 69.29             |
| - Annual Growth             | -1.45          | -0.33      | -1.94             |
| <b>Domestic Sales</b>       | 28,848,507     | 10,340,886 | 18,507,621        |
| - Percentage                | 100.00         | 35.85      | 64.15             |
| - Annual Growth Rate        | -1.06          | 0.15       | -1.73             |
| <b>Export Sales</b>         | 9,464,262      | 1,423,791  | 8,040,471         |
| - Percentage                | 100.00         | 15.04      | 84.96             |
| - Annual Growth Rate        | -2.60          | -3.66      | -2.41             |
| <b>Number of Employment</b> | 11,267         | 8,810      | 1,432             |
| - Percentage                | 100.00         | 78.19      | 12.17             |
| - Annual Growth Rate        | 0.62           | 0.57       | 1.20              |

Unit: Amount: TWD million; '000s person; percentage

TABLE 5.2

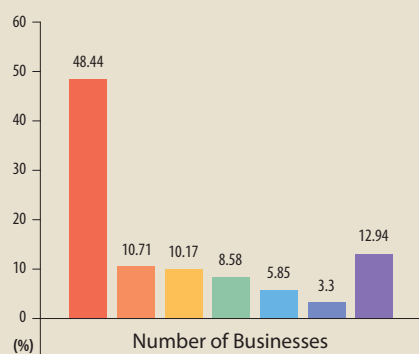
## SMEs BY SECTORS (2012–16)

| SMEs by Industry            |            |            |            |            |            |
|-----------------------------|------------|------------|------------|------------|------------|
| Indicator/Year              | 2012       | 2013       | 2014       | 2015       | 2016       |
| <b>Number of Businesses</b> | 1,306,729  | 1,331,182  | 1,353,049  | 1,383,981  | 1,408,313  |
| - Agriculture               | 0.90       | 0.90       | 0.85       | 0.84       | 0.81       |
| - Industry                  | 19.07      | 19.19      | 19.43      | 19.45      | 19.40      |
| - Service Industry          | 80.02      | 79.91      | 79.72      | 79.72      | 79.79      |
| <b>Sales Amount</b>         | 11,381,770 | 11,321,842 | 11,839,868 | 11,803,115 | 11,764,677 |
| - Agriculture               | 0.18       | 0.19       | 0.20       | 0.20       | 0.21       |
| - Industry                  | 50.13      | 48.67      | 49.27      | 48.23      | 47.41      |
| - Service Industry          | 49.69      | 51.13      | 50.53      | 51.56      | 52.38      |
| <b>Domestic Sales</b>       | 9,633,690  | 9,897,617  | 10,345,095 | 10,325,260 | 10,340,886 |
| - Agriculture               | 0.19       | 0.19       | 0.20       | 0.20       | 0.20       |
| - Industry                  | 45.65      | 45.72      | 46.23      | 45.13      | 44.35      |
| - Service Industry          | 54.16      | 54.09      | 53.58      | 54.68      | 55.45      |
| <b>Export Sales</b>         | 1,748,080  | 1,424,225  | 1,494,773  | 1,477,855  | 1,423,791  |
| - Agriculture               | 0.10       | 0.19       | 0.22       | 0.23       | 0.23       |
| - Industry                  | 74.82      | 69.21      | 70.36      | 69.94      | 69.66      |
| - Service Industry          | 25.08      | 30.60      | 29.42      | 29.83      | 30.11      |

Unit: Amount: TWD million; percentage

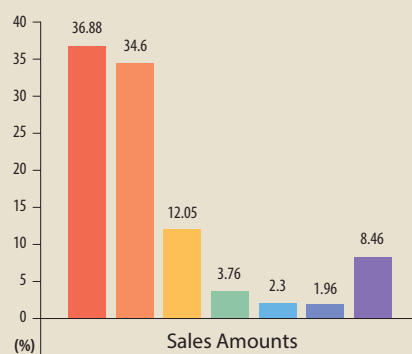
FIGURE 5.1

## PERCENTAGE OF SME BUSINESSES BY SECTORS IN ROC



■ Wholesale and Retail  
■ Accommodation and Food Service  
■ Manufacturing  
■ Construction  
■ Other Service  
■ Professional and Scientific Service  
■ Other Industry

## PERCENTAGE OF SME SALES DISTRIBUTION BY SECTORS IN ROC



■ Wholesale and Retail  
■ Manufacturing  
■ Construction  
■ Accommodation and Food Service  
■ Transportation and Warehousing  
■ Real Estate  
■ Other Industry



## Key Sectors Affected by Industry 4.0

ROC was the world factory about three decades ago, but PR China took over this position since then. However, many products are still made in the ROC. Many manufacturing SMEs are OEMs. As Industry 4.0 is related to sensors, IIoT, cloud computing, big data, and robots, the key sector in ROC affected by Industry 4.0 is manufacturing. According to PwC's Strategy & Global Digital Operations Study 2018 [2], about two-thirds of global manufacturing companies have barely, or not yet, begun digitization. The manufacturing SMEs in ROC are no exception.

## Major Challenges/Barriers and Needs of ROC's SMEs to Become Industry 4.0 Ready

The following are the major challenges for manufacturing SMEs in ROC.

- **Confusing terminologies related to digitization**

What is Industry 4.0? What is digitization? What is a cyber-physical system (CPS)? Different definition are held by experts and various companies. In the case of ambiguous definitions, it is very easy for a company's decision makers and employees to become confused, which in turn affects the effectiveness of promoting digitization, especially for SMEs that lack IT professionals or Industry 4.0 experts in their companies. If digitization is to be implemented effectively, the terminologies must be clearly defined. Otherwise, for companies working on digitization, it may lead to different results.

- **Unclear goals**

Some SMEs have been digitized to a certain degree. For example, several manufacturing companies already have a metrology system to keep the measured dimensions of their products in databases. The parameters of the manufacturing processes are also kept in databases. However, these stored data are never used. It is not uncommon that most companies, especially the SMEs, do not know how to take advantage of the data or turn the data into profit because they do not have the capability of data analysis and data analytics. Another fact is that the pursuit of digitization in a company never ends; for SMEs, there is a lot of information that can be digitized. However, determining what information should be digitized first, or how much digitization should be done, is often troublesome for SMEs. If there are no clear goals and requirements, there will be no direct incentive for SMEs to implement digitization. Sometimes SMEs may introduce digitization into their companies due to their customers' requirements. For example, if a key customer wants to understand the status of the production of an SME in real time, then the SMEs probably need to find a way to provide the information to the customer online. In this situation, the SME is under pressure to become digitized, so it will become very active in promoting digitization. Otherwise, if the drive of digitization is mainly from the inside of a company, the resistance to digitization is usually strong because the profit from digitization is usually unknown. Digitization can generate value from the integration of hardware and software as well as the data sharing between companies, but who will lead the integration of such information? This is also a problem that companies often encounter in the process of digitization. Currently, few demonstrations of digitization for SMEs are ready in ROC. It is difficult for SMEs to fully understand the advantages of digitization, let alone pursuing digitization.

- **Low levels of automation**

Most manufacturing SMEs in ROC are labor-intensive. Automation is not fully implemented in their companies. Most work still relies on manpower. If there is no automation, then digitization is

impossible. In the evolution of a company seeking to implement large-scale digitization, automation and the IIOT must be achieved first. Some SMEs are currently working hard to complete Industry 3.0 (automation) and then move toward Industry 4.0 (digitization). However, the drive is not for digitization itself, but stemming from low profit margin, high labor cost, and shortage of work force in ROC.

- **Lack of IT professionals**

Most SMEs have strict control over the headcount of employees due to their limited asset. In the initial process of pursuing digitization, SMEs are less likely to enjoy clear-cut benefits. In addition, the salaries offered by SMEs are usually less than those offered by larger companies in ROC. Therefore, it is less likely for good IT professionals to stay in SMEs to help them implement digitization. Some SMEs may not even have IT departments or IT supervisors. The executives of such companies need to come up with their own digitization strategy. However, they usually do not have the capability to do so due to the lack of sufficient knowledge and experience, leading to less-than-ideal digitization development and resource allocation.

- **Numerous communication protocols**

Numerous communication protocols are also a drag on digitization. In the implementation of digitization, factories need to obtain the information of machines through the controllers or sensors installed on the machines. The controllers and sensors usually have different communication protocols. Integrating the communication protocols is not easy. Although there are some standard communication protocols, such as Open Platform Communications Unified Architecture (OPC UA) and MTConnect, they are not used extensively. In addition, these protocols are unlikely to replace all existing ones. At present, each machine tool controller manufacturer has its own special communication protocol. The users cannot retrieve data from the controller without the help of the controller manufacturer. Some controller manufacturers do not allow users to access certain information stored in their controllers, which makes digitization more difficult.

- **Software scalability and connectivity**

Software scalability is another digitization issue. Due to the lack of IT capability, SMEs may work with system integrators (SIs) to implement digitization. They have to sign a long-term contract with SIs. Otherwise, SMEs may face system maintenance and upgrade problems. Doing this will increase the SMEs' cost. Moreover, the SMEs will be tied to the SIs. On the other hand, the connectivity between software is also a problem. An SME may use different software for different purposes, such as ERP and MES, but the lack of connectivity between the software may make the usage of data less efficient.

- **Information security issues**

The average SMEs do not have enough cybersecurity experts to handle information security issues. However, computer viruses, confidentiality of information, and the privacy of individual data are serious concerns for SMEs. In the process of digitization, many SMEs can only choose to store their data in their internal data servers without connecting to the Internet. SMEs are generally vulnerable to hackers' attack as well. Once information is shared, or information devices are connected to the Internet, it will make SMEs very concerned about the possible exposure of their confidential information. In August 2018, Taiwan Semiconductor Manufacturing Co Ltd (TSMC), a global leading chipmaker, shut down several of its factories after a virus attack, causing billions of dollars of losses. For a company with many cybersecurity experts, such disaster had still occurred. For SMEs, the risk will definitely be higher, especially when the SMEs connect their equipment for the realization of digitization.

- **Lack of resources**

Digitization is not free, and SMEs may need capital investment in the process of digitization. Therefore, SMEs must evaluate whether the investment is worthwhile. If there is no clear return rate, SMEs may not easily introduce digitization into their companies. Many SMEs in ROC may not have a big profit margin. It is impossible for them to implement large-scale digitization without any financial assistance.

- **Resistance from inside the company**

Attention need to be focused to the psychological side of employees in the digitization era. During digitization implementation, many data that were not disclosed become known. For example, before digitization, a company may only know the hours an employee works each day. After digitization, the company may be able to know how many hours an employee spent on project A, project B, etc. These data can be collected and used as a performance index for the employee. Among employees, there may be more severe competition, which may generate a lot of pressure on them. As a result, the pressure may be converted to resistance for digitization.

## Major Initiatives to Foster Digitization in SMEs' Preparation for Industry 4.0

There are several stakeholders taking the initiative to support digitization in SMEs.

### Government Initiatives to Foster Industry 4.0 in SMEs including National and Regional Digitization Strategies

One of the industries that the government is emphasizing is smart machinery industry, which is also crucial to strengthening ROC's Industry 4.0 development. There are various resources or projects from ROC's government to foster digitization in SMEs, such as:

- Industry upgrade and innovation project
- A+ industry innovation project
- Conventional industry technology development
- Small Business Innovation Research

### Academic Programs to Drive Industry 4.0 in Local SMEs (Education, Research, etc.)

The government is also driving academic programs, such as:

- Ministry of Science and Technology
  - Building the Internet of machines among universities in ROC
  - Encouraging research on Industry 4.0 or smart machines
- Ministry of Education
  - Establishing Industry 4.0 special programs in universities to teach college students technologies related to Industry 4.0

- Offering opportunities for SMEs to work with colleges to foster and elevate their engineers' capabilities

### Industry Initiatives to Foster Industry 4.0 in SMEs

Vertical integration is inevitable, and the digitization from upstream manufacturers to downstream ones will be integrated. To reduce cost and save time, the downstream manufacturers demand the digitization of the upstream manufacturers, which are usually SMEs.

### Trade Associations and Other Associations' Initiatives to Foster Industry 4.0 in SMEs

Associations have initiated several approaches, among others:

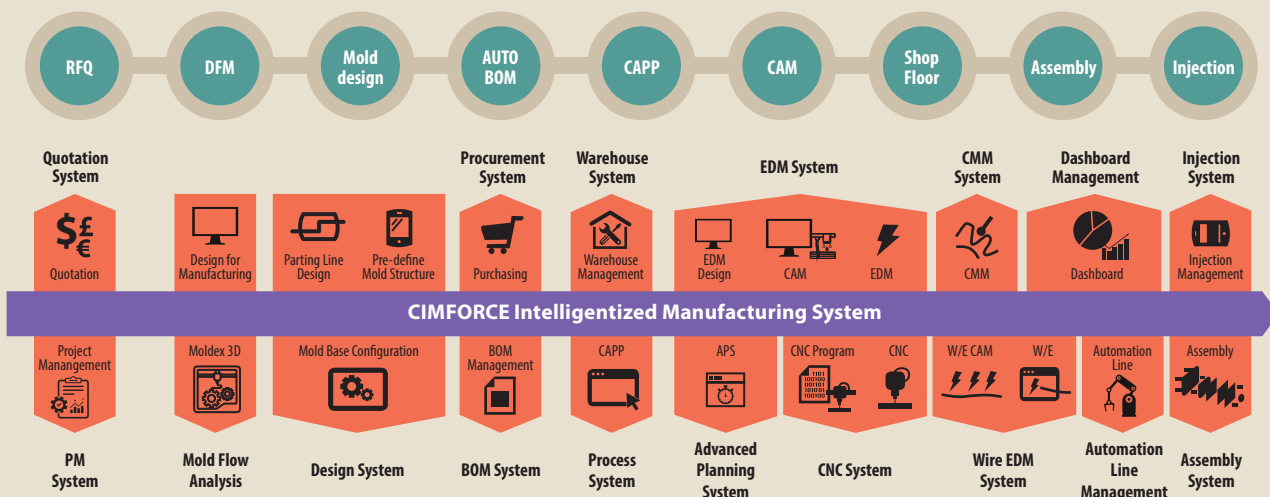
- Find and feature model companies that the SMEs can learn from
- Request the system integrators to provide a turn-key solution for IIoT in factories
- Help SMEs to resolve the problem of engineer shortage by introducing Industry 4.0 into SMEs

### Case Example

CIMForce, an SME in ROC, is a system integrator helping companies implement Industry 4.0. Its major product is manufacturing execution system (MES) with many software automation features (Figure 5.2) so that significant amount of time and cost can be saved when developing plastic molds. The software developed by the company covers all the detailed job encountered in the development of plastic molds, collates all engineering data and drawings in the digital format, and stores them in the database. The pressure on the shortage of engineers can be relieved as the software automation features perform some of the tasks usually carried out by engineers. This is one of the examples of an SME that can succeed by providing tools for digitization for the industry.

**FIGURE 5.2**

### MANUFACTURING SYSTEM DEVELOPED BY TAIWANESE SME, CIMFORCE



## Strategies to Increase SMEs' Competitiveness

For SMEs to survive in the wave of Digitization of Industry 4.0, several strategies can be considered:

First, the SMEs must examine their financial situation. SMEs must properly allocate resources to maintain or enhance their profitability. Under the circumstance where there is sufficient profit, the SMEs are able to conduct automation or digitization, including replacing some of the workers by automatic machines, autonomous guided vehicles (AGVs), robots, or connecting machines and robots to realize a smart factory or digital factory. However, not every SME needs immediate and comprehensive digitization. An SME still needs to look at the company's competitive situation to determine the next step. Otherwise, digitization may be just a blind investment. In the process of digitization, information that is generated without knowing how to use it will cause a burden on the company. Therefore, the SME has to clearly define why they want or need to digitize, the processes to digitize, and the expected return on investment.

Based on the financial situation, technical capability, and the immediate need, an SME can set up a clear goal for digitization and have digitization plans and timelines. SME executives must also have basic knowledge on digitization. They cannot rely entirely on external consultants for planning as the executives know best the needs of their companies. In addition, they have the authority to implement the digitization plan thoroughly. When there are obstacles during the implementation, the executives will be the ones to remove them.

On the matter of financial resources, ROC's Ministry of Economic Affairs, Ministry of Education, and Ministry of Science and Technology have many programs or initiatives to subsidize the digitization of SMEs, such as SBIR (Small Business Innovation Research) from Ministry of Economics, SBIR from the Taipei City Government, Industry-University Cooperation Project from the Ministry of Science and Technology, Cooperation Project from the Ministry of Education, etc. Using the funding from the government can release some financial pressure and get acquainted with the experts in schools or research institutes. Through these programs, SMEs can receive some funding for upgrading, automation, or digitization. Some SMEs do not have the capability or experience to apply for government funding. They may obtain help through university-industry cooperation.

On human resources, it is more difficult for SMEs to recruit good professionals to assist them in digitization than it is for large companies. Therefore, SMEs must improve their work environment and give special consideration to attract the professionals, such as increasing their incentives. SMEs can also conduct digitization with the assistance of consulting firms or system integration companies. Good long-term cooperation with these consulting firms or SIs is the key to success. Otherwise, the maintenance or upgrade of the digitization system may prove to be a serious problem after the cooperation is ended.

## Planning for Increased SMEs' Competitiveness: Developing the Industry 4.0 Ecosystem(s)

The ROC has already taken several steps in developing the Industry 4.0 Ecosystem as follows:

- In 2015, four years after the concept of Industry 4.0 was brought up in Germany, the Executive Yuan (with functions similar to the Cabinet in western countries) in ROC called for a meeting to promote Production 4.0 (the Taiwanese version of Industry 4.0). The Taiwanese government also approved the Taiwan Productivity 4.0 Initiative in the same year to promote digitization.

