International Labour Organization

ILO Working Paper 138

April / 2025

Responses of technical and vocational education and training institutions to the needs of industry's digital transformation in South-East Asia

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ISBN 9789220419113 (print), ISBN 9789220419120 (web PDF), ISBN 9789220419137 (epub), ISBN 9789220419144 (html). ISSN 2708-3438 (print), ISSN 2708-3446 (digital)

https://doi.org/10.54394/BJOX6123

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Authorization for publication: Akiko Sakamoto, Senior Skills and Employability Specialist

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Suggested citation:
Paryono, P., Mashod, H. 2025. *Responses of technical and vocational education and training institutions to the needs of industry's digital transformation in South-East Asia*, ILO Working Paper 138 (Geneva, ILO). https://doi.org/10.54394/BJOX6123

Abstract

This paper investigates the responses of technical and vocational education and training (TVET) institutions in South-East Asia to the demands of industry's digital transformation in the context of the Fourth Industrial Revolution (IR 4.0). TVET institutions play a crucial role in bridging the gap between education and industry by equipping students with the practical skills needed for the evolving workplace. Despite extensive discussions on this topic in various forums, there is a notable lack of comprehensive studies that evaluate the current adoption and readiness for IR 4.0 in TVET institutions across South-East Asia. Addressing this gap, this study develops a comprehensive framework — the Smart Education Readiness Index (SERI)—to assess the readiness of TVET institutions for IR 4.0. The framework draws from both industry readiness assessments and the specific criteria that are relevant to TVET institutions. This paper presents findings from data collected using the SERI framework across nine Association of Southeast Asian Nations member States: Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. The data collection involved surveys, interviews and focus group discussions with stakeholders from TVET institutions. The results reveal that on a scale from 0 to 4, the overall readiness index of TVET institutions in South-East Asia is 2.03, which indicates a level between "early adopter" and "learner". This readiness index is further broken down into three components: process (1.96), technology (1.92) and organization (2.21). These findings highlight the need for continuous improvement and greater alignment between TVET institutions and industry requirements. The study concludes with several key recommendations for enhancing the adoption of IR 4.0 in TVET institutions, including the continuous use of the SERI framework for self-assessment and monitoring; the development of action plans; and policy recommendations for ministries of education in ASEAN member States. This research contributes to a deeper understanding of the preparedness of TVET institutions for IR 4.0 and offers a structured approach to bridging the gap between education and the rapidly changing industrial landscape.

About the authors

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▶ Introduction

Technical and vocational education and training (TVET) institutions play a critical role in educating individuals for the Fourth Industrial Revolution (IR 4.0). The current period of digital transformation is characterized by developments in technologies including artificial intelligence, robots, big data and the internet of things, among others. The advancement of industries in countries in South-East Asia, as in countries in other regions, is primarily reliant on a competent workforce that can adapt to and use developing technology. Therefore, TVET institutions serve as a link between education and industry by providing students with the practical skills and competences required to thrive in today's changing workplace. Efforts to improve the status and efficacy of TVET institutions in South-East Asia are critical for developing a competent workforce capable of contributing to the advancement of industries in the context of IR 4.0.

TVET institutions, which serve as the anchor establishments for the job market, must adapt their methods of preparing graduates in order to ensure that they become qualified individuals capable of meeting the demands of IR 4.0. To remain relevant and competitive in the era of IR 4.0, TVET institutions must align their strategies and policies with the future requirements of the workforce. This will necessitate a shift towards preparing students for job positions in a globalized and knowledge-based society. In that way, these institutions can better equip their graduates with the skills and competencies needed to thrive in an increasingly digital and interconnected world.

Despite extensive discussions in various seminars and meetings at the national and regional levels in South-East Asia, there is a lack of comprehensive studies evaluating the current adoption of and readiness for IR 4.0 in the industry and TVET institutions. This paper seeks to address this gap by contributing to the assessment of TVET institutions' readiness for IR 4.0, while also establishing a connection to developments in the industry.

Several studies have attempted to assess the readiness of industry for IR 4.0 in Association of Southeast Asian Nations (ASEAN) member States and the impact of digitalization on employment. These studies adopted various frameworks and methodologies that could be valuable for this research to review and inspire the development of a framework to assess the readiness of TVET institutions for IR 4.0. Although there are several studies on the readiness of TVET institutions in the region, they mainly focus on the country level and assess only certain components or variables for IR 4.0 readiness, such as teacher readiness, curriculums or facilities. Nevertheless, the frameworks provided by these studies may serve as useful references for developing the proposed comprehensive framework.

The objective of this paper is to develop a comprehensive framework to assess the readiness of TVET institutions for IR 4.0 and to use this framework to examine the state of readiness of these institutions in South-East Asia to meet the digital transformation requirements of the industry. While the readiness of the industry for IR 4.0 is referenced, it is not the primary focus of this paper. Instead, it serves as a comparative backdrop for analysing the alignment between the realms of education and training and the evolving demands of the world of work. This comparative analysis aims to highlight potential gaps and synergies, thereby contributing to a more comprehensive understanding of the preparedness of TVET institutions in the context of IR 4.0.

▶ 1 Literature review

This section is divided into two parts: section 2.1 addresses the context that underscores the importance of this study, while section 2.2 examines the literature supporting the development of the proposed framework to assess the readiness of TVET institutions for IR 4.0. Section 2.1 reviews the significance of assessing the readiness of TVET institutions in the context of IR 4.0, highlighting the transformative impact of digitalization on the job market and the corresponding need for TVET institutions to evolve. Section 2.2 reviews existing literature and studies, exploring the various frameworks and methodologies that have been utilized to gauge the readiness of TVET institutions. This review will provide the foundation for developing a comprehensive framework to assess the preparedness of TVET institutions for IR 4.0.

1.1 Context

The sphere of TVET systems calls for skills responses to digital transformation, such as being relevant and globally competitive. This emphasizes the need to implement initiatives to support this transformation, including the development of digital learning platforms that can prepare learners for the demands of the digital economy. With the rapid development of IR 4.0, TVET systems are motivated to provide advanced capabilities and competitiveness for future work readiness in an effort to secure and maintain jobs in the global industrial market. Individuals are expected to possess readiness in terms of their knowledge, skills, attitudes and competences.

In 2015, the United Nations Sustainable Development Goals (SDGs) were adopted by the global community. Accordingly, the Southeast Asian Ministers of Education Organization (SEAMEO) is one of many educational organizations working to achieve SDG 4, commonly known as "Education 2030", which seeks to ensure better, more equitable and inclusive lifelong learning opportunities for all. The evolution of IR 4.0 has promoted digitalization and innovations such as artificial intelligence and robots, virtual reality, the internet of things, autonomous cars, 3D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing. The SEAMEO has recognized the technical advancements in the context of IR 4.0 and addressed the resulting digital gap at the fourth strategic dialogue for education ministers held in Kuala Lumpur in 2019.

The World Economic Forum's *Future of Jobs Report 2023* outlined ten indispensable skills for the future of work in the current decade and beyond, including the critical and vital skills needed for career entry and towards future career readiness, such as solving complex problems; thinking critically; thinking creatively; managing other people; coordinating with other people; having emotional intelligence; judgement and decision-making; orienting towards service; having the ability to negotiate; and possessing flexibility of intellect.

This highlights the importance of teaching new skills and adapting to the changing needs of society and the labour market. A report of the ASEAN TVET Council addressed the enhancement of skills development through TVET and lifelong learning as ways to survive within a competitive workforce. It is believed that the capacity of TVET can rapidly respond to changing labour market and has the potential to support employment opportunities, increase competency and productivity; improve the income of workers; promote enterprise competitiveness; heighten job security; and support green skills for green jobs.

Collaboration with the Ministry of Education of Thailand to convene the SEAMEO Congress 2021. This collaboration aimed to serve as a wisdom platform for educational stakeholders, at both the national and international levels, in order to reflect on how shared expertise can help enhance policymaking and support innovative teaching and learning paradigms to help students remain competitive while strengthening their values. There are three primary goals under the SEAMEO Congress 2021:

- to serve as a platform for conversations regarding innovations, breakthroughs and best practices in education, science, and culture to achieve SDG 4 by 2030;
- to examine the sustainable development, networking and strategic collaboration platforms used by educational stakeholders in South-East Asia and beyond in order to enhance the quality and relevance of learning and ensure wider access to education in the region; and
- to reach a consensus to concretize transformative educational programmes and action plans in order to develop a dynamic synergy of strengths, strategies and standards so that more inclusive and innovative learning paradigms and education policies can be implemented to meet global standards.

SEAMEO Strategic Plan 2021–2030. By 2030, SEAMEO hopes to accomplish this strategic plan, which sets out the strategic objectives and actions that the organization will take to further its excellence under four strategic themes:

(1) regional leadership and international and global visibility;

(2) programme excellence and relevance to the SDGs;

(3) strategic partnerships, stakeholder engagement, and networking; and

(4) digital transformation for rapid change.

Furthermore, by 2030 SEAMEO envisions a region full of highly skilled workers and lifelong learners who harness the power of technology such as artificial intelligence. Specifically, under strategic theme 4 on digital transformation for rapid change, the promotion of TVET falls under education priority agenda 4.

At the same time, a number of other programmes have been established by both the SEAMEO Regional Centre for Vocational and Technical Education and Training (SEAMEO VOCTECH) and the Regional Cooperation for the Development of Technical and Vocational Education and Training (RECOTVET) programme of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). These organizations recognize how critical it is to stay current with the demands of the continually evolving workplace in order to improve knowledge and skills related to digitalization and IR 4.0. This includes a number of topics covered in the "Learning Highlights" series, including digitalization and IR 4.0; energy efficiency dashboard; and steps in developing advanced occupational standards.

Indeed, the digitization of the skills/TVET sector has revolutionized the way that skills demands are identified, learning is delivered, assessments are conducted and digital skills are incorporated into training. Overall, the digitization of the skills/TVET sector has improved the identification of skills demands through data-driven approaches; facilitated online and blended learning for increased accessibility; streamlined assessment and management processes; and integrated

digital skills within training programmes. These efforts support the development of a future-ready workforce, promote lifelong learning and contribute to economic growth in the digital age.

1.2 Literature to support the development of the proposed framework to assess the readiness of TVET institutions for IR 4.0

Considering the limited number of frameworks to assess the readiness of TVET institutions for IR 4.0 and given the strong link between TVET institutions and industry, this section reviews and analyses the relevant frameworks for assessing the readiness of industry for IR 4.0, as well as relevant frameworks for assessing the readiness of educational institutions or education in general for IR 4.0. By synthesizing these perspectives, this section aims to inform the development of a comprehensive framework tailored to the unique context of TVET institutions in South-East Asia, thereby ensuring that they are well equipped to meet the demands of IR 4.0.

1.2.1 Theoretical frameworks adopted for assessing the readiness of industry for IR 4.0

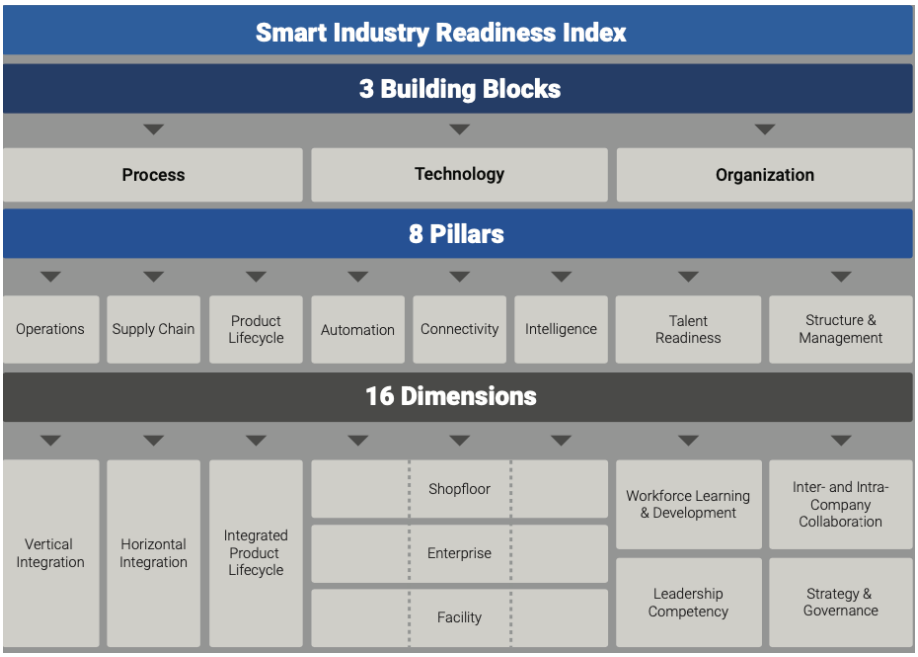
The following are the relevant references for assessing the readiness of industry for IR 4.0:

1. Singapore International Centre for Industrial Transformation. n.d. . The Smart Industry Readiness Index (SIRI) Framework". Available at: https://siri.incit.org/frameworks-tools/#
2. Malaysia, Ministry of International Trade and Industry. 2018. "Industry 4wrd Readiness Assessment: National Policy on Industry 4.0". Available at: https://www.miti.gov.my/miti/resources/National%20Policy%20on%20Industry%204.0/Industry4WRD_Final.pdf
3. Vora-Sittha, Pornpen, and Amirada Chinprateep. 2021. "Readiness of the ASEAN Community for the 4th Industrial Revolution". *Asian Social Science* 17(2): 31.
4. Anbumozhi, Venkatachalam, Krishnamurthy Ramanathan and Heinrich Wyes, eds. 2020. *Assessing the Readiness for Industry 4.0 and the Circular Economy.* Economic Research Institute for ASEAN and East Asia (ERIA).

