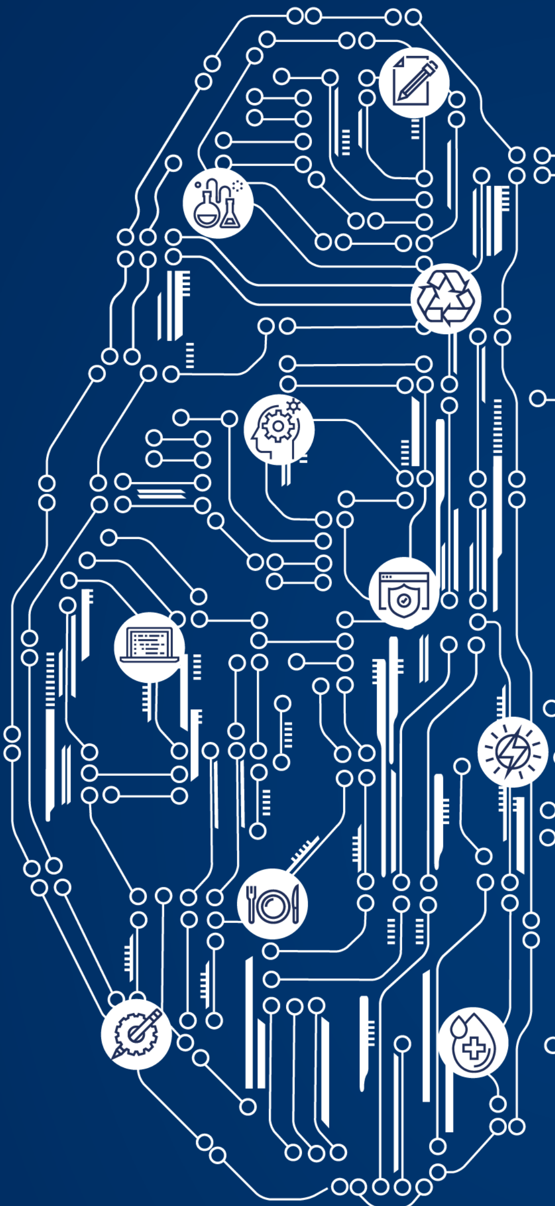

FUTURE OF STEM TALENT IN MALAYSIA

A DELPHI APPROACH

STI Foresight Report

2025 - 2040

KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

MiGHT
Malaysian Industry-Government Group for High Technology

REPORT BROUGHT TO YOU BY

KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI
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DISCLAIMER

This document has been prepared by the Malaysian Industry-Government Group for High Technology (MIGHT) exclusively for the Ministry of Science, Technology and Innovation (MOSTI) and other authorised stakeholders as part of the Future of STEM Talent in Malaysia: A Delphi Approach (STI Foresight Report 2025-2040). It presents provisional findings, analyses and recommendations pending final review.

All information is based on research, publicly available sources, stakeholder engagements and expert judgement as of October 2025. While every effort has been made to ensure accuracy, the content remains subject to validation and amendment in the final report.

APPENDICES

APPENDIX A: WORKING DEFINITIONS

TERM	DEFINITION	REFERENCE
Essential skills	Essential skills are non-technical competencies that complement STEM skills. They are critical for employability, support career mobility and remain relevant across all industries and technology divisions.	Developed by MIGHT and adapted from Global STEM Alliance, 2016, Singapore Skills Framework, 2016 and Future Skills Framework, 2024.
Industry	An economic activity or industry consists of a group of establishments engaged in the same, or similar, kinds of activity.	Department of Statistics Malaysia. (2008). Malaysia Standard Industrial Classification (MSIC) 2008.
MIGHT F.I.R.S.T® Matrix	The matrix is a checklist to assist assessing implication and defining possible responses through exploration from five perspectives. The five perspectives are: • Funding and Financing, • Infrastructure & Institution, • Regulatory and Policy, • Skills and Talents, and • Technology and Innovation.	Developed by MIGHT, 2018.
New and emerging technology	Technologies that are still in development or recently developed technologies that are in early stage of adoption. These technologies might not be fully established or may already be available and are gaining traction with significant potential in terms of impact, innovation and application.	Developed by MIGHT and adapted from OECD. (2019). OECD Science, Technology and Innovation Outlook 2018: Adapting to Technological and Societal Disruption. OECD Publishing.
Qualification Level	As defined in Malaysian Qualification Framework (MQF), the MQF maintains eight levels of learning achievement. These are Certificates (Level 1-3), Diploma and Advanced Diploma (Level 4-5) and Bachelor, Master and Doctoral degrees (Level 6, 7 and 8). Post-doctoral degrees are not included in the Framework.	Ministry of Higher Education (MOHE). (2017). Malaysian Qualifications Framework (MQF) 2nd Edition.
Skill	Skill is defined as the ability to carry out the tasks and duties of a given job.	Ministry of Human Resource. (2020). Malaysia Standard Classification of Occupations (MASCO).
Skill Certificate Level	As defined in National Occupational Skills Standard (NOSS), the levels are categorised as follows: • Level 5: Skilled in applying various fundamental principles and complex techniques across a broad scope, often in unpredictable situations. Holds high responsibility and autonomy, being accountable for both personal work and the work of others, as well as resource allocation. Also responsible for analysis, diagnosis, design, planning, management and evaluation. • Level 4: Skilled in performing a wide range of technical and professional activities within various scopes and contexts. Holds high responsibility and autonomy, often responsible for the work of others and resource allocation. • Level 3: Skilled in performing a range of activities in various contexts, most of which are complex and uncommon. Holds high responsibility and autonomy, while supervising and providing guidance to others. • Level 2: Skilled in performing a range of activities in various contexts, some of which are uncommon and require responsibility and autonomy. • Level 1: Skilled in performing a range of activities, most of which are common and predictable.	Ministry of Human Resource. (2025). National Occupational Skills Standard (NOSS).