- The Taiwanese government established a smart machinery promotion office in Taichung in February 2017 to promote digitization of machinery. The Smart Machinery Promotion Office has been established under the Ministry of Economic Affairs, and other agencies involved in the program including the Industrial Development Bureau (IDB) and the Precision Machinery Research and Development Center (PMC). Here the machinery is not limited to machine tools; it also includes all kinds of machines used for machining, assembly, printing, etc. The president of the ROC, Ing-wen Tsai participated in the opening ceremony to show the determination of the government to help the industry become digitized.
- Taiwan Association of Machinery Industry is promoting the idea of the “Smart Machine Box,” which was derived from the set-top box used in cable TV. Originally, it was expected that a box similar to the set-top box could be developed so that the box can acquire the necessary data or information from all the machines with different communication protocols, then pass the data to the designated destination, such as the database in a company’s data server or in a cloud server. It was discovered that accessing data from a machine is quite different from that for obtaining TV signals from a TV program provider. The “box” became a symbol that represents the integration of hardware and software to enable the digitization and communication between the machine and the outside world. The Industrial Development Bureau (IDB) and the Precision Machinery Research and Development Center (PMC) launched the “Smart Machine Box” program in early 2018. 1,000 Smart Machine Boxes were expected to be installed in 2018.
- Taichung City Government is establishing a smart machinery trial-run site in Taichung. The major machinery industries are located in Taichung, which is in the central part of ROC. The trial-run site will provide a demonstration of the smart machinery and Industry 4.0 to the surrounding factories.
- The Ministry of Science and Technology (MOST) also initiated several large-scale projects to promote digitization, such as IoT Sensor Service Platform Project and Smart Machinery Network Platform Project. The IoT Sensor Service Platform Project aims to develop sensors suitable for use on machines to acquire their status, such as temperature, vibration, power consumption, etc. The objective of the Smart Machinery Network Platform Project was to connect the machines in several universities located in the northern, the central, and the southern areas of ROC to demonstrate the data communication and the information distribution capability.

## **Expected Impact from Developing the Industry 4.0 Ecosystem(s)**

All the policies and programs for the development of Industry 4.0 in ROC will become a drive for SMEs, especially in the manufacturing sector. The pressure from the new technology will give the SMEs an opportunity to review their capability and try to become digitized in a certain way to reduce cost or save on labor. The government will also provide incentives to SMEs willing to adopt Industry 4.0 technologies. In the meantime, some low-level jobs may disappear while job vacancies related to IT may not be easily filled. As a result, the pressure on universities to produce more graduates in the Industry 4.0-related field increases. This is the expected impact from developing the Industry 4.0 ecosystems that will gradually affect almost all the SMEs in ROC.

## CHAPTER 6

# INDIA

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Robert Bosch Engineering and Business Solutions Private Ltd.

### **Executive Summary: Vision of Industry 4.0 Digitization Strategies for SMEs in India**

This report is an outcome of a research aimed at assessing the level of readiness and identifying the critical needs of SMEs to embrace Industry 4.0 (I4.0). It provides a set of strategies for improving the digitizing capability of SMEs. I4.0 and Digitization are complementary to each and is often used in this report almost interchangeably.

Industry 4.0 is an accelerating trend of new technology allowing for new business models that will transform the manufacturing capabilities of SMEs. Early adopters of these trends would be a major differentiator to their capability/competency. Digitization can yield improvement not only in quality and productivity but also accelerate production, increase flexibility, and simultaneously, remain cost competitive.

SMEs in India account for over 45% of total manufacturing output and 40% of total export. SMEs mainly are part of tier 3–4 of the industry and play an integral role in manufacturing and service industry. They depend on connectivity (even in smaller towns) in adopting digitization to cater to increasing demands of their customers. There is a growing number of customers who are online. Meeting their needs not only requires connectivity but also digitally secure payment channels, such as net-banking, e-wallets, and mobile payments.

With advanced manufacturing techniques and processes, SMEs will be able to cut costs due to improved efficiency, more flexibility, increased quality and value add, lower operational cost, lower failure costs, and reduced time to market. Industry 4.0 also eliminates human dependence in high-risk and fatalities-prone tasks, thus increase the safety of workers.

By adopting Industry 4.0 technologies, the future SMEs will benefit more to optimize and shorten their supply chain and also enable them to exploit new market opportunities. Digitally enabled SMEs will be well positioned to integrate into demand and supply of their customers.

Depending on how early these advanced technologies and trends are adopted by policy makers, and by various stakeholders involved with Indian SMEs, the benefits that come with huge productivity dividends can be exploited. This will enable the SMEs to gain the required prominence so that their products remain competitive globally.

This report focuses on avenues available to SMEs in India, who contribute actively in all industry sectors. It starts with current challenges and looks into initiatives taken to overcome them. Many steps are planned/taken to strengthen the SMEs' competitive positioning so that they can play active role in the industry in the coming future. Contents of this report are based on information available in public domain.



## Major Challenges/Barriers and Needs of India's SMEs to Become Industry 4.0 Ready

Various challenges that SMEs in India face on their way to digitization for Industry 4.0 readiness are related to infrastructure, taxes, tariffs, and import duties. SMEs generally do not have sufficient knowledge on the new technologies and there is inherent fear to adopt them. Most companies are unwilling to take the extra risk involved in experimenting with technology especially when it is new.

Some of the challenges faced by the SMEs are:

- **Infrastructure** - While India is spending a lot in increasing network of roads, accessibility to rural areas and tier-3 cities needs to be improved.
- **Connectivity** - Despite making a quantum leap with 4G technology, connectivity remains an issue especially in remote areas.
- **Adequate skills** - While SMEs are good at producing output they lack knowledge on latest technologies that would be best for meeting their challenges - automation and IT.
- **Financing** - SMEs also experience issues on the financial front, lack of adequate capital due to complex collaterals needed to get term loans, high transaction costs in imports and exports, difficulties in obtaining private equity funding, and delay in fund disbursement. In some cases, they arrange funds from informal sources at a higher rate which adds pressure to their margin and revenue. This in a way stops them in spending on technologies with long duration of return on investment.

Many of these challenges cannot be resolved by SMEs alone. They require collaborative efforts from the government, academia, and industries to serve the industries better. Steps are taken by government, academia, and technology/IT service provider toward digitization of SMEs so that they become more competitive globally.

The steps taken by government look into changing manufacturing policies and setting up platforms and incubation centers for scaling up SMEs competencies so that they contribute to the growth of the industry in a much better way.

## Strategies to Increase SMEs' Competitiveness

Indian manufacturers have the unique opportunity to integrate available advanced manufacturing technologies with low-cost labor to create extraordinary competitive advantage. The government of India is conscious of the new wave called Industry Revolution 4.0 and is gearing up to form policies and set up incubation centers to take a lead in this revolution. This shall also equip SMEs to understand the latest trend and adopt the technology that helps their business grow. Various government bodies, such as NPC, Confederation of Indian Industries (CII), Common Engineering Facility Centers (CEFC), and so on are tasked to increase awareness and adoption of Industry 4.0 across different industries. Sustainable initiatives need robust policies that boosts manufacturing at all levels.



The government of India is taking several steps to improve ease of doing business in India. These steps are pan India and intended to improve the state of SMEs in the country. Some of the initiatives are listed as following:

- Government initiatives to provide infrastructure, mentorship, incentives, and subsidies to motivate SMEs
- Collaborative transformation of SMEs with government, technology experts, and academic institutions to raise awareness of Industry 4.0 and benefits of digitization/Industry 4.0
- Training to re-skill, up-skill, and enhance knowledge of workforce for higher value adding task

### **National Manufacturing Policy**

The Department of Industrial Policy and Promotion (DIPP) is a government body formed to formulate, implement, and monitor development measures for the industrial sectors in India [1]. It is also responsible for intellectual property rights (related to Patents, Designs, Trademark, and Geographical Indication of Goods) and foreign direct investment (FDI).

DIPP has formed the National Manufacturing Policy for enhancing the share of manufacturing in GDP from current 16%–25% and creating 100 million jobs in the next 10 years. One way is by creating policies to incentivize infrastructural development projects through public-private partnerships. The other way is by creating National Investment and Manufacturing Zones (NIMZ) to provide a favorable environment to manufacturers for bringing qualitative and quantitative changes to the manufacturing sector. SMEs are bound to gain from these policies and expected to grow as they are an integral part of the industry.

With an eye to bring in transparency and improve efficiency, the government is planning to digitize different processes and make services more accessible. Thus a major initiative is taken, aptly named ‘Digital India’.

### **Digital India**

The government of India is increasingly looking at IT to bring in transparency and speed in operations.

‘Digital India’ [2] is one such initiative - to transform India into a digitally empowered and knowledge economy. Its objective is to capitalize on India’s strength in IT to transform the future of the nation. Key elements of the Digital India program is to provide digital infrastructure as utility to every citizen (in both rural and urban areas), use digitization to provide services on-demand, and provide digital empowerment to citizens of India. To deliver these promises, several complementary initiatives are taken to scale up the infrastructure/connectivity, manage and distribute services digitally, such as digital payment and so on. SMEs play an important role in implementing these initiatives. Although Digital India is a vast topic, the following sections will focus more on topics that impact industries directly.

One of the cornerstones of Digital India is to provide unique identification (under Aadhar initiative) to all residents of India. In its scale it is one of the world’s biggest initiatives to provide biometric-based unique identification. Among other uses, it helps to link an individual resident to different schemes from government and to services from private players. In certain cases, it helps in passing the ‘Direct Benefits Transfer’ from the government to the individual resident as long as their bank accounts are linked with their Aadhar number.

### Strategy to Improve Connectivity

Connectivity is one of the key requirements to propagate digital initiatives. Several steps are being planned alongside private players who are already investing heavily to strengthen connectivity and expand 4G subscriber base in India's urban areas. To address the situation of connectivity in rural areas, the government of India is considering following initiatives:

- **Bharat Net Project**

The project's objective is to offer reliable connection of 2–20 Mbps speed to all households at an affordable price and connect all villages in India using optical fiber. To make it happen, Bharat Broadband Network (BBNL), a special purpose vehicle is set up to create a National Optical Fiber Network (NOFN) across the whole of India. Private players, such as Google and Microsoft also volunteer to improve the connectivity.

- **Project Loon**

India, the second largest population of Internet users in the world, still have many residents who are not connected to the Internet, especially in rural and remote areas. To improve the broadband services in the rural areas, Indian government has approved the rollout of Google's Project Loon which is a "network of balloons travelling on the edge of space, designed to connect people in rural and remote areas and help filling coverage gaps".

Each balloon can provide connectivity to a ground area of approximately 40 km in diameter using wireless communication Long Term Evolution (LTE) or 4G. Project Loon partners with telecom companies to share cellular spectrum so that people will be able to access the Internet everywhere directly from their phones and other LTE-enabled devices.

- **WhiteSpace**

Microsoft India is ready with a plan to provide free last-mile Internet connectivity across the country. It proposes to use the "white space" - the unused spectrum between two TV channels - to provide free connectivity to large sections of the Indian population. It addresses the challenge in a cost-effective manner and creates an ecosystem that will benefit all, including manufacturers of routers and other technology devices, other technology companies, besides Microsoft.

### Strategy to Improve Financial Transactions

As part of 'Digital India' initiative, a large emphasis is put on cashless transactions. This section explains ways by which cashless transactions can be made by a resident of India. While there are multiple payment applications provided by private players, the following methods are provided by the government:

- **Unified Payment Interface (UPI)** - It allows payment through mobile phones by creating virtual payment address that is an alias of a user's bank account
- **Bharat Interface for Money (BHIM) App** - This app is provided by National Payments Corporation of India (NPCI) for providing fast, secure, and reliable cashless payments
- **Aadhar pay** - What if there is no app available to make payment, Aadhar pay addresses such situation. The merchant needs an app while the payer does not. Aadhar pay uses fingerprint authentication of the payer and deducts money from his/her account (provided he/she is already linked by Aadhar). SMEs need to be tech savvy to avail benefits of cashless transactions to increase their competitiveness.

These applications reduce the dependency of carrying cash and at the same time save time in frequent visits to banks, especially in rural areas where banks are far and few. This improves ease of doing transaction in any part of the country.

#### Strategy for Managing and Storing Data

It is obvious that the Digital India initiative will result in generating lots of data and it needs an effective way to manage big streams of data flowing in from multiple sources, such as mobile applications and websites, to name a few. The government is planning for:

- **Big Data initiative**

To tame big data and use it to understand the current state of market and formulate policies to help them grow further, the government is planning to use Big Data/Analytics.

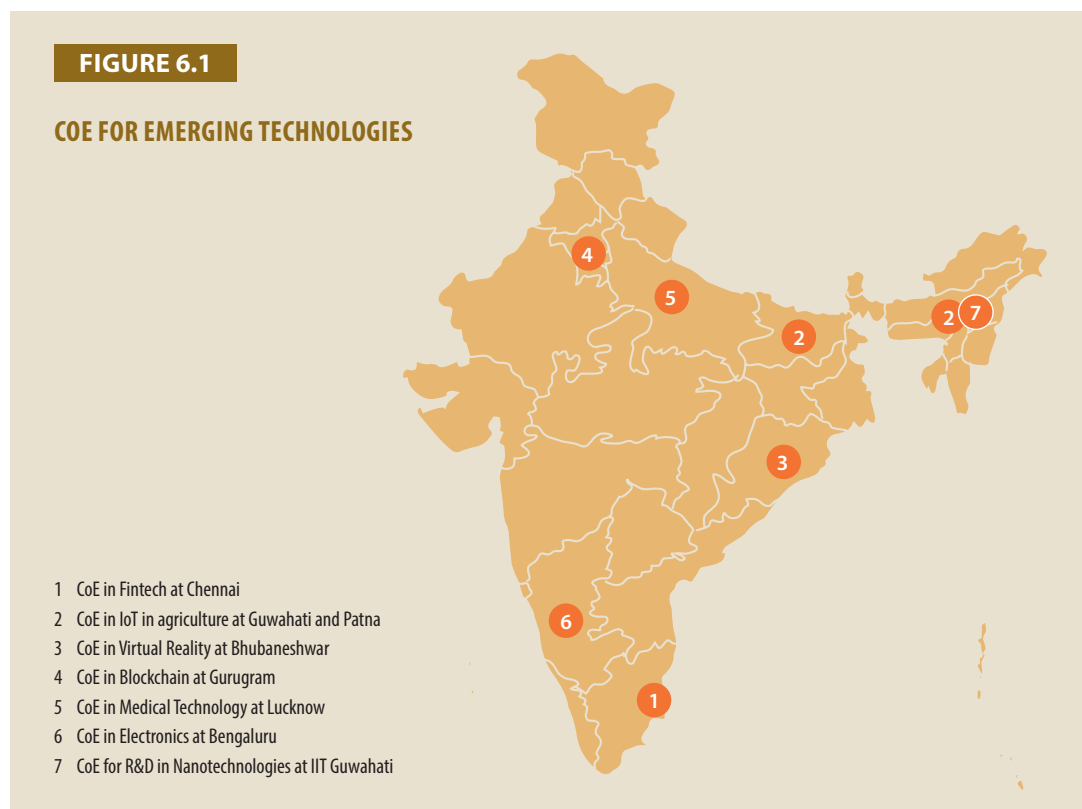
- **Meghraj**

Government is also planning to take advantage of cloud computing to deliver services digitally. It is aptly named as Meghraj, literal translation of ‘megh’ is cloud and it is otherwise also referred as GI cloud.

At the moment, SMEs will only be involved in data collection. This would help the government to get insights of SMEs so that appropriate initiative can be planned.

#### CoE for Emerging Technologies

As part of Digital India, there is a dedicated focus on the emerging technologies, how it can be utilized to address challenges in day-to-day life, and how it can be industrialized. With this in mind, dedicated CoEs are formed for emerging technologies (Figure 6.1):



Along with this, several committees are also formed for Artificial Intelligence, Cybersecurity, Safety, Legal, and Ethical issues.

### Strategies to Improve Skill Level

Industry 4.0 demands improved skill levels to make the organization efficient, productive, and remain competitive. SMEs shall focus on increasing the Skill and Talent of the workforce. The right set of talent will be key to the success of SMEs. The availability of adequate talent - both at a strategic leadership level as well as on the factory floor - can prove to be a significant challenge for companies in India. Building leaders who can successfully navigate their organizations in the digital age and up-skilling the workforce will require significant planning, investment, and collaboration from all stakeholders.

- **Leadership**

Industry 4.0 initiatives are big and have a wide impact in the organization. Leadership in SMEs shall be aware of possibilities of Industry 4.0 and challenges in implementing Industry 4.0 projects. They should not be carried away by the buzz in the industry. Industry 4.0 initiative will spawn widespread changes to the entire organization and leaders who will be able to manage this change, will ride the wave of Industry 4.0. In this regard, leaders will have to be aware of factors impacting their business both in medium and long term, and prepare for foreseen challenges in advance.

- **National Skill Development Corporation (NSDC)**

The government of India has started NSDC [7] with a vision to make India the Skill Capital of the world. It is focusing to upscale the skill level by creating and funding training institutions so that the skill level of entrepreneurs/students/workers can be matched with international standards. It is started in public-private partnership mode to meet the growing need to improve skill levels. So far 5.2 million people have been trained under 38 sector skill councils by 235 agencies. All of the trainees can either start their own enterprise or join SMEs/bigger organizations.

With Industry 4.0, the need of training is only going to increase. As SMEs do not have a dedicated training departments they generally rely on government agencies or private players for their training needs. While the government has to ensure the right policies are in place that promotes fair play among the organizations, adoption of technologies, curbing red tape, and so on. Academia will have to relook at the curriculum and align it according to the latest trends in the industry/technology so that employability of the student increases. SMEs will have to take advantage of the policies/demography and avenues available to them to keep skill levels of their staff up-to-date and stay ahead of the competition.

### Make In India

In the pursuit of an increasing share of manufacturing in India's GDP and capitalizing on the country's strength in IT, the government is taking steps to encourage companies globally to set up manufacturing facilities in India. It is aimed to make India the manufacturing hub of the world of which SMEs will be integral part.

### Goods and Services Tax (GST)

GST is the result of one of the biggest tax reforms in recent times from the government of India. Prior to GST there were several taxes levied to manufacturers and services providers. Hence the process was cumbersome and adding to the woes of manufacturers including SMEs. The government took note

of it and launched a single tax regime that greatly simplified taxation and improved the ease of doing business in India.

