

ดัชนีชี้วัดความพร้อมอุตสาหกรรมสมัยใหม่ (Smart Industry Readiness Index: SIRI)

ดร.รวิภัทร์ พุดพ้อง
ผู้อำนวยการฝ่ายความร่วมมืออุตสาหกรรมสมัยใหม่
เขตนวัตกรรมระเบียงเศรษฐกิจพิเศษภาคตะวันออก (EECi)

23 ก.ย. 2563

Benefits of Industry 4.0



Productivity

- Solutions to eliminate errors and wastage
- Produce more products
- Shortened cycle times



Flexibility

- Personalised products
- Efficient production
- Large variability in production control



Competitiveness

- Low manufacturing costs
- Use of innovative solutions
- Flexible response to fluctuations of demand



Profitability

- The advantages of mass production
- Optimized processes
- Low stock inventories
- Production efficiencies



Safety

- Software prevents defects
- Sensors are protecting worker safety
- Immediate reaction



Ecology

- Switching off unused objects
- Use of green solutions
- Renewable energy

Key Observations on the Adoption of Industry 4.0



Industry 4.0 will transform manufacturing



Growing adoption

Across various reports, a high percentage (60% to 80%) of companies plan to deploy Industry 4.0 solutions by 2020.



Yet many still:

1. Lack familiarity with Industry 4.0 concepts
2. Are unclear how to get started
3. Lack a systematic approach to identify opportunities and high-impact initiatives

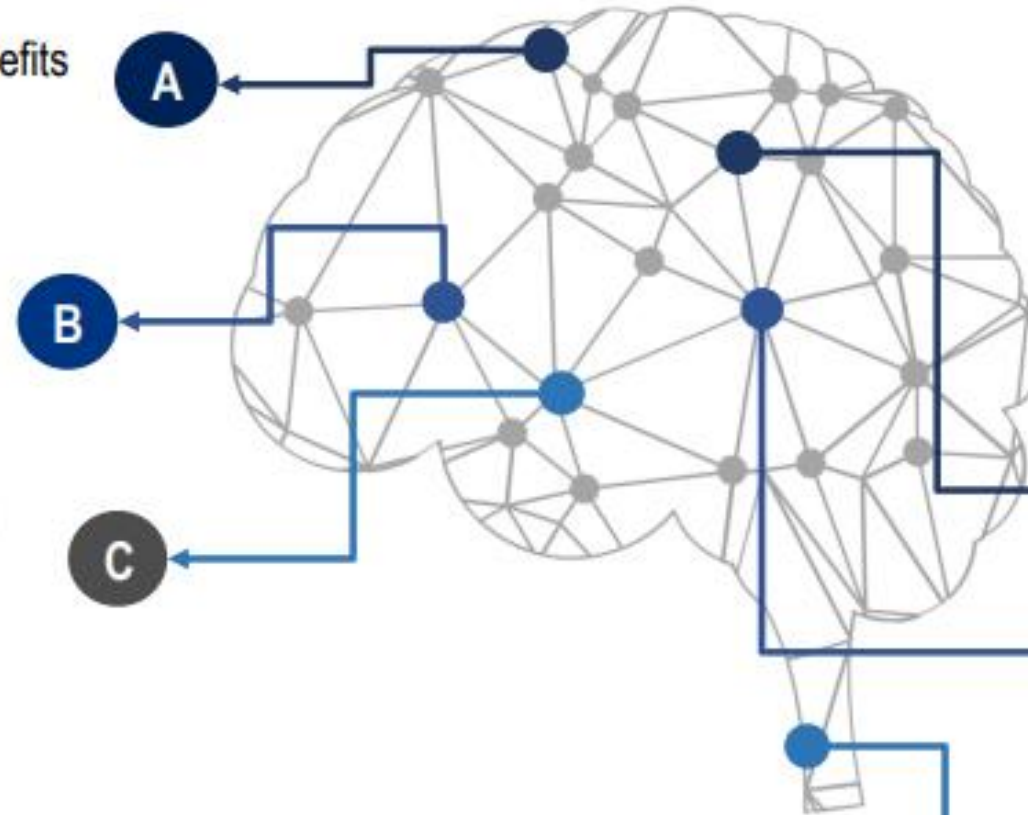
Objective of the Index

01 To help companies start, scale and sustain their transformation initiatives

What is Industry 4.0 and the tangible benefits that it can yield for my company?

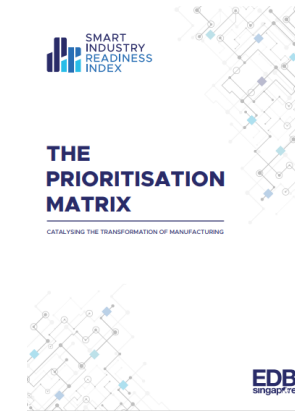
What is the Industry 4.0 maturity level of my organisation and manufacturing facility?

How can my company improve in a targeted and step-wise fashion?



02 Key considerations in the development of the Index:

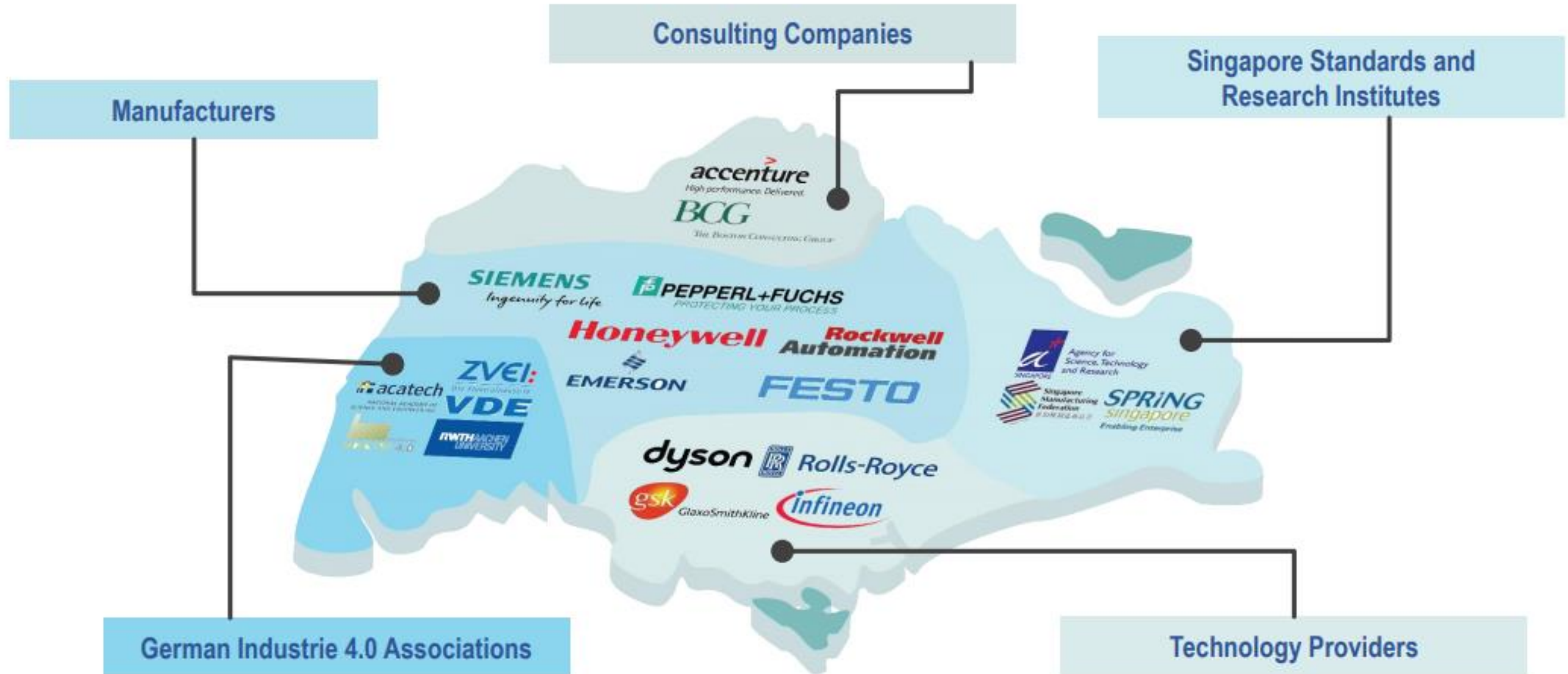
- A Comprehensive** to cover the key elements of Industry 4.0
- B Balance** between technical rigour & practical usability
- C Relevant to all companies**, regardless of industry, size, profile, and Industry 4.0 maturity



Development Process of the Index



Partners in development of the Index



SIRI Development Committee

EDB Core Development Team

Lim Kok Kiang, Assistant Managing Director
Fong Pin Fen, Director
Ang Chin Tah, Director
Xu Yinghui, Head
Ben Ong, Senior Lead
Crystalbel Foo, Senior Lead

Advisory Panel

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2. Mark Buswell, Head of Advanced Manufacturing Technologies, GlaxoSmithKline
3. Roxane Desmicht, Senior Director, Corporate Supply Chain, Infineon Technologies Asia Pacific
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5. Christian Hocken, Managing Partner, Industrie 4.0 Maturity Center, RWTH Aachen
6. Patrick Hyett, Head of Immersive Intelligent Manufacturing, GlaxoSmithKline
7. Dr -Ing Gunther Kegel, CEO Pepperl+Fuchs GmbH & President of VDE
8. Raimund Klein, Executive Vice President, Digital Factory & Process Industries & Drives, Siemens
9. Lim Yew Heng, Partner & Managing Director, BCG