TERM	DEFINITION	REFERENCE
STEM Field	All TVET (Technical and Vocational Education and Training) programs at the Malaysian Skills Certificate (Sijil Kemahiran Malaysia) Level 3 and above are categorised as STEM programs. The STEM fields are also based on the National Education Code (NEC) 2010 Manual, covering fields numbered 4 to 8 as follows: 4 - Science, Mathematics and Computing 5 - Engineering, Manufacturing and Construction 6 - Agriculture and Veterinary 7 - Health and Welfare 8 - Services If there are any TVET programs that include Social Sciences, they are also considered STEM programs even though they are not listed under the NEC codes. Meanwhile, according to the National Education Code (NEC) 2020 Manual, STEM fields are categorised under fields numbered 5 to 10 as follows: 5 - Natural sciences, mathematics and statistics 6 - Information and communication technologies 7 - Engineering, manufacturing and construction 8 - Agriculture, forestry, fisheries and veterinary 9 - Health and welfare 10 - Services	Kementerian Sains, Teknologi dan Inovasi (MOSTI). (2018). Pelan Tindakan Strategik STEM Nasional 2018-2025.
STEM skill area	Refers to a broad category of related STEM skills that are grouped based on their application in specific industries or technology divisions. This area represents overarching domains of expertise, critical for performing specialised tasks, solving complex problems and driving innovation in technical fields.	Developed by MIGHT and adapted from Industrial Skills Framework, 2022, Future Skills Framework, 2024 and Australia Skills Classification, 2021.
STEM skills	STEM skills belong to the group of technical skills based on the integration of the disciplines of science, mathematics, engineering and technology. They are a combination of the ability to produce scientific knowledge, supported by mathematical skills, in order to design and engineer technological and scientific products or services. The aim of STEM skills is to enhance people's competency in work and/or life and more generally respond to societal demands on technology.	Adapted from Siekmann, G & Korbel, P., 2016. Defining 'STEM' skills: review and synthesis of the literature — support document 2, NCVER, Adelaide.
Technology hierarchy structure	For technology hierarchy structure, the highest hierarchy is Division which represents the broadest subject area or discipline. Each Division has its own Category, Group and Area or Category and Group. The Categories, Groups and Areas at the lowest level represent more detailed dissections of the research disciplines.	Adapted from Ministry of Science, Technology and Innovation (MOSTI). (2021). Malaysian Research and Development Classification System MRDCS (7th Ed.). Putrajaya; Malaysia.
Technology prioritisation survey	A tool or process used to assess and rank various technologies based on their potential impact, feasibility and alignment with organisational or strategic goals. It helps decision-makers determine which technologies should be prioritised for development, investment, or adoption.	OECD. (2017). Policy Approaches to Research and Innovation. OECD Publishing. https://doi.org/10.1787/9789264267885-en
Technology tool	A technology tool is a technology software and/or hardware that are utilised together with STEM skills to perform specialised tasks, solve complex problems and drive innovation in technical fields.	Developed by MIGHT and adapted from Australian Bureau of Statistics. (2024-version-1.0). OSCA - Occupation Standard Classification for Australia. ABS.
Time of Realisation	This refers to the full timeline required for a technology to go from concept or early development to practical implementation and mainstream availability. It includes all stages of R&D, testing, commercialisation and early adoption. The time of realisation varies depending on factors like technological complexity, regulatory hurdles and market readiness.	KISTEP (Korea Institute of S&T Evaluation and Planning). (2022). 6th Science and Technology Foresight (2021-2045). Seoul: KISTEP.

APPENDIX B: LIST OF ABBREVIATIONS

AI	Artificial Intelligence
AR	Augmented Reality
ASEAN	Association of Southeast Asian Nations
CCUS	Carbon Capture, Utilisation and Storage
CPD	Continuing Professional Development
CREST	Creativity in Research, Engineering, Science and Technology
CSR	Corporate Social Responsibility
CTO	Chief Technology Officer
DevOps	Development Operations
DOSH	Department of Occupational Safety & Health
E&E	Electrical and Electronics
ERI	Education, Research and Innovation
ESG	Environmental, Social and Governance
EV	Electrical Vehicle
eVTOL	Electric Vertical Take-off and Landing Aircraft
F.I.R.S.T®	Funding and Financing, Infrastructure and Institution, Regulatory and Policy, Skills and Talents, and Technology and Innovation
FinTech	Financial Technology
FIRST	For Inspiration and Recognition of Science and Technology
GDP	Gross Domestic Product
GLC	Government-linked Company
GLP	Good Laboratory Practice
HAPS	High-Altitude Platform Systems
ICT	Information and Communication Technology
IoT	Internet of Things
IT	Information Technology
KISTEP	Korea Institute of Science and Technology Evaluation and Planning
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LLMs	Large Language Models
MaaS	Machinery as a Service
MQF	Malaysian Qualifications Framework
mRNA	Messenger Ribonucleic Acid
MRDCS	Malaysian Research and Development Classification System
MRO	Maintenance, Repair and Overhaul
MSIC	Malaysia Standard Industrial Classification
MYSA	Malaysian Space Agency
NEC	National Education Code
NETR	National Energy Transition Roadmap
NRF	National Research Foundation
OECD	Organisation for Economic Co-operation and Development
PAJSK	Pentaksiran Aktviti Jasmani, Sukan dan Kokurikulum
PDM	Predictive Maintenance
PTA	Parent Teacher Association
QA	Quality Assurance
QHSE	Quality, Health, Safety and Environment
R&D	Research and Development
SBIR	Small Business Innovation Research
SMEs	Small and Medium-sized Enterprises
SMRs	Small Modular Reactors
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering and Mathematics
STI	Science, Technology and Innovation
TVET	Technical and Vocational Education and Training
UX	User Experience
VR	Virtual Reality

APPENDIX C: IDENTIFICATION OF NEW & EMERGING TECHNOLOGY CANDIDATES

The rapid growth of emerging technologies is transforming the future of STEM talent. As industries adopt these innovations, new specialised skills and roles are needed, changing both job markets and how organisations develop their workforce. In this context, new and emerging technologies are those still in development or recently introduced, which are in the early stages of adoption but gaining momentum due to their potential impact and application.