Reference 1. SIRI framework

This is a self-diagnostic IR 4.0 tool that helps companies evaluate the current state of their factory or plant. It comprises the SIRI framework, the Learn, Evaluate, Architect, Deliver (LEAD) framework and the assessment matrix tool. The topmost layer of the framework is made up of the three fundamental building blocks of IR 4.0: process, technology and organization. Underpinning the building blocks are eight pillars, which represent critical aspects that companies must focus on to become future-ready organizations. The third and final layer comprises 16 dimensions that companies should refer to when evaluating the current maturity levels in response to digitalization (see figure 1).

▶ **Figure 1. SIRI framework**



The LEAD framework is a circular, continuous four-step process that all manufacturers can adopt in their approach towards IR 4.0 transformation. The four LEAD steps are:

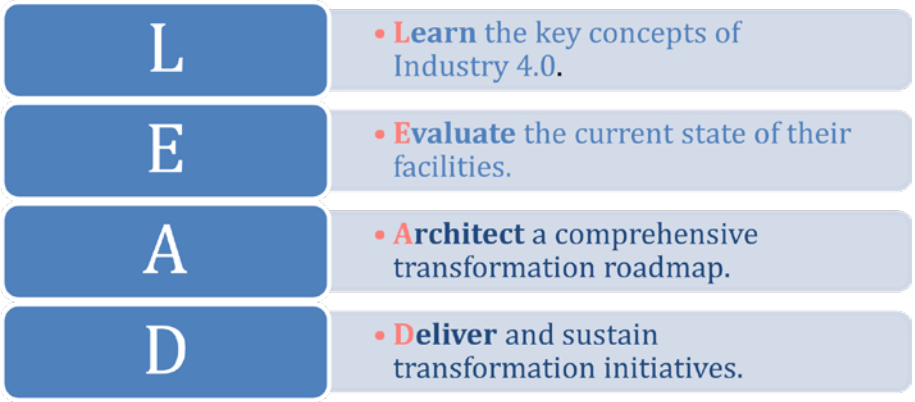
(1) **Learn** key concepts and build a common language for alignment;

(2) **Evaluate** the current industry maturity levels of existing infrastructures;

Architect a comprehensive transformation strategy and implementation road map; and

Deliver impact and sustain transformation initiatives (see figure 2).

▶ **Figure 2. LEAD framework**



The assessment matrix tool is designed to assess the 16 dimensions derived from the eight pillars. Each dimension is categorized into five or six levels or bands (level 0 = non-existence, level 1 = lowest integration/present, and level 4 or 5 = best integration/presence of IR 4.0 component). Examples of the assessment matrix are provided in tables 1 and 2.

▶ **Table 1: Assessment matrix for building block process**

Band		Definition	Description
0	Undefined		
1	Defined		
2	Digital		
3	Integrated		
4	Automated		
5	Intelligent		

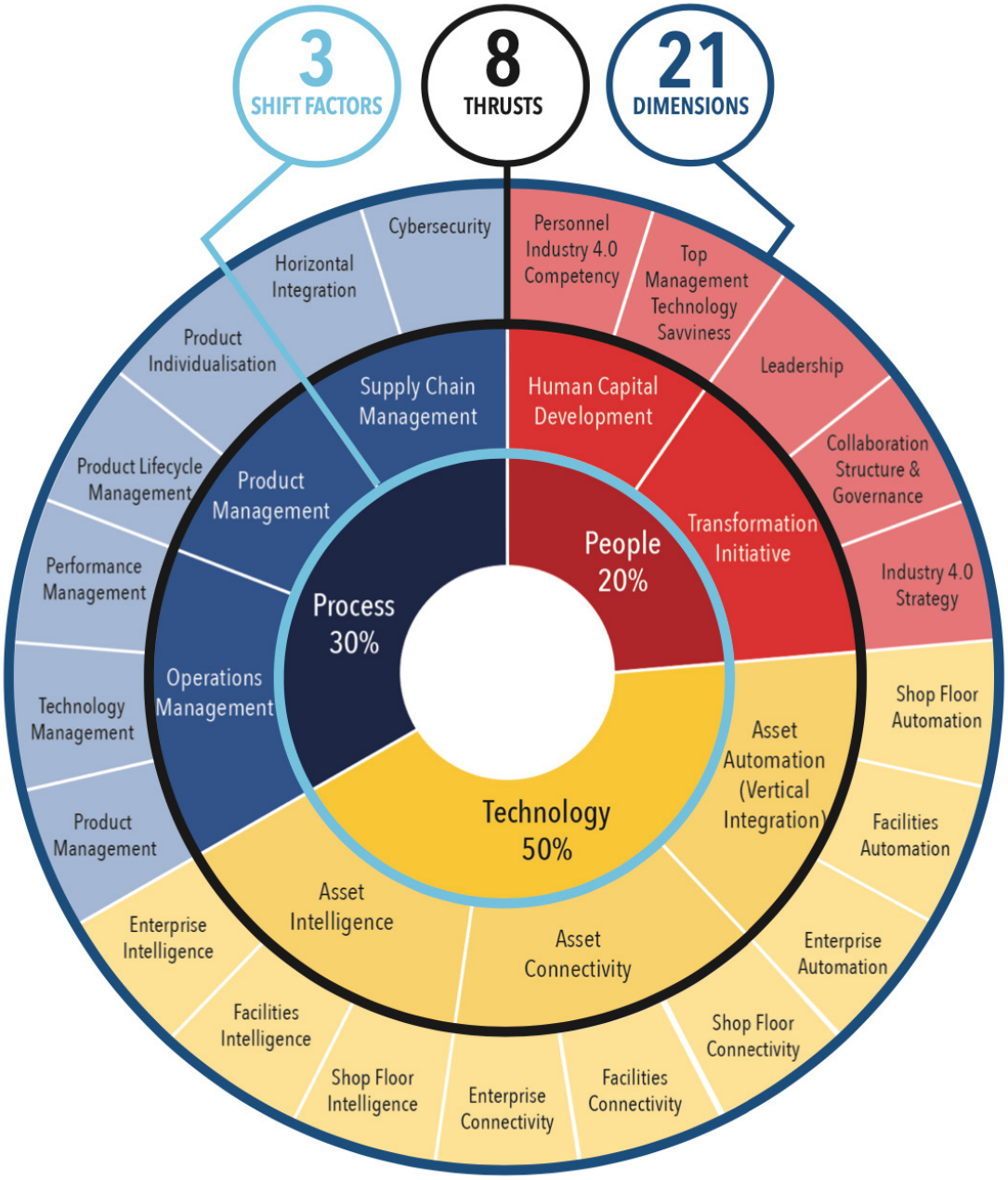
▶ **Table 2: Assessment matrix for organization of building block/structure and management pillar/intercompany and intracompany collaboration dimension**

Band		Definition	Description
0	Informal		
1	Communicating		
2	Cooperating		
3	Coordinating		
4	Collaborating		
5	Integrated		

Reference 2. Malaysia industry 4WRD

Like the SIRI framework, the Malaysia Industry 4WRD has three shift factors (building blocks in the Smart Education Readiness Index), eight thrusts (pillars in SIRI) and 21 dimensions (see figure 3).

▶ **Figure 3. Malaysia Industry 4WRD**

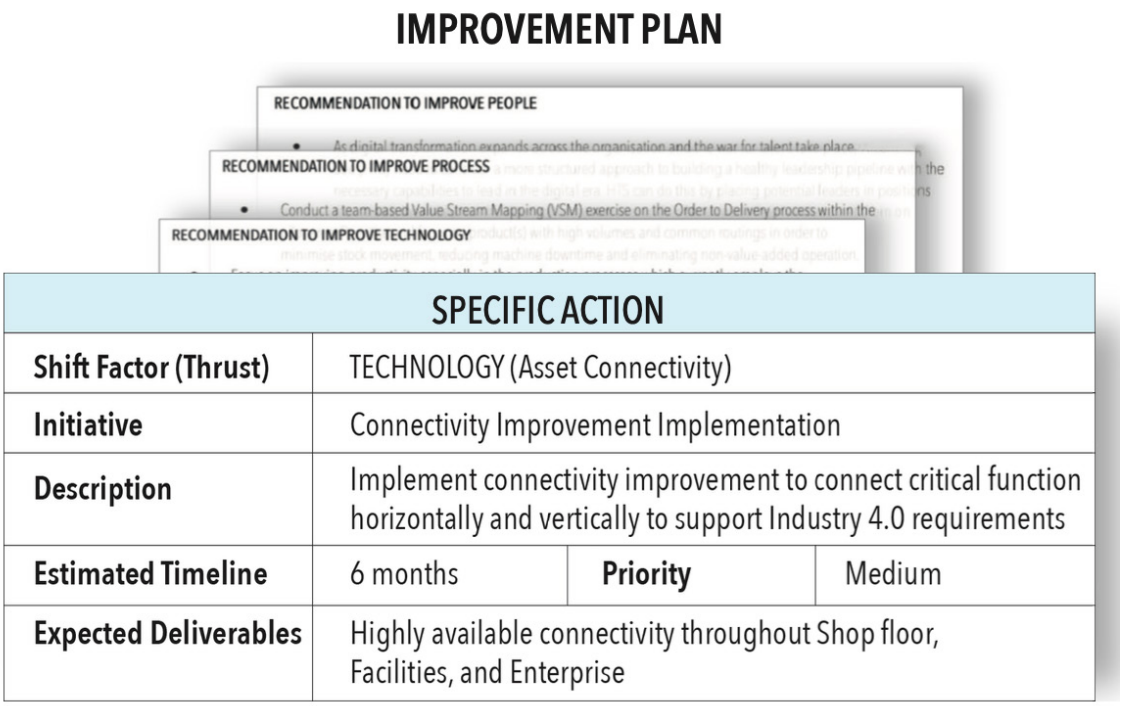


This framework is also accompanied by a scoring tool (table 3) and an improvement plan (figure 4).

▶ **Table 3. Readiness profile and scoring system**

READINESS PROFILE	PERCENTAGE SCORED	GENERAL DESCRIPTION
Conventional	0 % to 20 %	Operation remains "as is" with no intention or initiative to move into Industry 4.0 adoption.
Newcomer	21 % to 40 %	Has interest to pursue Industry 4.0 but with none or very minimal efforts or initiatives.
Learner	41 % to 60 %	Has interest to pursue pilot line Industry 4.0 adoption in operation, with existence of planning and strategies, efforts or simple and patches of initiatives being implemented. Ready for some system adoption.
Experienced	61 % to 90 %	Has pursued small to medium scale Industry 4.0 adoption initiatives in operation, horizontal integration and ready for large scale system adoption.
Leader	91 % to 100 %	Has implemented large scale Industry 4.0 adoption initiatives (company-wide) and system integration.

▶ **Figure 4. Improvement plan**



Reference 3. Readiness of the ASEAN community for IR 4.0

This study used strengths/weaknesses/opportunities/threats (SWOT) analysis and a threats/opportunities/weaknesses/ strengths (TOWS) matrix analysis. SWOT analysis was used to identify the internal and external factors – favourable or unfavourable – for ASEAN to cope with the IR 4.0. The SWOT matrix analysed the strengths within ASEAN countries, the weaknesses within ASEAN countries, the existing opportunities from external sources for ASEAN countries and the threats/obstacles that ASEAN countries face from external sources. The purpose of a TOWS matrix is to facilitate the integration of data from the SWOT matrix, enabling the identification of strategic alternatives that align external circumstances with internal factors. There are four categories of strategy derived from a TOWS matrix:

1. strengths and opportunities (SO), which are strategies that use strength to take advantage of an opportunity from outside;
2. weaknesses and threats (WT), which are strategies that try to minimize weaknesses and avoid threats;
3. strengths and threats (ST), which are strategies that maximize a strength to minimize a threat; and
4. weaknesses and opportunities (WO), which are strategies that use an opportunity to overcome a weakness.

▶ **Figure 5. Converting from SWOT to TOWS matrix**

STRENGTHS	WEAKNESSES
OPPORTUNITIES	THREATS

EXTERNAL ENVIRONMENT	INTERNAL ENVIRONMENT	
	STRENGTHS	WEAKNESSES
OPPORTUNITIES	SO	WO
THREATS	ST	WT

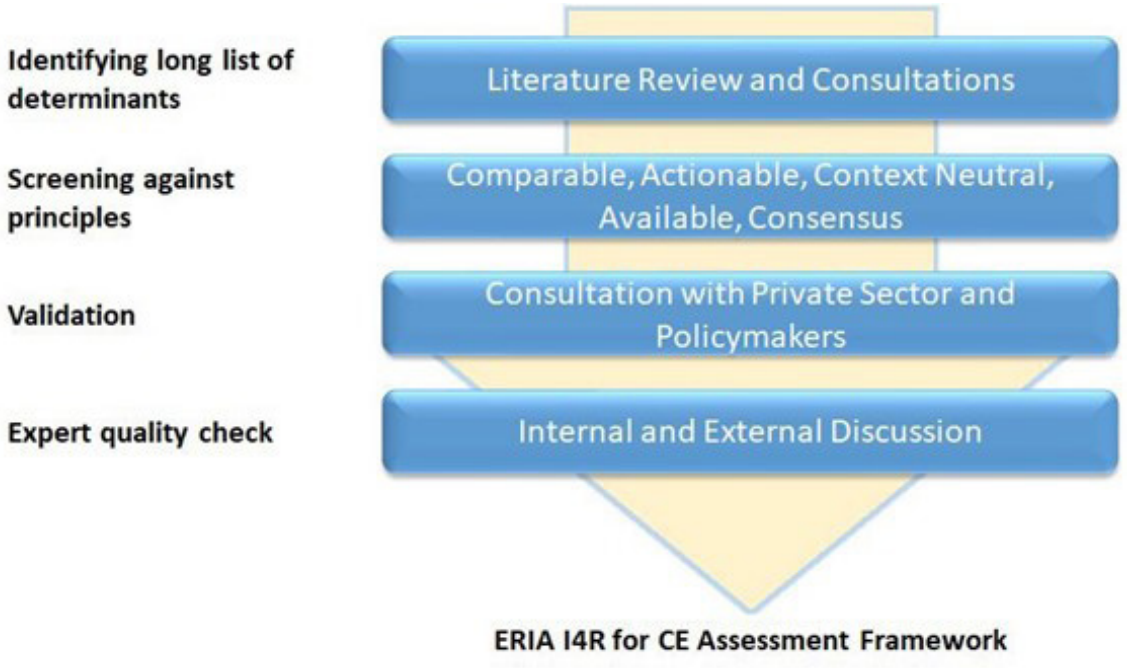
Reference 4. Assessing readiness for IR 4.0 and the circular economy

Reference # 4 describes various assessment frameworks of differing magnitude for embracing the two concepts of readiness for IR 4.0 and the circular economy in the context of the fast-growing emerging economies of ASEAN. This reference shows quantitative and multilevel self-assessment frameworks that provide governments and businesses with action-oriented information on the two concepts. The ERIA self – assessment tool for IR 4.0 and the circular economy has been refined through a validation process that can be used by countries and industries. The following tables and figures show the process of developing the assessment tools for IR 4.0 and the circular economy.