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10. Ling Keok Tong, Director, A*STAR, Science and Engineering Research Council
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14. Steven Phua, Deputy Director, Standards, SPRING
15. Senthil Ramani, Managing Director, IoT Centre of Excellence, Accenture
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Participating Organizations

1. Alcon Asian Manufacturing and Logistics Pte Ltd
2. Becton Dickinson Medical (S) Pte Ltd
3. Chevron Oronite Pte Ltd
4. Eagle Services Asia Pte Ltd
5. Feinmetall Singapore Pte Ltd
6. Glaxo Wellcome Manufacturing Pte Ltd
7. GLOBALFOUNDRIES Singapore Pte Ltd
8. Infineon Technologies Asia Pacific Pte Ltd
9. JEP Precision Engineering Pte Ltd
10. Onn Wah Tech Pte Ltd
11. PBA Systems Pte Ltd
12. People Bee Hoon Factory Pte Ltd
13. Rockwell Automation Asia Pacific Business Center Pte Ltd
14. Rolls-Royce Singapore Pte Ltd
15. Shell Jurong Island (Shell Chemicals Seraya Pte Ltd)
16. Univac Precision Engineering Pte Ltd

Supporting Singapore Government Agencies

Agency for Science, Technology & Research (A*STAR)
SPRING Singapore

Overview of Data Set



SMALL AND
MEDIUM ENTERPRISES



12
MANUFACTURING
INDUSTRIES



14
COUNTRIES

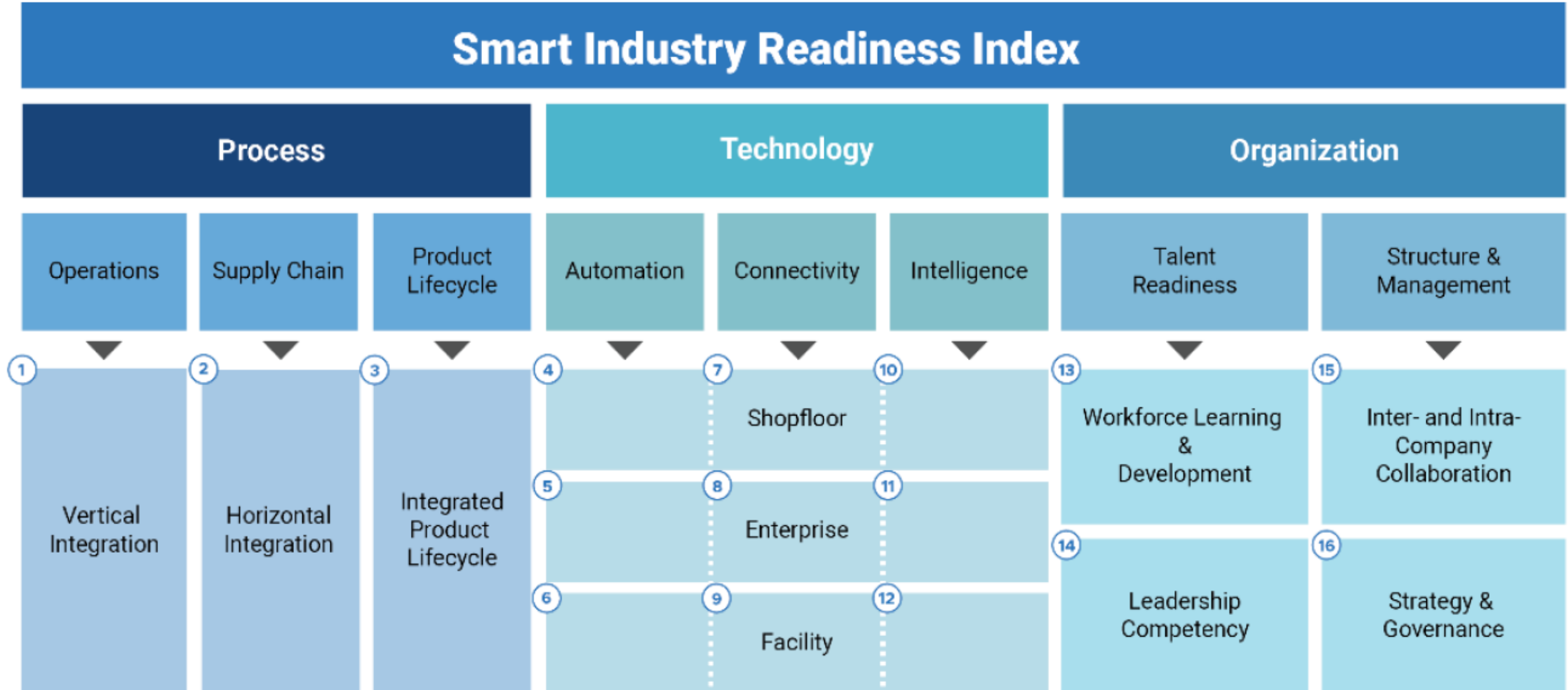


2018
-2019
ASSESSMENT
PERIOD

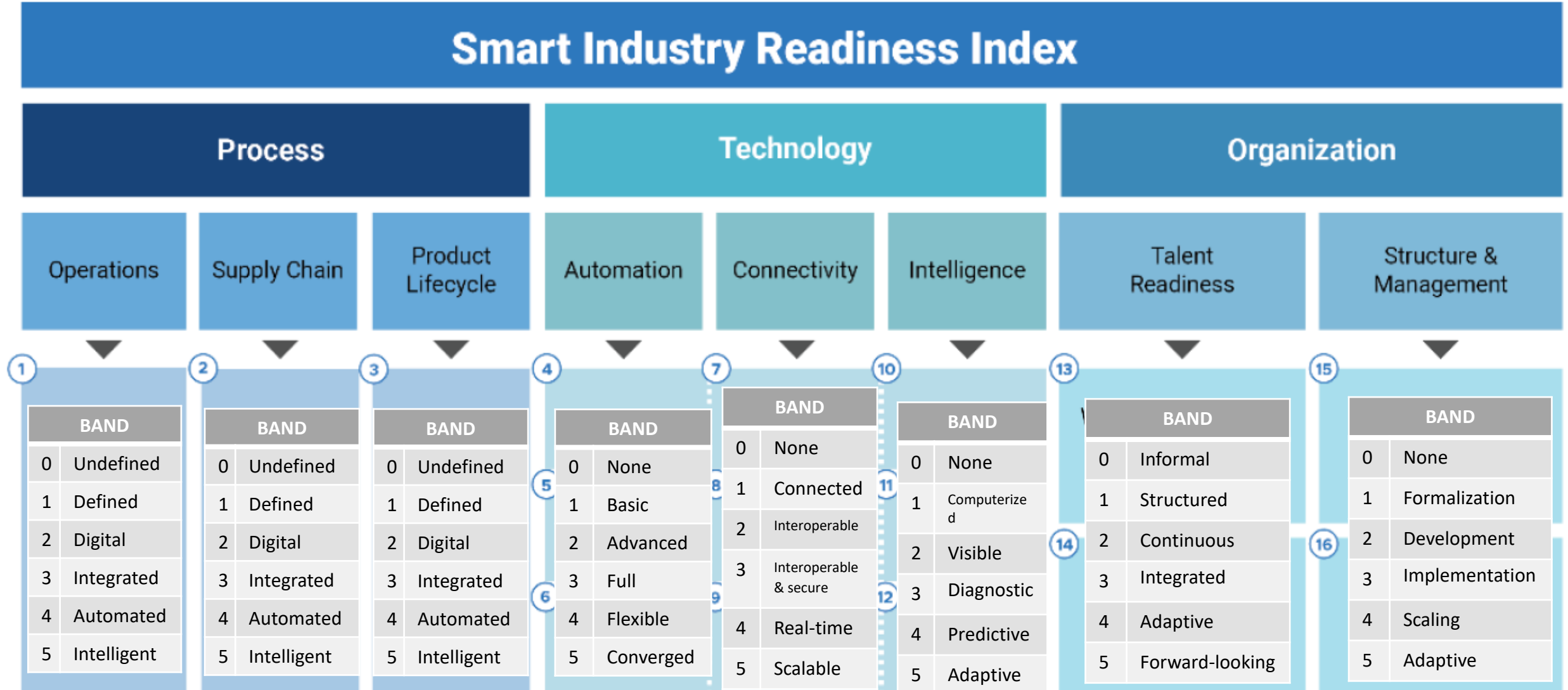
*All figures are in Singapore dollars

The Index: 16 Dimension

3 Building Blocks, 8 Pillars, 16 Dimensions



Meanings of SIRI Scores in 6 bands, Scoring 0-5



Smart Industry Readiness Index or “SIRI”

A guideline for the company to walk through the I4.0 journey

01 STEP

INITIATION

- I4.0 Readiness Assessment
- Gap Analysis & Prioritisation Matrix
- I4.0 Training

02 STEP

SOLUTIONING

- I4.0 Roadmap, Business Case
- I4.0 Trial Solution
- Qualified Vendor and Technologies

03 STEP

IMPLEMENTATION & OPERATION

- Implementation and Validation
- Real- Time Monitoring
- Data- Based Optimisation