Recognising the importance of these technologies in shaping future skill demands a comprehensive horizon scanning was conducted. This process involved multiple layers of review and analysis to capture signals of technological change and assess their relevance to Malaysia's STEM ecosystem. The scanning drew from a variety of sources, including:

- National and international reports
- Benchmarking of countries' strategic technology focus areas
- Media and news scanning
- Scenario building
- Investment analysis
- National policy review
- Stakeholder engagements and
- Patent scanning

These diverse sources provided a well-rounded and evidence-based foundation for identifying technologies with high potential to influence Malaysia's future STEM ecosystem. Consequently, a total of 147 technology candidates were identified.

To systematically organise and classify these technologies, this study used the Malaysian Research and Development Classification System (MRDCS), 7th Edition, 2021, as the reference taxonomy. As shown in Figure C-1, the classification framework consists of three hierarchical levels:

- Division – representing the broadest subject area or discipline
- Category – a more specific domain within the Division and
- Technology Candidates – the actual technologies identified under each Category.

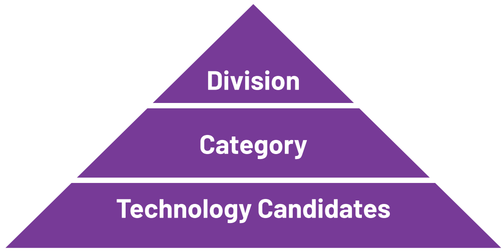

Figure C-1: Hierarchy structure for new and emerging technology candidate(s). Adapted from MRDCS (7th Edition), 2021.

Through this classification, the 147 technology candidates were grouped into six Divisions:

- Applied Sciences and Technology
- Earth Sciences
- Engineering
- Life Sciences
- Medical & Health Sciences and
- Social Sciences

Collectively, these six Divisions encompass 24 categories and 147 technology candidates.

How to read this chart?

For instance, under the Division of Social Sciences, one of the identified Categories is Education, which includes the Technology Candidate Sensing Classroom. This demonstrates how the classification allows for a detailed yet structured understanding of emerging technologies and their relevance to specific domains.

ENGINEERING

Aerospace, Aeronautics, and Astronautics Engineering
- Electric Vertical Takeoff and Landing Aircraft
- Small Satellites and Cubesats
- Low Earth Orbit Satellites
- Orbital Launch Site (Spaceport or Sea Launch)

Biomedical Engineering
- Artificial Implantable Organs

Chemical Engineering
- Supercritical Fluid Technology

Civil Engineering
- 3D Printed Architecture
- Building Information Modelling
- Urban Irrigation

Computer Engineering
- Additive Manufacturing
- 4D Printing
- Holographic 3D Printing
- Industrial 3D Printing
- Chiplet
- Neuromorphic Chip

Electrical and Electronics Engineering
- On-body and Off-body Sensors
- Optical Sensors Arrays

Environmental Engineering
- Carbon Capture, Utilisation and Storage
- Direct Air Capture
- Adaptive Processing of Recycled Materials
- Green Cement
- Green Steel
- Decentralised Wastewater Treatment

Manufacturing and Industrial Engineering
- Manufacturing Data Space
- Distributed Manufacturing
- Machinery as a Service
- Antimicrobial Packaging

Interdisciplinary Engineering
- Biomimicry
- Graphene Cytobot
- Human-robot Collaboration / COBOTs
- Autonomous Mobile Robots
- Humanoid General-Purpose Robot
- Autonomous Unmanned Aerial Vehicles
- Self-Driving Bus
- Low-code / No-code Robot
- Robot Caregiver
- Robotic Swarm
- Soft Robot
- Exoskeleton

Energy Resources and Engineering
- Long Duration Energy Storage Systems (Mechanical, Thermal, Electrochemical, and Chemical Storage Systems)
- Decentralised Energy Grid
- Sewage Harvested Energy
- Integrated Autonomous Energy Grid
- Long-Range Wireless Energy Transmission
- Piezoelectric Nanogenerator
- Small Modular Reactors
- Perovskite Solar Cell
- Onshore and Offshore Wind Turbines
- Clean Hydrogen
- Ocean Wave Energy Technology

LIFE SCIENCES

Agriculture Science
- Advanced Urban Farming
- Advanced Alternative Animal Feed
- Engineered Livestock
- Drought-Resistant Crop
- Precision Agriculture
- Plant Biostimulants
- Nano Silica Fertiliser
- Germplasm Bank
- Nanobiopesticides

Biological Science
- Sustainable Fuels (e-Biomass, e-Ammonia, e-Methanol Based Fuels, Sustainable Aviation Fuel)
- Next-generation Gene Therapies (RNA-Based Modalities and Editing, Novel Nucleases, Non-nuclease Editing and Modulation)
- Engineered Bacteriophage

MEDICAL AND HEALTH SCIENCES

Pharmacy
- Biosimilar
- Adult Stem Cell Generation
- Machine Learning-enabled Drug Discovery
- Precision Medicine (Early Disease Detection, Biomarker Discovery, Precision Population Health)
- Anti-ageing Drugs

Specialist Topics in Medical and Health Sciences
- Telehealth and Remote Patient Monitoring

Figure C-2: 147 new and emerging technology candidates.