▶ **Table 4. Organization of ERIA IR 4.0 assessment tool for circular economy framework**

	Production efficiency	*Policies and regulations*	*Cross-cutting*
IR 4.0	Readiness to implement key procedural decisions	Planning incentives, mandates and policies to directly support IR 4.0 preparedness	Sector/economy-wide innovation and institutional procedures that affect preparedness
Circular economy			

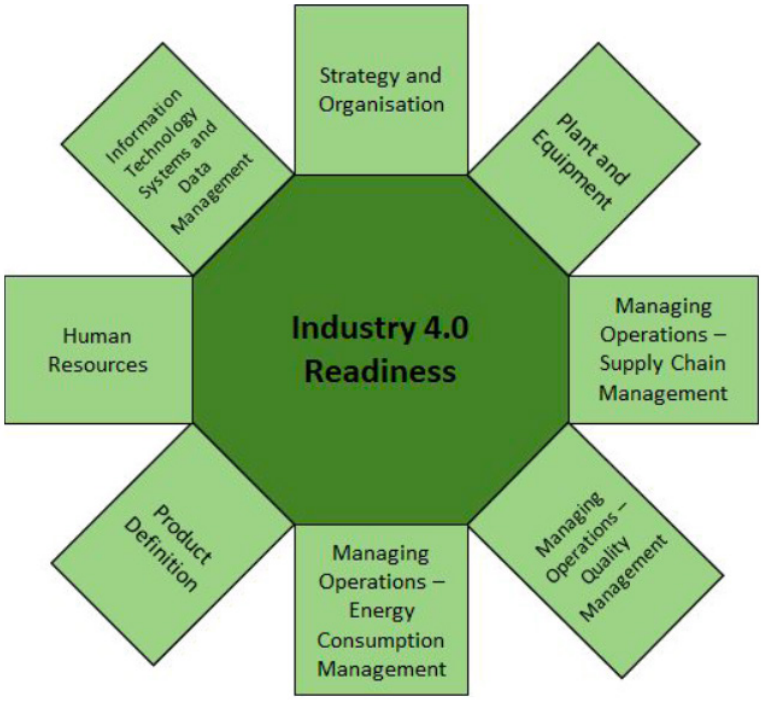
▶ **Figure 6. Methodology of ERIA IR 4.0 assessment for the circular economy**



▶ Table 5: Summary of core dimensions and subdimensions of selected IR 4.0 readiness assessment frameworks

IMPULS–Industrie 4.0 Readiness Framework (2015)	WMG–University of Warwick Industry 4.0 Readiness Assessment Tool (2017)	Yanez Maturity Index Framework (2018)	Akdil, Ustungdag, and Cevikcan Maturity and Readiness Model for Industry 4.0 (2018)
Strategy and Organisation • Strategy • Investments • Innovation management Smart Factory • Digital modelling • Equipment infrastructure • Data usage • Information technology (IT) Systems Smart Operations • Cloud usage • IT security • Autonomous processes • Information sharing Smart Products • Data analytics in the usage phase • Add-on functionalities Data-driven Services • Share of data used • Share of revenues • Data-driven services Employees • Staff acquisition • Employee skill set	Strategy and Organisation • Degree of strategy implementation • Measurement • Investments • People capabilities • Collaboration • Leadership • Finance Manufacturing and Operations • Automation • Machine and operations system integration • Equipment readiness for I4 • Autonomously guided workpieces • Self-optimising processes • Digital modelling • Operations data collection • Operations data usage • Cloud solution usage • IT and data security Supply Chain • Inventory control using real-time data management • Supply chain integration • Supply chain visibility • Supply chain flexibility • Lead times	Operational Processes • Sensoring, monitoring, and control • Intelligent processes • Virtualisation Industrial Assets • Flexible manufacturing and modular systems • Access and remote control • Predictive maintenance Energy • Monitoring and control • Smart consumer • Efficient energy systems People • Digital training • Interfaces • Human-cyber-physical Systems Internal Logistics and Supply Chain • Warehouse management • Internal logistics • Manufacturing supply Quality • Unitary quality control • Digital quality management • Full traceability in value chain	Smart Products and Services • Real-time data management • Interoperability • Decentralised • Service oriented Smart Business Processes: Production, Logistics, and Procurement • Real-time data management • Virtualisation • Decentralised • Agility • Integrated business process Smart Business Processes: R&D and Product Development • Real-time data management • Virtualisation • Agility Smart Business Processes: After-sales Service • Real-time data management • Virtualisation • Agility • Service oriented Smart Business Processes: Human Resources • Real-time data management • Agility

▶ Figure 7. Schematic representation of the determinants of IR 4.0 readiness



▶ **Table 6: Summary of IR 4.0 readiness and circular economy matrix**

Industry 4.0 Readiness Status		Status of CE Focus in I4R			
		Business as Usual (0–14)	CE Beginners (15–28)	CE Fast Adopters (29–42)	CE Leaders (43–56)
	Expert/ Frontrunner (100-133)	Unlikely			I4 and CE Champion
	Experienced (67-99)	Unlikely			
	Potentialists (34–66)	Unlikely			
	Hesitators (0-33)	I4 and CE Novice	Unlikely	Unlikely	Unlikely

CE = circular economy, I4 = Industry 4.0, I4R = Industry 4.0 readiness.

Notes:

The status of Industry 4.0 Readiness:

- 0 – 33 : Hesitators
- 34 – 66 : Potentialists
- 67 – 99 : Experienced
- 100 – 132 : Experts of Frontrunners

The status of Circular Economy (CE) focus on Industry 4.0 Readiness:

- 0 – 14 : Business as Usual
- 15 – 28 : CE Beginners
- 29 – 42 : CE Fast Adopters
- 43 – 56 : CE Leaders

1.2.2 Major findings from the literature reviews on the readiness of industry for IR 4.0 and related initiatives under way in industry in South-East Asia

Most of the assessment frameworks cited here are designed as self-assessment tools to examine the status and level of readiness for IR 4.0 integration. These tools enable countries or industries to develop road maps or plans for future direction and to enhance their level of readiness. The primary purpose of these tools is not to create an index for comparing the status of IR 4.0 readiness but rather to foster a culture of continuous improvement. Through self-assessment, organizations can identify strengths and weaknesses in their current systems, allowing them to strategically plan and implement necessary changes to align with IR 4.0 requirements. This approach promotes an ongoing process of evaluation and enhancement, ensuring that both industry and educational institutions remain agile and responsive to the evolving demands of the digital age.

General findings

Global SIRI

The Global Smart Industry Readiness Index *Initiative: Manufacturing Transformation Insights Report 2022* draws on data from manufacturers across 30 countries to provide: (a) new insights on the current state of industrial transformation across multiple manufacturing sectors; and (b) real-world case studies on how different manufacturing stakeholders are leveraging the SIRI programme to accelerate their digital transformation journeys (WEF 2022).

At the 10th ADB International Skills Forum, it was noted that the worldwide IR 4.0 readiness index for industry using the SIRI is 1.55 (Klein 2023). The average SIRI rating shows that globally, companies are moving from defining their transformation into the first stages of digital maturity. The aggregated result is that at the world level (12 industry clusters and 59 industry subsegments), the five bands of SIRI are (0) undefined, (1) defined, (2) digital, (3) integrated, (4) automated, (5) intelligent (Leeder 2023).

Industry 4WRD

Like the SIRI, the Industry 4WRD helps companies to (a) determine their level of readiness in adoption of IR 4.0 technologies; (b) identify the gaps and areas of improvements for IR 4.0 adoption, as well as opportunities for productivity improvement and growth; and (c) develop feasible strategies and plans to perform outcome-based intervention projects.

This framework is meant for self-assessment and continuous development, and no report has been issued to date on the overall status industry readiness against the framework. Other sources, such as a report by the World Economic Forum (2018) on the readiness for future production, have provided an assessment and positioned Malaysia in the "leader quadrant" among 100 other countries. This means that Malaysia has a solid current manufacturing base and is thus positioned well in the production sector. For each driver of IR 4.0, Malaysia is ranked from 21st to 30th out of 100 countries, especially in the technology and human capital groups. However, the gap of Malaysia, as compared to other world leaders, such as Japan, Germany and China, is still very wide, as these countries are moving rapidly into IR 4.0 implementation. Therefore, Malaysia should establish aggressive plans to catch up with this new IR 4.0 world.

Study on the readiness of the ASEAN community for the IR 4.0

Some of the findings of Vora-Sittha and Chinprateep (2021) are worth discussing. The International Development Research Centre (IDRC) used the Government Artificial Intelligence Readiness Index to measure government readiness in dealing with artificial intelligence. The report shows that governments in ASEAN countries are better prepared to cope with artificial intelligence than the world average and the Asia–Pacific region, with Singapore, Malaysia, the Philippines and Thailand being the key drivers, followed by Indonesia, Viet Nam, Brunei, Cambodia, the Lao People's Democratic Republic and Myanmar (IDRC 2019). The report concludes that among ASEAN countries, only Singapore is fully prepared for IR 4.0. Most ASEAN countries are only moderately prepared for the IR 4.0, except for Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar.

Study on readiness for IR 4.0 and the circular economy

Based on Venkatachalam, Ramanathan and Wyes (2020)*, a* comparison was made across various frameworks in terms of the data coverage and the feasibility and sustainability of the assessments in terms of access to datasets and the technical details of the methodology.

The comparison exercise suggests that none of the existing reports covers all ASEAN countries. However, there is value in synthesizing the assessment of these existing reports and indices to develop a hybrid ERIA readiness index for IR 4.0, particularly at the country and company levels to benchmark positions relative to others in the world and to verify the outcomes of necessary interventions. (Anbumozhi, Ramanathan and Wyes 2020,15).

This exercise indicates emerging patterns in readiness, innovativeness and competitiveness relative to each country in the region and in comparison. The comparison exercise of IR 4.0 and the circular economy clearly shows the diversity in readiness among individual economies in the region. The levels of development appear to be strongly correlated with projected future readiness.

The findings include the following (Anbumozhi, Ramanathan and Wyes 2020, 32):

- 85 per cent of responding businesses see the potential of IR 4.0;
- only 15 per cent of respondents have in place dedicated strategies for IR 4.0;
- 89 per cent of respondents are aware of the potential of information efficiency through the implementation of data standards;
- only 11 per cent of respondents have systematically implemented data security and standards;
- 81 per cent of respondents are aware of monitoring machine status for maintenance goals, but just 17 per cent have put the principles into practice; and
- 88 per cent of respondents consider energy management to be important, yet only a small percentage implement practices into their processes.

1.2.3 Common theoretical frameworks adopted in assessing the readiness of TVET institutions for IR 4.0 in South-East Asia

The following are the relevant references for assessing the readiness of TVET institutions for IR 4.0:

1. Ismail, A., et al. 2020. "Students' Readiness in Facing Industrial Revolution 4.0 among Students of Technical Teacher's Education". *International Journal of Scientific & Technology Research* 9 (08): 300–305**.**

2. Ahmad@Mohamed, Nurulanis, et al. 2019. "Readiness Aspects In Education Sector To Succeed In Industry 4.0 (IR 4.0): A Review". *ESTEEM Journal of Social Sciences and Humanities* 3: 38–47.

3. Zulnaidi, Hutkemri, and Mohamad Zuber Abd Majid. 2020. "Readiness and Understanding of Technical Vocational Education and Training (TVET) Lecturers in the Integration of Industrial Revolution 4.0". *International Journal of Innovation, Creativity and Change* 10 (10): 31–43.

4. Khin, Cho Tun, Zar Aung Nay and Kyaw Naing Oo Sai. 2021. "Awareness, Perception and Preparation of TVET Students, Teachers and Managers for Industry 4.0 in Myanmar". *TVET@Asia* 17: 1–21.

5. Zulnaidi, Hutkemri, Suzieleez Syrene Abdul Rahim and Umi Kalsum Mohd Salleh. 2020. "The Readiness of TVET Lecturers in Facing the Intelligence Age IR 4.0". *Journal of Technical Education and Training* 12 (3): 89–96.

Reference 1. Students' readiness for facing IR 4.0

This study aims to identify the knowledge, attitudes, interests and readiness of students to face the challenges of IR 4.0. This descriptive study uses questionnaires based on the Likert scale. The questionnaire was divided into two parts: Part A, which contains 4 items related to student demographics; and Part B, which contains 18 items, including questions related to knowledge, attitude and interest and students' readiness towards IR 4.0.