“SIRI” is here

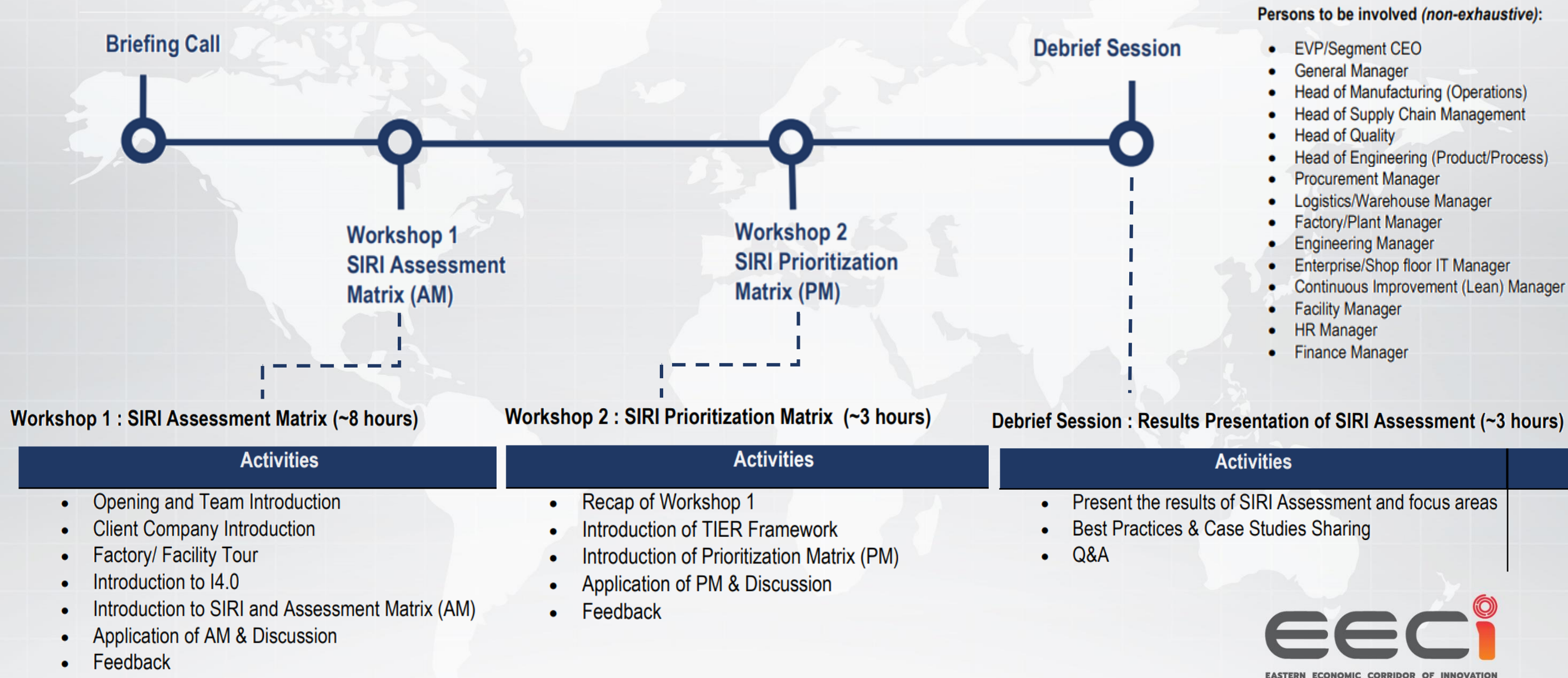




กระบวนการประเมินความพร้อมสู่อุตสาหกรรม 4.0

SIRI Assessment Process

Timeline of SIRI Assessment



Process – Operations – Vertical Integration



Vertical Integration is the integration of processes and systems across all hierarchical levels of the automation pyramid within a facility to establish a connected, end-to-end data thread.

These levels includes:

- Field level (*sensors and actuators interfacing with the production process*)
- Control level (*control of machines and systems*)
- Production level (*monitoring, control and supervision of product lines*)
- Operations level (*production planning, quality management*)
- Enterprise planning level (*order management and processing, enterprise production planning and business process management*).

Band		Definition	Description
0	Undefined	Vertical processes are not explicitly defined.	Resource planning and technical production processes are managed and executed in silos, based on informal or ad-hoc methods.
1	Defined	Vertical processes are defined and executed by humans, with the support of analogue tools.	Resource planning and technical production processes are managed and executed in silos, based on a set of formally defined instructions.
2	Digital	Defined vertical processes are completed by humans with the support of digital tools.	Resource planning and technical production processes are managed and executed in silos, by Operations Technology (OT) and Information Technology (IT) systems.
3	Integrated	Digitized vertical processes and systems are securely integrated across all hierarchical levels of the automation pyramid.	OT and IT systems managing resource planning and technical production processes are formally linked; however the exchange of data and information across different functions is predominantly managed by humans.
4	Automated	Integrated vertical processes and systems are automated, with limited human intervention.	OT and IT systems managing the resource planning and technical production processes are formally linked, with the exchange of data and information across different functions predominantly executed by equipment, machinery and computer-based systems.
5	Intelligent	Automated vertical processes and systems are actively analysing and reacting to data.	OT and IT systems are integrated from end to end, with processes being optimized through insights generated from analysis of data.

Evaluate current state of facilities and the companies' readiness level

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



Source: Shutterstock: Silk
Fabric Manufacturing Process
At Home

Evaluate current state of facilities and the companies' readiness level

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



Source: ELGi Equipments Limited

Evaluate current state of facilities and the companies' readiness level

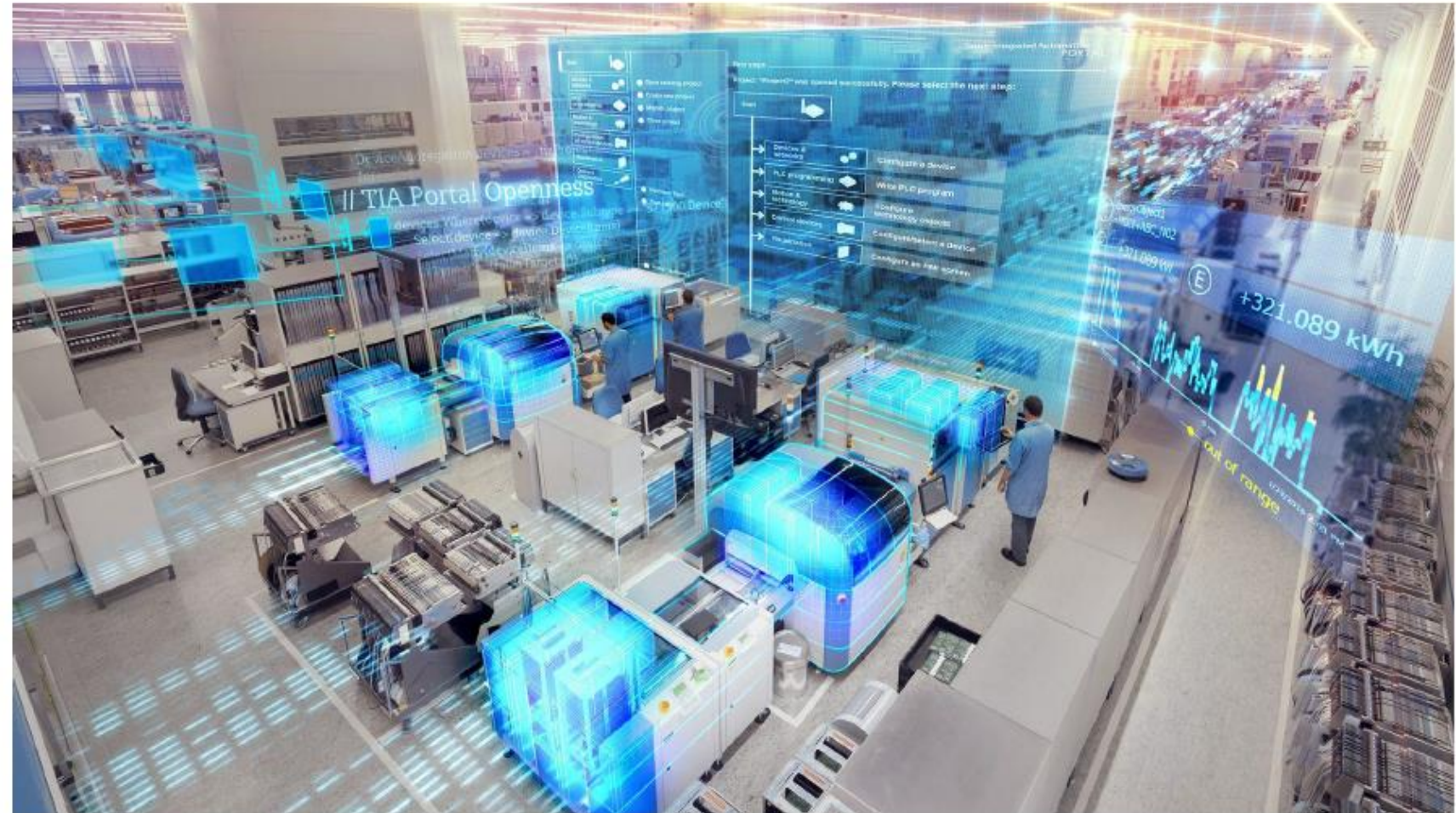
Band	
0	Undefined
1	Defined
2	Digital
3	Integrated
4	Automated
5	Intelligent



Source: Bosch

Process – Operations – Vertical Integration

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



Source: Siemens

Process – Operations – Vertical Integration

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



Source: Daimler

Process – Operations – Vertical Integration

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



Source: Zotera

Prioritized Enablers								
		Bands						
Dimensions		0	1	2	3	4	5	
		Undefined	Defined	Digital	Integrated	Automated	Intelligent	
Process	1. Vertical Integration							
	2. Horizontal Integration							
	3. Integrated Product Lifecycle							
Technology	4. Shopfloor Automation							
	5. Enterprise Automation							
	6. Facility Automation							
	7. Shopfloor Connectivity							
	8. Enterprise Connectivity							
	9. Facility Connectivity							
	10. Shopfloor Intelligence							
	11. Enterprise Intelligence							
	12. Facility Intelligence							
	Organization	13. Workforce Learning & Development						
		14. Leadership competency						
		15. Inter- & Intra- Company Collaboration						
16. Strategy & Governance								