GST is implemented digitally so that it simplifies the process of transfer of goods (finished/semifinished) and removes paper work. SMEs also benefit as they can reach out to a bigger pool of customers without worrying too much about the various taxes that were imposed earlier. GST made India one big market open to all SMEs.

## **Planning for Increased SMEs' Competitiveness**

Industry 4.0 is a big topic for any organization. While big companies have the resources and a dedicated team to contribute in this area, SMEs do not have this luxury. This is where contribution from government and academia becomes very important. This also brings in the necessity to develop an ecosystem where the government can set up labs to test new technologies and find ways to make it available to SMEs. Academia shall also put efforts in R&D and help build the next generation of graduates who are competent to contribute toward the success of the industry.

To cater to the SME sector, IT majors are also working on Software As A Service (SAAS) model where SMEs can subscribe to specific module based on their need and pay as per their requirements. This helps to limit their IT spend and at the same time make them more productive/efficient.

### **Developing the Industry 4.0 Ecosystem(s)**

Industry 4.0 deals with the entire supply chain. No initiative in an OEM can be complete without the involvement of their suppliers. SMEs are important players in this ecosystem and need a platform and support to match the expectations of their customers.

The following sections will shed light on different initiatives from the government to create and nurture ecosystem where SMEs can participate and flourish.

### **SAMARTH Udyog**

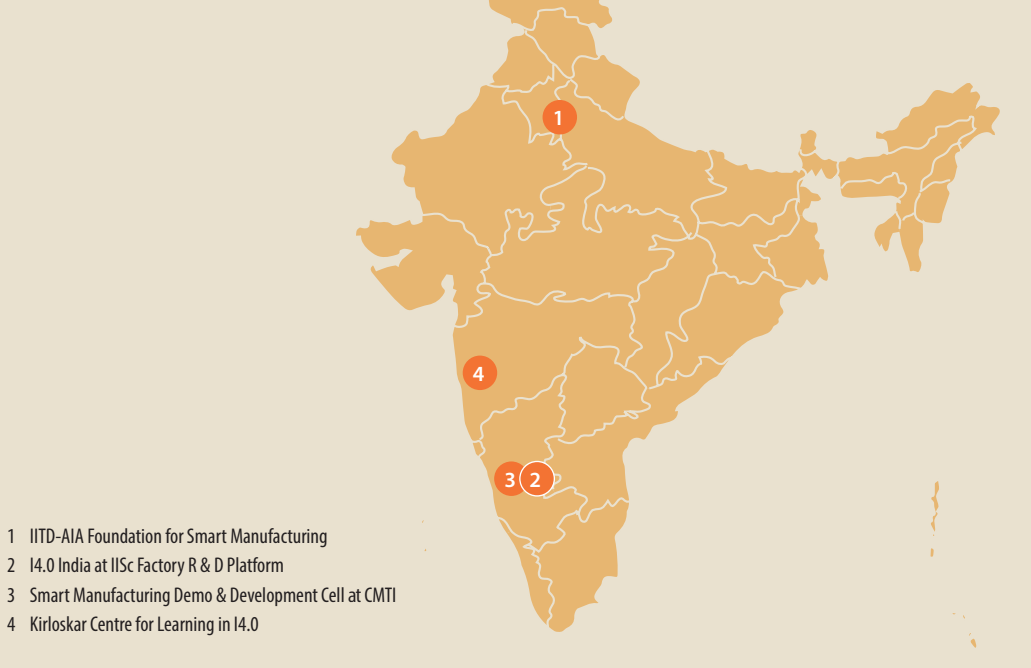
The Department of Heavy Industries (DHI) has taken SAMARTH (Smart Automated Manufacturing and Rapid Transformation Hub) [3] Udyog Bharat project a 4.0 initiative. The objective of this initiative is to bring academia, government, and industry on the same platform to understand and meet changing demands of manufacturing industry. It also plans to set up incubators at universities where various niche technologies can be tried and tested. Once it is proven, it shall be taken to SMEs in various clusters. As part of this following CEFCs (Figure 6.2) are established at different universities and institutions [6].

#### **IITD-AIA Foundation for Smart Manufacturing**

One of the premier engineering colleges of India, the Indian Institute of Technology Delhi has set up a CEFC [4]. Along with bringing in awareness on Industry 4.0, it will also work on proving technologies for simulation, prototypes development, and testing. Additionally, it will offer training, certification, and consulting services.

#### **I4.0 India at IISc Factory R&D Platform**

Another CEFC has come up at yet another top rank college - the Indian Institute of Science (IISc) [5], which is located at Bangalore. At this center, an experience zone is built to showcase the capabilities of Industry 4.0. While the CEFC develop new solutions for SMEs, they will also

**FIGURE 6.2****LOCATIONS OF CEFCS IN INDIA**

integrate legacy machines to platforms as way to extract data for analysis. Along with this, they will also help start-ups to understand new technologies and also encourage them to develop their own offerings. Last but not least, they will give their inputs to government in formulating the right policies.

#### Smart Manufacturing Demo & Development Cell at CMTI

Central Manufacturing Technology Institute (CMTI) at Bangalore has set up a demo unit. The unit will establish a Smart Manufacturing Demo cum Development Center (Machine Tool centric) as a pilot implementation of Smart Manufacturing at cell level. The unit will use sensors, actuators, PLCs (Programmable Logic Controller), and communication channel to mimic a real plant with minimal human intervention. Apart from this they will also provide support in setting up/rolling out smart manufacturing. This shall help SMEs in evaluating the right technology as per their needs and seek assistance as and when required.

#### Kirloskar Centre for Learning in Industry 4.0

At Kirloskar Center at Pune, which is also the automotive hub of the country, a Center for Industry 4.0 (C4I4) lab is going to be set up. The objective of this lab is to create awareness through workshops, do a readiness assessment, develop an ecosystem, and also provide support in these areas to SMEs to make them competitive.

#### startupindia

startupindia [8] is one-of-a-kind platform that brings together entrepreneurs, investors, mentors, incubators, service providers, and government bodies. Along with this, the platform also provides information regarding various government schemes, a common place to discuss challenges, or share information about success as well as provide resource for training. Various states in India are running this initiatives in their area to spot entrepreneurs and encourage them to get on board. This initiative was

launched in January 2016 and received overwhelming response. So far more than 30,000 start-ups are registered and among them 11,000 start-ups are recognized. Although convincing investors for funds is as big of a challenge as finding the right idea for the start-up, 129 start-ups have secured funding through different financing agencies. They have access close to 200,000 learning and development modules. This kind of ecosystem will inspire entrepreneurs to start up small and with proper guidance through mentors and knowledge become bigger enterprises of tomorrow.

### **CoE IoT India [10]**

Launched in 2015 as part of 'Digital India' initiative, CoE IoT India's objective is to create innovative applications (by merging hardware and software capabilities) by capitalizing on its strengths in IT. These applications are in the areas of Smart Manufacturing, Smart Health, Smart City, and Smart Agriculture. Under this initiative various entities, such as start-ups, enterprises, venture capitalists, government, and academia are connected. They enable start-ups in areas of IoT, Big Data, AR/VR, AI, and Robotics to reach their maximum potential. This program brings together industry users, technology creators, system integrators, and enterprise partners for development.

### **CoE by NPC (National Productivity Council)**

NPC is the apex national level organization to promote the productivity culture in India. Established under the Department of Industrial Policy and Promotion of the Ministry of Commerce and Industry in 1958, it is an autonomous, multipartite, nonprofit organization with equal representation from employers' and workers' organizations and government, apart from technical and professional institutions and other interests. NPC is a constituent of the Tokyo-based Asian Productivity Organization (APO), an intergovernmental body, of which the government of India is a founding member.

NPC has established a "Centre of Excellence on IT for Industry 4.0 (CoE: IT for Industry 4.0)" in collaboration with the APO. This CoE can be very effective in the collection of information, development and dissemination of knowledge/information, facilitation in capacity-building of industries in coordination with various stakeholders. This will result in the "Smart Factory", which is characterized by versatility, resource efficiency, ergonomic design, and direct integration with business partners.

### **Scope of the CoE**

The CoE: IT for Industry 4.0 will:

- Function as a knowledge center for entrepreneurs and start-ups relating to concepts of IT and its application in Industry 4.0
- Disseminate this knowledge through workshops, lectures, and training programs
- Coordinate with the APO for guest faculty to disseminate knowledge regarding practical application of Industry 4.0 in other countries
- Facilitate the display of the latest technology/demonstration projects to help new start-ups
- Facilitate the establishment of CoEs in other non-APO countries especially in Africa. NPC has signed a Memorandum of Understanding (MoU) with National Small Industries Corporation Ltd. (NSIC) to have a demonstration facility at NSIC along with other areas of collaboration
- Train NPC consultants in Industry 4.0 so that they can consult SMEs in different clusters

- Augment their pool of experts with consultants from technology providers that can help them to scale up Industry 4.0 implementation at SMEs

## SMEs' Digitization Strategies

SMEs are integral to all industries and economy of the country. While the government is taking steps to create awareness for Industry 4.0 by setting up experience centers for SMEs, it is the SMEs' responsibility to make themselves acquainted with the latest technological developments and plan on how to adopt them for their benefit. Following are suggestions for the SMEs to become part of the current industrial revolution:

- **Have a mid- to long-term plan for the organization**

Although most of the time in an organization is spent on fighting day-to-day operational challenges, the mid- to long-term plan remains a priority. Having a long-term plan and awareness of the latest technological advancements shall help them in making the right decisions.

- **Identify needs, prioritize, and decide Key Performance Indicators**

Each organization shall then make a list of their needs that they would like to address either by aligning their process/practices first and then explore if there is a technology that can be adopted to address their needs. At this stage it is worth mentioning that organizations shall also decide on their Key Performance Indicators (KPIs) that shall be monitored periodically.

- **Have a champion**

Leadership shall also identify/designate Industry 4.0 champions within the organization who can explore possibilities of Industry 4.0 and help in making unbiased decisions (e.g., to implement IT/automation) to become Industry 4.0 ready. This champion shall wear the hat of Industry 4.0 subject matter expert (SME) and help in mapping the right technology to overcome the challenge and plan Industry 4.0 initiative in the organization. Although there are several solutions/technologies available in the market, SMEs shall decide based on which technology will address their need as opposed to getting carried away with the buzz with respect to Industry 4.0. Thus having an expert will be helpful.

- **Identify a partner**

The partner can be from the government organization, academia, or technology provider. The partner shall guide them to different options available that can be adopted to become more competent.

- **Finalize a project and Track KPIs**

Having identified the needs, the next vital step is identifying the project that would address the needs. At this stage, the champion (in-house) and the partner shall sit together and finalize the project, its scope, and time frame to finish it. Any process alignment/investment/technology adoption shall be tracked by monitoring the KPIs that were defined before starting the digitization journey. KPIs should be connected more with factors contributing to the success of the business than success of technology adoption.

- **Be agile**

If everything goes on well as planned then the SMEs shall continue their journey but in the event there are any hiccups then counter actions shall be taken swiftly so that effort/money and more importantly time is saved, and the journey is aligned as per the mid- to long-term plan.



While government, academia, and technology providers are taking steps toward enabling SMEs to adopt the right technology, the decision rests with SMEs to identify what works for them, resulting in making the right decisions. The need of the hour for SMEs is to take the lead in adopting new technologies and make it an integral part of their business strategies. Those that are successful in understanding the power of digitalization and harnessing it across their businesses will lead a new wave of growth.

## CHAPTER 7

# INDONESIA

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### **Executive Summary: Vision of Industry 4.0 Digitization Strategies for SMEs in Indonesia**

In general, Industry 4.0 has been welcomed enthusiastically by the industries in Indonesia, and especially the government. Media has reported routinely over the importance, opportunities as well as threats of this technological development. Many expect that Industry 4.0 can revitalize the country's existing manufacturing industries that have been stagnant for quite some time. Therefore, the government needs to promote and support the transformation of manufacturing industries into Industry 4.0. On 4 April 2018, the Indonesian Ministry of Industry released the roadmap of Making Industry 4.0, describing what the government will do to lead and support the national manufacturing industries into the era of Industry 4.0.

The Indonesian government has selected to focus on five manufacturing industries, two of which, F&B as well as textile and apparel, are largely populated by SMEs. Thus the government moots the importance of engaging SMEs so that they are not left behind in Industry 4.0 initiatives. Lack of capital and knowledge among SMEs creates great challenges for both government and SMEs as adopting technologies of Industry 4.0 requires both high capital and knowledge. In their roadmap, the government has in general addressed the problem and its solution.

### **SMEs' Current Readiness for Industry 4.0**

Indonesian manufacturing industries enjoyed major global market share in the past and were able to compete against competitors from PR China, India, and other developing countries. While their competitors, especially from PR China, have been able to maintain their growth and compensate the wage increase with more automation, Indonesian industries mostly kept relying on cheap labor. Their slowness in adopting new technologies has been partly the major source of their stagnant growth and even decline.

### **Key Sectors in Indonesia Affected by Industry 4.0**

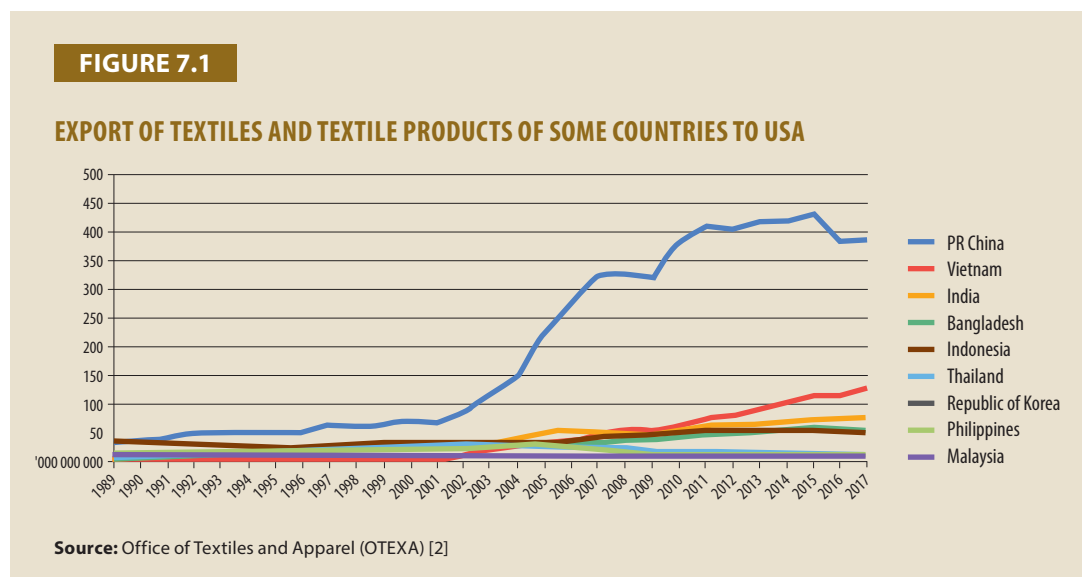
If Industry 4.0 is to be understood as the digital transformation of manufacturing that enables a more autonomous manufacturing and integrated value chains, which rely on the most recent technologies, such as IoT, robotics, and artificial intelligence, then Indonesian industries, and even more so SMEs, have not reached that level. Some elements of technologies, especially those to be used internally in single company, are already there. A certain level of automation has already been used to deal with the increasing cost of labor. But, seamless digital integration between Indonesian manufacturing companies and their suppliers and buyers are still to be developed.

Due to lack of capital and skill, SMEs usually lag behind larger corporations. Therefore, the statistics that indicate the performance of the whole industry can be used to understand the performance of SMEs. They show that the productivity of the average SMEs may not be better than the performance of large corporations. And the connectivity or logistic performance of a country will limit SMEs more than large corporations.

In general, Indonesia's competitiveness in the global market is relatively stagnant, while its major competitors, such as PR China and some ASEAN countries have made significant progress. Indonesia has relied too much on its abundance of cheap labor and natural resources. In manufacturing industries, as technology keeps progressing, those two sources of comparative advantage have been surpassed by technological innovation as the determining factor of competitiveness.

Indonesia's competitiveness in the global market has been threatened by countries that have been capable to develop their technologies and economic efficiency and by countries that have abundant cheap labor. Technologies related to Industry 4.0 do affect Indonesia indirectly. Its low investment in production technologies caused it to be left behind by countries that could incorporate more advanced technologies in their industries, such as PR China. In the 1990s, Indonesia has enjoyed significant market share in textile and apparel. However, PR China has been able to develop their industry faster than Indonesia. In 2000, Indonesia could outperform PR China only in a few product lines. "In the 75 lines in which Indonesia gained share, they only outperformed PR China in nine cases. The same trend broadly holds in Japan, where Indonesian apparel exporters lost share in 60% of their product lines over the decade" [1]. And among its top ten exports to the USA in 2008, only its cotton trousers had a higher market share than PR China. "The downside of this story is the nature of the product. Of Indonesia's top 10 apparel export products, cotton trousers have the lowest unit value and have experienced the lowest growth in unit value over this period. Thus Indonesia's exporters are becoming competitive in a product where the margins are likely to be low and coming increasingly under pressure. On the other hand, it argues against the conventional wisdom that Indonesia can no longer compete with "low cost" producers at the low end of the market" [1].

Figure 7.1 shows the development from 1989 to 2017. In 1989 Indonesia was not too far behind PR China. While PR China has been able to keep the growth of its export to the USA, market share of Indonesian textile in the USA has been almost stagnant, and then surpassed by two new textile exporting countries - Vietnam and Bangladesh - which also rely on cheap labor. PR China has been able to keep its growth because it can increase its productivity through the utilization of technology.



Indonesia had a labor cost advantage compared to PR China, but given the 10 years data of 2006–16, the ratio of productivity to labor cost of Indonesia was almost stagnant, whereas PR China and India have grown significantly [3]. While PR China has now grown to be a technology giant, Indonesia still struggles with the same problem, and therefore has to compete against countries which build their competitiveness on cheap labor, such as Bangladesh and Vietnam.