Reference 2. Readiness aspects in education sector to succeed in IR 4.0

This paper reviews the readiness aspects in the education sector for engaging in IR 4.0 and identifies possible ways of succeeding in IR 4.0. This study suggests that education needs to consider readiness aspects in terms of psychological, environmental, financial, technological skills and curriculum content to meet the changes brought about by IR 4.0. These suggestions were inspired by Chapnick (2000), which categorized readiness into eight parts:

1. psychological readiness, emphasizing the individual's mind;
2. sociological readiness, consisting of the environmental context in which programmes are conducted;
3. environmental readiness, involving both internal and external factors;
4. human resources readiness, related to human support systems;
5. financial readiness, including readiness on financial aspects;
6. technological skill readiness, related to support systems in technical areas;
7. equipment readiness, which refers to the availability and adequacy of equipment; and

8. content readiness, which focuses on readiness in curriculum design.

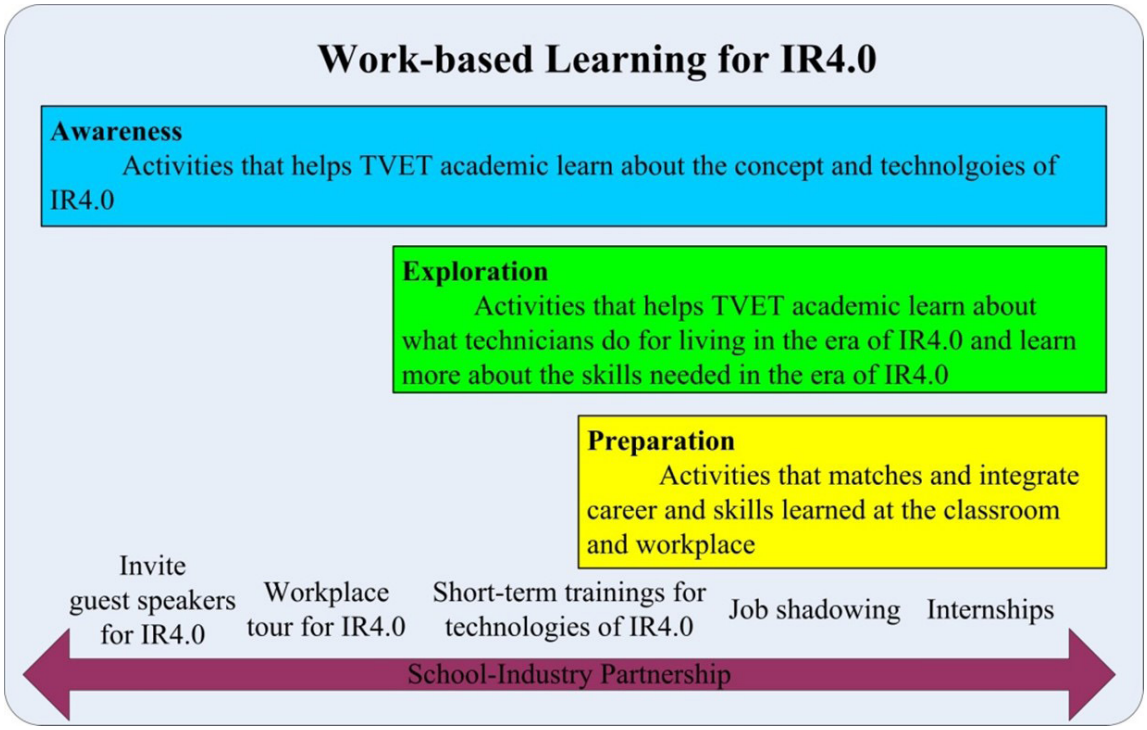
Reference 3. Readiness and understanding of TVET lecturers concerning the integration of IR 4.0

This study aims to determine the readiness and understanding of TVET lecturers in the implementation of IR 4.0. This study used a correlation design to determine the readiness and understanding of TVET lecturers concerning the implementation of IR 4.0. Thus, thus study is to identify the significant link between lecturers' readiness and understanding in implementing IR 4.0 using structural equation modelling. This study aimed to examine the relationship between understanding and professional ethics, as well as the effects of such a relationship on IR 4.0 readiness. The scale consists of 15 questions addressing the level of IR 4.0 understanding (five items), readiness (five items) and integration (five items). A five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was applied to measure IR 4.0 understanding, readiness and integration.

Reference 4. Awareness, perception and preparation of TVET students, teachers and managers for IR 4.0 in Myanmar

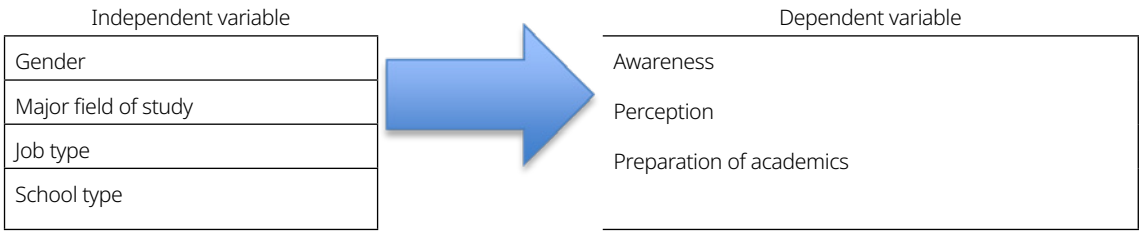
This study aimed to assess TVET academics' awareness and perceptions of IR 4.0 and ascertain how prepared they are to strategically and effectively manage work-based learning. A survey based on 16 structured questionnaires was conducted to measure the awareness, perception and preparation of respondents, including TVET managers, teachers and students from different TVET institutions. The study adopted work-based learning for IR 4.0 framework (see figure 9).

▶ **Figure 8. Work-based learning for IR 4.0 (with reference to work-based learning process of Johnson et al. 2017)**



In this study, the researchers identified the following independent variables: gender, major field of study, job type and type of school for academics. For dependent variables, the researchers selected awareness levels, perception and preparation of academics (see figure 9).

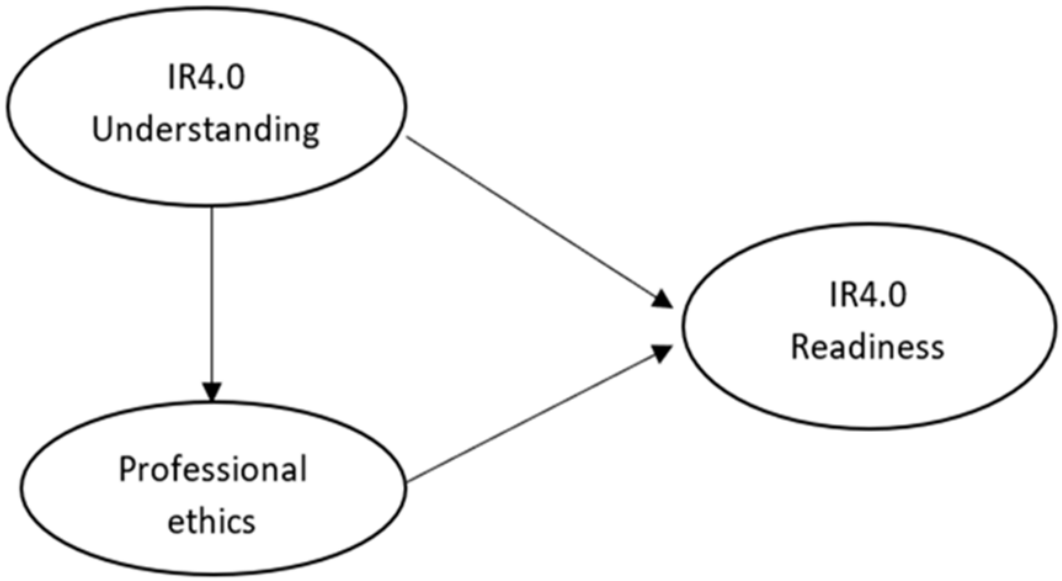
▶ **Figure 9. Research model for work-based learning for IR 4.0**



***Reference 5*. Readiness of TVET lecturers to face the IR 4.0 intelligence age**

This study aimed to determine the influence of professional identity and ethics on the readiness of TVET lecturers in facing IR 4.0. Two instruments were used to measure professional ethics, IR 4.0 understanding and IR 4.0 readiness. A correlation survey was conducted to determine IR 4.0 readiness, IR 4.0 understanding and professional ethics among TVET lecturers in Malaysia. An a priori model was adopted as the study framework, showing the integration of variables developed from theories and previous studies. The three main variables are understanding, professional ethics and IR 4.0 readiness, and their correlation is indicated by the straight arrows (see figure 10).

▶ **Figure 10. A priori model**



1.2.4 Major findings from the literature reviews on the readiness of TVET institutions for IR 4.0 and initiatives taking place in schools/ colleges in South-East Asia

General findings

Study on students readiness in facing IR 4.0 among students of technical teacher's education

The findings showed that students' knowledge on IR 4.0 was weak. The study also found that students' interest and attitudes were high and their readiness to deal with IR 4.0 was also high.

Study on readiness aspects in the education sector to succeed in IR 4.0

The study found that education needs to consider readiness aspects in terms of psychological, environmental, financial, technological skills and curriculum content in order to meet the changes brought about by IR 4.0. The readiness in terms of the content of education also needs to be aligned with industry needs and technological changes in order to secure industry employability for future generations especially generation Z. The transformation of educational delivery methods needs to be examined in IR 4.0. There are many proposals for establishing innovative learning, flexible curricula and empowering practical-based skills as a basis for facing the new frontiers of the IR 4.0 era.

Study on readiness and understanding of TVET lecturers in the integration of IR 4.0

The findings revealed that the correlation between IR 4.0 understanding and readiness ($r = .90$, $p < .01$), IR 4.0 understanding and IR 4.0 integration ($r = .80$, $p < .01$) and IR 4.0 readiness and IR 4.0 integration ($r = .79$, $p < .01$) were significant and strong. Also, IR 4.0 readiness positively affected IR 4.0 understanding, while IR4.0 readiness positively affected IR 4.0 integration and IR 4.0 understanding shows a significant mediating effect on the contribution of IR 4.0 readiness to IR 4.0 integration. The findings and information gathered in this study could become a valuable reference for other parties in implementing IR 4.0 at higher education levels. This study contributes a new IR 4.0 lecturers' readiness model, which involves two main factors, namely, IR 4.0 understanding and IR 4.0 integration.

Study on awareness, perception and preparation of TVET students, teachers and managers for industry 4.0 in Myanmar

The findings confirmed that gender, the major field of study and the type of job and school influenced the awareness, perception and preparation of TVET academics. Strategic plans and reforms can be effectively introduced for future skills development in work – based learning scenarios which are relevant to the major field of study and the type of job and school.

Study on the readiness of TVET lecturers for facing the intelligence age IR 4.0

The findings reveal the significant influence of lecturers' understanding of the intelligence age and their readiness to face IR 4.0. However, professional ethics is not found to be a mediator of the relationship between IR 4.0 understanding and readiness. Based on the study, it was recommended that the Ministry of Education of Malaysia should improve the lecturers' IR 4.0 readiness by providing IR 4.0 courses and

▶ 2 Methodology

To accomplish the first objective of the study, which is to develop a framework for evaluating the preparedness of TVET institutions for IR 4.0, the research team conducted a thorough review and discussion of pertinent frameworks outlined in the literature review chapter. These frameworks encompass those designed for assessing industry readiness for IR 4.0, as well as those tailored specifically for evaluating the readiness of TVET institutions. The criteria for selecting the frameworks to be reviewed were based on considerations that the frameworks are relevant to and contributed to assessing the readiness of TVET institutions for IR 4.0.

Initially, the search primarily targeted frameworks pertinent to assessing the readiness of TVET institutions for IR 4.0. However, upon realizing that the findings did not sufficiently support the development of a comprehensive assessment framework for IR 4.0 readiness, the team broadened its scope to include frameworks designed for evaluating industry readiness for IR 4.0. This expanded search strategy aimed to gather insights and methodologies that could inform the formulation of a robust and comprehensive framework tailored to the specific needs and challenges faced by TVET institutions in preparing for IR 4.0. Taking into account the insights gathered from industry and TVET, the research team proposes the Smart Education Readiness Index (SERI) assessment matrix, which underwent pilot testing to assess its validity and reliability.

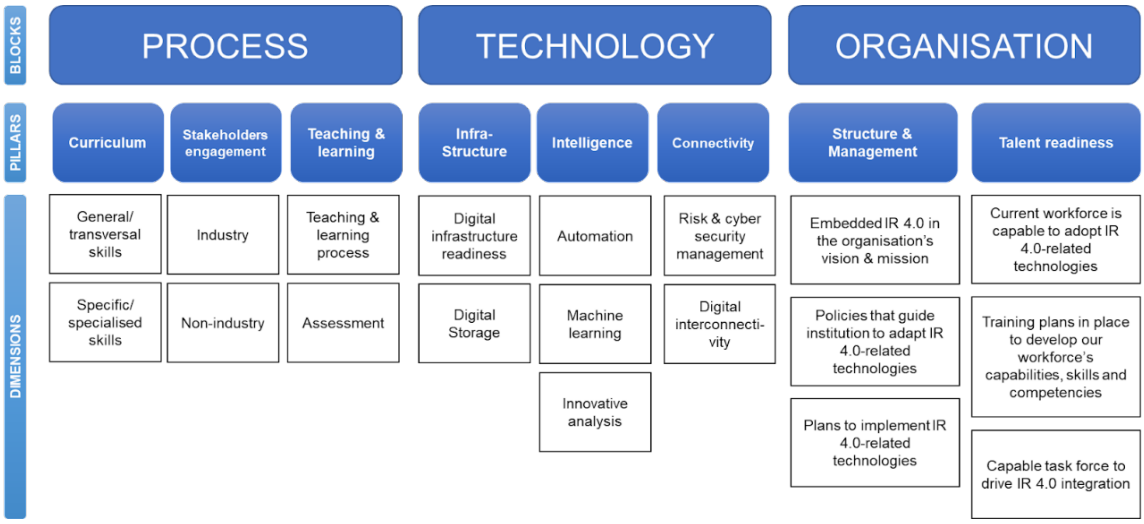
To achieve the second objective — to assess the readiness of TVET institutions for IR 4.0 – the research team, representing nine ASEAN member States (Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, the Philippines, Singapore, Thailand and Viet Nam), collected data from TVET institutions by using the SERI assessment matrix. To enrich the data, the researchers also conducted interviews or focus group discussions to representatives from industry and TVET institutions. This methodological extension involved conducting interviews and facilitating focused group discussions with a diverse array of stakeholders, drawn from both industrial sectors and TVET institutions. By embracing this multifaceted approach, the researchers sought to capture a comprehensive spectrum of perspectives, experiences and insights pertaining to the readiness and responsiveness of both sectors to the imperatives of IR 4.0.

