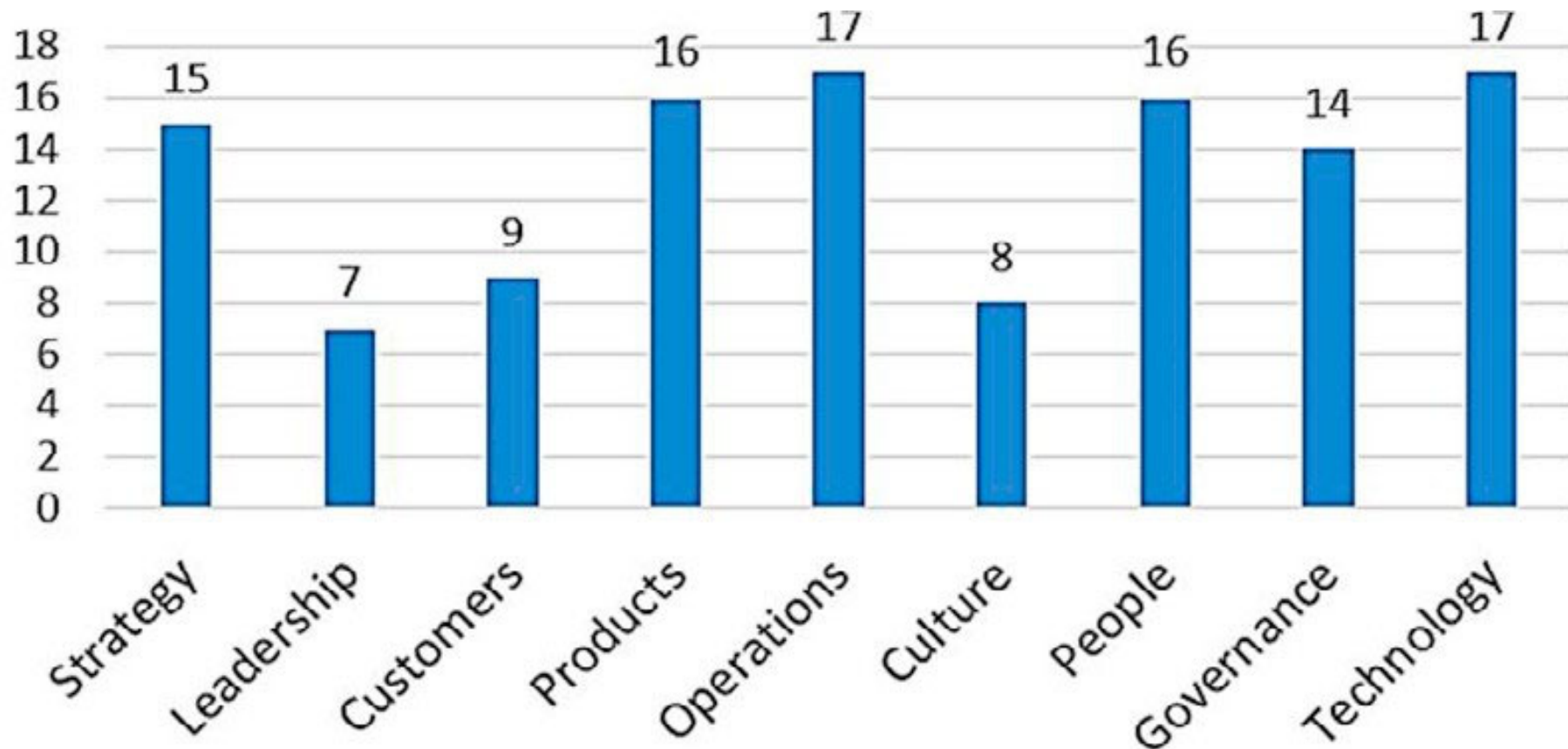


Industry 4.0

Technology Readiness Assessment

(Week two Recap)