The competitiveness of Indonesian value chain can also be seen from its Logistic Performance Index (LPI). Indonesia is left behind PR China and India, which have a much larger number of population.

Table 7.1 shows that it is also behind Thailand, Malaysia, and Vietnam, but better than Philippines. It can be expected that LPI also indicates the constraint that affect the effectiveness of SMEs in conducting their businesses.

**TABLE 7.1**

**LOGISTIC PERFORMANCE INDEX (LPI) OF SOME COUNTRIES**

| Economy     | Mean Rank | Mean LPI Scores (2012 - 18) | Highest Performer % |
|-------------|-----------|-----------------------------|---------------------|
| Singapore   | 5         | 4.05                        | 96.9                |
| PR China    | 27        | 3.60                        | 86.1                |
| Thailand    | 34        | 3.36                        | 80.2                |
| Malaysia    | 35        | 3.34                        | 79.9                |
| India       | 42        | 3.22                        | 77.0                |
| Vietnam     | 45        | 3.16                        | 75.5                |
| Indonesia   | 51        | 3.08                        | 73.6                |
| Philippines | 64        | 2.91                        | 69.6                |

**Source:** Arvis et al. [4]

Without the exploitation of production technology, Indonesian industry has only to rely on cheap labor, which increases its competitiveness when its competitors' wage has increased. But, Indonesia has to compete against new players that have the same competitive edge, such as Vietnam and Bangladesh.

Many Indonesians seem enthusiastic in facing Industry 4.0. Industry 4.0 combines operating technologies with information technologies, and its creative combination is believed to be able to revive manufacturing industries. Stakeholders have not yet seen the real example of Industry 4.0 but they seem to derive their optimism from the success of some Internet business start-ups. A small number of Indonesian fast-growing start-ups have reached the status of Unicorn, those with the valuation over USD1 billion. Within a relatively short period they have been able to disrupt their sectors, or at least, threaten the major players in those sectors.

## Major Challenges/Barriers and Needs of Indonesia's SMEs to Become Industry 4.0 Ready

Fragmentation and internationalization of production processes provide the opportunity to developing countries to engage in global value chain (GVC) [5]. Certain level diffusion of knowledge and technology will be initiated by developed countries to developing countries in return for more efficient or cheap production. This will benefit developing countries in upgrading their industries [6] in terms of enhanced productivity, sophistication, and diversification of exports [5]. Sophisticated machineries

and production systems have been introduced in Indonesia through FDI or to Indonesian companies by foreign partners or technology vendors. The level of upgrading will be different for different countries depending on various factors. "GVCs can be an important avenue for developing countries to build productive capacity where local firms can capture a significant share of the value added: but technology dissemination, skill-building and upgrading are not automatic and require significant investment" [7]. Now any country would want to participate in GVC, therefore the participation is a competitive necessity, not a source of competitive advantage. GVC will spread new knowledge and technology, but passive recipients will gain much less than more active companies or countries in acquiring technologies and creatively utilizing them.

The more globalized the economy, the more complex and unpredictable the challenges are for any government to deal with. Though not every economic challenge can be effectively dealt with government policy, it is important for the government to engender entrepreneurial activities in their people. Besides providing education and training in entrepreneurship, more importantly, the government should be "improving the domestic business environment to unlock the potential for local entrepreneurship, raising the skills and productivity of the workforce, and perhaps most critically addressing the weak innovation and quality environment that prevents the development of deep and competitive domestic value chains" [1]. Entrepreneurs are supposed to carry out innovation, that is, creating new combinations which manifest either in the new and sometime more complex form of technology, organization, or business arrangement. An innovation, as something new, is not easy to realize and introduce. It requires special persons who have the creativity, energy, and courage to transform an idea into products or services in the marketplace. Thus the government must improve the business environment including the infrastructure.

Entrepreneurship of a country can be seen in the agility of its SMEs. "The role of small and medium sized enterprises has become increasingly vital for transition economies (TEs) because of their ability to respond to the systemic shock rapidly and their potential to generate jobs and income at the time when the large firm sector was undergoing a rapid decline" [8]. Even though entrepreneurship and innovativeness are manifestation of individual agency, courage, and creativeness, they take and exploit the opportunities given by their environment. They are constrained by regulatory environment, skills of workforce, access to finance, market access, and infrastructure.

In Indonesia, the business regulatory environment was considered as the second most commonly cited constraint, after infrastructure [1]. The regulatory regimes lack transparency, which therefore can

TABLE 7.2

## EASE OF DOING BUSINESS

| Economy     | Global Rank Doing Business | Global Rank Starting a Business | Starting a Business Time (days) | Starting a Business - Cost (% of income per capita) |
|-------------|----------------------------|---------------------------------|---------------------------------|---|
| PR China    | 78                         | 93                              | 22.9                            | 0.6   |
| Indonesia   | 72                         | 144                             | 23.1                            | 10.9  |
| Malaysia    | 24                         | 111                             | 18.5                            | 5.4   |
| Philippines | 113                        | 173                             | 28                              | 15.8  |
| Singapore   | 2                          | 6                               | 2.5                             | 0.5   |
| Thailand    | 26                         | 36                              | 4.5                             | 6.2   |
| Vietnam     | 68                         | 123                             | 22                              | 6.5   |
| Bangladesh  | 177                        | 131                             | 19.5                            | 22.3  |

Source: World Bank [9]

be exploited by corrupt bureaucrats. Democracy which is expected to increase transparency has not occurred. It leads to decentralization and corruption by local government. This condition specifically impairs the competitiveness of SMEs. The ease of doing business partly indicates the level of support for entrepreneurship.

The Global Competitiveness Report 2017–2018 [10] puts Indonesia at the rank 36th of 137 countries, behind Thailand (32th), PR China (27th), Malaysia (23th), and Singapore (3th), but above India (40th), Vietnam (55th), and the Philippines (56th). In terms of business sophistication, Indonesia ranks below Malaysia and Singapore, but higher than the rest in the table. Its rank in innovation is higher (31), but its technological readiness is lagging far behind (80th). Low technological readiness indicates low technological adoption which leads to low productivity at firm level. Technological adoption, especially by SMEs, is constrained by access to financing. Implementing Industry 4.0 is not cheap for most SMEs. However, the Indonesian government has had a program assisting textile and product textile industries (TPT) and footwear to replace their old machineries. Between 2007–11, the government allocated IDR1,100 billion (USD75 million) for TPT industries, and in 2012 IDR172 billion (USD11.8 million) for TPT and footwear industries to buy new machinery. The government help companies pay 10% of the cost of the machines if purchased from overseas, and 15% from national companies [11]. However, improving productivity requires more than just the replacement of old machineries. Buying the same technologies which are also available to other countries and letting the rest remain as status quo would not help Indonesian industries gain more competitiveness relative to other countries. They have to learn to creatively utilize the available technologies, and then upgrade their capabilities to do their own technological innovation.

The abundance of cheap workforces might give temporary competitive advantage, but if they are cheap because they have low skills, then they will limit the companies from innovating. "One factor is clearly the nature of firms in the manufacturing sector. Relative to peers, such as Malaysia and Thailand, Indonesia's firms tend to operate in labor-intensive, low-technology activities. In subsectors, such as apparel and furniture, for example, it is common in many firms to train workers on machinery when they first begin the job, but not again during their career" [1].

Having low ranks in infrastructure (52) also indicates the challenges faced by businesses, such as the high cost of logistics and the length of time which constrain the agility of businesses to quickly respond to the dynamics of business demands. As a vast country comprising over 17,000 islands with a population of over 250 million people, it is a great challenge for Indonesia to deploy proper infrastructure across the country. However, without well-distributed infrastructure, it will be difficult to operate good logistics services, and "the lack of continuity of logistics services beyond the main gateway puts SMEs in remote regions at a disadvantage to reach markets. Inter-island trade in Indonesia provides a telling example. The high cost of transporting high-quality goods, such as shrimp from eastern Indonesia to processing centers in Java, makes them too expensive to export, or similarly it is cheaper to import oranges from PR China than to ship them from Kalimantan to Java" [12].

Low connectivity among businesses are not only due to the lack of physical infrastructure, but also to informational infrastructure. Technically, digitization in manufacturing sectors needs to be improved. Interorganizational system which is based on IoT might help industries to improve the connectivity among themselves. But, most importantly, building trust and reliability are even more needed.

Table 7.3 shows only five from the 12 pillars of GCI, thus not representative in comparing the eight countries. For example, Singapore ranks first globally for public-sector performance while in one of the categories of institutions pillars, it also excels (second). In quality of institutions, besides infrastructure, can be seen as the foundation upon which business can easily operate.

TABLE 7.3

## COMPARISON OF GLOBAL COMPETITIVE INDEX (GCI) OF SOME COUNTRIES

| Economy     | GCI Rank | Rank of Pillar            |                |                         |            |                         |
|-------------|----------|---------------------------|----------------|-------------------------|------------|-------------------------|
|             |          | Macroeconomic Environment | Infrastructure | Business Sophistication | Innovation | Technological Readiness |
| Singapore   | 3        | 18                        | 2              | 18                      | 9          | 14                      |
| Malaysia    | 23       | 34                        | 22             | 20                      | 22         | 46                      |
| PR China    | 27       | 17                        | 46             | 33                      | 28         | 73                      |
| Thailand    | 32       | 9                         | 43             | 42                      | 50         | 61                      |
| Indonesia   | 36       | 26                        | 52             | 32                      | 31         | 80                      |
| India       | 40       | 80                        | 66             | 39                      | 29         | 107                     |
| Vietnam     | 55       | 77                        | 79             | 100                     | 71         | 79                      |
| Philippines | 56       | 22                        | 97             | 58                      | 65         | 83                      |

Source: The Global Competitiveness Report 2017–2018 [10]

## Major Initiatives to Foster Digitization in SMEs' Preparation of Industry 4.0

The country's roadmap of Industry 4.0 entitled "Making Indonesia 4.0" [13] was launched on 4 April 2018. It is still to be elaborated and implemented. The roadmap has selected five manufacturing sectors; namely, F&B, textile & apparel, automotive, electronics, and chemical industries. The first two sectors - F&B and textile & apparel - consist of fragmented local players with many SMEs. The roadmap highlights that the government will empower SMEs by funding and providing technology support. The latter will be realized by establishing a technology bank, but it is yet unknown how the technology bank will offer its services or improve the technological capability of SMEs.

In a number of established sectors, such as F&B, textile, footwear, or wood products, SMEs, especially the smaller ones, were among the latecomers in adopting ICT. The Ministry of Cooperative and SMEs (MoCSME), which has the responsibility in empowering cooperatives and SMEs, has had a number of programs to diffuse ICTs among them. Since 2016, the MoCSME, in cooperation with local government, has established the Center for Integrated Services (CIS) of Cooperatives and SMEs. The CIS hires private consultants to assist cooperatives and SMEs in a minimum of seven services, such as business consulting and mentoring. One of the services is promotion or marketing, IT, and e-Commerce. Through CIS, cooperatives' and SMEs' staff are trained to use ICT, especially the Internet or online media, to reach their markets. This effort is to educate cooperatives and SMEs to use the Internet for marketing to reach their markets and customers. There is no program to digitize internal processes of SMEs, therefore this initiative is still far from what is called Industry 4.0.

The Ministry of Communication and Information (MoCI) also has a program to help SMEs to go online. By 2020 they targeted that the number of micro, small, and medium enterprises (MSMEs) that go online will reach eight million enterprises and the volume of e-commerce transactions in Indonesia will reach USD130 billion [14].

The Creative Economy Agency (Bekraf) was established to promote creative industries, which also include software application, computer games, and animation. Promoting start-ups, which are very popular among ICT practitioners, is among the important programs of Bekraf. It includes a program called Government Incentive Assistance which were given to start-ups in creative industries. In 2017 the financial assistance is given to more than 40 start-ups belonging to two subsectors of creative

industries; namely, culinary and computer applications and games. They were selected through a business plan competition. Bekraf also helped start-ups and MSMEs in accessing funding, either through the banking system or nonbanking systems, such as venture capital or angel investors. Bekraf also organized events, including collaboration with international organizations, to introduce Indonesian start-ups to international investors. In April the 2018 Global Ventures Summit was held in Jakarta, a platform that allowed national start-ups to meet venture capitalists from Silicon Valley and everywhere else. And occasionally, Bekraf took the start-ups to events organized overseas, such as the Startup World Cup organized by Fenox Venture Capital.

These initiatives are part of promoting start-ups in the Internet businesses, however they may pave the way to Industry 4.0.

## **Strategies to Increase SMEs' Competitiveness**

The Indonesian president has issued the e-commerce roadmap through Presidential Decree No. 74 of 2017 on E-Commerce Roadmap for the Year of 2017–2019 [15]. This roadmap does not directly address Industry 4.0, however, it is expected to increase the digitization of Indonesian businesses, especially in retail sectors. To address Industry 4.0 the Roadmap of Making Indonesia 4.0 has been released by the Ministry of Industry, which is however not as elaborate as the E-Commerce Roadmap, and not issued in the governmental or presidential decree. So, formally the "Making Indonesia 4.0" has less power as a basis for policy action.

On improving SMEs' readiness for Industry 4.0 either through E-Commerce Roadmap, Making Indonesia 4.0, or other already implemented policies, the government's strategies can be categorized into addressing entrepreneurship, digitization and access to technologies, and participating in the value chains. Many of these attempts have not been linked to Industry 4.0 explicitly because they were initiated before Industry 4.0. These attempts will influence SMEs' readiness for Industry 4.0.

### **Strategies to Address the Entrepreneurship**

Even before the government had a clear strategy to deal with entrepreneurship in the era of Industry 4.0, the Indonesian president has already showed his support for innovative entrepreneurs. In October 2015, about a year after President Joko Widodo assumed presidency, he took four digital entrepreneurs to Silicon Valley during his visit to the USA. They were the founders of Gojek (a company like Uber, but in the beginning it facilitated motorcycles to be used as public transportation and now expand its services to various types of delivery and even electronic payment), Kaskus (Indonesian social media), Traveloka (a company that serves travelers from airline tickets to hotel booking), and Tokopedia (online mall that facilitates transactions between businesses and buyers).

Prior to the launching of the roadmap of Making Indonesia 4.0 the president had often mentioned the importance of e-commerce or e-business. His commitment for e-commerce was later shown by the issuance of Presidential Decree No. 74 of 2017 on E-Commerce Roadmap for the Year of 2017–2019 and more importantly, the active involvement of various government organizations to implement this roadmap. The roadmap consists of eight key areas - funding, taxation, customer protection, education and human resources, telecommunication infrastructure, logistic, cybersecurity, and establishment of a coordinating function (in the form of steering and management committee). These key areas are further divided into 26 programs, which must be implemented by the respective governmental organizations in the 2017–19 period.



According to the roadmap, various schemes will be developed to help financing SMEs and developing start-ups. Kredit Usaha Kecil (People's Credit for Business) which was introduced in 2007 by three state-owned banks (BRI, Bank Mandiri, and Bank Nasional Indonesia) to help micro and SMEs will be adapted to accommodate e-commerce business model. Prior to the implementation of this roadmap, it was difficult for e-commerce companies to get sufficient loan because they were assessed according to traditional business model. Currently the government through Bekraf provide assistance for start-ups in creative industries. The roadmap states that the government will increase the number of start-ups by developing a funding and grant scheme for business incubators, which help the establishment and development of start-ups. Besides that, the government will develop schemes to provide grants for e-commerce businesses, which are obtained from community social responsibility (CSR) of state-owned companies or the like. MoCI would also utilize a large amount of Universal Service Obligation (USO) funds collected from telecommunication operators. Another incentive for business is that the government will also simplify taxation and create tax incentive for investors in e-commerce.

### Strategies to Address Value Chain Inefficiency

Value chain refers to the full range of activities that are required to bring a product or service from conception, through the different phases of production, and delivered to end consumers and final disposal after use [16]. Some of the stages have to be done by companies internally while the others require good interactions with other organizations. There are also activities whose effectiveness depend on public infrastructures. "The World Bank says Indonesia has a USD1.5 trillion infrastructure gap compared to other emerging economies. A lack of good roads and transport corridors across the archipelago -- a string of more than 17,000 islands that would stretch from New York to London -- are adding to logistical barriers and driving up costs for business" [17].

The current Indonesian government has emphasized the development of physical infrastructures, from transportation infrastructures (toll roads, railways, seaports, and airports) to energy plants and irrigation infrastructures. About one fifth of state budget has been allocated for the development of new infrastructures and maintenance of old infrastructures. In 2017, the Indonesian government allocated IDR387.7 trillion (USD26.5 billion) or 18.6% of state budget, and in 2018, IDR410.7 trillion (USD 28.1 billion) or 18.6% of state budgets [18]. The infrastructures will either enable some productive activities or reduce the cost of carrying out those activities, and it will significantly help the SMEs.

So far, the government has already invested heavily in physical infrastructure, and following the E-Commerce Roadmap, the investment will be expanded to ICT infrastructure which is also needed to support e-commerce and logistics. The government will also develop a National Payment Gateway for electronic payment in both traditional retail and e-commerce.

### Strategies to Address Digitization and Access to Technology for SMEs

In Making Indonesia 4.0, government has already realized that Indonesia's investment in technology is low. Information and communications technology spending as percentage of GDP of Indonesia is 1.3%, lower than countries, such as PR China (1.4%), India (2.2%), Thailand (2.4%), and Malaysia (4.5%) [13]. Labor productivity/cost index of Indonesia is also lower than those countries. Therefore, it is believed that the level of utilization of technology affects the productivity of workforce.

The roadmap suggests the increase in technology spending, and also the need to have 2% of R&D spending, even though it is not clarified who will make such spending, and what is the proportion of spending by government and private sectors.

To help SMEs, the roadmap plans to establish a technology bank. The Center for Integrated Services (CIS) that was established by MoCSME in cooperation with local governments to support cooperatives and SMEs in simple utilization of ICT for businesses, especially marketing and transaction, not production. So, the industries will have to wait for the establishment of technology bank and see how it can help them.