▶ 3 Proposed framework for assessing the readiness of institutions for IR 4.0: SERI

Based on a review of various conceptual frameworks, a comprehensive framework has been developed to assess the readiness of TVET institutions in South-East Asia: the SERI framework, which was developed by the SEAMEO/VOCTECH research team, consisting of 23 national researchers from nine ASEAN member States. It underwent pilot testing in these nine ASEAN member States, including Brunei Darussalam, whose country report was incorporated into a United Nations Eductional, Scientific and Cultural Organization (UNESCO) Global Education Monitoring Report (Paryono, Bakar and Mashod 2023). The readiness level is indicated based on the level or stage of an institution within a particular dimension, as evaluated using a dedicated assessment matrix that spans from 0 (indicating the lowest level) to 4 (representing the highest level).

The SERI framework is divided into three hierarchical levels. The foundational layer includes three structural components: process, technology and organization. The intermediate layer is composed of eight pillars, each representing the critical aspects within these structural components that institutions must address when preparing for and integrating with IR 4.0. Finally, the third layer comprises 19 dimensions, which serve as evaluative criteria for assessing the current level of IR 4.0 adoption.

▶ **Figure 11. SERI framework**



Source: Paryono, Bakar and Mashod (2023).

Each dimension was defined and described across five bands (scales) (for example, see the dimension "General/transversal skills", under the pillar "Curriculum" and the building block "Process".

▶ **Table 7: Example of SERI assessment matrix**

BLOCK – PROCESS **PILLAR – CURRICULUM** **DIMENSION – TRANSVERSAL SKILLS** **Transversal skills are those typically considered as not specifically related to a particular job, task, academic discipline or area of knowledge but as skills that can be used in a wide variety of situations and work settings (UNESCO n.d).**			
Band		**Definition**	**Description**
0	**Conventional**	Use existing curriculum	Curriculum content without IR 4.0
1	**Early adopter**	Early stage adopting IR 4.0 Curriculum	Curriculum content only has a little component of IR 4.0
2	**Learner**	Moderate usage with IR 4.0 Curriculum	Curriculum content adopts basic components of IR 4.0
3	**Experienced**	Almost every time expose/ use IR 4.0 Curriculum	Curriculum content incorporates majority components of IR 4.0
4	**Exemplary**	Transformative use of IR 4.0 Curriculum	Curriculum content incorporates all components of IR 4.0 and the referral centre of the IR 4.0 curriculum

Given that transversal skills comprise several skills, the survey lists those skills as described in table 8. A complete set of the SERI assessment matrix can be found in Appendix 1.

▶ **Table 8. Assessment of transversal skills**

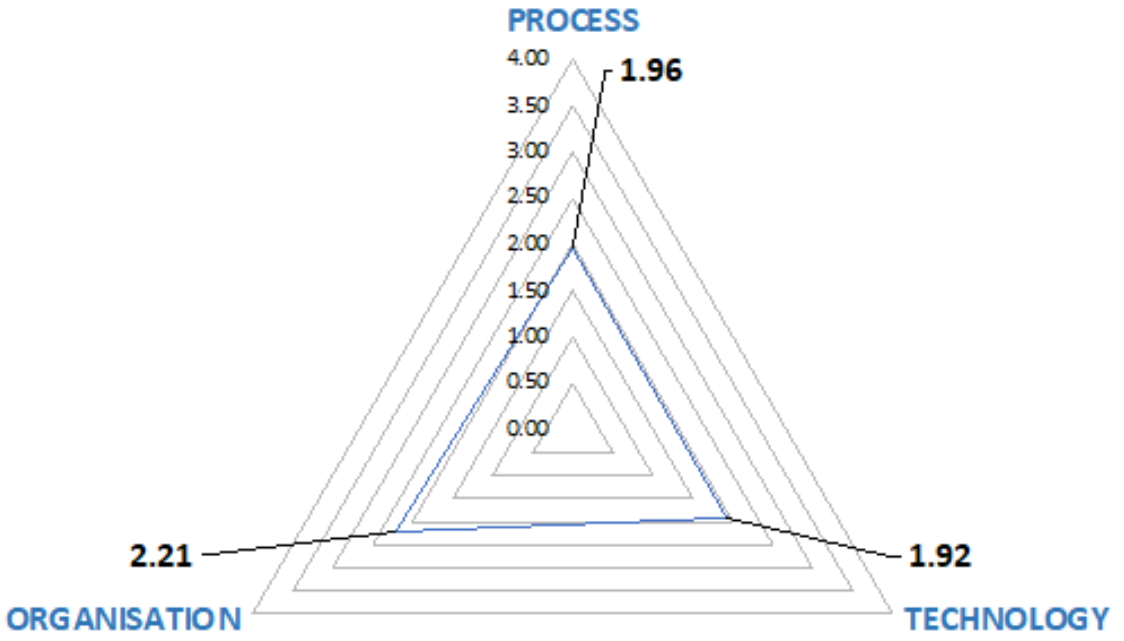
Transversal skills	**Conventional**	**Early adopter**	**Learner**	**Experienced**	**Exemplary**
Complex problem-solving	O	O	O	O	O
Social skills	O	O	O	O	O
Process skills	O	O	O	O	O
Cognitive abilities	O	O	O	O	O
People management	O	O	O	O	O
Content skills	O	O	O	O	O
Digital skills	O	O	O	O	O
Entrepreneurial skills	O	O	O	O	O

▶ 4 Findings from the analyses

Using the proposed framework to assess the readiness of TVET institutions for IR 4.0 in South-East Asia, the researchers from 9 ASEAN member countries of SEAMEO VOCTECH collected data from TVET at secondary and post-secondary levels from those participating countries. This round of data collection serves as an initial stage in applying the proposed framework represented in the SERI assessment matrix. The findings provide a basis for developing institutional action plans and understanding the current status. As a tool for assessing the readiness of TVET institutions for IR 4.0, we recommend that SEAMEO members adopt this framework to continuously assess institutional readiness, either annually or biannually.

Based on this initial study, the quantitative findings, based on the SERI using a scale of 0 (lowest level) to 4 (highest level), show that the readiness index of TVET institutions for IR 4.0 in South-East Asia is 2.03 (ranging from "early adopter to "learner"). This overall index is a composite index of the index for each of the three building blocks: process (1.96), technology (1.92) and organization (2.21) (see figure 12). For comparison and to provide a perspective on the level of adoption of IR 4.0 in companies using the SIRI framework, the worldwide IR 4.0 readiness index for industry is 1.55 (first stage of digital maturity) (Klein 2023; Leeder 2023). Unfortunately, no detailed findings are available for the industry readiness index; only the overall readiness index.

▶ **Figure 12. Overall SERI assessment of the three building blocks (2.03)**



Examining the readiness of TVET institutions for IR 4.0 in terms of the three building blocks – process, technology and organization – at the level of dimensions gives a clearer picture of readiness at the most specific levels. Under the process building block, there are three pillars and six dimensions. Figure 13 shows the readiness indices of TVET institutions for IR 4.0 within these six dimensions.

▶ **Figure 13. Readiness indices of TVET institutions for IR 4.0 within the six dimensions under the process building block (1.96)**

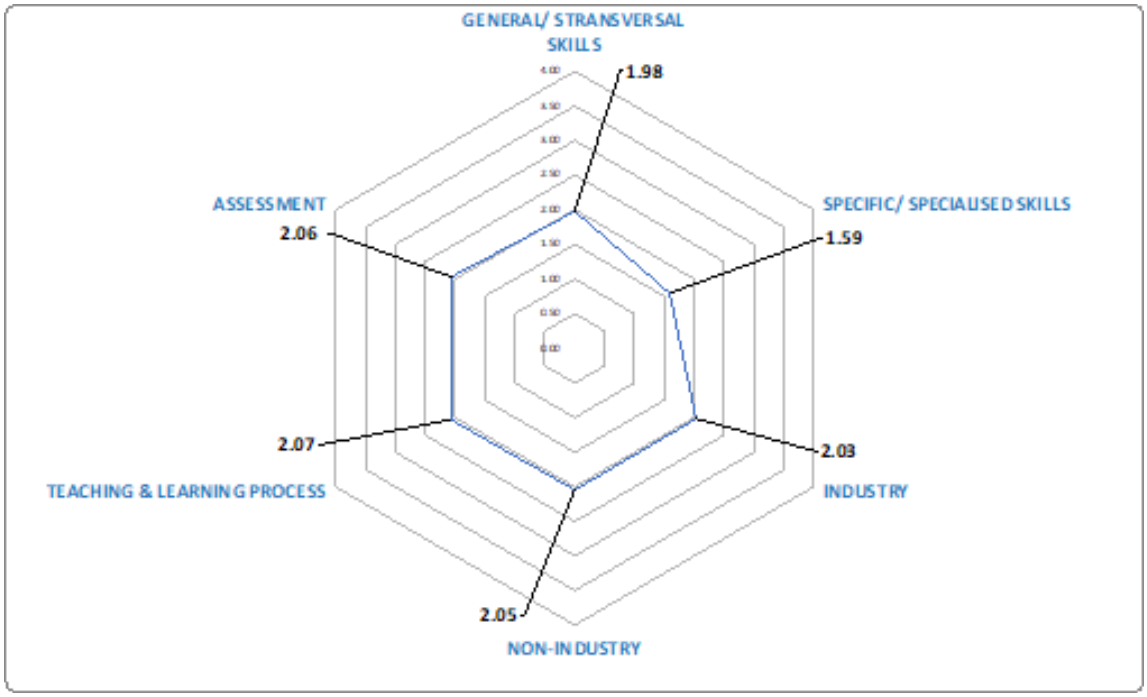


Figure 13 shows that under the pillar of curriculum (general/transversal skills and specific/specialized skills) the readiness index is 1.98 and 1.59 or below 2.0, which indicates an early stage of adopting IR 4.0 in the curriculum. This means that the curriculum content has a few components that support IR 4.0 adoption. Under the pillar of stakeholder engagement (collaboration with non-industry and collaboration with industry), the readiness index slightly exceeded 2.0 or equivalent to the regulatory compliance stage. This reflects that stakeholders show sufficient engagement effort towards the institutional tasks on IR 4.0. Under the pillar of teaching and learning (teaching and learning process and assessment), the readiness index exceeded 2.0. This demonstrates the adaptive and independent (self-reliant) use of IR 4.0 technology in teaching and learning and assessment.

Under the building block of technology, there are three pillars (infrastructure, intelligence and connectivity) and seven dimensions (digital infrastructure, automation, risk and cybersecurity management, digital storage, machine learning, digital connectivity and innovative analysis). Figure 14 shows the readiness indices of these seven dimensions.

▶ Figure 14. Readiness inices of TVET institutions for IR 4.0 within the seven dimensions under the technology building block (1.92)

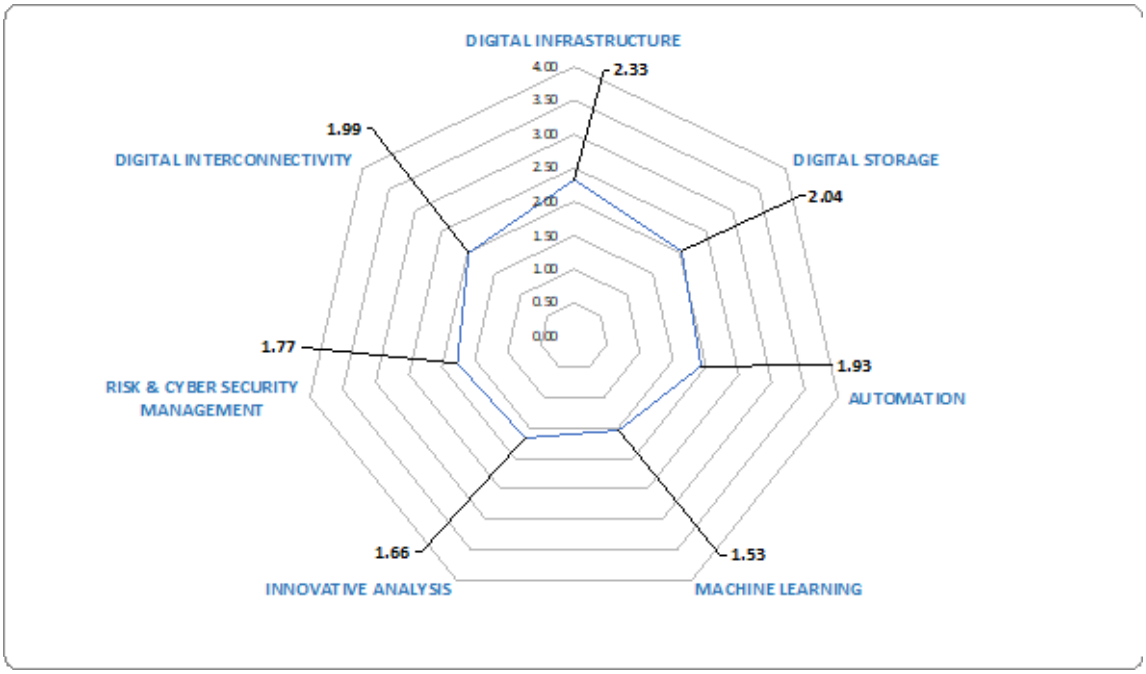


Figure 14 shows that the overall readiness index in the technology building block is below 2.0, or at early adoption of technology in response to IR 4.0 requirements. TVET institutions in South-East Asia are more prepared for IR 4.0 adoption in the areas of providing digital infrastructure and digital storage (readiness index of more than 2.0) but less prepared in the areas of digital interconnectivity, automation, risk and cybersecurity management, innovative analysis and machine learning (readiness index ranging from slightly below 2.0 to 1.53).