THE 10 KEY PERFORMANCE INDICATORS



Scoring of Cost and Revenue Components

Profit-and-Loss Components	% of Revenue
Aftermarket Services / Warranty	0.1%
Depreciation	7%
Labour	12%
Maintenance & Repair	1%
Raw Materials & Consumables	56.8%
Rental & Operating Lease	0%
Research & Development	0.1%
Selling, General & Administrative Expenses (SG&A)	10%
Utilities	10%
Earnings Before Interest & Taxes (EBIT)	3%

THE PRIORITISATION MATRIX FORMULA



P&L Category	Description
 Aftermarket Services / Warranty	Expenses that the company expects to or has already incurred for the repair or replacement of goods that it has sold. The total expense is limited by the warranty period that the company provides.
 Depreciation	A non-cash expense representing the portion of all fixed assets owned by the company that has been considered consumed over an accounting or financial period.
 Labour	The sum of all wages paid to employees, as well as the cost of employee benefits and payroll taxes paid by an employer. This covers employees who are directly involved in the maintenance and production processes, and support teams that ensure the smooth running of the entire facility.
 Maintenance & Repair	All expenses required to bring capital assets – such as building, infrastructure, equipment, and machinery – back to good working order, or to keep them operating in optimal condition. This includes fixing broken assets and routine servicing.
 Raw Materials & Consumables	Inventory of all component parts currently in stock that have not yet been used in work-in-process or finished goods production. They include both direct materials, which are incorporated into the final product, and indirect materials that are consumed during the production process but not incorporated into the final product.
 Rental & Operating Lease	Costs associated with the use of assets which the company does not own. These include but are not limited to property, plant, and equipment.
 Research & Development	All expenses relating to activities for the development or improvement of products or processes. Such activities can include product design improvement and production process enhancement.
 Selling, General & Administrative Expenses ("SG&A")	All operating expenses which are not directly tied to the cost of making a product. These include corporate, accounting, legal, sales, and marketing expenses.
 Utilities	Cost of electricity, heat (gas/fuel), sewer, and water used by a factory or plant to ensure the smooth running of both the direct manufacturing process and its surrounding environmental conditions.
 Earnings Before Interest & Taxes ("EBIT")	A calculation of the operational earnings or profitability of a company. It excludes interest, which is a finance cost, and taxes, which are imposed by a governmental entity.

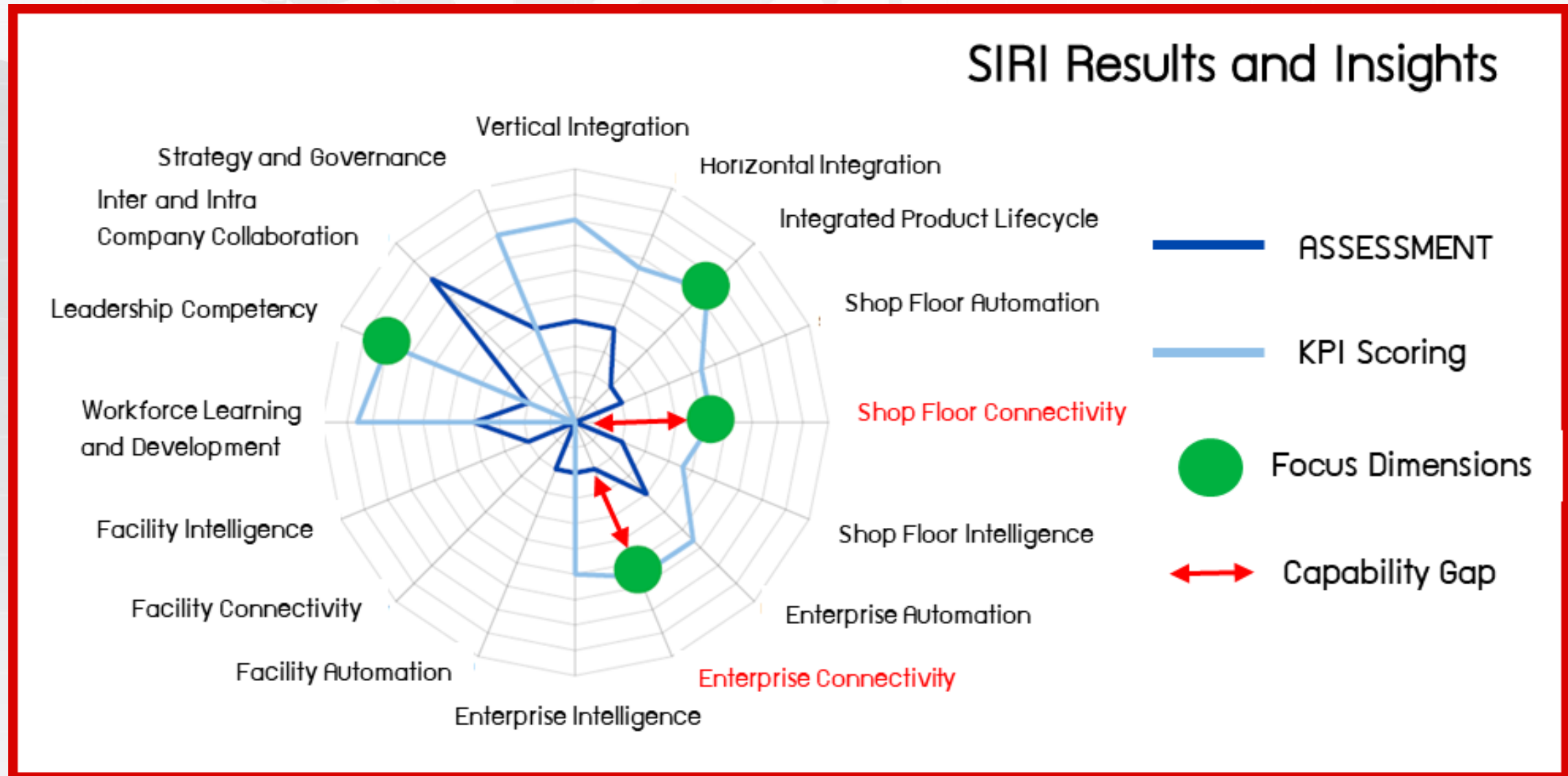
Assessment Scores and Priority Areas

Prioritized Enablers								
Dimensions		Bands						
		0	1	2	3	4	5	
		Undefined	Defined	Digital	Integrated	Automated	Intelligent	
Process	1. Vertical Integration							
	2. Horizontal Integration							
	3. Integrated Product Lifecycle							
Technology	4. Shopfloor Automation							
	5. Enterprise Automation							
	6. Facility Automation							
	7. Shopfloor Connectivity							
	8. Enterprise Connectivity							
	9. Facility Connectivity							
	10. Shopfloor Intelligence							
	11. Enterprise Intelligence							
	12. Facility Intelligence							
	Organization	13. Workforce Learning & Development						
		14. Leadership competency						
		15. Inter- & Intra- Company Collaboration						
16. Strategy & Governance								

Legend:
 Current State
 Future State

Assessment, Gap Analysis, and Focus Dimension

Combining “assessment scores”, “revenue-cost profile”, “business objective” and “industry best practice”, a company obtains “**Focus Dimensions**” or Priority Areas to start the I4.0 journey. This EDB’s proprietary method is called “**Prioritization Matrix**”



A faint, light gray world map is visible in the background of the slide, centered behind the main text.

Intermediate **Results** of SIRI pilot projects in Thailand

NSTDA-EDB-Tuv Sud Collaboration

EDB
singapore

NSTDA

NSTDA



10 Oct 2019 :

LOI with EDB on SIRI pilot assessment in Thailand.



Dec 2019 :