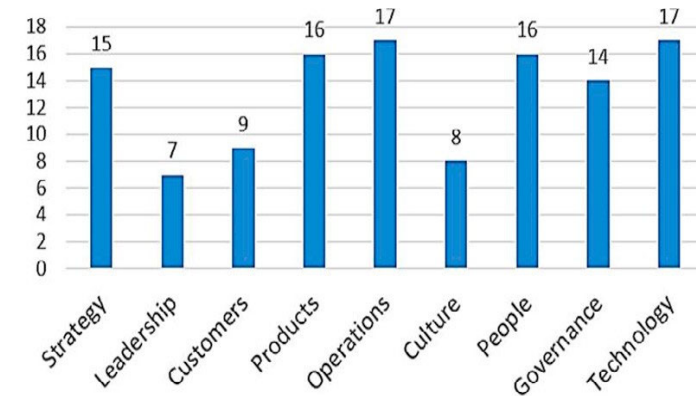
Scope of Dimensions



L S Angreani, A Vijaya, H Wicaksono. "Systematic Literature Review of Industry 4.0 Maturity Model for Manufacturing and Logistics Sectors". 5th International Conference on System-Integrated Intelligence. Procedia Manufacturing 52 (2020) 337–343

Calculations (for each dimension, M_D)

$$M_D = \frac{\sum_{i=1}^n M_{DIi} \times W_{DIi}}{\sum_{i=1}^n W_{DIi}}$$



M – Maturity

DI – Maturity measurement item (parameter) for a Dimension

W – Weighting factor

i – Maturity measurement item index

n – Total number of maturity measurement items for a Dimension

A selection of Maturity Models

- **Warwick Manufacturing Group**

https://warwick.ac.uk/fac/sci/wmg/research/scip/reports/final_version_of_i4_report_for_use_on_websites.pdf

- **Shoestring Assessment tool**

<https://www.digitalshoestring.net/>

- **Smart Industry Readiness Index**

<https://siri.gov.sg/assessment>

- **Callaghan Innovation readiness assessment tool kit**

https://www.callaghaninnovation.govt.nz/sites/all/files/Self-Assessment-Tool-May-2019_0.pdf

- **Impulse Industry 4.0 Model**

<https://www.industrie40-readiness.de/?lang=en>

Smart Industry Readiness Index (SIRI)



ABOUT FRAMEWORKS & TOOLS **ASSESSMENT** INSIGHTS TRAINING & CERTIFICATION PARTNERSHIPS SUPPORT Q

What is it

Principles of Assessment

Take Action

Find Certified Assessors

Assessment

Learning the key concepts is an essential first step in any transformation journey, but that alone is not enough. Companies must next evaluate the current state of their manufacturing facilities, before they can identify areas of improvement. Companies can conduct this comprehensive evaluation of their facilities through the SIRI Assessment. This includes the Assessment Matrix to establish their standing across 16 key dimensions and the Prioritisation Matrix to identify high-impact dimensions for further action.