APPLIED SCIENCES AND TECHNOLOGY

Bioinformatics
- DNA Data Storage
- Portable DNA Sequencer

Biotechnology
- Alternative-protein Production
- Bioremediation
- Wastewater Bioplastic
- Genomic Vaccines
- Cell Therapy 2.0 (Innate Immune Cells, Precision Control of Cell Therapy, in Vivo Cell Therapy)
- Programmable Cells
- Cytotoxic Therapeutic
- Stabilised mRNA Therapeutics

Food Technology
- Edible Packaging
- Active Packaging

Geoinformation
- Geospatial Artificial Intelligence

Geomatics
- Hyperspectral Imaging

Material Sciences and Technology
- Self-Healing Materials
- Elastocalorics
- Solar Glass
- Biobased Materials
- Quantum Compass
- Circular Batteries
- Carbon-Cement Supercapacitor
- Solid State Lithium-Ion Battery
- Biosensor
- Metamaterials
- Mycological Biopolymers
- Graphyne
- Carbon Nanotube
- Advanced Composite Materials
- High Performance Thermoplastics
- Superhydrophobic Coatings
- Auxetic Material

Medical Technology
- Health Monitoring Skin Patch
- Implantable Sensor
- Medical Nanobot
- Medical Tricorder
- Brain Chip Implant

Information and Communication Technology (ICT)
- Generative AI
- Federated Machine Learning
- Responsible AI
- AI Mentor
- Machine Vision
- Edge Cloud Computing
- Neuromorphic Computing
- Quantum Computing
- Quantum Communication
- Quantum Key Distribution / Quantum Security
- Quantum Sensing
- Edge Computing
- Spatial Computing
- Predictive Maintenance
- Synthetic Data
- Metro edge / High Performance Data Storage and Data Centers
- Zero-trust Architecture
- Cybersecurity Mesh Infrastructure
- IoT Device Edge
- Wi-Fi 6 and 7
- 6th-Generation Wireless
- High-altitude Platform Systems
- Direct-to-handset Satellite Connectivity
- Industrial Internet of Things
- Mobility as a Service
- Low- and No-code Platforms
- Microservices and Application Programming Interfaces
- Blockchain of Things
- Web 3.0
- Middleware
- Proof-of-Stake Blockchain
- Augmented Reality
- Virtual Reality
- Mixed Reality
- Digital Twins
- AR Workforce Assistance
- Industrial Metaverse
- Cognitive Twin

EARTH SCIENCES

Environmental Sciences and Management
- Autonomous Sustainability Monitoring
- Carbon Dioxide Extractor Array

SOCIAL SCIENCES

Education
- Sensing Classroom
- Smart Classroom

Figure C-2: 147 new and emerging technology candidates.

Technology Assessment on New and Emerging Technologies for Malaysia Towards 2040 and the STEM Skills Needed for Malaysian Talent

Building upon extensive desktop research and classification of 147 technology candidates, a survey was conducted to validate these findings and prioritise the technologies most likely to drive Malaysia's economic growth through 2040. This survey also aimed to identify the STEM skill sets required to support the development, implementation and scaling of these technologies.

Each technology was evaluated based on its potential application, potential industries, time of realisation, required STEM skills and non-technical skills needed for development and deployment of this technology candidate.

The survey on new and emerging technologies engaged researchers, technology adopters and policymakers to ensure a comprehensive understanding of Malaysia's future STEM talent needs:

- **Researchers** played a crucial role in identifying emerging trends and breakthrough technologies that may not yet be widely recognised, but which hold the potential to drive significant economic and societal advancements for Malaysia.
- **Technology adopters** played a critical role in providing insights into the alignment between talent development and sector-specific needs, helping to ensure that the future workforce is well-equipped to meet upcoming technological demands.
- **Policymakers** played an important role in shaping Malaysia's strategic direction by contributing to the survey, ensuring the nation is prepared to address future challenges and capitalise on opportunities in technology and STEM talent development.
- **Investors** contributed by highlighting areas with strong potential for commercialisation and economic return, guiding the prioritisation of technologies that can attract funding and stimulate innovation-driven growth.

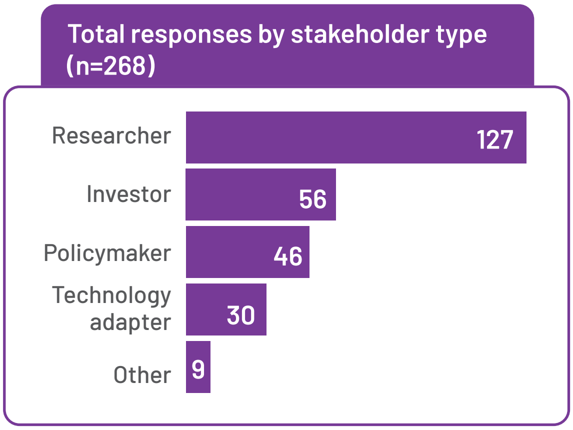

Figure C-3 Total responses by stakeholder type.

For the survey, a total of 268 responses were collected from 210 respondents, drawn from the 4,000 targeted participants across Malaysia. A total of 96 technology candidates has been assessed by the domain experts as shown in Figure C-4.