MoU with Tuv Sud

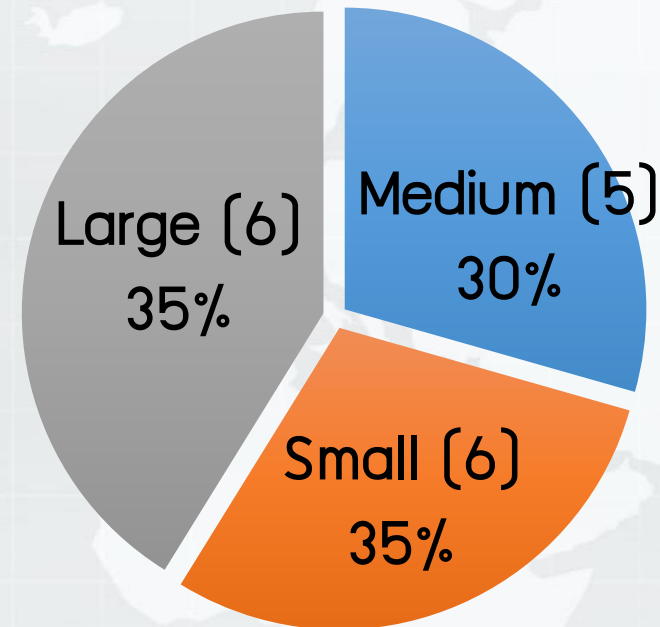
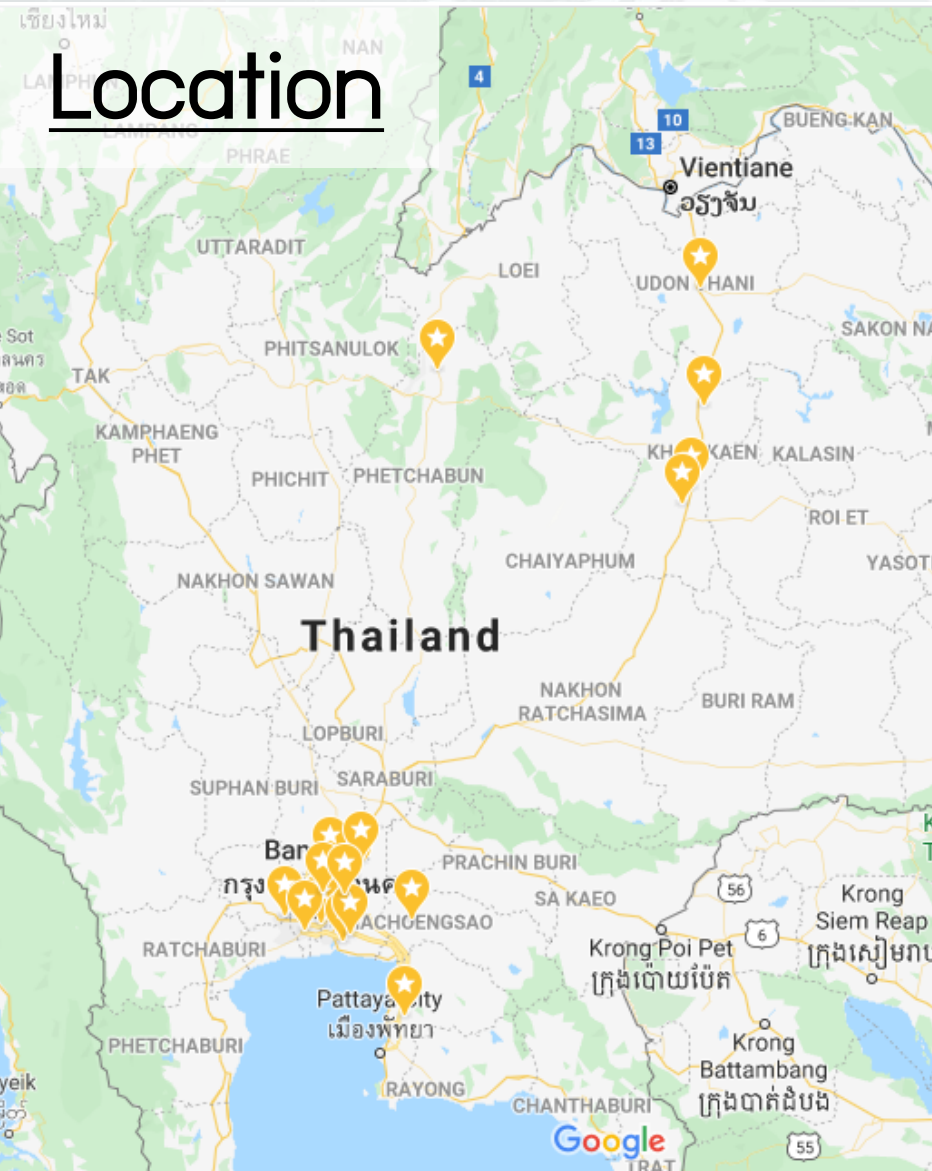


Nov '19 – Mar '20 :

Assessment of 17 pilot companies.

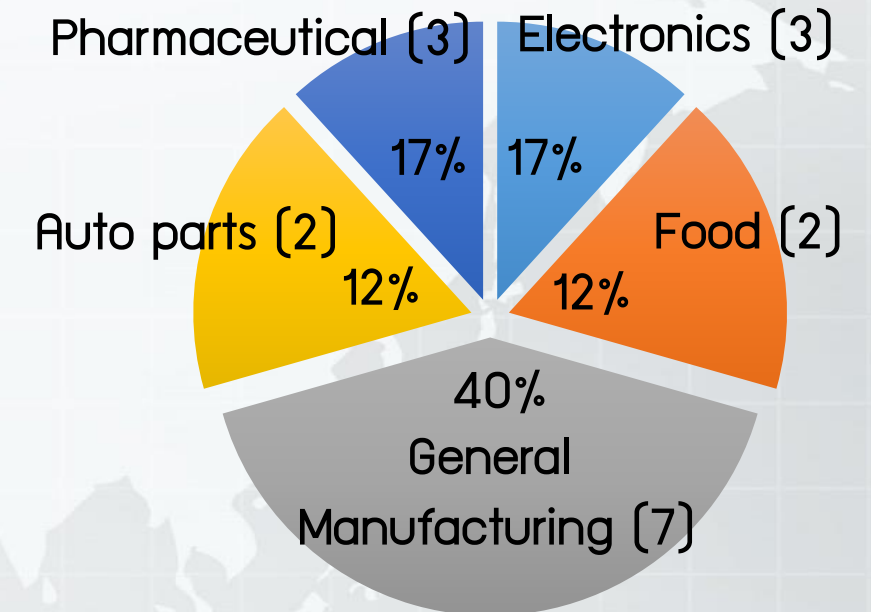
17 Pilot Projects in 5 Industrial Sectors