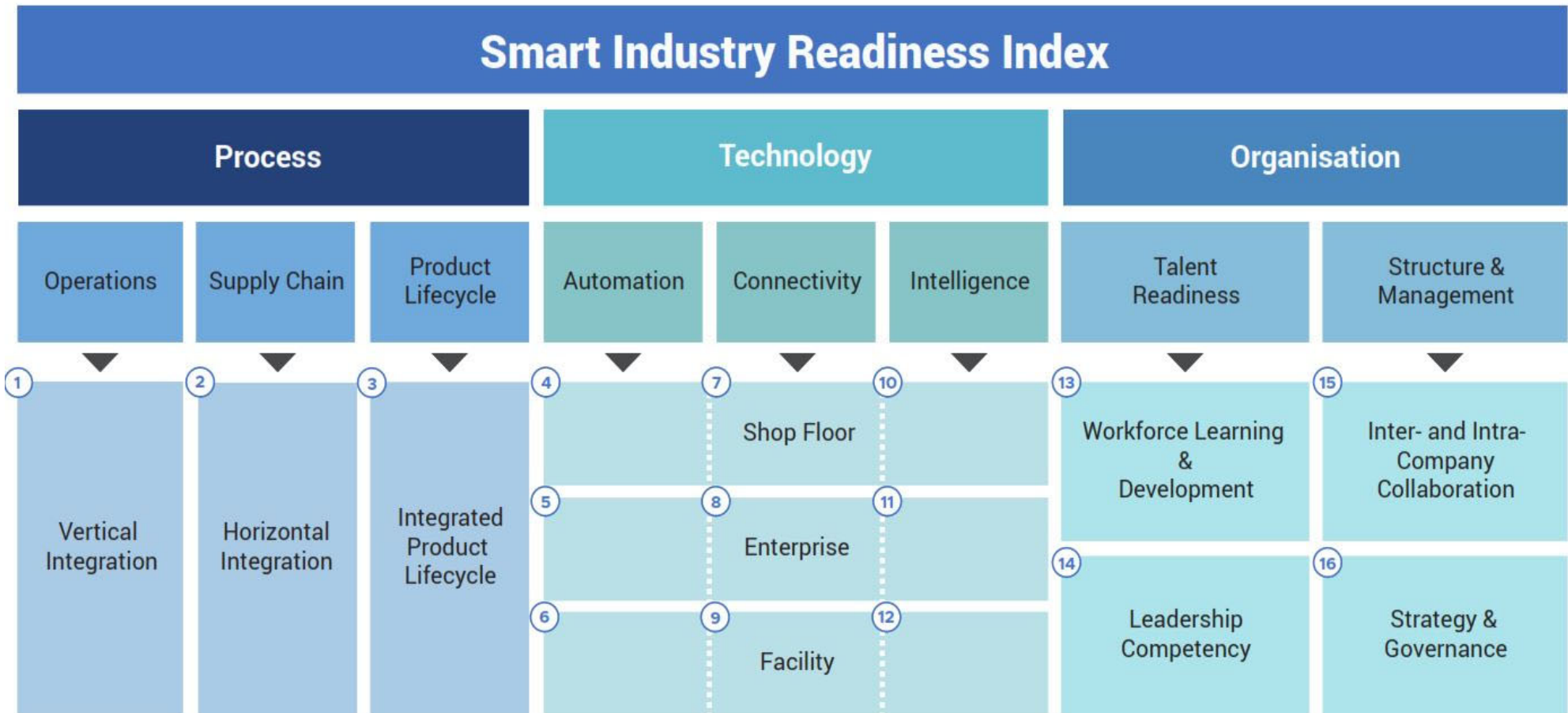
Companies only need two days to self-conduct this internal review, with guidance from the SIRI Self-Assessment Application and whitepapers. Alternatively, they may engage a Certified SIRI Assessor to conduct the Official SIRI Assessment.