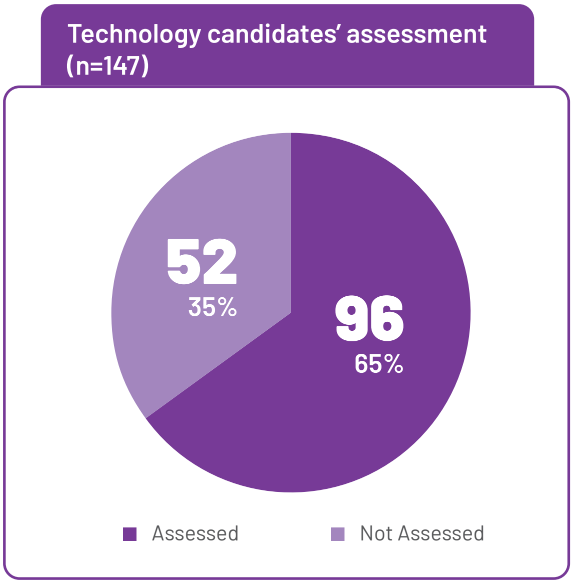

Figure C-4 Technology candidates' assessment.

Most technologies assessed came from the Applied Sciences (39 assessed out of 75 total identified) and Engineering (39 out of 50), reflecting their strong alignment with Malaysia's current industrial and technological development priorities.

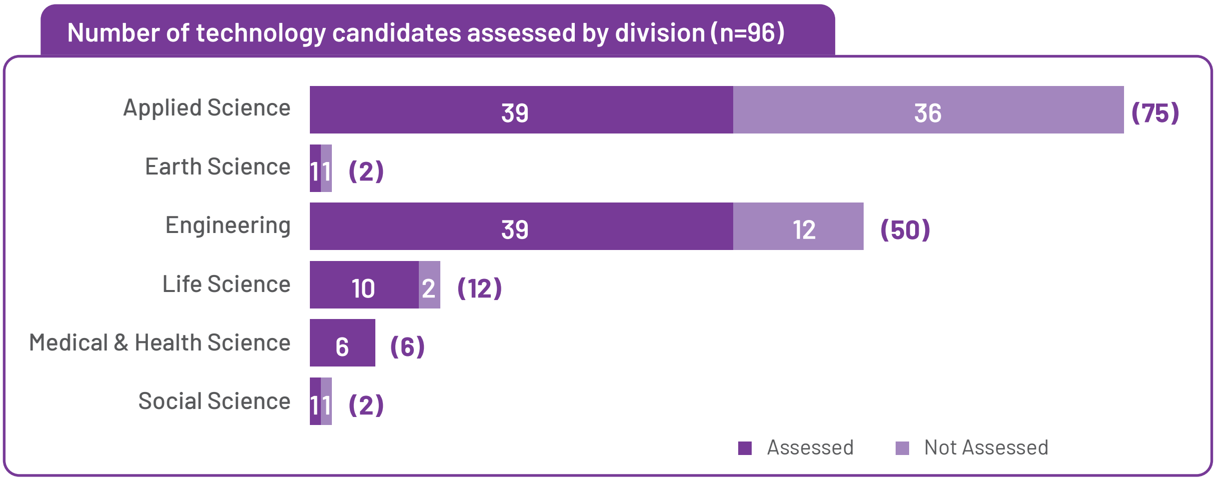

Figure C-5: Number of technology candidates assessed by technology division.

From the 96 assessed technology candidates, the survey identified the top ten most assessed technology candidates, with Smart Classroom receiving the highest number of assessments (19). This was followed by Generative AI and Telehealth & Remote Patient Monitoring, each with 13 assessments. Other technologies that ranked highly include Machinery as a Service (10), Advanced Urban Farming (8), Distributed Manufacturing (8), Precision Medicine (8) and Sustainable Fuels (8). Completing the list were Edible Packaging and the Industrial Internet of Things, each receiving 7 assessments. These technologies highlight priority areas among stakeholders in guiding Malaysia's future STEM talent development.

Technology Realisation Period: Local and Global Perspectives

New and emerging technologies progress through multiple stages, from early concept and research to testing, commercialisation and widespread adoption. The time required for this full trajectory, often referred to as the realisation period, can vary considerably depending on technological complexity, regulatory environments and market readiness (KISTEP, 2022). Understanding when these technologies are likely to become mainstream is critical to preparing the talent pipeline and aligning national strategies. This dual-layered analysis helps in identifying technologies that are rapidly advancing globally and those likely to be adopted more gradually within Malaysia due to differences in infrastructure, ecosystem maturity, or policy support.

The findings reveal that many technologies are anticipated to reach global maturity within the near term. Specifically, 77 technologies are expected to be globally realisable by 2030, with an additional 15 expected between 2031 and 2035 and three more by 2040. Notably, a further 15 technologies were included in the global list based on prior literature review and horizon scanning, even though they were not evaluated by respondents. In total, 110 technology candidates have been mapped with a global realisation period. Figure below visualises the distribution of global realisation periods.