## **Planning for Increased SMEs Competitiveness by Becoming Industry 4.0 Ready**

### **Developing the Industry 4.0 Ecosystem(s)**

The preparation and integration of SMEs into Industry 4.0 will depend on the players that help SMEs integrate into the value chains that are already advanced in Industry 4.0. The key players that will have an effect on SMEs' readiness for Industry 4.0 are technology providers, large buyers that require SMEs to use Industry 4.0 technologies, infrastructure/platform operators, and government. Higher education can help SMEs to increase the skill of their workforces.

Reliable and affordable information infrastructure, such as broadband network that reaches industry clusters inhabited by SMEs needs to be implemented first. Technology implementation should be implemented at the same time with the integration with large buyers, so that SMEs can directly benefit from the adoption of technology. Various knowledge and technology providers are needed to educate SMEs, not just technology vendors, so that SMEs can compare information and advice given to them. Education institutions can both help the development of human resources as well as learn from the process of implementation of Industry 4.0.

The government should intervene either by providing financial assistance and tax incentives related to the adoption of technology, information, training centers, and more importantly, the required regulation that eases the transition into Industry 4.0.

### **Expected Impact from Developing the Industry 4.0 Ecosystem(s)**

The highlighted initiative is needed to allow SMEs to participate in the progress of Industry 4.0. Since this initiative is something new, openness to trial and error, to admit mistakes and learn, and flexibility to change is needed by every stakeholder. No one has the final solution for the whole process in advance. The government and education institutions can learn a lot and spread the learned practices and best practices to anyone who wants to enter into Industry 4.0.

Indonesia needs industry vendors that are not only reselling imported machineries. Customization and development that suit local needs have to be carried out. R&D in production systems is needed, otherwise Indonesia will not gain in competitiveness because imported technologies will also be used in other countries.

## CHAPTER 8

# MALAYSIA

**Sarimah binti Misman**

Director, Delivery Management Office  
Malaysia Productivity Corporation

### **Executive Summary: Vision of Industry 4.0 Digitization Strategies for SMEs in Malaysia**

Technological innovation is revolutionizing industries across all sectors in Malaysia and greatly impacting work and lifestyle too. These changes are imminent at the national level and will transform businesses through the way they think and operate. SMEs that seize the opportunities arising from the megatrends will stand to gain significantly.

Malaysian SMEs need to be nurtured on the importance of moving to Industry 4.0 rather than maintaining themselves in conventional business. Benefits of industries moving to Industry 4.0 are proliferation in flexibility, productivity, efficiency, quality, reduced time to market, more research development and demonstration (R&D&D) activities, and the potential of developing new skills and talent globally.

In Malaysia, the government is currently formulating a national policy and the blueprint on Industry 4.0. It serves as a guideline for the industry to move forward and accelerate the adoption of industry 4.0 among industry players. The national policy and the blueprint on Industry 4.0 was launched on 31 October 2018.

### **Introduction**

How ready is Malaysia for Industry 4.0? The report on the Readiness for the Future of Production Report 2018, jointly published by the World Economic Forum (WEF) and A.T. Kearney (Figure 8.1) that provides a global assessment of 100 countries has positioned Malaysia in the “Leader” quadrant. These are countries with a “strong current production base” and that are “positioned well for the future”. It is also interesting to note that Malaysia and PR China are the only two countries in the “Leader” quadrant that are not high-income countries.

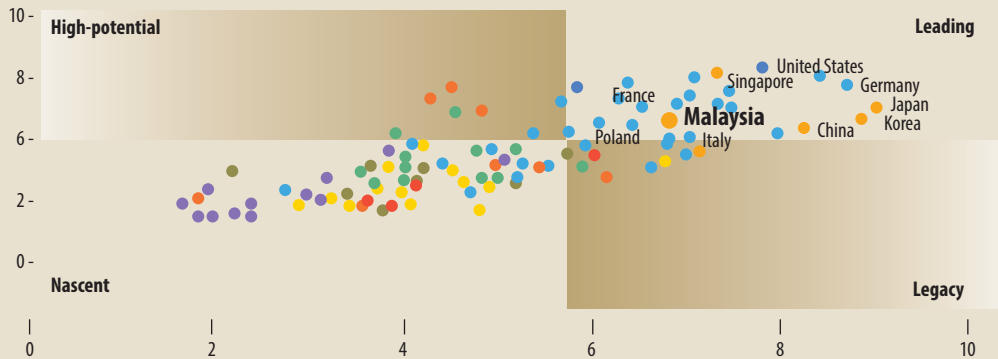
This is both an enviable and a challenging position for Malaysia. On one hand, it underscores Malaysia’s strong current manufacturing position and its readiness for Industry 4.0. On the other, it also highlights the economic value is at stake if Malaysia is not able to transform itself in an accelerated manner. The gap to global leaders like Japan, the Republic of Korea, Germany, Switzerland, and PR China is still significant and to other regional countries, such as India and Indonesia, WEF’s analysis identifies technology, human capital, global trade and networks, and institutional frameworks as the key drivers of production for Industry 4.0. Singapore and Thailand have aggressive plans and are moving fast in their implementation plans for Industry 4.0.

On global trade and investment, Malaysia is already well integrated into regional value chains and exhibits a very good trade infrastructure, which is reflected in its strong global ranking (7th). In terms

FIGURE 8.1

## READINESS FOR THE FUTURE OF PRODUCTION REPORT

Drivers of Production score (0-10)



Structure of Production score (0-10)



Note: Average performance of the top 75 countries is at the intersection of the four quadrant

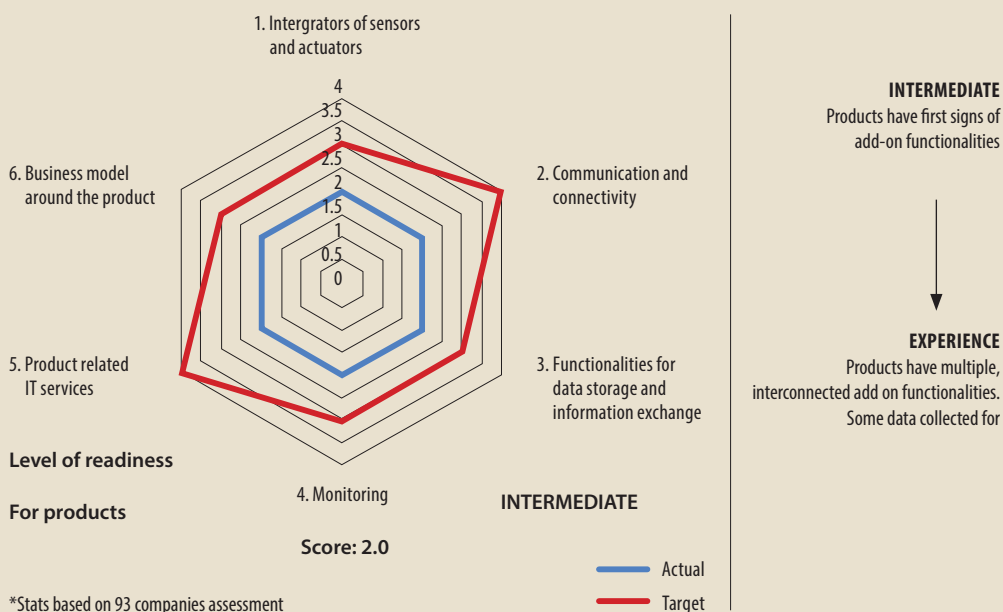
Source: World Economic Forum, 2018

FIGURE 8.2

## ASSESSMENT ON PRODUCT DEVELOPMENT (EXISTING AND NEW)

## Assessment 1 :

\*To what extent can new products be developed or existing ones be further developed with help of Industry 4.0?



\*Stats based on 93 companies assessment

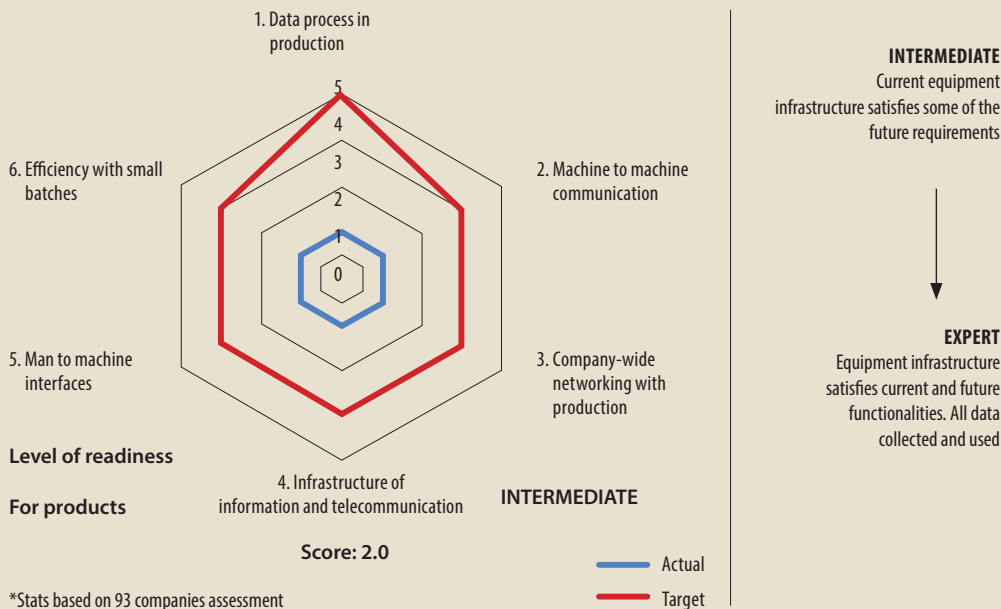
Source: IME Group

FIGURE 8.3

## ASSESSMENT ON PRODUCT PROCESSES

## Assessment 2 :

\*How production processes can be optimized and how production cost can be reduced with help of Industry 4.0?



of the level of readiness of product and process connectivity, most of the SMEs in Malaysia were ranked at intermediate level with scores at 2.0 of maximum 4. This is illustrated in assessment 1 (Figure 8.2) and 2 (Figure 8.3) based on a survey conducted by IME Group, a local solution provider that surveyed 93 companies using the international assessment of the Mechanical Engineering Industry Association (VDMA).

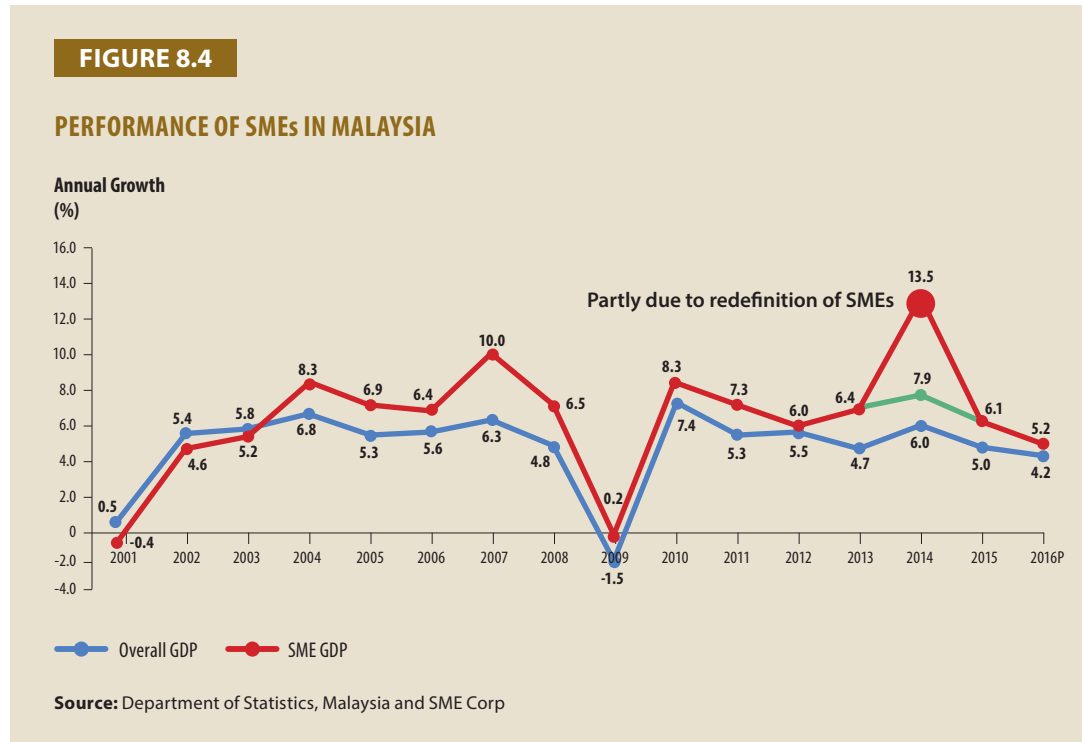
## SMEs Performance in Malaysia

SMEs are key players in national economies, contributing to economic growth around the globe. The Asia-Pacific Economic Cooperation (APEC) reported that 97% of establishments and over 50% of employment in the workforce comprises of SMEs in its economies [1]. Meanwhile, the report by the OECD entitled ‘Enhancing the Contributions of SMEs in a Global and Digitalised Economy’ highlighted that SMEs assume a key role in national economies around the world, generating employment, value added, and contributing to innovation.

Based on the national Economic Census 2016: “Profile of Small and Medium Enterprises by the Department of Statistics, Malaysia (DOSM)”, SMEs in Malaysia constituted 98% of the total business establishments [1]. The majority of the businesses were in service sectors, mainly in wholesale and retail trade, followed by manufacturing, construction, agriculture, and mining and quarrying.

For the growth period of 2011–16 [1], the average annual growth rate of SMEs was 6.5%, higher than the average growth of the overall economy of 5.1%. This has led to higher SME contribution to GDP

from 32.2% in 2010 to 36.6% in 2016. In terms of performance by key economic sectors, the increase in share of SMEs to GDP was largely contributed by the services sector and further supported by the construction sector. SME GDP growth in the construction and services sectors expanded at average annual rates of 10.2% and 7.0%, respectively in the growth period of 2011–16, much higher than the average overall SME GDP growth of 6.5% (Figure 8.4).



## New Era of Digitalization

Digitalization started in Industry 3.0, where it is also known as Digital Revolution. It is the transition from analog and mechanical system to digital system. In the industrial revolution, the usage of Internet and digital significantly increased. Digital technologies have transformed and changed business models, provide new avenues and value-producing opportunities for the industry which involves process from semiautomated to digital. Big data, robotics, and additive manufacturing are just a part of the technologies that are driving the convergence of digital and physical aspects in every sector. Some of these technologies are already in use, for example, the RFID technologies and the augmented reality. The advent of the smart factory is enabling communications between machines and robot, enabling both to work independently [2].

As governments across the economies pursue inclusive growth, SMEs must be an integral part of the solution by adopting the latest megatrends in the technological development and innovation. SMEs' participation in the GVCs can provide the opportunity to the public and private sectors in achieving economies of scale, expanding market share, and increasing productivity [1]. In terms of business to business transactions, the majority of the e-commerce transactions are concentrated in the manufacturing sector. In 2015, Malaysian businesses earned MYR398 billion from e-commerce sales, 16% of total business income for the year. But only 5% of establishments were involved in e-commerce, implying a highly concentrated digital economy [3]. Megatrends have been identified to disrupt and transform SMEs. The megatrends which will have a significant impact on SMEs are the megatrends on Digital Future and 4th Industrial Revolution (IR4.0).

Industry 4.0 will ultimately change the competitiveness of companies and regions to support the manufacturing industry transition into this rapidly changing industrial landscape. Industry leaders and policy makers in several countries have established various programs on smart manufacturing to enable industries to adopt Industry 4.0 principles to enhance global competitiveness as well as to sustain countries' economies.

## National Policy to Support Industry 4.0

The higher education system in Malaysia has been restructured in order to prepare the future generations for Industry 4.0. The Minister of Higher Education mentioned that the process of teaching and learning at higher education will be transformed. The policy of education will be improved, allowing all higher education institutions programs with 70% of the content focusing on core subjects, while the remaining 30% are open to content that is relevant to current trends [4]. The role of higher education institutions is to prepare students for the changes triggered by Industry 4.0.

A national policy on Industry 4.0 is currently being formulated by the government. In May 2017, the Cabinet tasked the Ministry of International Trade and Industry Malaysia (MITI), Ministry of Science, Technology and Innovation (MOSTI), and Ministry of Higher Education (MOHE) to lead this initiative. A High Level Task Force (HLTF) led by MITI with members from relevant ministries and agencies was established in March 2017 to spearhead the development of government's strategy for Industry 4.0 with strong stakeholders' feedback including from the industry.

The Industry 4.0 HLTF has five Technical Working Groups (TWGs):

- i. Digital Infrastructure and Ecosystem led by Ministry of Communications and Multimedia
- ii. Funding and Incentives led by Ministry of Finance
- iii. Talent and Human Capital led by Ministry of Human Resource and MOHE
- iv. Technology and Standards led by MOSTI
- v. SMEs led by SME Corporation Malaysia

The Technical Working Groups are to identify challenges, analyze existing gaps, and propose action to be taken accordingly. Recommendations will be included in the overall National Policy on Industry 4.0. MITI and its agencies in collaboration with relevant ministries and agencies are also undertaking various outreach programs to increase public, industry, academia, and training institutes' awareness on Industry 4.0. More outreach programs are in the planning stages, including at the state and regional levels.

The current economic plans (Third Industrial Masterplan (IMP3) and 11th Malaysia Plan (11MP)) are still relevant and remain as Malaysia's mid-term policy guide until 2020. 11MP (2016–20) has identified the three catalyst (electrical and electronics (E&E), machinery and equipment (M&E), and chemical) plus two new growths sectors (aerospace and medical devices) as game changers for the manufacturing sector. These sectors will continue as the focus sector together with other sectors, such as automotive, petrochemicals, textiles, and services to be exposed to Industry 4.0 concept.