Location

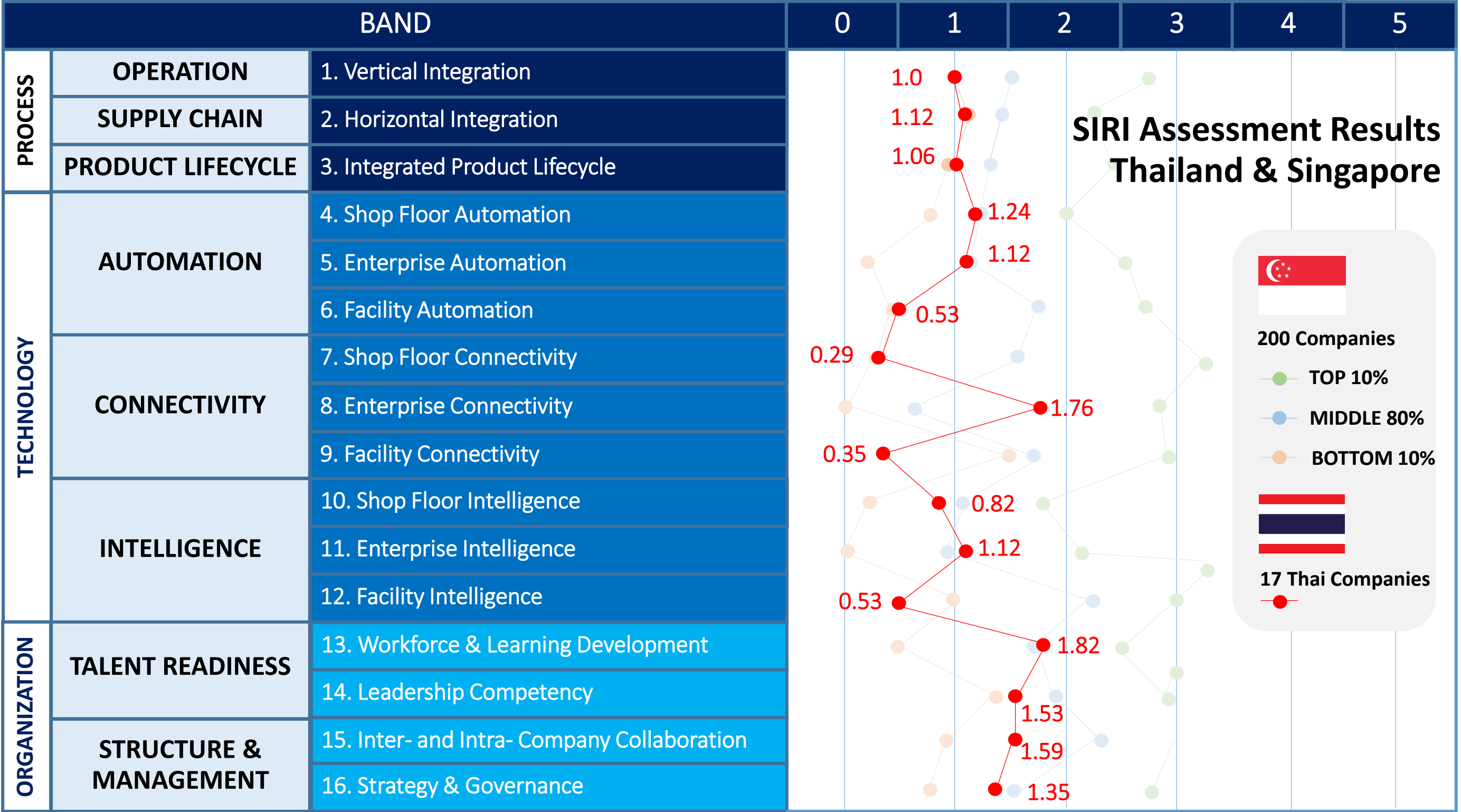


Enterprise Sizes

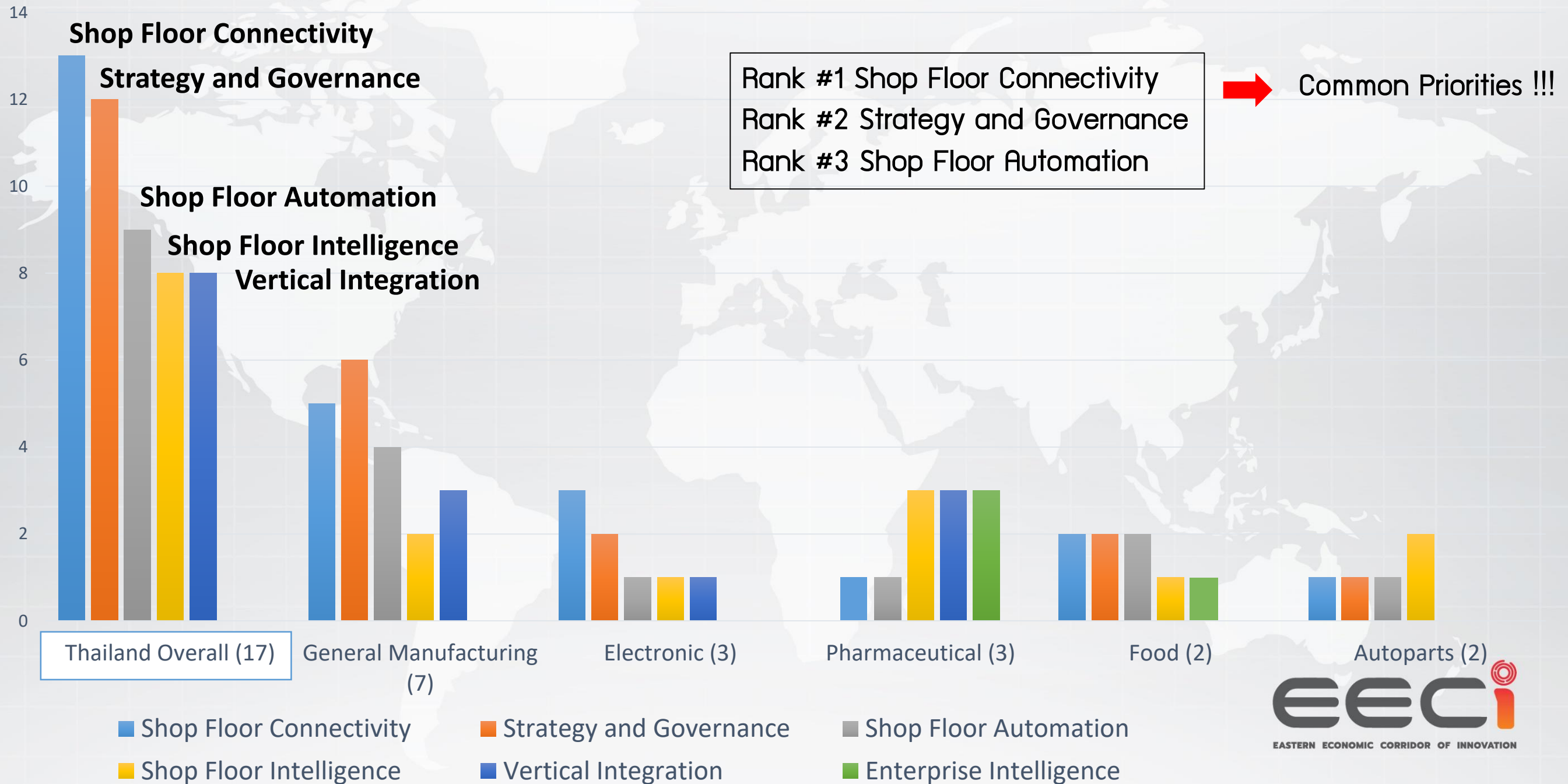
S = รายได้ < 100 ลว.
M = รายได้ 100-500 ลว.
L = รายได้ > 500 ลว.



Industrial Sectors

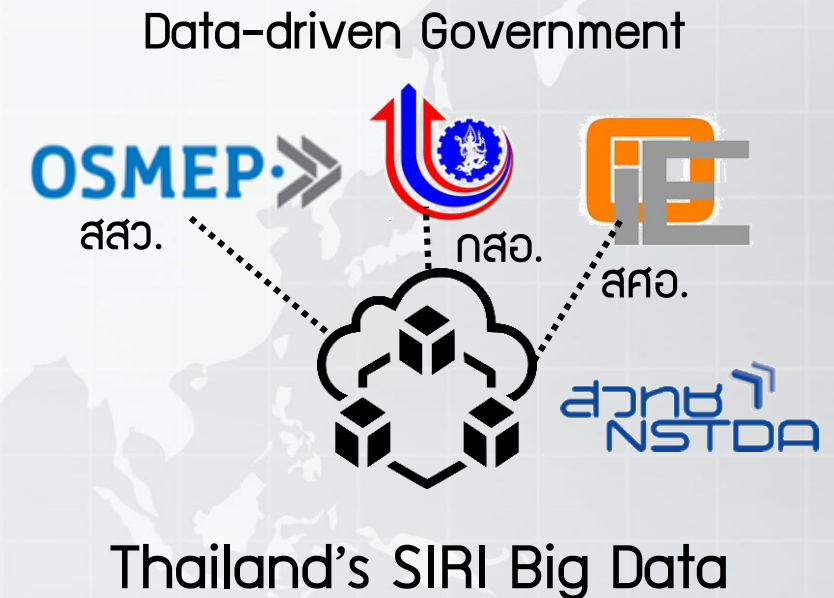


SIRI helps identify “Real Demands” from the Industries



Potential Benefits of Larger Scale SIRI Deployment

1. “Big Picture” – a country Industry 4.0 Readiness
2. Industry 4.0 Readiness per industrial sectors, S-curve industries
3. “Priority areas” in short, medium, long terms
 - ◎ Roadmaps of Technology Deployment / R&D
 - ◎ HR Development – researchers, consultants, system integrators, etc.
 - ◎ Supporting Infrastructures & NQIs
4. Data-driven government / Supporting government policy planning and evaluation
5. Benchmarking with other countries



การขับเคลื่อนการยกระดับอุตสาหกรรมโดย EECi ARIPOLIS

ขั้นที่ 1 การประเมินความพร้อม

- การอบรม Industry 4.0
- การประเมินความพร้อมด้วยดัชนีชี้วัด (SIRI)
- การวิเคราะห์ช่องว่าง และการกำหนดด้านที่จำเป็นต้องปรับปรุงเป็นลำดับแรก

1. การพัฒนาดัชนีชี้วัดอุตสาหกรรม 4.0 ฉบับภาษาไทย (SIRI-Thai edition) และผลักดันให้เป็นดัชนีชี้วัดของประเทศ
2. การพัฒนาผู้ประเมิน (Assessor) ชาวไทย

ขั้นที่ 2 การให้คำปรึกษา

- การทำแผนที่นำทางเทคโนโลยี
- การทดลอง Solution/Proof of Concept
- การคัดเลือกเทคโนโลยีและผู้ให้บริการ (SI)

1. การมีกลไกการให้คำปรึกษา เช่น ITAP
2. การสร้างที่ปรึกษาเทคโนโลยี (Consultants)

ขั้นที่ 3 การลงมือปฏิบัติ

- ผู้ให้บริการลงมือติดตั้ง ทดสอบการใช้งาน
- การใช้งานในสถานประกอบการ
- การบำรุงรักษา

1. การพัฒนา Testbed
2. การพัฒนาเทคโนโลยีและการถ่ายทอดเทคโนโลยี
3. การพัฒนา SI

กลไก
สนับสนุน

EECi

Eastern Economic Corridor
of Innovation



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Phahonyothin Road,
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Assessment Tool: Dimension 1-2

Process Building Block Operations Pillar Vertical Integration Dimension			
Vertical Integration is the integration of processes and systems across all hierarchical levels of the automation pyramid within a facility to establish a connected, end-to-end data thread.			
Band		Definition	Description
0	Undefined	Vertical processes are not explicitly defined.	Resource planning and technical production processes are managed and executed in silos, based on informal or ad-hoc methods.
1	Defined	Vertical processes are defined and executed by humans, with the support of analogue tools. ¹	Resource planning and technical production processes are managed and executed in silos, based on a set of formally defined instructions.
2	Digital	Defined vertical processes are completed by humans with the support of digital tools.	Resource planning and technical production processes are managed and executed in silos, by Operations Technology (OT) and Information Technology (IT) systems.
3	Integrated	Digitized vertical processes and systems are securely integrated across all hierarchical levels of the automation pyramid. ²	OT and IT systems managing resource planning and technical production processes are formally linked; however the exchange of data and information across different functions is predominantly managed by humans.
4	Automated	Integrated vertical processes and systems are automated, with limited human intervention.	OT and IT systems managing the resource planning and technical production processes are formally linked, with the exchange of data and information across different functions predominantly executed by equipment, machinery and computer-based systems.
5	Intelligent	Automated vertical processes and systems are actively analysing and reacting to data.	OT and IT systems are integrated from end to end, with processes being optimized through insights generated from analysis of data.

Process Building Block Supply Chain Pillar Horizontal Integration Dimension			
Horizontal Integration is the integration of enterprise processes across the organization and with stakeholders along the value chain.			
Band		Definition	Description
0	Undefined	Supply chain processes ³ are not explicitly defined.	Enterprise processes are managed and executed in silos, based on informal or ad-hoc methods.
1	Defined	Supply chain processes are defined and executed by humans, with the support of analogue tools.	Enterprise processes are managed and executed in silos, based on a set of formally defined instructions.
2	Digital	Defined supply chain processes are completed by humans with the support of digital tools.	Enterprise processes are managed and executed in silos by IT systems.
3	Integrated	Digitized supply chain processes and systems are securely integrated across business partners and clients along the value chain.	IT systems managing enterprise processes are formally linked; however the exchange of data and information across different functions is predominantly managed by humans.
4	Automated	Integrated supply-chain processes and systems are automated, with limited human intervention.	IT systems managing enterprise processes are formally linked, with the exchange of data and information across different functions being predominantly executed by computer-based systems.
5	Intelligent	Automated supply chain processes and systems are actively analysing and reacting to data.	IT systems are integrated from end to end, with processes being optimized through insights generated from analysis of data.