Assessment
+
Prioritisation

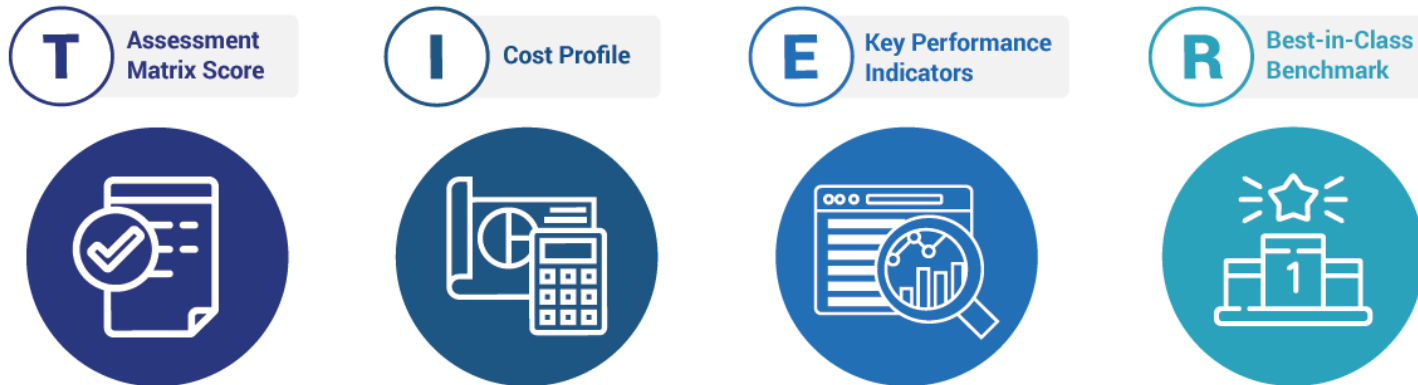


Dimensions of assessment for SIRI



SIRI THEPRIORITISATIONMATRIX – Catalysing the transformation of manufacturing. Singapore Economic Development Board (EDB), 2020

Prioritisation matrix formula



THE PRIORITISATION MATRIX FORMULA

$$\begin{aligned}
 \text{Impact Value of SIRI Dimension}_i &= \text{Weighted Cost Factor}_i + \text{Weighted KPI Factor}_i + \text{Weighted Proximity Factor}_i \\
 &= W_c \cdot \text{Cost Factor}_i + W_k \cdot \text{KPI Factor}_i + W_p \cdot \text{Proximity Factor}_i \\
 &= W_c \cdot [\text{DOR}_c \cdot \text{Cost Profile}]_i + W_k \cdot [\text{DOR}_k \cdot \text{Top KPIs}]_i + W_p \cdot [\text{BIC} - \text{AMS}]_i
 \end{aligned}$$

AMS: Assessment Matrix Score

DOR_c: Degree of Relevance (Cost)

W: Weightage assigned to the factor

BIC: Industry Best-in-Class Benchmark

DOR_k: Degree of Relevance (KPI)

SIRI THEPRIORITISATIONMATRIX – Catalysing the transformation of manufacturing. Singapore Economic Development Board (EDB), 2020

$$\text{Impact Value of SIRI Dimension}_i = W_c \cdot [\text{DOR}_c \cdot \text{Cost Profile}]_i + W_k \cdot [\text{DOR}_k \cdot \text{Top KPIs}]_i + W_p \cdot [\text{BIC} - \text{AMS}]_i$$

A company's data

Calculating Cost Factors

Degree of Relevance (Cost)																	
Cost Categories	Input	Process			Technology									Organisation			
		Vertical Integration	Horizontal Integration	Integrated Product Lifecycle	Shop Floor Automation	Enterprise Automation	Facility Automation	Shop Floor Connectivity	Enterprise Connectivity	Facility Connectivity	Shop Floor Intelligence	Enterprise Intelligence	Facility Intelligence	Workforce Learning & Development	Leadership Competency	Inter- & Intra-Company Collaboration	Strategy & Governance
Aftermarket Services / Warranty	0.00	0	1	3	0	3	0	0	1	0	0	3	0	1	1	1	1
Depreciation	0.03	1	0	0	0	0	0	1	0	1	1	0	1	0	1	0	1
Labour	0.24	3	0	0	3	0	3	1	0	1	3	0	3	3	3	3	3
Maintenance & Repair	0.01	3	1	1	1	1	1	1	1	1	3	1	3	3	1	1	1
Raw Material & Consumables	0.38	3	3	1	1	1	1	1	1	1	3	3	1	0	1	1	1
Rental & Operating Lease	0.00	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1
Research & Development	0.05	1	1	3	0	3	0	0	1	0	0	3	0	3	1	3	3
SG&A	0.17	1	3	1	0	3	0	0	1	0	0	3	0	3	3	3	3
Transportation & Distribution	0.03	0	3	0	0	1	0	0	1	0	0	3	0	1	1	3	1
Utilities	0.05	1	1	0	1	1	3	1	1	1	1	1	3	0	1	0	1
Cost Factor		2.19	1.85	0.71	1.16	1.13	1.26	0.71	0.69	0.71	1.97	1.95	1.31	1.44	1.78	1.86	1.88