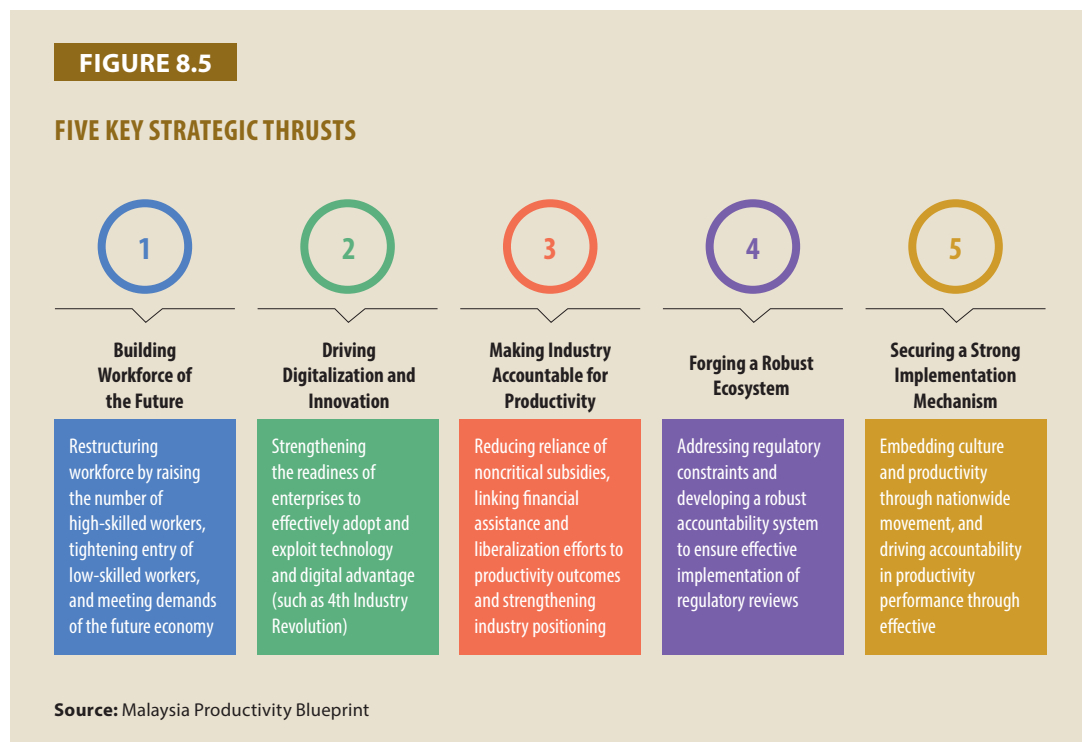
As such, it is imperative for Malaysia to transform at an accelerated pace and embrace Industry 4.0 as a critical cornerstone to propel and sustain its future manufacturing competitiveness. Focus needs to be given to drive continuous growth in manufacturing GDP to increase national productivity, create higher skill employment opportunities, raise innovation capabilities, and competitiveness.

In Malaysia's transformation, particular attention needs to be focused toward SMEs as they account for the bulk of manufacturing companies (98%) and a major part of employment (42%). While most of the large manufacturing firms are already anticipating the benefits and risks of adopting Industry 4.0 practices, Malaysian SMEs appear to be cautious in taking the leap.

Industry 4.0 has the potential to transform manufacturing SMEs in multiple ways: improving productivity, efficiency and cost; enhancing organizational, management, and production capabilities; enabling better quality monitoring; and developing innovators and producers of Industry 4.0 technologies.

The level of transformation required for SMEs is however, substantial. It will not just be about adopting Industry 4.0 technologies, but also toward changing business processes and operating models. For example, SMEs will need to learn how to deal with these disruptions, be more resilient, and embrace the rate of change as an opportunity [1].

To strengthen the effort of promoting and accelerating the readiness of enterprise in adopting Industry 4.0, the Malaysia Productivity Blueprint (MPB) has outlined one of the key strategic thrusts which focuses on driving digitalization among the industry players, specifically SMEs. The national thrust concentrates on the immediate priority activities to be conducted. It is important for the enterprises to embrace Industry 4.0, hence fully taking advantage of the benefits derived from the advancement. The five key strategic thrusts are shown in Figure 8.5. In order to ensure the objective of the thrust is achieved, the Malaysia Productivity Corporation (MPC) is tasked to monitor and evaluate the effectiveness for all the activities and initiatives at the sectoral and enterprise level.





## Government Initiatives to Foster Industry 4.0

The Malaysian government has also provided financial assistance and incentives for the SMEs to accelerate the adoption of Industry 4.0 that includes the extension of the 200% Accelerated Capital Allowance (ACA) and Automation Equipment Allowance (AEA), which were previously introduced to encourage automation in the manufacturing industry. The extension is focused on certain labor-intensive products within the industry. Further, a separate ACA and AEA have been proposed specifically to encourage the manufacturing sector and related services activities to transform to Industry 4.0. Recognizing the importance of financing, the government has allocated MYR245 million (approximately USD59.2 million) under the existing Domestic Investment Strategic Fund (DISF), where eligible businesses will be able to apply for a matching grant to upgrade to Smart Manufacturing facilities (Ministry of Finance, 2018). SMEs will need to collaborate and participate in broader production networks with other SMEs, large firms, or multinational corporations. Digitalization of the manufacturing system will be important to build direct links to end customers and produce innovative and customized products. As such, manufacturing SMEs will need to learn how to deal with these disruptions, be more resilient, and embrace the rate of change as an opportunity.

## Benefits of Industry 4.0 for SMEs

Big data is the huge amount of data stored in the cloud that a company does not own. With big data, companies can predict market trends and tap into them quickly. They can also diagnose specific issues and challenges which their particular industry is facing to come up with solutions quickly.

Malaysia is now at the stage of digital transformation. “The next step Malaysia should be focusing on big data analysis and high-performance computing, which enables the AI function” [4]. Chellam [5] further asserts that IoT, which enables big data analysis, is the next technology local companies should invest in. In fact, the implementation of IoT is crucial to SMEs in the manufacturing sector in order for them to stay ahead of their competitors in the local and overseas market. Malaysia has always been one of the destinations for global companies to implement advanced technology to enhance manufacturing efficiency and productivity. Local companies are advanced in terms of technology and are open to new ideas. Artificial Intelligence (AI) is the next big thing and it will benefit local manufacturers, especially the agricultural players. “Agriculture is the third largest sector contributing to the economy after services and manufacturing. Palm oil plays a big role in the sector. With big data and AI, companies can improve the genetic components of the oil palm tree and make the trees grow faster and produce more yields.” [5].

“Many SMEs have secondhand machines, which are old and unable to communicate with each other. However, they do not need to purchase new machines. They only need to modify them by adding smart sensors to show some crucial data, such as how much production have gone up and what the voltage of the machine is.” [6]. Edwin [6] asserted further that there are three options for SMEs to upgrade from industry 3 to industry 4:

### Option 1 : Replacing existing equipment with modern IoT-enabled machineries

The pros : Most up-to-date technology

The cons : Costly, IoT-enabled machine takes time

### Option 2 : Retrofitting existing equipment incorporating IoT-ready connectivity solutions

The pros : IoT-ready and local expertise available

The cons : A lot of coordination is required

**Option 3 : In-house solutions on specific goals**

The pros : Lower cost

The cons : Partial solution, mainly on software aspect

**ICT Adoption by SMEs**

Recent statistics suggest a discernible increase in the adoption of ICT among SMEs, particularly in the last two years from 2014 to 2016. In the first quarter 2016 (1Q 2016) SME Corp carried out an SME Survey with 2,176 SMEs. The findings showed that:

- Devices - mobile phones, computers, and laptops - used by the respondents did not change much (from 92.6% recorded in the 1Q 2014 to 98.3% in the 1Q 2016) but the number of respondents using the Internet has increased significantly to 90% (1Q 2014: 33.3%)
- Usage of social media to promote and market their products and services also increased to 78.2% (1Q 2014: 12.1%)
- e-commerce and e-payment were conducted by 32.3% of respondents (1Q 2014: 7.1%) while 30.9% have websites (1Q 2014: 11.4%)
- First-time users of ICT tools were at 10.8%
- 89.1% of the respondents cited that they have utilized computers for business purpose as compared to 27% recorded in 2010 based on the 2011 Economic Census conducted by the Department of Statistics, Malaysia (DOSM) [3]

Malaysia continues to trail its international peers in digital adoption by businesses, especially as the country increasingly compares itself to high-income rather than upper-middle-income peers. Only 62% of business establishments are connected to the Internet, 46% have fixed broadband (often of low quality), and just 18% have a web presence [4].

Based on another survey conducted by DOSM on ICT use by individuals and households in 2015, the findings also reveal that the usage of mobile phones and computers have increased including for business purpose. Social networking tops the list with 84.3% respondents using it while about 79.6% utilized the Internet to get information on goods and services, 27.4% were involved in Internet banking, and about 16.1% purchased goods and services online.

These findings suggest that consumers are more well-informed about their personal needs through Internet and have begun relying on ICT to make up their mind upon purchase of products and services. At the same time, there has been a mind-set change among businesses particularly in SMEs that are coming on board to respond to the consumer behavior and leveraging ICT, the Internet, and social media to conduct more online business transactions. This includes programs, such as e-Trade which involves the SME companies to do the transaction through MATRADE's website in the form of international business-to business (B2B) and business-to-consumer (B2C) e-marketplaces; namely, TradeIndia.com, Amazon.com, and eBay.com.

## Driving Digitization and Innovation in SMEs

Starting with Enabling E-Payment Services and boosting the e-commerce industry in Malaysia are two important initiatives to drive digitization and innovation in local SMEs.

### Enabling e-Payment Services Program for SMEs

As technology continues to develop, the range of devices and processes to transact electronically continues to increase while the percentages of cash and check transactions have reduced significantly. The Internet has the potential to become the most active trade intermediary within the decade. The Enabling e-Payment Services Program for SMEs aims to facilitate and encourage the sector's participation in the digital economy by increasing their adoption of e-payment. The ultimate objective is to simplify the purchasing process and lower the cost. The target groups for the e-payment program are the microenterprise, small businesses, and cottage industries. For the period of 2015, a total of 13,846 SMEs have been enabled with e-payment solutions involving 22,236 terminals. By 2020, the project is expected to generate 1,125,000 e-payment merchant outlets points enabled by Electronic Funds Transfer Point-of-Sale (EFTPOS) terminal. This platform acts as an enabler for the companies to perform their transactions using big data and system integration.

### #MYCYBERSALE

#MYCYBERSALE aims to boost the e-commerce industry in Malaysia to encourage SMEs to adopt e-commerce in their businesses and to increase domestic revenue of e-commerce. For 2015, a total of MYR117 million (USD28.2 million) worth of transactions generated through #MYCYBERSALE and MYR61 million (USD14.7 million) is from SMEs' Gross Merchandise Value (GMV).

Ganesh [7] highlighted that #MYCYBERSALE 2017 was able to reduce government funding for the project by 40% while increasing the GMV or sales generated through online sales by 55% with a total revenue of MYR311 million (USD75.1 million) (+3.7% of target export revenue) and export revenue of MYR39 million (USD9.4 million) (+95% of target). The increased sales were enjoyed by over 1,000 entrepreneurs which were mainly Malaysian SMEs. The key ingredients for the success of this initiative are the collaboration between the public and private sectors with a strong focus on key objectives and outcomes. In today's economic environment where government funding is becoming scarce, more of such collaborations need to be promoted. Thus having e-commerce market leaders, such as Lazada Malaysia to help SMEs continue their online growth will greatly assist realizing the Government's aim of doubling the e-commerce growth from 10.8% to 20.8% by 2020.

## Industry 4.0 Adoption Among Malaysian SMEs

Malaysian SMEs are moving from an exploratory stage facing many challenges to an embracing stage when it comes to Industry 4.0 technologies.

### Malaysia's Readiness for Industry 4.0

The Federation of Malaysian Manufacturers (FMM) notes that small businesses are still finding their way around technologies that are suitable to their needs. "The readiness of the Malaysian manufacturing sector in adopting Industry 4.0 depends on various factors including the nature of business, their products and services and business model. Most multinationals and the larger companies may already be implementing Industry 4.0. But many SMEs could still be at the exploratory stage of understanding and identifying the Industry 4.0 technologies most relevant to their operations." [8]. FMM further highlights that while most companies are aware of the need to embrace Industry 4.0, only a small

percentage of them have actually installed such technologies. In the 2H2017 FMM-MIER Business Conditions Survey, which looks at the status of adoption and awareness of FMM members toward the nine pillars of Industry 4.0 technologies - IIoT, cloud computing, simulation, additive manufacturing, big data, cybersecurity, vertical and horizontal system integration, augmented reality, and autonomous robots - the top three technologies which are already in use by SMEs are cybersecurity (35%), cloud computing (27%), IIoT (24%), and autonomous robots (7.4%). About 19.3% intend to use robots in their production. From the findings, it shows that Industry 4.0 technology adoption is low. According to the 3Q 2017 SME Survey conducted by the SME Corporation Malaysia, there are insufficient knowledge and skills of employees on Industry 4.0 in SMEs with a percentage of 62%. This is reiterated by a study by McKinsey (2018) that states there are low optimism level among suppliers and manufacturers in SMEs with a percentage of 38%. Hence, SMEs need to embrace Industry 4.0 to stay competitive amid the rising cost of doing business.

### Challenges of Industry 4.0 for SMEs

SMEs in Malaysia - as in many other countries - face the challenge of competency development, cybersecurity, and data protection as well as access to funding and capital.

#### Competency Development

The awareness for ICT application is still lacking among employees. To address this issue the knowledge in ICT application among SMEs' employees need to be strengthened and enhanced, in order to embrace the Industry 4.0 challenges. They need to have intensive training to improve their skills which relate to current demand. According to the New Straits Times [9], work will be on-demand and the nature of work will mostly be project-based, replacing regular employment. Globally, the developed countries are already investing in R&D technologies breaking new grounds in production, service delivery, healthcare, education, and others [10]. Most of the developed countries have their own initiatives and programs with focused areas to embrace Industry 4.0. For example, the USA have the Industrial Internet (Consortium) and Smart Manufacturing Industry 4.0 platforms [10].

Industry 4.0 is fundamentally reforming the job landscape and will foster significant changes in how industrial worker perform their jobs. Entirely new jobs with very different skill requirements will be created, while others, especially manual tasks, will become obsolete. The shifting employment landscape has significant implications for industry, education systems, and the government.

A qualified and skilled workforce is indispensable for the introduction and adoption of Industry 4.0. The technical knowledge required is high and will be primarily recruited from the STEM (science, technology, engineering, mathematics) subjects. However, enrollment for the STEM program has reduced significantly over the years.

The Eleventh Malaysia Plan puts special emphasis on TVET and lifelong learning. It estimates the demand for skilled labor will require expanding TVET intake from 164,000 in 2013 to 225,000 in 2020. Quality needs to commensurate, and the plan proposes collaborating with industry in curriculum design and job placement. Tying TVET to digital entrepreneurship, which is viewed favorably by the public, could help rebrand it as a favorable option [11].

There is an urgent need to create a skilled and diverse workforce, with high salary, by up-skilling the existing labor pool and developing future talent in the manufacturing sector. One of the initiatives of up-skilling is the collaboration between USAINS Malaysia and American Malaysian Chamber of Commerce (AMCHAM) in nurturing talent development for the SMEs. Apart from this, Inari Amertron Berhad also offers services to upskill employees for SMEs as human capital is a key element in driving impact for productivity.

In Malaysia, the Penang Skills Development Centre (PSDC) was established to spearhead industry skills training and serves as an education center for SMEs. To date, the center has trained over 200,000 participants through more than 10,000 courses related to human capital development and contributed directly to the Malaysian workforce transformation initiatives. Moving forward, the PSDC has expanded its role and become the CoE for Industry 4.0 in Penang. Besides PSDC, the Collaborative Research in Engineering, Science & Technology (CREST) is also appointed as a CoE for SMEs talent development guided by three working pillars - R&D, talent development, and commercialization. MPC assumes an important role in training and upskilling the SMEs workforce and nurturing the SMEs companies to enhance their productivity through the implementation of projects related to process improvements, such as Lean Manufacturing and Kaizen activities.

### Cybersecurity and Data Protection

The most challenging aspect of implementing Industry 4.0 techniques is the IT security risk. Cyber threats continue to multiply, and data breaches are growing in size and frequency. Therefore, further research in cybersecurity is crucial. Training and retraining of employees in the aspect of cybersecurity is a great importance to ensure the awareness of cybersecurity issues is fully understood.

Cybersecurity is an investment that must be considered to ensure the sustainability of technology, the well-being of people, and to govern the policy and process that reduce the exposure of technology to vulnerability. For Malaysia, the National Security Council would be responsible for monitoring and taking appropriate action regarding cybersecurity. Security Posture Assessment had become widely accepted as one of key elements to test a company's current defense mechanism, thus it is crucial for companies to have such test to ensure their current system is up to date. SMEs could encourage their staff for training at CyberSecurity Malaysia. Awareness training is provided for those who need basic information security understanding. Through its information, Security Professional Development, CyberSecurity Malaysia also provides a platform to nurture Information Security practitioners and promote knowledge sharing sessions with industry experts and academicians as well as fostering local and international collaborations [12].

CyberSecurity Malaysia found that 80% of SMEs have not invested in cybersecurity due to cost while others are not aware that they need to. For SMEs, managing information is often seen as costly. They do not appreciate the benefits of proper and secure information management and how this can assist to generate further revenue for their companies [13].

### Access to Capital

The transformation of SMEs requires a huge investment especially in integrating new system and technology. SMEs need to be stimulated by strong government financial assistance to finance infrastructure, technology acquisition, digitization, and start-ups.