Assessment Tool: Dimension 3-4

Process Building Block Product Lifecycle Pillar Integrated Product Lifecycle Dimension			
Integrated Product Cycle is the integration of people, processes and systems along the entire product lifecycle, encompassing the stages of design and development, engineering, production, customer use, service, and disposal.			
Band		Definition	Description
0	Undefined	Product lifecycle ⁴ processes are not explicitly defined.	Processes along the product lifecycle are managed and executed in silos, based on informal or ad-hoc methods.
1	Defined	Product lifecycle processes are defined and executed by humans, with the support of analogue tools.	Processes along the product lifecycle are managed and executed in silos, based on a set of formally defined instructions.
2	Digital	Defined product lifecycle processes are completed by humans, with the support of digital tools.	Processes along the product lifecycle are managed and executed in silos, by digital tools.
3	Integrated	Digitized product lifecycle processes and systems are securely integrated across all stages of the product lifecycle.	Digital tools and systems that manage the product lifecycle are formally linked with each other; however, the exchange of information along the product lifecycle is predominantly managed by humans.
4	Automated	Integrated product lifecycle processes are automated, with limited human intervention.	Digital tools and systems that manage the product lifecycle are formally linked with each other, and the exchange of information along the product lifecycle is predominantly executed by computer-based systems.
5	Intelligent	Automated product lifecycle processes are actively analysing and reacting to data.	Digital tools and systems deployed for the management of the product lifecycle are integrated from end to end, with the processes being optimized through insights generated from analysis of data.

Technology Building Block Automation Pillar Shop Floor Automation Dimension			
Shop Floor Automation is the application of technology to monitor, control and execute the production and delivery of products and services, within the location where the production and management of goods is carried out.			
Band		Definition	Description
0	None	Repetitive production ⁵ and support processes ⁶ are not automated.	Production processes are executed by humans.
1	Basic	Repetitive production processes are partially automated, with significant human intervention. Repetitive support processes are not automated.	Production processes are executed by humans with the assistance of equipment, machinery and computer-based systems.
2	Advanced	Repetitive production processes are automated, with minimal human intervention. Repetitive support processes are not automated.	Production processes are predominantly executed by equipment, machinery and computer-based systems. Human intervention is required to initiate and conclude each process.
3	Full	Repetitive production processes are fully automated, with no human intervention. Repetitive support processes are partially automated, with limited human intervention.	Production processes are fully automated through the use of equipment, machinery and computer-based systems. Human intervention is required for unplanned events.
4	Flexible	Automated production processes are reconfigurable through plug-and-play automation. Repetitive support processes are partially automated, with limited human intervention.	Equipment, machinery and computer-based systems can be modified, reconfigured, and re-tasked quickly and easily when needed. Limited human intervention is required for unplanned events.
5	Converged	Flexible production and support processes are converged with enterprise and facility automation platforms to form highly autonomous networks.	Equipment, machinery and computer-based systems are flexible and formally integrated with enterprise and facility systems, to allow for dynamic, cross-domain interactions.

Assessment Tool: Dimension 5-6

Technology Building Block Automation Pillar Enterprise Automation Dimension			
Enterprise Automation is the application of technology to monitor, control and execute processes, within the location where the administrative work is carried out. These processes include, but are not limited to, sales and marketing, demand planning, procurement, and human resource management and planning.			
Band		Definition	Description
0	None	Enterprise processes are not automated.	Enterprise processes are executed by humans.
1	Basic	Enterprise processes are partially automated, with significant human intervention.	Enterprise processes are executed by humans with the assistance of computer-based systems.
2	Advanced	Enterprise processes are automated, with minimal human intervention.	Enterprise processes are predominantly executed by computer-based systems. Human intervention is required to initiate and conclude each process.
3	Full	Enterprise processes are fully automated, with no human intervention.	Enterprise processes are fully automated through the use of computer-based systems. Human intervention is required for unplanned events.
4	Flexible	Automated enterprise processes are adaptable.	Computer-based systems can be modified, reconfigured, and re-tasked quickly and easily when needed. Limited human intervention is required for unplanned events.
5	Converged	Flexible enterprise processes are converged with shop floor and facility automation platforms to form highly autonomous networks.	Computer-based systems are flexible and formally integrated with those of shop floor and facility systems to allow for dynamic, cross-domain interactions.

Technology Building Block Automation Pillar Facility Automation Dimension			
Facility Automation is the application of technology to monitor, control and execute processes within the physical building and/or premises where the production area is located. These processes include but are not limited to the management of HVAC, chiller, security, and lighting systems.			
Band		Definition	Description
0	None	Facility processes are not automated.	Facility processes are executed by humans.
1	Basic	Facility processes are partially automated, with significant human intervention.	Facility processes are executed by humans, with the assistance of equipment, machinery and computer-based systems.
2	Advanced	Facility processes are automated, with minimal human intervention.	Facility processes are predominantly executed by equipment, machinery and computer-based systems. Human intervention is required to initiate and conclude each process.
3	Full	Facility processes are fully automated, with no human intervention.	Facility processes are fully automated through the utilization of equipment, machinery and computer-based systems. Human intervention is required for unplanned events.
4	Flexible	Automated facility processes are adaptable.	Equipment, machinery and computer-based systems can be modified, reconfigured, and re-tasked quickly and easily when needed. Limited human intervention is required for unplanned events.
5	Converged	Flexible facility processes are converged with shop floor and enterprise automation platforms to form highly autonomous networks.	Equipment, machinery and computer-based systems are flexible and formally integrated with those of shop floor and enterprise systems to allow for dynamic, cross-domain interactions.

Assessment Tool: Dimension 7-8

Technology Building Block Connectivity Pillar Shop Floor Connectivity Dimension			
Shop floor connectivity is the interconnection of equipment, machines and computer-based systems, to enable communication and seamless data exchange, within the location where the production and management of goods is carried out.			
Band		Definition	Description
0	None	Production assets and systems are not connected.	Equipment, machinery and computer-based systems are not able to interact or exchange information.
1	Connected	Production assets and systems are connected via multiple communication technologies & protocols.	There are formal network links that will enable equipment, machinery and computer-based systems to interact or exchange information.
2	Interoperable	Connected production assets and systems are interoperable across multiple communication technologies & protocols.	Equipment, machinery and computer-based systems are able to interact and exchange information without significant restrictions.
3	Interoperable And Secure	Interoperable production assets and systems are secure.	There is a vigilant and resilient security framework to protect the network of interoperable equipment, machinery, and computer-based systems from undesired access and/or disruption.
4	Real-Time	Interoperable production assets and systems are secure and capable of real-time communication.	Interoperable and secure network links across different equipment, machinery and computer-based systems are able to interact or exchange information as the information is generated without delay.
5	Scalable	Interoperable production assets and systems are secure, capable of real-time communication, and scalable.	Existing networks can be configured quickly and easily to accommodate any modifications made to the existing composition of equipment, machinery and computer-based systems.

Technology Building Block Connectivity Pillar Enterprise Connectivity Dimension			
Enterprise connectivity is the interconnection of equipment, machines and computer-based systems, to enable communication and seamless data exchange, within the location where the administrative work is carried out.			
Band		Definition	Description
0	None	Enterprise IT systems are not connected.	Computer-based systems are not able to interact or exchange information.
1	Connected	Enterprise IT systems are connected via multiple communication technologies & protocols.	There are formal network links that will enable computer-based systems to interact or exchange information.
2	Interoperable	Enterprise IT systems are interoperable across multiple communication technologies & protocols.	Computer-based systems are able to interact and exchange information without significant restriction.
3	Interoperable And Secure	Interoperable Enterprise IT systems are secure.	There is a vigilant and resilient security framework to protect the network of interoperable computer-based systems from undesired access and/or disruption.
4	Real-Time	Interoperable Enterprise IT systems are secure and capable of real-time communication.	Interoperable and secure network links across the different computer-based systems are able to interact or exchange information as the information is generated without delay.
5	Scalable	Interoperable Enterprise IT systems are secure, capable of real-time communication, and scalable.	Existing networks can be configured quickly and easily to accommodate any modifications made to the existing composition of computer-based systems.

Assessment Tool: Dimension 9-10

Technology Building Block Connectivity Pillar Facility Connectivity Dimension			
Facility connectivity is the interconnection of equipment, machines and computer-based systems, to enable communication and seamless data exchange, within the physical building and/or land plot where the production area is located.			
Band		Definition	Description
0	None	Facility assets and systems are not connected.	Equipment, machinery and systems are not able to interact or exchange information.
1	Connected	Facility assets and systems are connected via multiple communication technologies & protocols.	There are formal network links that will enable equipment, machinery and computer-based systems to interact or exchange information.
2	Interoperable	Facility assets and systems are interoperable across multiple communication technologies & protocols.	Equipment, machinery and computer-based systems are able to interact and exchange information without significant restrictions.
3	Interoperable And Secure	Interoperable facility assets and systems are secure.	There is a vigilant and resilient security framework to protect the network of interoperable equipment, machinery, and computer-based systems from undesired access and/or disruption.
4	Real-Time	Interoperable facility assets and systems are secure and capable of real-time communication.	Interoperable and secure network links across different equipment, machinery and computer-based systems are able to interact or exchange information as the information is generated with delay.
5	Scalable	Interoperable facility assets and systems are secure, capable of real-time communication, and scalable.	Existing networks can be configured quickly and easily to accommodate any modifications made to the existing composition of equipment, machinery and computer-based systems.