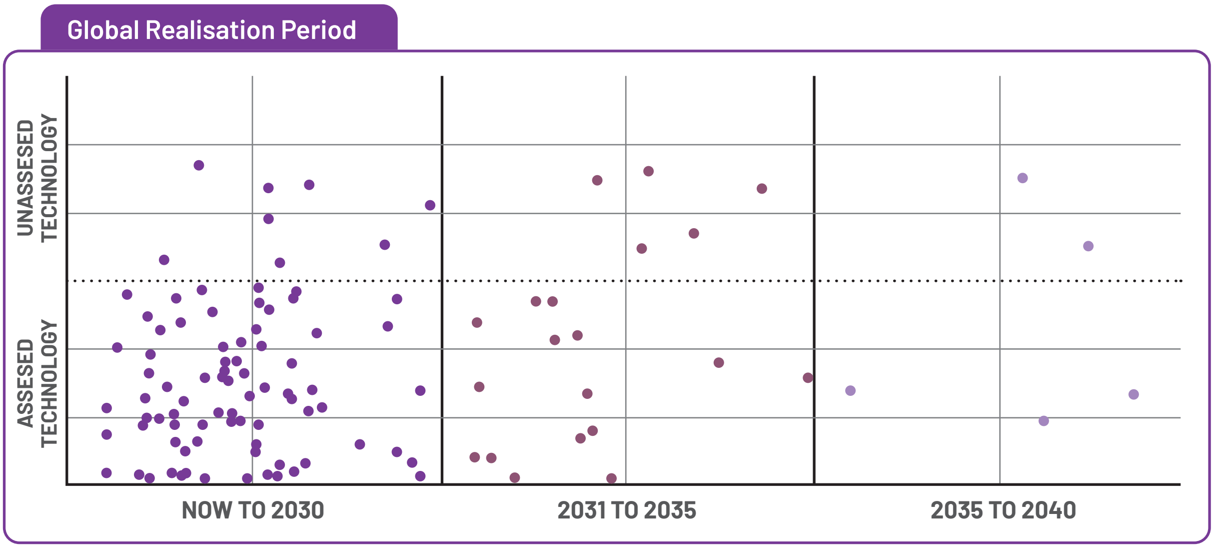

Figure C-6: Distribution of the technology candidates' global realisation periods

In comparison, the local realisation period presents a more staggered trajectory. Of the assessed technologies, 51 are projected to reach mainstream application in Malaysia by 2030, followed by 33 between 2031 and 2035 and 11 more between 2036 and 2040. While this indicates that most technologies could become locally relevant in the near term, it also reflects a noticeable delay in adoption relative to global timelines. This variation underscores the differing pace of technological integration across contexts. Figure below illustrates the distribution of local realisation periods.

Figure C-7: Distribution of the technology candidates' local realisation periods.

The analysis of global and local realisation periods offers valuable foresight into the maturity trajectories of new and emerging technologies. While most are anticipated to reach global maturity by 2030, Malaysia's adoption timelines are generally slower, highlighting critical gaps in ecosystem readiness. This delay underscores the urgency of aligning national strategies, infrastructure and policy to accelerate technology uptake. By understanding these timelines, Malaysia can better prioritise investments, tailor its STEM talent development efforts and position itself competitively in the global innovation landscape.

The tables below summarise the technologies by their respective global and local realisation periods:

Technology Candidate(s)	Global Realisation Period	Local Realisation Period
3D Printed Architecture	Now to 2030	Now to 2030
Active Packaging	Now to 2030	Now to 2030
Adaptive Processing of Recycled Materials	Now to 2030	2031 to 2035
Additive Manufacturing	2031 to 2035	Now to 2030
Adult Stem Cell Generation	Now to 2030	2031 to 2035
Advanced Alternative Animal Feed	Now to 2030	Now to 2030
Advanced Composite Materials	Now to 2030	Now to 2030
Advanced Urban Farming	Now to 2030	Now to 2030
Alternative-protein Production	Now to 2030	2036 to 2040
Anti-ageing Drugs	2031 to 2035	Now to 2030
Artificial Implantable Organs	Now to 2030	2031 to 2035
Autonomous Mobile Robots	Now to 2030	Now to 2030
Autonomous Sustainability Monitoring	Now to 2030	Now to 2030
Autonomous Unmanned Aerial Vehicles	2031 to 2035	2031 to 2035
Biobased Materials	Now to 2030	Now to 2030
Bioremediation	Now to 2030	Now to 2030
Biosensor	Now to 2030	Now to 2030
Biosimilar	Now to 2030	Now to 2030
Brain Chip Implant	2036 to 2040	2036 to 2040
Building Information Modelling	Now to 2030	Now to 2030
Carbon Capture, Utilisation and Storage	Now to 2030	Now to 2030
Carbon Nanotube	Now to 2030	2031 to 2035
Carbon-Cement Supercapacitor	Now to 2030	2036 to 2040
Cell Therapy 2.0	Now to 2030	2031 to 2035
Circular Batteries	Now to 2030	2031 to 2035
Clean Hydrogen	Now to 2030	Now to 2030
Cytotoxic Therapeutic	Now to 2030	2031 to 2035
Decentralised Energy Grid	Now to 2030	Now to 2030
Decentralised Wastewater Treatment	Now to 2030	Now to 2030
Digital Twins	Now to 2030	2031 to 2035
Direct Air Capture	2031 to 2035	2036 to 2040
Distributed Manufacturing	Now to 2030	Now to 2030
DNA Data Storage	Now to 2030	2031 to 2035
Drought-Resistant Crop	Now to 2030	Now to 2030
Edge Cloud Computing	2031 to 2035	2031 to 2035
Edible Packaging	Now to 2030	Now to 2030
Electric Vertical Takeoff and Landing Aircraft	2031 to 2035	2031 to 2035
Engineered Bacteriophage	Now to 2030	2036 to 2040
Engineered Livestock	Now to 2030	Now to 2030
Exoskeleton	Now to 2030	2031 to 2035
Generative AI and Agentic AI	Now to 2030	Now to 2030
Genomic Vaccines	Now to 2030	Now to 2030