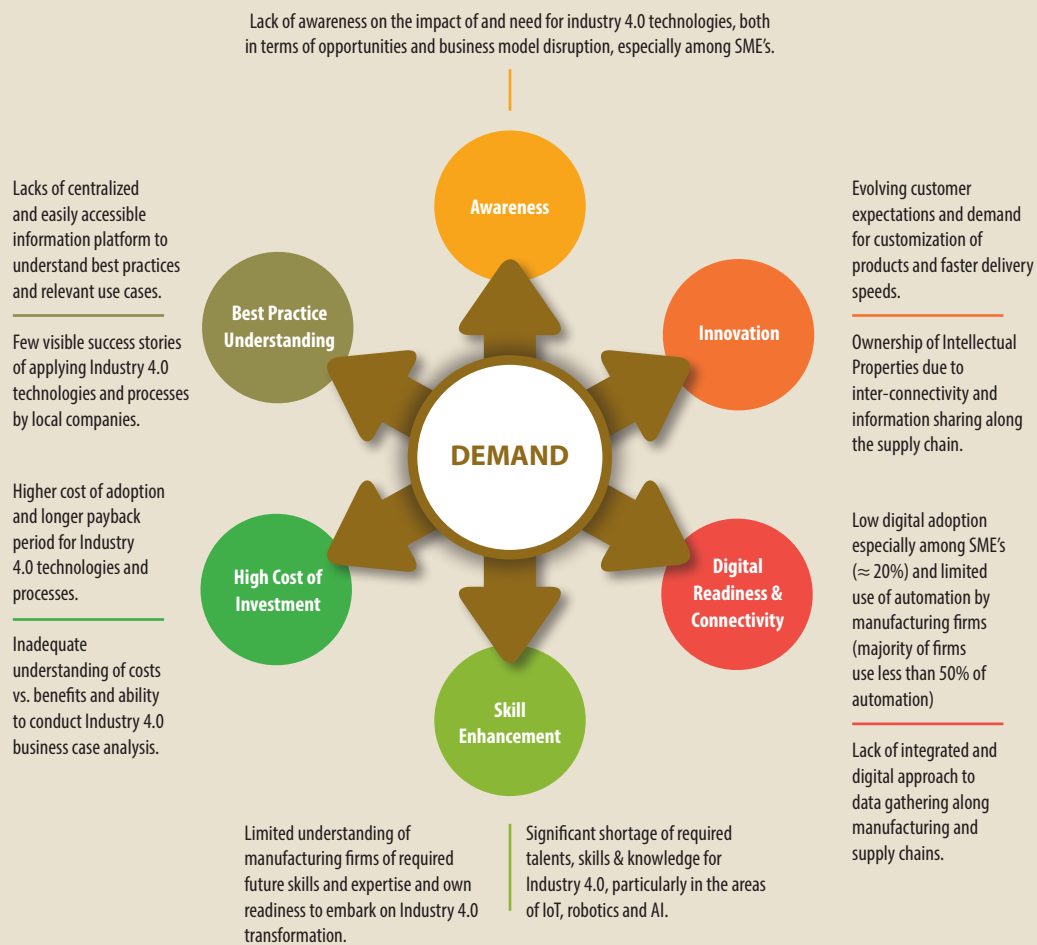
Industry 4.0 requires existing installations to be adapted and, in some cases, it may require an entirely new set-up of the IT infrastructure. The development and introduction of Industry 4.0 technologies may require substantial investment. The cost implication is, however, a key factor for all SMEs, when making the decision as to whether to improve the existing IT infrastructure or to design and develop new systems. These costs may present barriers for SMEs, especially micro and small firms, to embrace Industry 4.0. However, these huge investments will eventually yield big impacts. As in the long run, SMEs will experience cost efficiency when Industry 4.0 has been fully implemented.

### Addressing Malaysia's Issues and Challenges

According to MITI Draft Policy Framework, some of Malaysia's issues and challenges are shown in Figure 8.6.

FIGURE 8.6

## ADDRESSING MALAYSIA'S ISSUES AND CHALLENGES IN SUPPLY



**Source:** Ministry of International Trade and Industry (MITI) Draft Policy Framework 2018 (p. 30)

These challenges are addressed by different policies with clear focus on impact. They are summarized under “strategic enablers”.

### Strategic Enablers: Funding and Outcome-based Incentives

The development and adoption of Industry 4.0 technologies and processes may require substantial investments by manufacturing firms. The public funding strategies are aimed at encouraging companies to adopt new manufacturing technologies and processes and invest in R&D, specifically to develop local solutions targeted at Malaysia's needs and priorities. Special attention will be given to collaborative efforts in developing and deploying Industry 4.0 technologies. To ensure progress and impact, the incentives will be linked to specific outcomes. These strategies are applicable to both manufacturing firms as the users and adopters and to service providers of Industry 4.0 technologies and solutions.

### Strategic Enablers: Infrastructure - Enabling Ecosystem and Efficient Digital Infrastructure

Fast and secure data connection is a basic requirement for the realization of Industry 4.0. A good



and reliable Internet speed rate is needed for implementing Internet-based production technologies or services, be it IoT solutions, use of augmented reality and wearables in production, or the evaluation of real-time data. Although Malaysia has deployed High Speed Broadband and 4G technologies on a wide-spread basis, there are still some gaps in key industrial and training locations. A digitalized and connected infrastructure across supply and manufacturing value chains is critical to foster a seamless movement of goods, data and services, drive efficiency and resource optimization, and support joint development efforts. Currently, a number of value chain elements are still not digitalized across many ministries and agencies, ranging from various approval, licensing, certification, to goods clearance and other processes. Service providers will play an essential role in helping Malaysian companies accelerate their transition to Industry 4.0, particularly in developing people, transforming processes and adopting technologies. As such, involving service providers and linking them to manufacturing firms, especially SMEs, is important to create a holistic and effective Industry 4.0 ecosystem.

### **Regulations - Regulatory Framework and Industry Adoption**

Regulation is a key enabler of Malaysia's Industry 4.0 transformation. Special emphasis will need to be on increasing the awareness of the need and benefits of adopting Industry 4.0 technologies and processes. This is particularly important for SMEs who still have a limited understanding of digital and Industry 4.0 and often are concerned about the cost and level of change required. To foster an accelerated transformation, mechanisms will need to be put in place to help manufacturing firms understand their current capabilities and upgrade processes and skills.

Data integrity, security, and analysis are another important area of focus to ensure seamless data flow across value chains. This will also help the government understand priority issues across initiatives, ministries, and agencies and, consequently, can chart effective programs and regulatory support. The Communications and Multimedia Act 1998 which came into effect on 1 April 1999, provides a regulatory framework to cater for the convergence of the telecommunications, broadcasting, and computing industries with the objective of making Malaysia a major global center and hub for communications and multimedia information and content services whereas the National Cyber Security Policy ensures data integrity and security for SMEs.

### **Technologies - Access to Smart Technologies and Standards**

At present, the majority of Malaysian manufacturing firms surveyed adopt less than 50% automation. The experiences from other countries demonstrate the importance of digital/technology labs and collaborative platforms, especially public-private partnerships (PPP), in disseminating Industry 4.0 technologies and transferring knowledge. The government aims to work with global and local industry majors to set up digital and Industry 4.0 demonstration and collaboration labs. Technology adoption and diffusion are particularly important for SMEs to create production networks and collaborations with MNCs and large companies. Among the targeted SME group are industrial electronics and automation which deals with product testing, to ensure reliability of the products produced.

## **Conclusion and Way Forward to Secure and Further Leverage Malaysia's Advanced Digitization for Industry 4.0**

From the stakeholder interactions and issue analyses, five themes emerge to drive the development of an end-to-end Industry 4.0 ecosystem in Malaysia. They have also been guiding the development of the new Industry 4.0 policy framework and the four key Industry 4.0 goals of GDP contribution, national productivity, higher skilled employment, and innovation capabilities.

- **Upskilling and reskilling** existing and future labor pools need to be at the heart of Malaysia's transformation
- **Inclusive involvement of SMEs** is critical to power a holistic step up in labor productivity across the economy
- **Significant evolution in innovation** capabilities and collaboration platforms is essential to foster the development of and access to cost-effective technologies that address specific sector needs
- **Focused funding support** is needed to kickstart the adoption and complement private sector investments
- **Good digital infrastructure** is required to enable reliable and secure Industry 4.0 operations

Industry 4.0 is about companies integrating the big data horizontally and vertically. Industry 4.0 will change the entire manufacturing system, from the architecture and organizational structure to products, services and business models, customer and supplier. The development and deployment of these solutions will be incremental and part of a long-term trend, but the opportunity is already here today. In terms of productivity, an organization will need to invest into automation and adopt as well as embrace the digital platforms and big data to remain competitive. The support of the Malaysian government in introducing policies which supports the SMEs in riding the Industry 4.0 phenomenon will be a major catalyst in bringing SMEs closer toward the adoption of Industry 4.0. The government will need to raise the awareness among local SMEs of the importance of Industry 4.0 through frequent engagements in making the Industry 4.0 a reality.



## CHAPTER 9

# VIETNAM

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### **Executive Summary: Vision of Industry 4.0 Digitization Strategies for SMEs in Vietnam**

Industry 4.0 is being encouraged worldwide, which has a direct effect on the economy in Vietnam, including SMEs. This not only offers opportunities but also challenges for companies and industry sectors.

In 4.0 Industry Summit 2018, the Deputy Prime Minister concludes, "Not only connecting the device to the device, but also devices with humans and humans with humans. Each Vietnamese as well as Vietnam will not be left behind the 4.0 revolution" [1]. Companies as well as the national government of Vietnam agree on the need to transform into Industry 4.0. Therefore, the national government of Vietnam have set up a long-term plan: "The issue is how to prioritize, how to harmonize domestic production, small and medium-sized enterprises using world technology...leading firms needing cohesive support. Enterprise science and business start-up need to develop their own new products. With the policy of enterprise as the center, the government and the Prime Minister have adopted a major policy and action program to promote production in the technological revolution 4.0." [2].

Due to lack of technologies, SMEs in Vietnam in general are just end users. The primary use of technologies and products, such as cloud computing, mobile devices, location detection technologies, authentication, and fraud detection or smart sensors, were developed by more developed countries. However, with the wide range of Internet users (60% of population) as well as a very young population, Vietnam has the opportunity of experiencing exponential growth with model companies, such as Viettel, one of Vietnam's most popular and successful companies in cloud computing.

SMEs in Vietnam primarily focus on using Industry 4.0 technology in customer service/communication using apps on smartphones to connect with customers for introducing products or receiving feedback. However, SMEs in Vietnam are still scratching the surface - being the end user and utilizing the existing technologies that is just the first step in becoming fully adapted to the Industry 4.0 ecosystem.

### **Steps for Vietnam's SMEs in Adopting Industry 4.0 Technologies**

The experts for Vietnamese economic development are recommending the following steps:

- Application of IT as a starting platform 4.0 for business
  - Being the end user
  - Utilizing technologies which are being developed by the third party

- Application of automation, IoT depending on the budget of the SMEs
- Connecting SMEs together to create an ecosystem
  - Creating a circle of producers
  - Being the user
- Applying automation and using robot in manufacturing

## SMEs' Current Readiness for Industry 4.0 - Supported but Not Competitive

In a survey, half of SMEs (55%) evaluated that Industry 4.0 is the key success factor for the Industry 4.0 development. Some of them (23%) believe that this trend will affect the Vietnamese economy. Only a few think it has a minor impact (11%), or will have no effect at all (10%), or have no opinion on whether the Industry 4.0 will affect their businesses (6%) [3].

Overall, travel, local trading, IT, education, medical, and construction have the biggest opportunities while the others, such as energy, electricity, or engineering is struggling to adapt.

The benchmarking results from local firms on Digital Innovation Quotient will be presented to illustrate their current readiness for Industry 4.0.

### Overview on Local Firms' Involved in the International Benchmarking

The firms that have been included in the assessment with the IMP<sup>3</sup>rove Digital Innovation Quotient come from different industries and represent very different size classes, including companies with more than 250 employees (Based on the Decree of 39/2018/NĐ-CP of Vietnamese Government SMEs maximum number of employees in Vietnam is not over 300 employees [4] and their capital is not over VND100 billion, approximately EUR3.5 million [5]).

**TABLE 9.1**

### KEY SECTORS AND NUMBER OF COMPANIES SURVEYED

| Sectors  | Number of Companies |
|--|---------------------|
| 1. Administrative and support service activities                         | 1                   |
| 2. Construction  | 4                   |
| 3. Education   | 4                   |
| 4. Human health and social work activities                               | 1                   |
| 5. Information and communication   | 4                   |
| 6. Manufacturing and trading   | 1                   |
| 7. Manufacturing   | 4                   |
| 8. Mining and quarrying  | 1                   |
| 9. Other service activities  | 1                   |
| 10. Transportation and storage   | 1                   |
| 11. Wholesale and retail trade, repair of motor vehicles and motorcycles | 1                   |

SMEs did the survey based on the features in the DIQ including Digital Innovation Strategy, Digital Business Model, Digital Processes, Digital Ecosystem and Culture, and Enablers for Digital Innovation.

First, **Digital Innovation Strategy** reflects the capacity of SMEs' strategy for Digital Innovation as well as their ambition toward the 4.0 Development.

Second, their ability in utilizing customer interaction, data capturing and analytics, and so on which is described in **Digital Business Model**.

Third, SMEs' sales and marketing digital-based or process automation is the **Digital Processes**.

Fourth, **Digital Ecosystem and Culture** of SMEs are built from employees, external partners, and their encouragement for digital innovation.

Finally and important to note, the best reflection of the readiness for Industry 4.0 of Vietnamese SMEs (in my opinion) is the **Enabler for Digital Innovation** which looks into SME's ability of developing or organizing digital innovation. In the IMP<sup>3</sup>rove Digital Innovation Quotient, the following enablers for digital innovation are addressed:

- Development of digital capabilities in an organization
- Financial resources for digital innovation
- Specialized expertise in IT, digital risk and cybersecurity management, legal aspects of data privacy, intellectual properties for digital offerings, and tax regulations of e-commerce
- IT process efficiency
- IT resilience
- Cybersecurity awareness and measures
- Impact measurement of digital innovation

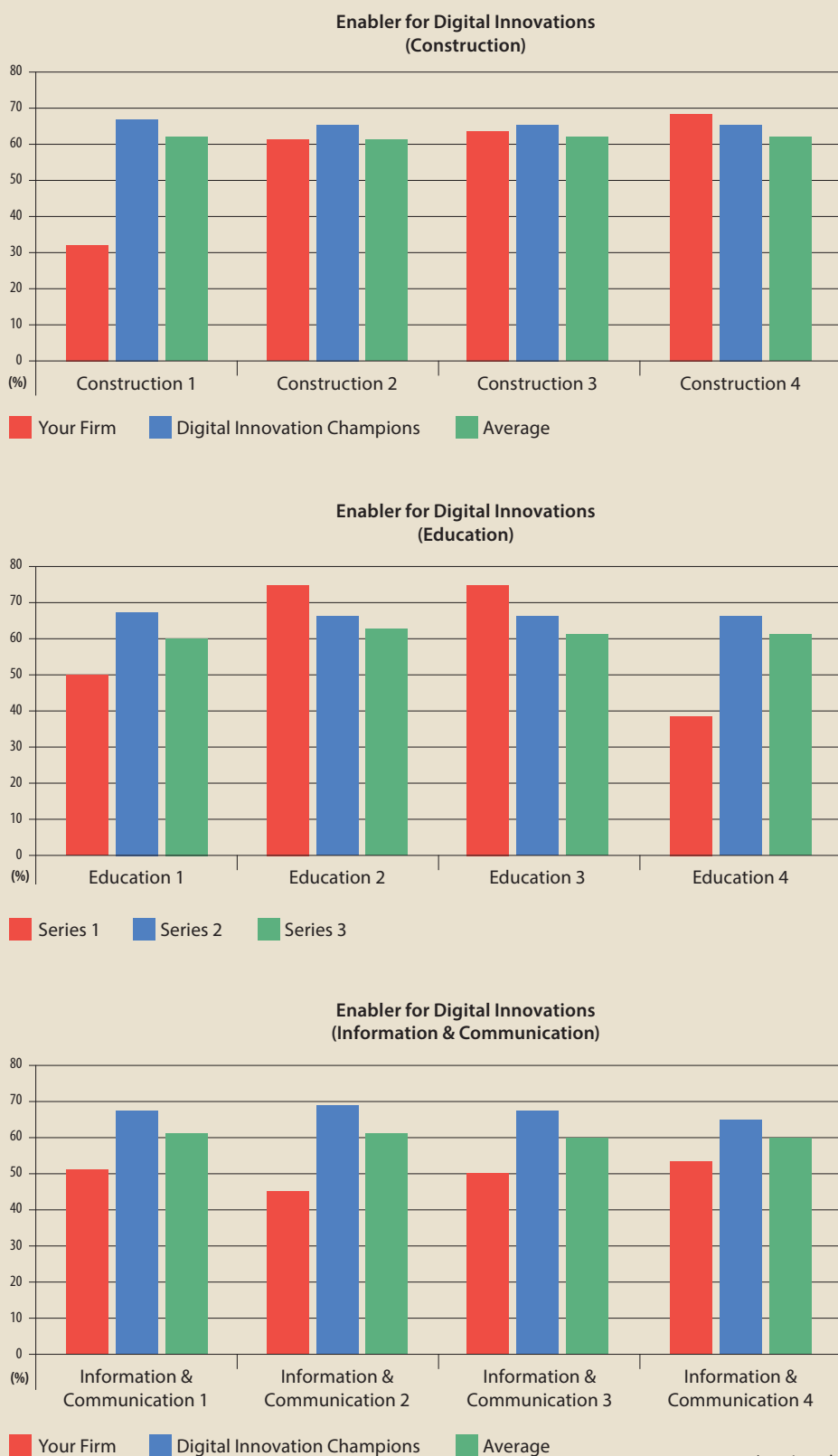
Choosing the enabler for Digital Innovations is not only one of the most important features of Innovation 4.0 in Vietnam but is also one of the strategic focus of Vietnamese government. With Vietnamese SMEs being the end user, the sector have always been ready to adapt to new technologies from developed countries. Therefore, enabler for Digital Innovations of SMEs describes most clearly the ability of Vietnamese SMEs in the era of Industry 4.0 Development. The benchmarking compares their company with the Digital Innovation Champions and the average in the selected benchmarking sample, based on the global IMP<sup>3</sup>rove DIO database.