Technology Building Block Intelligence Pillar Shop Floor Intelligence Dimension			
Shop Floor Intelligence is the processing & analysis of data to optimize existing processes and create new applications, products, and services, within the location where the production and management of goods is carried out.			
Band		Definition	Description
0	None	OT & IT systems are not in use.	No electronic or digital devices are used.
1	Computerized	OT & IT systems execute pre-programmed tasks and processes.	Equipment, machinery and computer-based systems are able to perform tasks based on pre-programmed logic.
2	Visible	Computerized OT & IT systems are able to identify deviations.	Equipment, machinery and computer-based systems are able to notify operators of deviations from predefined parameters.
3	Diagnostic	Computerized OT & IT systems are able to identify deviations and diagnose potential causes.	Equipment, machinery and computer-based systems are able to notify operators of deviations, and provide information on the possible causes.
4	Predictive	Computerized OT & IT systems are able to diagnose problems and predict future states of assets and systems.	Equipment, machinery and computer-based systems are able to predict and notify operators of potential deviations, and provide information on the possible causes.
5	Adaptive	Computerized OT & IT systems are able to diagnose problems, predict future states and autonomously execute decisions to adapt to changes.	Equipment, machinery and computer-based systems are able to predict and diagnose potential deviations, and independently execute decisions to optimize performance and resource efficiency.

Assessment Tool: Dimension 11-12

Technology Building Block Intelligence Pillar Enterprise Intelligence Dimension			
Enterprise Intelligence is the processing & analysis of data to optimize existing administrative processes and create new applications, products and services.			
Band		Definition	Description
0	None	Enterprise systems are not in use.	No electronic or digital devices are used.
1	Computerized	Enterprise IT systems execute pre-programmed tasks and processes.	Enterprise computer-based systems perform tasks based on pre-programmed logic.
2	Visible	Enterprise IT systems are able to identify deviations.	Enterprise computer-based systems are able to notify relevant personnel of deviations from predefined parameters.
3	Diagnostic	Enterprise IT systems are able to identify deviations and diagnose potential causes.	Enterprise computer-based systems are able to notify relevant personnel of deviations, and provide information on the possible causes.
4	Predictive	Enterprise IT systems are able to diagnose problems and predict future states of assets and systems.	Enterprise computer-based systems are able to predict and notify relevant personnel of potential deviations, and provide information on the possible causes.
5	Adaptive	Enterprise IT systems are able to diagnose problems, predict future states, and autonomously execute decisions to adapt to changes.	Enterprise computer-based systems are able to predict and diagnose potential deviations, and independently execute decisions to optimize performance and resource efficiency.

Technology Building Block Intelligence Pillar Facility Intelligence Dimension			
Facility Intelligence is the processing & analysis of data to optimize existing processes and create new applications, products and services, within the physical building and premises where the production area is located at.			
Band		Definition	Description
0	None	OT & IT systems are not in use.	No electronic or digital devices are used.
1	Computerized	OT & IT systems execute pre-programmed tasks and processes.	Equipment, machinery and computer-based systems perform tasks based on pre-programmed logic.
2	Visible	Computerized OT & IT systems are able to identify deviations.	Equipment, machinery and computer-based systems are able to notify relevant personnel of deviations from predefined parameters.
3	Diagnostic	Computerized OT & IT systems are able to identify deviations and diagnose potential causes.	Equipment, machinery and computer-based systems are able to notify relevant personnel of deviations, and provide information on possible causes.
4	Predictive	Computerized OT & IT systems are able to diagnose problems and predict future states of assets and systems.	Equipment, machinery and computer-based systems are able to predict and notify relevant personnel of potential deviations, and provide information on the possible causes.
5	Adaptive	Computerized OT & IT systems are able to diagnose problems, predict future states, and autonomously execute decisions to adapt to changes.	Equipment, machinery and computer-based systems are able to predict and diagnose potential deviations, and independently execute decisions to optimize performance and resource efficiency.

Assessment Tool: Dimension 13-14

Organization Building Block Talent Readiness Pillar Workforce Learning & Development Dimension			
Workforce Learning & Development ("L&D") is a system of processes and programmes that aims to develop the workforce's capabilities, skills and competencies to achieve organizational excellence.			
Band		Definition	Description
0	Informal	Informal mentorship and apprenticeship is the predominant mode of workforce L&D.	There is no formal L&D curriculum to on-board and train the workforce.
1	Structured	Formally designed training curricula for skills acquisition is the predominant mode of workforce L&D.	There is a formal L&D curriculum with clear commencement and conclusion points. The scope of L&D is limited to skills acquisition.
2	Continuous	Structured L&D programmes are designed to run on an ongoing basis, to enable the ongoing enhancement and/or expansion of employees' skillsets.	There is a structured L&D curriculum that adopts an approach of continuous learning, to enable the constant learning, re-learning, and improvement of new and existing skills.
3	Integrated	Continuous L&D programmes are formally aligned with the organization's business needs and human resources (HR) functions.	There is a continuous L&D curriculum that is integrated with organizational objectives, talent attraction, and career development pathways.
4	Adaptive	Integrated L&D programmes are actively developed, refreshed and customized based on insights provided by key stakeholders through feedback loops.	Formal feedback channels are in place to allow integrated L&D programmes to be jointly curated and updated by employees, HR, and business teams.
5	Forward-looking	Active efforts are made to identify and incorporate innovative L&D practices and training for future skillsets into the adaptive L&D programmes.	There are proactive steps to incorporate requirements for future skillsets and novel L&D methodologies into existing L&D programmes.

Organization Building Block Talent Readiness Pillar Leadership Competency Dimension			
Leadership competency refers to the readiness of the management core to leverage the latest trends and technologies for the continued relevance and competitiveness of the organization.			
Band		Definition	Description
0	Unfamiliar	Management is unfamiliar with the most recent trends and technologies.	Management is unacquainted with the latest concepts that can enable the next phase of advancement.
1	Limited Understanding	Management has some awareness, through ad-hoc channels, of the most recent trends and technologies.	Management is partially familiar with the latest concepts that can enable the next phase of advancement.
2	Informed	Management is well-informed, through formal channels and avenues, of the most recent trends and technologies.	Management is fully familiar with the latest concepts that can enable the next phase of advancement.
3	Semi-dependent	Management is reliant on external partners to develop initiatives that leverage on the most recent trends and technologies to improve at least one area of the organization.	With external assistance, management is able to apply the latest concepts to enable improvements in at least one area.
4	Independent	Management is able to, with relative independence, develop initiatives that leverage on the latest trends and technology to improve more than one area of the organization.	Management is able to apply the latest concepts to enable improvements across multiple areas.
5	Adaptive	Management is able to independently adapt its organizational transformation framework to changing trends and technologies.	Management is able to augment its improvement initiatives as the latest concepts change or evolve over time.

Assessment Tool: Dimension 15-16

Organization Building Block Structure & Management Pillar Inter- and Intra- Company Collaboration Dimension			
Inter- and intra- company collaboration is the process of working together, through cross-functional teams and with external partners, to achieve a shared vision and purpose.			
Band		Definition	Description
0	Informal	Communication and information sharing across teams happens on an informal basis.	Teams generally work in silos. Communication and collaborations happen on a casual, ad hoc basis.
1	Communicating	Formal channels are established for communication and information sharing across teams.	Teams are provided with formal avenues to exchange information.
2	Cooperating	Formal channels are established to allow teams to work together on discrete/one-off tasks and projects.	Teams are provided with formal avenues to interact and work on discrete tasks and projects together.
3	Coordinating	Teams are empowered by the organization to make adjustments that will facilitate cooperation on discrete tasks and projects.	Teams have the mandate to alter or adjust certain obligations and responsibilities, to reduce the barriers for cooperation on joint tasks and projects.
4	Collaborating	Teams are empowered by the organization to share resources on both discrete and longer-term tasks and projects.	Teams have the mandate to commit resources to both discrete and longer-term tasks and projects. Risk, responsibility and rewards are partially shared.
5	Integrated	Formal channels are established to enable dynamically-forming teams to work on cross-functional projects with shared goals, resources and KPIs.	Teams can be formed with flexibility and agility to address problem statements as they arise. Risk, responsibility and rewards are predominantly shared.

Organization Building Block Structure & Management Pillar Strategy & Governance Dimension			
Strategy and governance is the design and execution of a plan of action to achieve a set of long-term goals. It includes identifying priorities, formulating a roadmap, and developing a system of rules, practices and processes to translate a vision into business value.			
Band		Definition	Description
0	None	Transformation towards a Factory/Plant-of-the-Future is not present in any part of the organization strategy.	Intentions to establish a Factory/Plant-of-the-Future are not identified as a strategic focus in the company's current or future plans.
1	Formalization	Transformation towards a Factory/Plant-of-the-Future has been formally identified as a business strategy at the corporate or business level.	Intentions to establish a Factory/Plant-of-the-Future have been identified as a strategic focus in the company's current or future plans.
2	Development	Transformation initiative towards a Factory/Plant-of-the-Future is being developed or has been developed by a dedicated team.	A long-term strategy and governance model to establish a Factory/Plant-of-the-Future is being developed or has been developed.
3	Implementation	Transformation Initiative towards a Factory/Plant-of-the-Future has been formally implemented in least one functional area.	The long-term strategy and governance model to establish a Factory/Plant-of-the-Future has been put into action.
4	Scaling	Transformation initiative towards a Factory/Plant-of-the-Future is expanded to include more than one functional area.	The long-term strategy and governance model to establish a Factory/Plant-of-the-Future is scaled up to include other secondary areas.
5	Adaptive	Transformation initiative towards a Factory/Plant-of-the-Future is refreshed and updated dynamically.	The long-term strategy and governance model to establish a Factory/Plant-of-the-Future is constantly reviewed and dynamically refreshed to account for the latest advancements in technology, business philosophy, and practices.