Technology Candidate(s)	Global Realisation Period	Local Realisation Period
Geospatial Artificial Intelligence	Now to 2030	Now to 2030
Germplasm Bank	2031 to 2035	Now to 2030
Graphyne	2036 to 2040	Now to 2030
Green Cement	Now to 2030	Now to 2030
Green Steel	Now to 2030	2031 to 2035
Health Monitoring Skin Patch	Now to 2030	Now to 2030
High Performance Thermoplastics	Now to 2030	2031 to 2035
Humanoid General-Purpose Robot	2031 to 2035	2031 to 2035
Human-robot Collaboration	2031 to 2035	2031 to 2035
Hyperspectral Imaging	Now to 2030	2031 to 2035
Implantable Sensor	Now to 2030	2036 to 2040
Industrial 3D Printing	2031 to 2035	Now to 2030
Industrial Internet of Things	Now to 2030	Now to 2030
Integrated Autonomous Energy Grid	Now to 2030	2031 to 2035
IoT Device Edge	Now to 2030	2031 to 2035
Long Duration Energy Storage Systems	Now to 2030	Now to 2030
Low- and No-code Platforms	Now to 2030	Now to 2030
Low Earth Orbit Satellites	Now to 2030	2031 to 2035
Low-code / No-code Robot	Now to 2030	Now to 2030
Machine Learning-enabled Drug Discovery	Now to 2030	2031 to 2035
Machinery as a Service	Now to 2030	Now to 2030
Manufacturing Data Space	Now to 2030	Now to 2030
Medical Nanobot	Now to 2030	2031 to 2035
Microservices and Application Programming Interfaces	Now to 2030	2031 to 2035
Middleware	Now to 2030	Now to 2030
Neuromorphic Chip	2036 to 2040	2031 to 2035
Next-generation Gene Therapies	2031 to 2035	2036 to 2040
Ocean Wave Energy Technology	Now to 2030	Now to 2030
Onshore and Offshore Wind Turbines	Now to 2030	2031 to 2035
Optical Sensor Arrays	Now to 2030	Now to 2030
Orbital Launch Site	Now to 2030	2031 to 2035
Perovskite Solar Cell	2031 to 2035	2036 to 2040
Plant Biostimulants	Now to 2030	Now to 2030
Portable DNA Sequencer	Now to 2030	2036 to 2040
Precision Agriculture	Now to 2030	Now to 2030
Precision Medicine	Now to 2030	Now to 2030
Predictive Maintenance	Now to 2030	2031 to 2035
Quantum Computing	Now to 2030	2036 to 2040
Quantum Key Distribution / Quantum Security	Now to 2030	Now to 2030
Responsible AI	Now to 2030	2031 to 2035
Self-driving Bus	Now to 2030	2036 to 2040
Sewage Harvested Energy	2031 to 2035	Now to 2030
Small Modular Reactors	Now to 2030	2031 to 2035
Small Satellites	Now to 2030	Now to 2030

Technology Candidate(s)	Global Realisation Period	Local Realisation Period
Smart Classroom	Now to 2030	Now to 2030
Soft Robot	Now to 2030	2031 to 2035
Solar Glass	Now to 2030	Now to 2030
Stabilised mRNA Therapeutics	Now to 2030	2031 to 2035
Supercritical Fluid Technology	Now to 2030	Now to 2030
Sustainable Fuels	2031 to 2035	Now to 2030
Telehealth and Remote Patient Monitoring	Now to 2030	Now to 2030
Urban Irrigation	Now to 2030	Now to 2030
Virtual Reality	2031 to 2035	2031 to 2035
Wastewater Bioplastic	Now to 2030	Now to 2030
4D Printing	Now to 2030[1]	Not Assessed
6th-Generation Wireless	Now to 2030[1]	Not Assessed
AI Mentor	2031 to 2035[2]	Not Assessed
Auxetic Material	Now to 2030[2]	Not Assessed
Carbon Dioxide Extractor Array	2036 to 2040[2]	Not Assessed
Chiplet	2031 to 2035[2]	Not Assessed
Holographic 3D Printing	2031 to 2035[1]	Not Assessed
Medical Tricorder	2031 to 2035[2]	Not Assessed
Piezoelectric Nanogenerator	2031 to 2035[2]	Not Assessed
Programmable Cells	2031 to 2035[1]	Not Assessed
Quantum Communication	2031 to 2035[1]	Not Assessed
Robot Caregiver	Now to 2030[1]	Not Assessed
Robotic Swarm	2031 to 2035[2]	Not Assessed
Sensing Classroom	Now to 2030[2]	Not Assessed
Solid State Lithium-Ion Battery	2036 to 2040[2]	Not Assessed

[1] *KISTEP (Korea Institute of S&T Evaluation and Planning). (2022). 6th Science and Technology Foresight (2021-2045). Seoul: KISTEP.*
[2] *World Governments Summit. (2019). Technology Radar.*

APPENDIX D: LIST OF NEW AND EMERGING TECHNOLOGY CANDIDATES

Division: Life Sciences

Category: Agriculture Sciences		
Technology Candidate	Description	Source
Advanced Alternative Animal Feed	In modern animal nutrition, an advanced alternative animal feed typically merges precision feeding ensuring optimal macro- and micronutrient intake with functional feed additives. This leads to enhanced feed efficiency, improved animal health and greater overall productivity	Food and Agriculture Organization of the United Nations. (2023). Alternative and advanced feeding practices to promote the responsible use of antimicrobials: Report of FAO Expert Meeting, FAO headquarters,
Advanced Urban Farming	Advanced urban farming grows food in cities using new methods. It saves space and helps the environment. Methods like vertical farming and hydroponics use smart tools like sensors and AI. These farms save water, use clean energy and recycle waste. They can be on rooftops or indoors. Though it can be expensive and hard to grow big, urban farming helps produce local food, reduce pollution and create jobs, making cities more sustainable.	Agrilog. (2024). Emerging Technologies in Agriculture: Innovations for the Future of Farming.
Drought-Resistant Crop	A genetically altered crop with a heightened tolerance to drought, which reduces the impact of dehydration on plant growth, allowing it to continue to produce when rainfall is limited. Thus, helping farmers in areas with inadequate waterfall improve the yield of their crops.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.
Engineered Livestock	Engineered livestock are genetically modified animals using techniques like CRISPR, transgenesis and precision breeding. These methods improve traits such as disease resistance, growth and product quality, while also lowering farming's environmental impact. This approach supports food security, sustainable agriculture and the production of new biopharmaceuticals, highlighting the powerful role of genetic engineering in animal science.	Kwon, D. H., Gim, G. M., Yum, S. Y., & Jang, G. (2024). Current status and future of gene engineering in livestock. BMB reports, 57(1), 50–59.
Germplasm Bank	A germplasm bank serves as a critical repository for preserving the genetic diversity of plant and animal species. By storing seeds, tissues, or genetic material, these banks safeguard biodiversity, enable research and support breeding programs to enhance agricultural resilience. Germplasm banks play a pivotal role in ensuring food security and environmental sustainability amidst climate challenges.	World Governments Summit. (2019). Technology Radar.
Nano Silica Fertiliser	Nano silica is a special nanomaterial made from silicon with tiny pores that make it ideal for carrying helpful substances like biofertilisers and biopesticides in agriculture. Its porous structure boosts plant metabolism, increasing resistance, seedling growth, root development and photosynthesis. This helps farmers grow crops more efficiently and sustainably. Nano silica can also carry soil enhancers and nano sensors to analyse soil health.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.