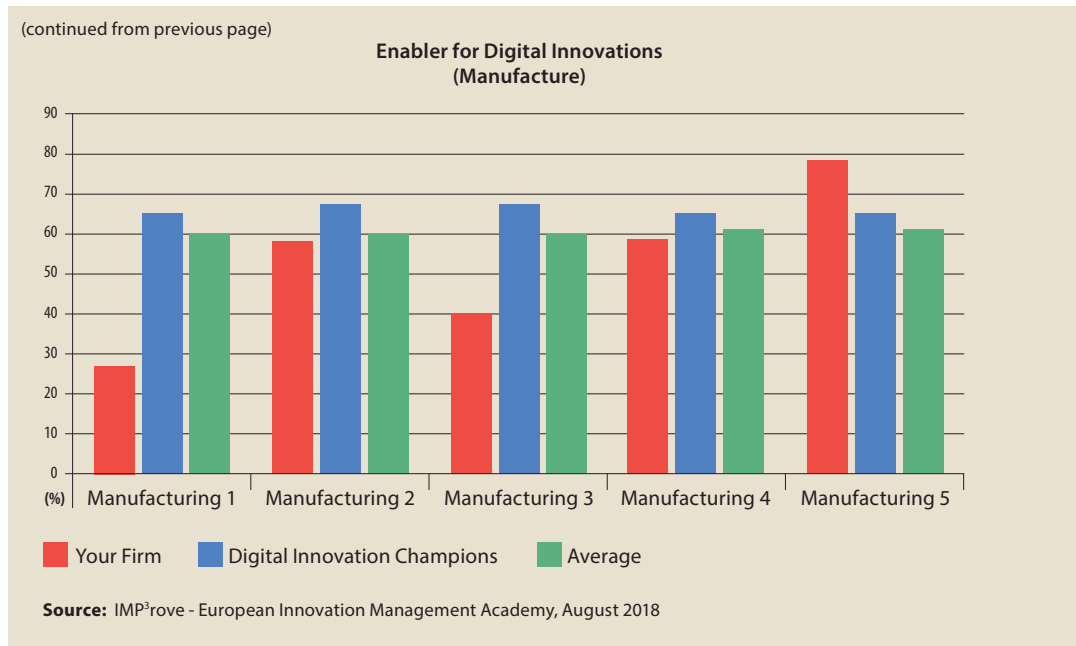
**Your firm:** The readiness of the surveyed SMEs in Enabler for Digital Innovation

**Digital Innovation Champions:** The highest readiness of the surveyed SMEs

**Average:** The average readiness of general SMEs attended the research

The scores in Figure 9.1 present the aggregated scores for the enablers for digital innovation for each of the companies within their industry.

**FIGURE 9.1****PERFORMANCE OF VIETNAMESE SMEs IN DIFFERENT INDUSTRIES MEASURED BY “ENABLERS FOR DIGITAL INNOVATION”**



In conclusion, based on the survey Figure 9.1, it is evident that the readiness of these SMEs is average in general. Therefore, these researched SMEs are aware of digitization needs and benefits.

### Major Challenges/Barriers and Needs of SMEs to become Industry 4.0 Ready

There are several challenges, barriers, and needs of Vietnamese SMEs to become Industry 4.0 ready. The following are a few, among others:

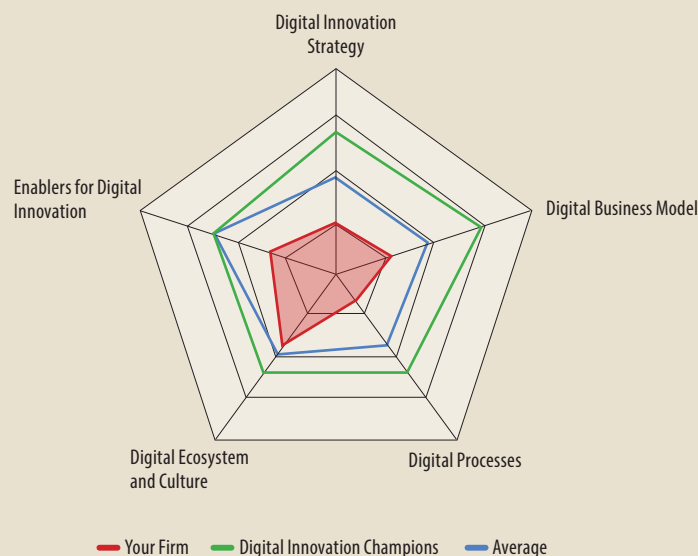
- The management of the company is not fully aware of the importance of Industry 4.0 in their business
- SMEs in Vietnam do not have the capability to develop their own solutions in Industry 4.0 technologies as theirs is rather simple and outdated. This creates dependency and at the same time, money consuming
- Access to financing Industry 4.0 technologies, such as automation is limited and difficult as the administrative procedure is time consuming

For example, an SME who is in manufacturing and trading company, specifically in water supply materials, is being challenged by their outdated technologies in manufacturing. With about 260 employees, about EUR2.5 million capital, and about EUR1 million turnover, this SME manufactures products as well as carry out trading.

Figure 9.2 is a five dimensions chart of an SME, where its biggest development is the Digital ecosystem and culture element. It is at almost the 'Average' of SMEs in Vietnam as their high-quality employees are provided good training. The firm also carries out selective recruitment and it is reflected in its ability to upgrade their customer service with technology. This company is continuously expanding their customer service, transporting methods, or trading using mobile devices and GPS.

FIGURE 9.2

### IMP<sup>3</sup>ROVE DIGITAL INNOVATION QUOTIENT - DIMENSION OVERVIEW FOR AN SME THAT MANUFACTURES WATER SUPPLY MATERIALS



Source: IMP<sup>3</sup>rove Digital Innovation Quotient 2018

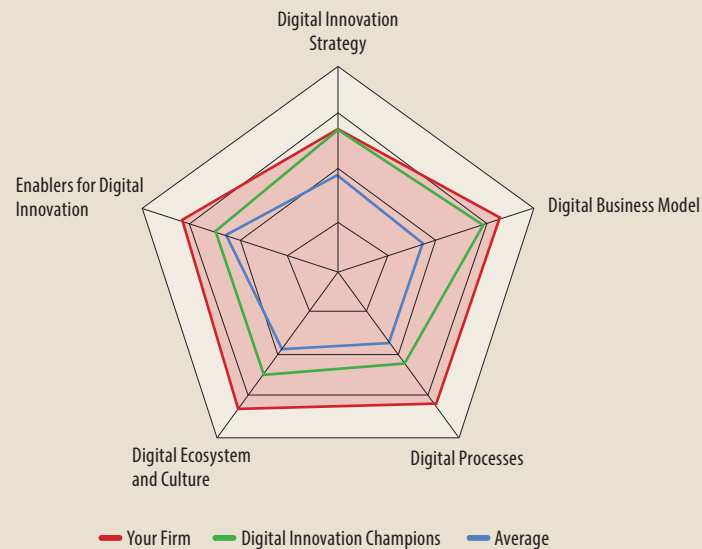
However, its Digital processes, Digital business model, and Enabler for digital innovation elements are relatively weak. It is because of its outdated technology in manufacturing. Without working or expanding these elements, its readiness for 4.0 development is not at the best stage. As the result, it is very hard for them to improve their sales as well as their manufacturing in general.

## Major Initiatives to Foster Digitization in SMEs

Despite the highlighted challenges, SMEs in Vietnam still have several big advantages, such as its young population, large Internet users (60%), and an open-minded society that creates an effective learning work force and an easy-to-access society.

Another sample SME is one that is involved in the Information and Communication sector. It is an Administrative and Support Service Company, which has about 70 employees, EUR600,000 capital, and EUR15 million turnover. The SME is very successful in transforming itself into a highly digitized company. With the wide range of its customers using the Internet, this company focuses on developing their online shopping services.

Figure 9.3 highlights an SME with a fully developed strategy in every element, making it a competitive company in the Industry 4.0 era. Its readiness is even higher than the digital innovation champions. They develop their website system to be quicker and more precise; they connect their agents everywhere that make their processes become faster and more satisfying for the customers. Their evaluation result is also very competitive. The SME's sharp focus on Information and Communication creates a huge advantage in its readiness for Industry 4.0 innovation because the current focus of Vietnam economic is developing IT.

**FIGURE 9.3****IMP<sup>3</sup>ROVE DIGITAL INNOVATION QUOTIENT - DIMENSION OVERVIEW OF AN SME THAT IS IN ADMINISTRATIVE AND SUPPORT SERVICES**

Source: IMP<sup>3</sup>rove Digital Innovation Quotient 2018

## Strategies to Increase the SMEs' Competitiveness

Vietnamese SMEs need to have rounded strategies to overcome the current challenges that include increasing the awareness on the importance of Industry 4.0, access to technologies, and challenges of financing.

### i) Strategies to Increase the Awareness on the Importance of Industry 4.0

The public sector is making major efforts to highlight the importance of Industry 4.0. This includes the government as well as academia to develop the SMEs' Industry 4.0 capabilities and competitiveness.

#### Government Initiatives to Mobilize Vietnamese SMEs

The Vietnamese government continuously organizes workshops and exhibitions to raise the awareness of SMEs' leader about the importance of Industry 4.0 in the future. Some prominent examples are, among others:

- CEO Forum: Industrial Revolution 4.0 - Gain & Lose  
4 July 2017 - Approximately attended by 500 Companies
- I4.0 Summit and Expo 2018  
12–13 July 2018 - Approximately attended by 1,500 visitors

The exhibitions showed new technological experiences with smart manufacturing applications and leading tech products in the fields of smart factory, automation, 3D printing, AI and robotics,

smart sensors, big data, blockchain, network security, IIoT, e-KYC, cloud computing, mobile device software, authentication, and customer experience solutions.

#### Initiatives by Training Providers to Provide Training for SMEs

The FPT School of Business has introduced courses that focuses on training as way to prepare SMEs for the Industry 4.0 ecosystem. The ecosystem here refers to a wide range of interconnected devices and services spanning from hardware to software. The ability to synchronize easily brings many benefits to customers in both entertainment and work, completely changing the experience that is common in everyday life.

#### Expected Impact of the Initiatives

There are two major areas in which impact is expected:

- Development of Industry 4.0 capabilities
- Increasing competitiveness of SMEs

### ii) Strategies to Provide Access to Technologies

FPT is not only an IT company but also an education company that brings in the latest technologies to high schools as well as university students (FPT high school and FPT University). With the introduction of the newest technologies, a new young workforce with the capability of adopting and developing new technologies will be the competitive factor of SMEs.

FPT University planned to introduce a new major in Artificial Intelligence as well as further develop the current major studies, such as IT, Computer Science, and Information Security.

FPT High School have a mini course for its pupils, such as IT or Robotics to introduce the technologies and provide orientation for future careers. FPT university students do get job offers from FPT Company.

#### Expected Impact from Providing Access to Technologies

Similar to the initiative of creating awareness, training and access to technologies are aimed at developing Industry 4.0 capabilities as well as enhancing the SMEs' competitiveness. At the same time, there is an expected impact on enhanced economic development resulting from job creation, reduction of youth unemployment, and the development of new value chains and/or more global value chains.

### iii) Strategies to Address the Challenge of Financing

The overall objective is to reform the administrative procedures. The State Bank of Vietnam has implemented regular and continuous solutions to strictly control the issuance of administrative procedures.

- The entire process of handling administrative procedures at the State Bank of Vietnam is managed and implemented uniformly according to ISO standards and the one-stop shop mechanism - from receiving documents to returning results.
- Only in 2016 and 2017, the State Bank of Vietnam has reviewed, simplified, and abolished 22 administrative procedures, promulgated amendments to 48 administrative procedures, cut more than 20% of the cost of compliance with administrative procedures.



### Expected Impact from Streamlining Administrative Procedures for Access to Funding

The reform of administrative procedures initiated by the State Bank of Vietnam will help to develop the Industry 4.0 capabilities, especially digitization. Further, it will raise its FDI. The system of credit institutions has actively reviewed, cut down, and abolished many administrative procedures to facilitate enterprises' access to loans and use of services. In addition to the tasks under management, the State Bank of Vietnam has set specific objectives and tasks for the system of credit institutions to simplify loan procedures and cut down interest rates and service fees to directly support businesses.

## Developing the Industry 4.0 Ecosystem(s)

Unfortunately, Vietnamese SMEs are just being introduced to the concept of Industry 4.0 Ecosystem, making them unprepared and devoid of strategic plans for developing an Industry 4.0 ecosystem. To develop the Industry 4.0 ecosystem, Vietnamese SMEs must first have the capabilities to adopt and develop the necessary technologies to become Industry 4.0 ready. This has to start with education. Education should be the way of training, not only for the young workforce but also the current workforce and the management of the company.

For the best development of the Industry 4.0 ecosystem, the Vietnam government recommend four steps that are most suited to Vietnamese SMEs:

Step 1: Application of IT as a starting platform Industry 4.0 for business

- Being the end user
- Utilizing technologies which are developed by third parties.

Step 2: Application automation, IoT depending on the budget of the SMEs

Step 3: Connecting SMEs together to create an ecosystem

Step 4: Applying automation and using robots in manufacturing

SMEs in Vietnam are mostly in Step 1 or Step 2; therefore, it is not the right time to build an Industry 4.0 ecosystem without suitable technology.

These four steps are just the basis for the SMEs to develop their Industry 4.0 readiness. The necessary step is to translate them into their own four steps. The advantage the country has is the high number of IT users. They are already familiar with the great benefits of various IT applications, particularly those improving the quality of life and business operations. On the other hand, the manufacturing-based SMEs need to focus on developing automation, which is the core of increasing productivity and value.

## **Estimated Impact from Developing Industry 4.0 Ecosystem(s) in the Future**

Overall, the impact from developing the Industry 4.0 ecosystem is manifold.

- The SMEs can increase their competitiveness and developed to become part of a community of connected SMEs
- Selected industries, such as travel, local trading, IT, education, medical, and construction will be the most developed sectors
- Education/skills development will give access to advanced technologies to even younger generation including children from 12–15 years old. It also provides higher quality courses for those working with automation and robots
- Social issues, such as illiteracy and crime rate will decrease in the long run with the development of Industry 4.0 in the country

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# ABBREVIATIONS

|                |   |
|----------------|---|
| <b>11MP</b>    | Eleventh Malaysia Plan                                      |
| <b>ACA</b>     | accelerated capital allowance                               |
| <b>AEA</b>     | automation equipment allowance                              |
| <b>AI</b>      | artificial intelligence                                     |
| <b>AMCHAM</b>  | American Malaysian Chamber of Commerce                      |
| <b>APEC</b>    | Asia-Pacific Economic Cooperation                           |
| <b>CAGR</b>    | compound annual growth rate                                 |
| <b>CEFC</b>    | Common Engineering Facility Centers                         |
| <b>CEO</b>     | chief executive officer                                     |
| <b>CoE</b>     | centre of excellence  |
| <b>CREST</b>   | Collaborative Research in Engineering, Science & Technology |
| <b>DIH</b>     | digital innovation hub                                      |
| <b>DIQ</b>     | IMP <sup>3</sup> rove Digital Innovation Quotient           |
| <b>DISF</b>    | Domestic Investment Strategic Fund                          |
| <b>DOSM</b>    | Department of Statistics Malaysia                           |
| <b>EBIT</b>    | earnings before interest and tax                            |
| <b>EFTPOS</b>  | Electronic Funds Transfer Point-of-Sale                     |
| <b>FDI</b>     | Foreign Direct Investment Index                             |
| <b>FTE</b>     | full-time equivalent  |
| <b>FMM</b>     | Federation of Malaysian Manufacturers                       |
| <b>GDP</b>     | Gross Domestic Product                                      |
| <b>GPS</b>     | Global Positioning System                                   |
| <b>GVC</b>     | global value chain  |
| <b>HLTF</b>    | High Level Taskforce  |
| <b>I4.0</b>    | Industry 4.0  |
| <b>ICT</b>     | information communication technology                        |
| <b>IIoT</b>    | industrial Internet of Things                               |
| <b>IMP3</b>    | Third Industrial Masterplan                                 |
| <b>IoT</b>     | Internet of Things  |
| <b>ISO</b>     | International Standardization Organization                  |
| <b>IT</b>      | information technology                                      |
| <b>KKMM</b>    | Ministry of Communications and Multimedia                   |
| <b>MATRADE</b> | Malaysia External Trade Development Corporation             |
| <b>MDEC</b>    | Malaysia Digital Economy Corporation                        |

|              |  |
|--------------|--|
| <b>MES</b>   | manufacturing execution system                         |
| <b>MHE</b>   | material handling and equipment                        |
| <b>MITI</b>  | Ministry of International Trade and Industry           |
| <b>MNC</b>   | multinational company                                  |
| <b>MOF</b>   | Ministry of Finance                                    |
| <b>MOHE</b>  | Ministry of Higher Education                           |
| <b>MOHR</b>  | Ministry of Human Resources                            |
| <b>MOSTI</b> | Ministry of Science, Technology and Innovation         |
| <b>MPB</b>   | Malaysia Productivity Blueprint                        |
| <b>n.a.</b>  | Not applicable   |
| <b>NPC</b>   | National Productivity Council                          |
| <b>OECD</b>  | Organisation for Economic Co-operation and Development |
| <b>OEM</b>   | original equipment manufacturer                        |
| <b>PhD</b>   | Doctor of Philosophy                                   |
| <b>PPP</b>   | public-private partnerships                            |
| <b>PSDC</b>  | Penang Skills Development Centre                       |
| <b>RFID</b>  | radio-frequency identification                         |
| <b>ROW</b>   | Rest of the World                                      |
| <b>SI</b>    | system integrator                                      |
| <b>SMEs</b>  | small and medium-sized enterprises                     |
| <b>STEM</b>  | science, technology, engineering, and mathematics      |
| <b>SMEX</b>  | Smart Manufacturing Exhibition                         |
| <b>WEF</b>   | World Economic Forum                                   |

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