Under the building block of organization, there are two pillars (structure and management and talent readiness) and six dimensions (integration in vision and mission, workforce capability, relevant policies, training plans, implementation plans, IR 4.0 task force and its capability). Figure 15 shows the readiness indices of these six dimensions.

▶ **Figure 15. Readiness indices of TVET Institutions for IR 4.0 within the six dimensions under the organization building block (2.21)**

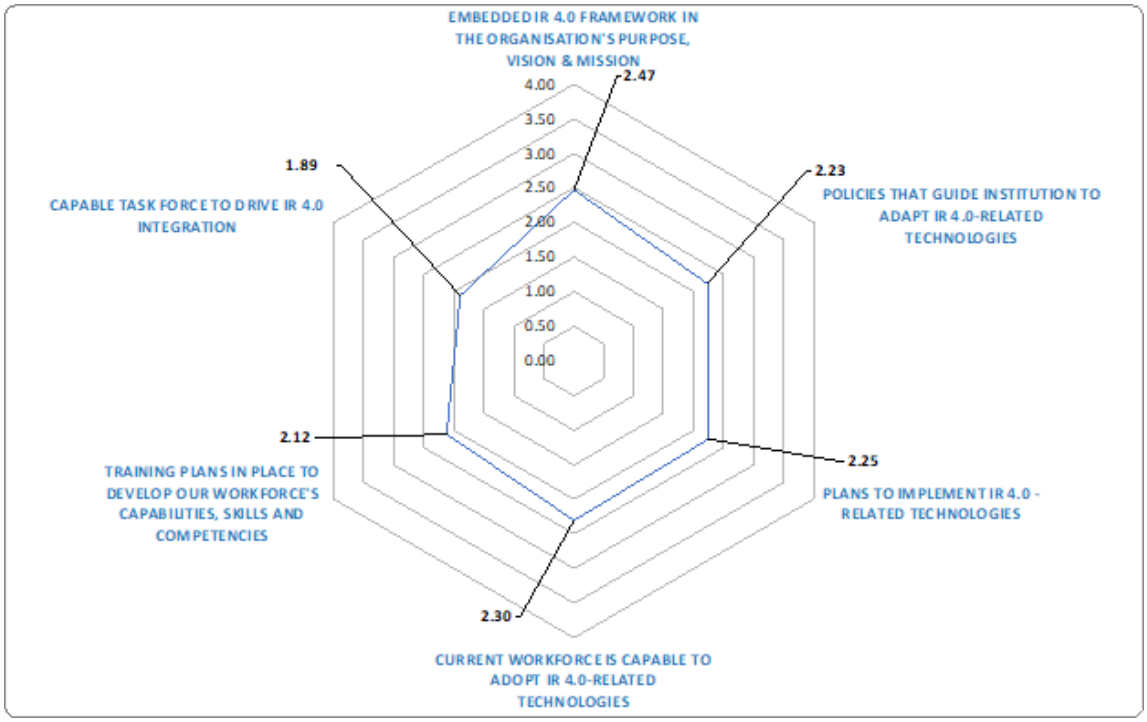


Figure 15 shows that the overall readiness index in the organization building block is 2.21 and is therefore in progress toward adopting IR 4.0 requirements. TVET institutions in South-East Asia have integrated IR 4.0 in their vision and mission statements to some degree (2.47 readiness index) followed by having a capable workforce (2.30 readiness index), having implementation plans (2.25 readiness index), having policies that guide IR 4.0 adoption (2.23 readiness index), having training plans (2.12 readiness index) and lastly having a relatively less capable task force that drives IR 4.0 integration (1.89 readiness index).

The qualitative findings obtained from the interview and focus group discussion sessions with representatives of TVET institutions and industry stakeholders were meticulously analysed to discern the common themes that emerged. This analysis provides a comprehensive understanding of the perspectives and insights shared by the participants, highlighting the critical areas of focus and concern related to the integration of IR 4.0 within TVET institutions. This approach not only facilitates the identification of overarching trends and patterns but also underscores the specific needs and priorities of both TVET institutions and industry representatives.

The themes that emerged from the focus group discussion sessions with TVET institutions encompass a broad spectrum of issues, including the importance of integrating IR 4.0 within TVET institutions; policy development and implementation; resource and infrastructure needs; innovation and skills development; alignment with industry needs; gender inequality and inclusivity; partnership and collaboration; and continuous evaluation and adaptation. Meanwhile, the outcomes of the focus group discussion sessions with industry representatives revealed five predominant themes: positive changes and opportunities; challenges and preparedness; cybersecurity and connectivity; skill development and training; and government support.

The findings of this initial study can serve as benchmarks for institutions or countries to chart their road maps or action plans. Within these action plans, institutions can identify areas requiring

immediate action or improvement. The impact of these plans can then be assessed and monitored using the same tool – the SERI assessment matrix – in the coming years.

Synthesis and ways forward on TVET institutions' responses to the needs of industry in the area of digital transformation in South-East Asia

Based on the findings of the relevant studies cited in this paper, the authors propose the following key takeaways:

- Most of the assessment frameworks are meant for self-assessment tools and continuous improvement.
- The proposed framework represented in the SERI assessment matrix is intended to be a tool for continuously assessing institutional readiness, either annually or biannually, rather than for one-time data collection.
- Based on the current study, the level of readiness for IR 4.0 adoption at the levels of both education institutions and industry remains low. The study using the SERI framework indicates that TVET institutions in South-East Asia have a higher level of readiness at the level of the organization building block (2.21), followed by the process building block (1.96) and the technology building block (1.92).
- There is room for improvement for advancing to the next level of readiness for digitalization or IR 4.0 and adoption in the areas of both industry and education.
- There were big gaps between the potentials and the implementation/adoption practices; for example, although 85 per cent of responding businesses saw the potential of IR 4.0 only 15 per cent have in place dedicated strategies for IR 4.0.

Recommendations to move towards a higher level of IR 4.0 adoption at TVET institutions include the following.

- Efforts should continuously be exerted to enhance the adoption of digitalization and IR 4.0 in TVET institution and industry. TVET institutions and industry should share and exchange experiences to synergize the effort for digitalization and reduce the mismatches.
- Considering that there is no comprehensive assessment tool available, we recommend using the SERI assessment matrix as a tool for gauging readiness. Meanwhile, the current survey can serve as an initial step in crafting a road map to guide progress toward IR 4.0. A policy brief will be circulated to policymakers for possible consideration and adoption.
- It is noteworthy that the qualitative component, including interviews and focus group discussions, serves as a complementary method. Qualitative methods offer valuable insights into the nuanced perspectives and experiences of stakeholders, providing in-depth understanding. However, it is important to emphasize that the incorporation of qualitative methods is not mandatory. The decision to utilize these approaches should be tailored to the specific needs and contexts of the institutions or countries involved.
- An action or enhancement plan, outlined in conjunction with the road map, should be devised, including a timeline and precise activities aimed at elevating the status to the succeeding tier.
- The following policy recommendations are proposed for ministries of education in ASEAN member States:
    - The SERI may be adopted as one of the tools to assess and monitor the progress of education institutions towards readiness for digitalization or IR 4.0.

  - The SERI may be used as an annual, biannual or triannual monitoring tool for assessing digital readiness that can be part of accreditation components.
- The following policy recommendations are proposed for TVET institutions in ASEAN member States:
  - The SERI may be used as a self-assessment tool for institutions to gauge the current level of readiness for digitalization.
  - Based on the initial assessment, institutions can gauge the status of their readiness at the building block level (process, technology and organization), at the pillar level (8 pillars) and at the dimension level (19 dimensions).
  - Institutions may then strategize and make an action plan on how to progress to the next level of IR 4.0 adoption. An example of action plan is provided in Appendix 2.
- Ideally, the assessment of the readiness of TVET institutions should be complemented by an assessment of the industry's readiness for IR 4.0. This dual approach would allow the connections between developments in education and the workplace to be monitored and examined. By understanding both perspectives, a comprehensive view may be obtained of how educational institutions are preparing students for the demands of the digital transformation and how well these preparations align with industry needs and expectations.

Appendix 1

▶ **SERI assessment matrix**

TABLE 1

BLOCK – PROCESS

PILLAR – CURRICULUM

DIMENSION – TRANSVERSAL SKILLS

"Transversal skills" are those typically considered as not specifically related to a particular job, task, academic discipline or area of knowledge but as skills that can be used in a wide variety of situations and work settings (UNESCO n.d.).

Band		*Definition*	*Description*
0	Conventional	Use existing curriculum	Curriculum content without IR 4.0
1	Early adopter	Early stage adopting IR 4.0 curriculum	Curriculum content has a few components of IR 4.0
2	Learner	Moderate usage with IR 4.0 curriculum	Curriculum content adopts basic components of IR 4.0
3	Experienced	Almost every time expose/use IR 4.0 curriculum	Curriculum content incorporates a majority of components of IR 4.0 in a context related to the area of specialization
4	Exemplary	Transformative use of IR 4.0 curriculum	Curriculum content incorporates all components of IR 4.0 in a context related to the area of specialization and the referral centre of the IR 4.0 curriculum

Please refer to the descriptors in table 1 to answer question 1.

1. My institution has embedded the following transversal skills in the IR 4.0 curriculum:

	Conventional	*Early adopter*	*Learner*	*Experienced*	*Exemplary*
Complex problem-solving	O	O	O	O	O
Social skills	O	O	O	O	O
Process skills	O	O	O	O	O
Cognitive abilities	O	O	O	O	O
People management skills	O	O	O	O	O

	Conventional	*Early adopter*	*Learner*	*Experienced*	*Exemplary*
Content skills	O	O	O	O	O
Digital skills	O	O	O	O	O
Entrepreneurial skills	O	O	O	O	O

TABLE 2

BLOCK – PROCESS

PILLAR – CURRICULUM

DIMENSION – SPECIALIZED SKILLS

"Specialized skills" include the specific "know-how" needed for a fulfilling and meaningful life and decent employment, which learners often acquire as a result of their participation in post-basic education, including through TVET or after-school activities. These skills may relate to a specific job, task, academic discipline (e.g. teacher, geographer, medical doctor or journalist) or area of particular knowledge and skills (e.g. hobby). (UNESCO, 2014).

Band		*Definition*	*Description*
0	Conventional	Use existing curriculum	Curriculum content without IR 4.0
1	Early adopter	Early stage adopting IR 4.0 curriculum	Curriculum content only has a few components of IR 4.0
2	Learner	Moderate usage with IR 4.0 curriculum	Curriculum content adopts basic components of IR 4.0
3	Experienced	Almost every time exposed to/ use IR 4.0 curriculum	Curriculum content incorporates a majority of components of IR 4.0
4	Exemplary	Transformative use of IR 4.0 curriculum	Curriculum content incorporates all components of IR 4.0 and the referral centre of IR 4.0 curriculum

Please use the descriptors in table 2 to answer question 2.

2. My institution has adopted the following technology in the IR 4.0 curriculum:

	Not applicable	*Conventional*	*Early adopter*	*Learner*	*Experienced*	*Exemplary*
Big data	O	O	O	O	O	O
Autonomous robotics	O	O	O	O	O	O

	Not applicable	*Conventional*	*Early adopter*	*Learner*	*Experienced*	*Exemplary*
Simulations (e.g. augmented reality/virtual reality)	O	O	O	O	O	O
Artificial Intelligence and machine learning	O	O	O	O	O	O
Internet of things	O	O	O	O	O	O
Cloud computing	O	O	O	O	O	O
Cybersecurity	O	O	O	O	O	O
Smart manufacturing	O	O	O	O	O	O
Block chain	O	O	O	O	O	O

TABLE 3

BLOCK – PROCESS

PILLAR – STAKEHOLDERS ENGAGEMENT

DIMENSION – INDUSTRY AND NON-INDUSTRY

"Stakeholders engagement" refers to the involvement of the institution with other individuals or institutions in the process of embedding and promoting components of IR 4.0 in the TVET system.

Band		*Definition*	*Description*
0	No engagement	Zero engagement or involvement/no effort on IR 4.0	Stakeholders show no engagement effort towards the institutional tasks on IR 4.0
1	Passive compliance	Lack of effort and persistence engagement on IR 4.0	Stakeholders show minimal effort of engagement, lack of inquiry and interest towards the institutional tasks on IR 4.0
2	Regulatory compliance	Sufficient/moderate effort of engagement and involvement on IR 4.0	Stakeholders show sufficient engagement effort towards the institutional tasks on IR 4.0

TABLE 3

BLOCK – PROCESS

PILLAR – STAKEHOLDERS ENGAGEMENT

DIMENSION – INDUSTRY AND NON-INDUSTRY

"Stakeholders engagement" refers to the involvement of the institution with other individuals or institutions in the process of embedding and promoting components of IR 4.0 in the TVET system.