The 3 Degrees of Relevance

- 0 – Negligible
- 1 – Small and/or Indirect
- 3 – High and Direct

SIRI THEPRIORITISATIONMATRIX – Catalysing the transformation of manufacturing. Singapore Economic Development Board (EDB), 2020

Smart SME Technology Readiness Assessment (SSTRA)

- Focus: Product design phase in a SME
- SSTRA consists of three main criteria (MC)
 - Design Execution (MC_1)
 - Design System Flexibility (MC_2)
 - Design Real-Time Data Management (MC_3)
- Each main criterion comprises three drivers (D_1, D_2, D_3)
- Each driver has two technologies (T_1, T_2)

Saad, S.M., Bahadori, R., Jafarnejad, H. "The smart SME technology readiness assessment methodology in the context of industry 4.0". 2021. Journal of Manufacturing Technology Management. 32(5), pp. 1037-1065

Smart SME Technology Readiness Assessment

Main Criteria (MC)	W_{mcz}	Driver (D)	W_{dj}	Technology (T)	W_{ti}
Design Real Time Data Management	0.46	Data Acquisition	0.57	Sensors & Actuators	0.67
				RFID & RTLS	0.33
		Data Analytics	0.29	Data Mining Technology	0.75
				Cloud Computing	0.25
		Data Security	0.14	Virtual Private Network (VPN)	0.33
			Blockchain	0.67	
Design System Flexibility	0.29	Collaborative Customisation	0.25	Software-Based Configurators	0.50
				Web-based Configuration Systems	0.50
		Agility	0.50	ICT Infrastructure	0.75
				Machine to Machine connection (M2M)	0.25
		Collaborative Design	0.25	Communication and Networking	0.50
			Internet of People (IoP)	0.50	
Design Execution	0.25	Decision Making	0.41	Machine Learning	0.67
				Computational Intelligence	0.33
		Modelling	0.33	Simulation Based Design	0.50
				Design Automation	0.50
		Prototyping	0.26	Virtual Reality (VR) and Augmented Reality (AR)	0.67
			Digital Twin	0.33	

Saad, S.M., Bahadori, R., Jafarnejad, H. "The smart SME technology readiness assessment methodology in the context of industry 4.0". 2021. Journal of Manufacturing Technology Management. 32(5), pp. 1037-1065

Smart SME Technology Readiness Assessment

- Score of each technology (T_i) with an achieved score (S_i),

$$T_i = S_i \times W_{ti}$$

- Score of each driver (D_j),

$$D_j = W_{dj} \sum_{i=1}^n S_i \times W_{ti}$$

- Score of a main criterion (MC_z)

$$MC_z = W_{mcz} \sum_{j=1}^k W_{dj} \sum_{i=1}^n S_i \times W_{ti}$$

- Total score of a company's (R)