Band		*Definition*	*Description*
3	Strategic compliance	Strategic, creative and productive effort of engagement and involvement on IR 4.0	Stakeholders show clear effort, with some creativity and engaged focus, on task directions to completion towards the institutional tasks/progress on IR 4.0
4	Innovative engagement	Concerted, continuous and innovative engagement and involvement on IR 4.0	Stakeholders show persistence towards a sustained inquiry that is proactive, self-engaged and directed, with ongoing interest and inquisitiveness and self-motivation for engagement and progress on IR 4.0

Please use the descriptors in table 3 to answer questions 3 and 4.

3. My institution works closely with industry stakeholders in terms of:

	No engagement	*Passive compliance*	*Regulatory compliance*	*Strategic compliance*	*Innovative engagement*
Curriculum alignment	O	O	O	O	O
Industrial attachment	O	O	O	O	O
Staff training and development	O	O	O	O	O
Skill-based assessment	O	O	O	O	O
Funding	O	O	O	O	O
Human resources	O	O	O	O	O
Shared facilities	O	O	O	O	O
Employment	O	O	O	O	O

	No engagement	*Passive compliance*	*Regulatory compliance*	*Strategic compliance*	*Innovative engagement*
Apprenticeship on IR 4.0-related technologies	O	O	O	O	O

4. My institution works closely with non-industry stakeholders (parent/student/community/alumni/NGO/ government) in terms of:

	No engagement	*Passive compliance*	*Regulatory compliance*	*Strategic compliance*	*Innovative engagement*
Curriculum alignment	O	O	O	O	O
Service learning	O	O	O	O	O
Industrial attachment	O	O	O	O	O
Staff training and development	O	O	O	O	O
Skill-based assessment	O	O	O	O	O
Funding	O	O	O	O	O
Human resources	O	O	O	O	O
Shared facilities	O	O	O	O	O
Employment	O	O	O	O	O
Certification	O	O	O	O	O
Research collaboration	O	O	O	O	O

TABLE 4

BLOCK – PROCESS

PILLAR – TEACHING AND LEARNING

DIMENSION – TEACHING AND LEARNING PROCESS

"Teaching and learning process" refers to combined processes in which an instructor assesses learning needs, establishes specific learning objectives, develops teaching and learning strategies, implements plan of work and evaluates the outcomes of the instruction (Holz-Clause et al. 2015).

Band		*Definition*	*Description*
0	Conventional	Zero demonstration of the integration of IR 4.0 in teaching and learning process	– No evidence of IR 4.0 technology use in teaching and learning process – Instruction is teacher-centred (only lectures, with occasional demonstrations and discussions, no tutorial) – Takes place fully in traditional classroom settings
1	Adoption	Demonstration of adoptive and directed use of IR 4.0 technology in teaching and learning process	– Instructor directs students on conventional and procedural use of IR 4.0 technology tools – Instruction is teacher-centred (heavily dependent on lectures, with occasional use of demonstrations, discussions and tutorials) – Takes place fully in traditional classroom settings
2	Adaptation	Demonstration of adaptive and independent (self-reliant) use of IR 4.0 technology in teaching and learning process	– Instructor facilitates students' exploration and independent (self-reliant) use of IR 4.0 technology tools – Instruction is student-centred and self-paced learning (minimal use of lectures, frequent use demonstrations, discussions and tutorials) – Takes place either in traditional classroom settings and/or blended learning settings
3	Infusion	Demonstration of infused and independent (self-reliant) use of IR 4.0 technology in teaching and learning process	– Instructor provides the learning context and students choose IR 4.0 technology tools – Instruction is student-centred and self-paced learning (occasionally uses problem-based and project-based learning, including minimal use of lectures, integration of demonstrations, discussions and tutorials) – Takes place either in traditional classroom settings and/or blended learning settings

TABLE 4

BLOCK – PROCESS

PILLAR – TEACHING AND LEARNING

DIMENSION – TEACHING AND LEARNING PROCESS

"Teaching and learning process" refers to combined processes in which an instructor assesses learning needs, establishes specific learning objectives, develops teaching and learning strategies, implements plan of work and evaluates the outcomes of the instruction (Holz-Clause et al. 2015).

Band		*Definition*	*Description*
4	Transformational	Demonstration of transformational and independent (self-reliant) IR 4.0 technology in teaching and learning process	– Instructor encourages the innovative use of IR 4.0 technology tools to facilitate higher-order learning activities that may not be possible without the use of technology – Instruction is student-centred and self-paced learning (effective use of problem-based and or project-based learning, with minimal use of lectures and selective use of demonstrations, discussions and tutorials) – Takes place in a blended learning setting

Please use the descriptors in table 4 to answer question 5.

5. The teaching & learning process in my institution consists of the following:

	Conventional	*Adoption*	*Adaptation*	*Infusion*	*Transformational*
Planning theoretical and practical lessons in classrooms/ workshops	O	O	O	O	O
Planning theoretical and practical lessons in industrial workplaces (if any)	O	O	O	O	O
Delivering learning sessions to support competence development of learners	O	O	O	O	O

	Conventional	*Adoption*	*Adaptation*	*Infusion*	*Transformational*
Involvement in students' competence development (in and out of lesson)	O	O	O	O	O
Improving learning and interaction processes by choosing and developing suitable methods	O	O	O	O	O
Preparing learning and teaching materials and media	O	O	O	O	O

TABLE 5

BLOCK – PROCESS

PILLAR – TEACHING AND LEARNING

DIMENSION – ASSESSMENT

"Assessment" refers to the process of gathering evidence, making judgements, and drawing inferences about the achievement and performance of the students (UNESCO n.d.).

Band		*Definition*	*Description*
0	Conventional	Zero demonstration of IR 4.0 integration in assessment and feedback	– No evidence of IR 4.0 technology use in assessment and feedback – Contains a brief assessment by instructor via examination/test – Assessment conducted annually
1	Adoption	Demonstration of adoptive and directed use of IR 4.0 technology in assessment and feedback	– Instructor directs students in the procedural use of IR 4.0 technology tools in assessment and feedback – Contains a brief assessment by instructor, mostly via examinations/tests and occasionally via practical exercises – Assessment conducted annually

TABLE 5

BLOCK – PROCESS

PILLAR – TEACHING AND LEARNING

DIMENSION – ASSESSMENT

"Assessment" refers to the process of gathering evidence, making judgements, and drawing inferences about the achievement and performance of the students (UNESCO n.d.).

Band		*Definition*	*Description*
2	*Adaptation*	Demonstration of adaptive and independent use of IR 4.0 technology in assessment and feedback	– Instructor facilitates students' exploration and independent use of IR 4.0 technology tools in assessment and feedback – Contains a comprehensive assessment by instructor, with a mix of examinations/tests and practical exercises – Assessment conducted twice a year
3	*Infusion*	Demonstration of infused and independent use of IR 4.0 technology in assessment and feedback	– Instructor provides the context of assessments and students choose IR 4.0 technology tools – Contains a comprehensive assessment by instructor, with a mix of examinations/tests and practical exercises – Assessment conducted three times a year
4	*Transformational*	Demonstration of transformational and independent IR 4.0 technology in assessment and feedback	– Instructor encourages innovative use of IR 4.0 technology tools to facilitate assessment and feedback that may not be possible without the use of technology – Contains a comprehensive and innovative assessment by instructor, with a mix of examinations/tests and practical exercises – Assessment conducted continuously

Please use the descriptors in table 5 to answer questions 6 and 7.

6. My institution employs the following types of assessment in teaching and learning:

	Conventional	*Adoption*	*Adaptation*	*Infusion*	*Transformational*
Authentic assessment (e.g. observation, interview, portfolio, test, performance test)	O	O	O	O	O

	Conventional	*Adoption*	*Adaptation*	*Infusion*	*Transformational*
Constructivist assessment (e.g. inquiry-based teaching, problem-solving teaching, cooperative learning, reciprocal teaching/learning)	O	O	O	O	O
Performance-based assessment (e.g. presentations, group or solo projects, debates, performances)	O	O	O	O	O

7. My institution integrates the following digital tools in conducting assessment and providing feedback.

	Conventional	*Adoption*	*Adaptation*	*Infusion*	*Transformational*
Social media	O	O	O	O	O
Simulations (e.g. Modelling of work environments in digital worlds)	O	O	O	O	O
Learning management system	O	O	O	O	O
Gaming (e.g. using game incentive scheme to increase motivation)	O	O	O	O	O
Mobile apps (e.g. Google classroom)	O	O	O	O	O

SECTION 2: TECHNOLOGY

Please use and read the table containing the bands, definitions and descriptions carefully before answering the questions. Please select an appropriate response by checking the box provided.

TABLE 6

BLOCK – TECHNOLOGY

PILLAR – INFRASTRUCTURE

DIMENSION – DIGITAL INFRASTRUCTURE READINESS

"Digital infrastructure readiness" refers to the preparedness of the institution to transition into digitized workflows that are enabled by software and technology. Digital infrastructure includes communication network infrastructure (e.g. 5G, optical network, internet of things) and computing power infrastructure (e.g. intelligence, storage, computing and data centres). It focuses on data and supports end-to-end data-related activities, including data collection, perception, real-time transmission and distribution, *storage, computing, processing, mining, analysis and decision-making (***Huawei 2021).**

Band		Definition	Description
0	Conventional	Non-existence of digital infrastructure	Institutions do not have any digital infrastructure in place
1	Early Adopter	Existence of digital infrastructure but not utilized due to lack of knowledge and understanding	Institutions have technology infrastructure but do not know how to utilize
2	Learner	Existence of digital infrastructure but not fully utilized	Institutions have the ability to use several types of technology
3	Experienced	Existence of digital infrastructure, which is used regularly and effectively	Institutions have the ability to choose and contextualize technological tools based on institutional needs and thus are able to flexibly utilize these tools
4	Leader	Existence of digital infrastructure, which is used extensively (IR 4.0 ready)	Referral centre of digital infrastructure and institutions effectively utilize digital infrastructure according to its purpose

Please used the descriptors in table 6 to answer question 8.

8. Please select and rate which of the following digital infrastructures are available at your institutions.

	Conventional	*Early adopter*	*Learner*	*Experienced*	*Leader*
Hardware (e.g. internet backbone, data centres, network, network security)	O	O	O	O	O

	Conventional	*Early adopter*	*Learner*	*Experienced*	*Leader*
Operating system (e.g. Apple Mac, Microsoft Windows, Google's Android OS, Linux Operating System)	O	O	O	O	O
Fast, safe and stable internet (e.g. 4G, 5G, optical network)	O	O	O	O	O
Learning management system	O	O	O	O	O
Communication tools	O	O	O	O	O

TABLE 7

BLOCK – TECHNOLOGY

PILLAR – INFRASTRUCTURE

DIMENSION – DIGITAL STORAGE

Digital storage allows the users to store mass amounts of data in a small space and allows the users to easily share information with others.

Band		*Definition*	*Description*
0	Conventional	Non-existence of digital storage	Institutions do not have any digital storage in place
1	Early adopter	Existence of digital storage	Institutions have basic digital storage, such as hard drives and USB flash drives
2	Learner	Existence of digital storage, but it is not effectively used	Institutions have the ability to use several types of digital storage and mostly utilize hard drives, USB flash drives and occasionally utilize cloud storage
3	Experienced	Existence of digital storage, which is used regularly	Institutions have the ability to choose, contextualize and integrate various technological usage, such as hard drives, USB flash drives and cloud storage
4	Leader	Existence of digital storage and full automation (IR 4.0 ready)	Referral centre of digital storage and institutions effectively utilizes technologies such as hard drives, USB flash drives, cloud storage and decentralized storage

Please use the descriptors in table 7 to answer question 9.

9. Please rate the efficiency of the digital storage available at your institution.

	Conventional	*Early adopter*	*Learner*	*Experienced*	*Leader*
Digital storage	O	O	O	O	O

TABLE 8

BLOCK – TECHNOLOGY

PILLAR – INTELLIGENCE

DIMENSION – AUTOMATION

"Automation" refers to intelligent automated technology that effectively connects users, systems and data and minimizes the need for human interaction.

Band		*Definition*	*Description*
0	None	Non-existence of automation technology	Institutions do not have any automation technology in place
1	Visible	Existence of automation technology, but it is not implemented	Institutions have automation technology but do not know how to utilize due to lack of knowledge and understanding
2	Operation Technology	Existence of automation technology, but it is not effectively used	Institutions have the ability to use several types of automation technology
3	Semi-automation	Existence of automation technology, which is used regularly	Institutions have the ability to choose and contextualize technological tools based on the institutional needs, and are thus able to flexibly utilize automation technology
4	Full automation	Existence of automation technology, which is fully utilized (IR 4.0 ready)	Referral centre of automation technology and institutions effectively utilizes the technology according to its purpose

Please use the descriptors in table 8 to answer question 10.

10. Please select the automation features at your institution.

	None	*Visible*	*Operation technology*	*Semi-automation*	*Full automation*
Intelligent automation technology (in administrative and/or classroom)	O	O	O	O	O
Connect users online	O	O	O	O	O
Systems and data (e.g. automated administrative workflows)	O	O	O	O	O
Reduce human interventions	O	O	O	O	O

TABLE 9

BLOCK – TECHNOLOGY

PILLAR – INTELLIGENCE

DIMENSION – MACHINE LEARNING

"Machine learning" is a branch of artificial intelligence and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy (IBM 2020). Some of the implementations of machine learning in education settings: predict students' performance, learning analytics, improve retention rate (Kučak, Juričić and Đambić 2018).

Band		*Definition*	*Description*
0	None	Non-existence of machine-learning technology	Institutions do not have any machine-learning technology in place
1	Visible	Existence of such technology, but it is not fully implemented	Institutions have machine-learning technology but do not know how to utilize it due to lack of knowledge and understanding
2	Operation technology	Existence of such technology, but it is not effectively used	Institutions have the ability to use several types of machine-learning technology
3	Semi-automation	Existence of such technology, which is used regularly	Institutions have the ability to choose and contextualize technological tools based on the institutional needs, thus able to flexibly utilize machine-learning technology
4	Full automation	Existence of such technology, which is fully utilized;IR 4.0 ready	Referral centre of machine-learning technology and institutions effectively utilize the technology according to its purpose

Please use the descriptors in table 9 to answer question 11.

11. Please select the machine-learning components that are available in your institution.

	None	*Visible*	*Operation technology*	*Semi-automation*	*Full automation*
Data (large amount of data to train and learn patterns)	O	O	O	O	O
Algorithms (used to process the data and make predictions or decisions)	O	O	O	O	O
Building model (used to make predictions or decisions based on new data)	O	O	O	O	O
Data visualization (can be simple, such as a single value, or complex, such as an image or text)	O	O	O	O	O
Evaluation (to determine how accurate they are at making predictions or decisions)	O	O	O	O	O
Optimization (involves adjusting the algorithm, adding or removing features, or changing the data used to train the model)	O	O	O	O	O

TABLE 10

BLOCK – TECHNOLOGY

PILLAR – INTELLIGENCE

DIMENSION – INNOVATIVE ANALYSIS

"Innovative analysis" refers to the technological advancement tools utilized by the institutions to carry out their day-to-day activities.

Band		Definition	Description
0	None	Non-existence of innovative analysis	The institutions do not carry out innovative analysis
1	Visible	Existence of such analysis, but it is not implemented due to lack of knowledge and understanding	The institutions carry out innovative analysis but do not support the institutional strategies
2	Operation Technology	Existence of such analysis, but it is not effectively used	The institutions carry out innovative analysis as one of the problem-solving strategies in several fields
3	Semi-integration	Existence of such analysis, which is used regularly	The institutions carry out innovative analysis as one of the problem-solving strategies, as needed
4	Full integration	Existence of such analysis;IR 4.0 ready	The institutions carry out innovative analysis in all fields

Please use the descriptors in table 10 to answer question 12.

12. Innovative analysis/technological advancements

	None	*Visible*	*Operation technology*	*Semi-integration*	*Full integration*
Analysis of students' learning abilities and performance	O	O	O	O	O
Digital readers and tablets	O	O	O	O	O
Augmented reality/ virtual reality	O	O	O	O	O
Gamification	O	O	O	O	O
Cloud technology	O	O	O	O	O
Mobile technology	O	O	O	O	O

TABLE 11

BLOCK – TECHNOLOGY

PILLAR – CONNECTIVITY

DIMENSION – RISK AND CYBERSECURITY MANAGEMENT

"Risk and cyber security management" is the practice of prioritizing cybersecurity defensive measures based on the potential adverse impact of the threats they are designed to address (Chickowski 2020).

Band		*Definition*	*Description*
0	None	Systems are not connected	Systems at the institutions are not able to interact or exchange information. Incompatibility between protocols, components, products and systems.
1	Connected	Systems are connected but are not secure via multiple communication technologies and protocols	Institutions have formal network links that will enable equipment, machinery and computer-based systems to interact or exchange information. Institutions do not anticipate enterprise system vulnerabilities and machine-level operational vulnerabilities that could be a security threat.
2	Interoperable	Systems are interoperable and exchangeable across multiple communication technologies and protocols	Equipment and computer-based systems at the institutions are able to interact and exchange information without significant restrictions.
3	Interoperable & secure	Interoperable systems are secure	There is a vigilant and resilient security framework at the institutions to protect the network of interoperable equipment and computer-based systems from undesired access and/or disruption
4	Real-time and scalable	Interoperable systems are secure, capable of real-time communication and scalable	Institutions have a scalable, secure and interoperable platform that is IR 4.0 ready

Please use the descriptors in table 11 to answer question 13.

13. Please select the level of risk and cybersecurity management available at your institution.

	None	*Connected*	*Interoperable*	*Interoperable and secure*	*Real-time and scalable*
Risk and cybersecurity management	O	O	O	O	O

TABLE 12

BLOCK – TECHNOLOGY

PILLAR – CONNECTIVITY

DIMENSION – DIGITAL Interconnectivity

"Digital interconnectivity" is an interaction between computers, servers/hubs and the web that is fast and safe.

Band		*Definition*	**Description**
0	None	Non-existence of any digital interconnectivity	Institutions have zero digital ecosystem density (less than 50 per cent using 4G)
1	Connected	Existence of such interconnectivity, but it is not implemented due to lack of knowledge and understanding	Institutions have a huge gap in technical skills and knowledge on how to provide effective digital interconnectivity (at least 50 per cent using 4G)
2	Interoperable	Existence of such interconnectivity, but it is limited	Institutions have only limited digital interconnectivity, as they need to redesign the current organizational and operational structures to be IR 4.0 ready (at least 75 per cent using 4G)
3	Interoperable and secure	Existence of such interconnectivity, which is used regularly	Institutions are digitally interconnected but are not 100 per cent IR 4.0 ready (100 per cent using 4G)
4	Real-time and scalable	Existence of such interconnectivity; IR 4.0 ready	Institutions are 100 per cent IR 4.0 ready, with digital connectivity (wired or wireless), and possess full augmentation of machines, with at least 5G capabilities, which provide faster response times, allowing for near real-time communication between systems

Please use the descriptors in table 12 to answer question 14.

14. Please select the level of digital interconnectivity available at your institution.

15.

	None	*Connected*	*Interoperable*	*Interoperable and secure*	*Real-time and scalable*
Digital interconnectivity	O	O	O	O	O

SECTION 3: ORGANIZATION

TABLE 13

BLOCK – ORGANIZATION

PILLAR – STRUCTURE AND MANAGEMENT

DIMENSION – EMBEDDED IR 4.0 FRAMEWORK IN THE ORGANIZATION'S PURPOSE, VISION AND MISSION

Band		*Definition and description*
0	Not stated at all	IR 4.0 is not mentioned in the purpose, vision and mission statements
1	Not clear	IR 4.0 is not stated clearly in the purpose, vision and mission statements
2	Slight influence	IR 4.0 is stated in the purpose, vision and mission statements and provided slight inspiration to some degree
3	Moderate influence	IR 4.0 is stated in the purpose, vision and mission statements and provided moderate inspiration
4	Strong influence	IR 4.0 is clearly articulated in the purpose, vision and mission statements and provided strong inspiration

Please use the descriptors in table 13 to answer question 15.

15. Is the IR 4.0 framework embedded in your organization's purpose, vision and mission?

	Not stated at all	*Not clear*	*Slight influence*	*Moderate influence*	*Strong influence*
Purpose	O	O	O	O	O
Vision	O	O	O	O	O
Mission	O	O	O	O	O

TABLE 14

BLOCK – ORGANIZATION

PILLAR – STRUCTURE AND MANAGEMENT

DIMENSION – POLICIES THAT GUIDE INSTITUTION TO ADAPT IR 4.0-RELATED TECHNOLOGIES

Band		*Definition and description*
0	No policies	There are no institutional policies on the adaptation of IR 4.0-related technologies
1	Not clear	Institutional policies related to IR 4.0 exist but do not offer guidelines for the adaptation of IR 4.0 technologies
2	Slightly clear	Institutional policies related to adaptation of IR 4.0 technologies are stated briefly and provide guidelines to some degree
3	Moderately clear	Institutional policies to implement the adaptation of IR 4.0 technologies are stated and provide modest guidelines
4	**Extremely clear**	Institutional policies to implement and evaluate the adaptation of IR 4.0 technologies are comprehensive and provided clear guidelines

Please used the descriptors in **Table 14** to answer **Question 16**.

16. Does your organization have institutional policies for the adaptation of IR 4.0-related technologies?

No policies	Not clear	Slightly clear	Moderately clear	Extremely clear
O	O	O	O	O

TABLE 15

BLOCK – ORGANIZATION

PILLAR – STRUCTURE AND MANAGEMENT

DIMENSION – PLANS TO IMPLEMENT IR 4.0-RELATED TECHNOLOGIES

Band		*Definition and description*
0	No plan	Institutions have no plan to implement IR 4.0-related technologies
1	Not clear	Plans to implement IR 4.0-related technologies exist but are not stated clearly
2	Somewhat clear	Strategic plans to implement IR 4.0-related technologies exist and are stated clearly
3	Moderately clear	Strategic plans to implement and manage IR 4.0-related technologies exist and offer modest direction
4	Extremely clear	Strategic plans to implement, manage and evaluate IR 4.0-related technologies exist and offer clear direction

Please use the descriptors in table 15 to answer question 17.

17. Are there plans for the implementation of IR 4.0-related technologies in your organization?

No plan	*Not clear*	*Somewhat clear*	*Moderately clear*	*Extremely clear*
O	O	O	O	O

TABLE 16

BLOCK – ORGANIZATION

PILLAR – TALENT READINESS

DIMENSION – CURRENT WORKFORCE IS CAPABLE OF ADOPTING IR 4.0-RELATED TECHNOLOGIES

Band		*Definition and description*
0	Not capable	The current workforce is unable to demonstrate adequate skills, abilities and personal qualities to carry out tasks related to IR 4.0 technologies
1	Slightly capable	The current workforce possesses limited skills, abilities and personal qualities relevant to carry out tasks related to IR 4.0 technologies
2	Somewhat capable	The current workforce possesses some skills, abilities and personal qualities relevant to carrying out tasks related to IR 4.0 technologies

TABLE 16

BLOCK – ORGANIZATION

PILLAR – TALENT READINESS

DIMENSION – CURRENT WORKFORCE IS CAPABLE OF ADOPTING IR 4.0-RELATED TECHNOLOGIES

Band		*Definition and description*
3	Moderately capable	The current workforce possesses modest skills, abilities and personal qualities and is moderately able to carry out tasks related to IR 4.0 technologies
4	Extremely capable	The current workforce possesses extensive skills, abilities and personal qualities and is highly capable of carrying out tasks related to IR 4.0 technologies

Please use the descriptors in table 16 to answer questions 18 and 19.

18. Is the current workforce of your organization capable of adopting IR 4.0-related technologies?

Not capable	*Slightly capable*	*Somewhat capable*	*Moderately capable*	*Extremely capable*
O	O	O	O	O

19. Is the current workforce capable of addressing challenges related to IR 4.0-related technologies?

Not capable	*Slightly capable*	*Somewhat capable*	*Moderately capable*	*Extremely capable*
O	O	O	O	O

TABLE 17

BLOCK – ORGANIZATION

PILLAR – TALENT READINESS

DIMENSION – TRAINING PLANS IN PLACE TO DEVELOP THE WORKFORCE'S SKILLS, ABILITIES AND PERSONAL QUALITIES

Band		*Definition and description*
0	No plan	No training plan for upskilling/reskilling/cross-skilling the workforce
1	Inadequate	Training plans are limited and offer insufficient guidelines for upskilling/ reskilling/ cross-skilling the workforce
2	Needs improvement	Training plans offer guidelines but lack of clarity, relevancy and practicability to upskill/re-skill/cross-skill the workforce
3	Effective	Training plans offer guidelines with modest clarity, relevancy and practicability to upskill/ reskill/cross-skill the workforce
4	Very effective	Training plans offer guidelines with extensive clarity, relevancy and practicability to up-skill/reskill/cross-skill the workforce

Please use the descriptors in table 17 to answer question 20.

20. are your organization's training plans effective to develop your workforce's skills, abilities and personal qualities?

No plan	*Inadequate*	*Needs improvement*	*Effective*	*Very effective*
O	O	O	O	O

TABLE 18

BLOCK – ORGANIZATION

PILLAR – TALENT READINESS

DIMENSION – CAPABLE TASK FORCE TO DRIVE IR 4.0 INTEGRATION

Band		*Definition and description*
0	No task force assigned	No task force to drive IR 4.0 integration
1	No capable task force	The task force is able to develop a timetable or short-term plan, with limited execution
2	Sufficiently capable task force	The task force is able to develop various ranges of plans, with modest execution capability
3	Capable task force	The task force is able to develop various ranges of plans and capable of driving IR 4.0 integration in the organization, with minimal stakeholders' engagement
4	Extremely capable task force	The task force is able to develop various ranges of plans and capable of driving IR 4.0 integration in the organization with full stakeholders' engagement

Please use the descriptors in table 18 to answer question 21.

21. How capable is your organization's task force/steering committee, if any, in driving IR 4.0 integration?

No task force assigned	*No capable task force*	*Sufficiently capable task force*	*Capable task force*	*Extremely capable task force*
O	O	O	O	O

Appendix 2

An example of an action plan for a TVET institution

IMPROVEMENT PLAN

BLOCK - *PROCESS*
PILLAR - *CURRICULUM*
DIMENSION - *TRANSVERSAL SKILLS*

Current level: 2/Learner-Moderate usage with IR 4.0 Curriculum (Curriculum content adopts basic components of IR 4.0)

Next level: 3/Experienced-Almost every time expose/ use IR 4.0 Curriculum (Curriculum content incorporates majority components of IR 4.0)

Activity	Timeline	Target
Integrating transversal skills in curriculum	6 months	Fifty percent courses have integrated transversal skills in their curricukum
Integrating transversal skills in teaching-learning	6 months	Fifty percent courses have integrated transversal skills in teaching-learning
Integrating transversal skills in assessment	6 months	Fifty percent courses have integrated transversal skills in their assessment
Notes	There is a long list of tranversal skills. The transversal skills to be focused on for this period are complex problem solving, social skills, and digital skills.	

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ISBN 9789220419113