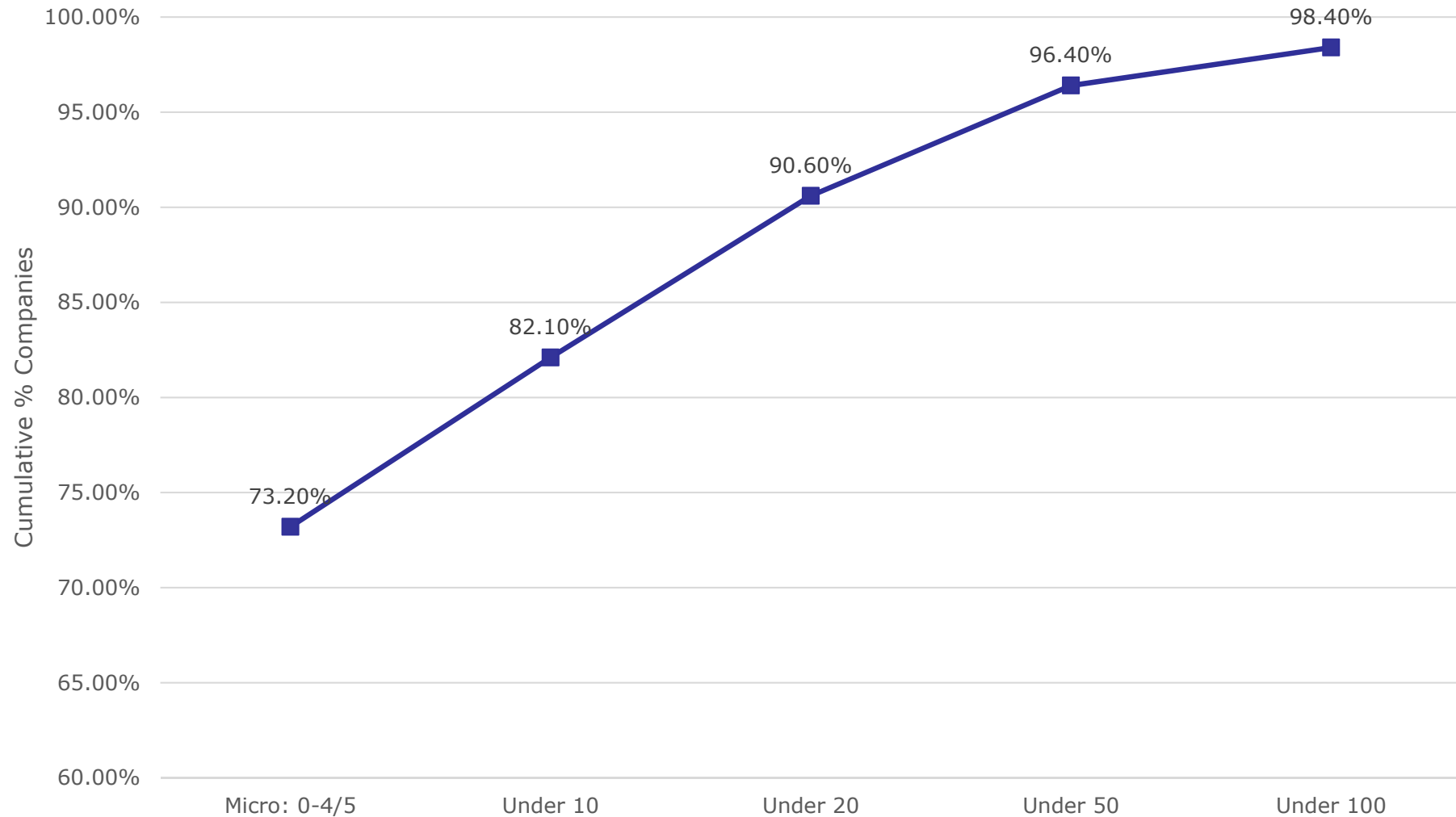
$$R = \sum_{z=1}^h W_{mcz} \sum_{j=1}^k W_{dj} \sum_{i=1}^n S_i \times W_{ti}$$

$$n = 2; k = 3; h = 3$$

New Zealand manufacturers

- Small size, many privately-owned or family-owned
- A small number of large firms
- Companies struggle to compete internationally on price alone
- Tend to manufacture a diverse range of niche products
- Tend to do well when targeting niche markets globally that international companies ignore
- Finance and resources limitations
- New Zealand SME manufacturers generally lag international firms on the technology front
- A consistently low productivity growth in the sector
- Lack of ICT infrastructure
- Lack of skilled resources in Industry 4.0
- Lack of knowledge of Industry 4.0 concepts and technologies and therefore, unable to self-assess their Industry 4.0 readiness

New Zealand manufacturers sizes



MBIE. 2022. July. <https://www.mbie.govt.nz/business-and-employment/economic-development/industry-policy/industry-transformation-plans/advanced-manufacturing/>.