Category: Agriculture Sciences		
Technology Candidate	**Description**	**Source**
Nanobiopesticides	Nanobiopesticides combine nanotechnology with biological materials to create more precise and sustainable pest control. They improve the delivery, stability and effectiveness of active ingredients, allowing for controlled release and longer-lasting protection. This reduces chemical use and helps combat pest resistance. While they offer a more eco-friendly and efficient approach to agriculture, large-scale use and regulation still pose challenges.	Hazafa, A., Murad, M., Umer Masood, M., Bilal, S., Nasir Khan, M., Farooq, Q., ... Naeem, M. (2022). Nano-Biopesticides as an Emerging Technology for Pest Management. IntechOpen. doi: 10.5772/intechopen.101285
Plant Biostimulants	Plant biostimulants contain substances and/or microorganisms whose function when applied to plants or the rhizosphere is to stimulate natural processes to improve nutrient uptake, nutrient use efficiency, tolerance to abiotic stress and crop quality. This hub focuses on nonmicrobial biostimulants.	Magnabosco, P., Masi, A., Shukla, R. et al. Advancing the impact of plant biostimulants to sustainable agriculture through nanotechnologies. Chem. Biol. Technol. Agric. 10, 117 (2023). https://doi.org/10.1186/s40538-023-00491-8
Precision Agriculture	Precision agriculture uses technology to make farming more efficient and sustainable. Tools like data analysis, sensors, satellite images and automation help farmers use water, fertiliser and pest control wisely. This reduces waste and harm to the environment. It works for small farms with apps and big farms with robots, helping farming produce more and handle climate change better.	Eccarelli, T., Chauhan, A., Rambaldi, G., Kumar, I., Cappello, C., Janssen, S., & McCampbell, M. (2022). Leveraging automation and digitalization for precision agriculture: Evidence from the case studies. Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cc2912en

Category: Biological Sciences		
Technology Candidate	**Description**	**Source**
Engineered Bacteriophage	Bacteriophages, natural viruses known for their bacteria-eating properties, can be engineered using synthetic biology tools to create enhanced variants with unique attributes for prophylactic and therapeutic applications. Approaches such as high-throughput sequencing and genome editing can be employed to improve phage therapy efficacy and programmability.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.
Next-generation Gene Therapies	Researchers are advancing scalable methods for next-generation gene therapies that utilise RNA-based modalities, cutting-edge editing tools like CRISPR-Cas9 and novel nucleases to precisely target and rectify genetic defects. Non-nuclease editing and modulation methods enhance safety and efficiency, enabling therapies tailored to individual genetic profiles. These innovations open pathways to in vivo applications where edits occur directly in the body, offering transformative solutions for previously untreatable genetic diseases.	National Institutes of Health. (2023). Gene Editing – Digital Media Kit.
Sustainable Fuels	Sustainable fuels, including biomass-derived fuels, e-ammonia and e-methanol, are emerging as pivotal in reducing reliance on fossil fuels. Researchers are developing efficient methods to produce these fuels using renewable energy sources, enabling their application in various industries, including aviation through sustainable aviation fuels. These innovations are critical for meeting global climate targets while ensuring energy security.	IEA (2024), Towards Common Criteria for Sustainable Fuels, IEA, Paris. Retrieved from https://www.iea.org/reports/towards-common-criteria-for-sustainable-fuels, Licence: CC BY 4.0

Division: Medical and Health Sciences

Category: Pharmacy		
Technology Candidate	**Description**	**Source**
Adult Stem Cell Generation	Adult stem cells maintain tissue health and can replace cells that die due to injury or disease. Research suggests some adult stem cells could create various types of cells through a phenomenon known as transdifferentiation. If proved, it will open new frontiers in stem cell technologies.	Innovate UK. (2023). Welcome to the future Innovate UK's 50 Emerging Technologies.
Anti-ageing Drugs	Geroprotective' drugs aim to affect the root cause of ageing and age-related diseases, lengthening the lifespan of animals. Approaches are being explored to selectively kill ageing, or 'senescent', cells or to suppress inflammation associated with ageing.	Innovate UK. (2023). Welcome to the future Innovate UK's 50 Emerging Technologies
Biosimilar	Biosimilars are medicines very similar to existing biologic drugs in safety, effectiveness and quality. Made after the original drug's patent ends, they use advanced biotech to match the original treatment. Biosimilars help make important medicines more affordable and accessible, especially for chronic diseases like cancer, diabetes and autoimmune conditions.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.
Machine Learning-Enabled Drug Discovery	Machine learning-enabled drug discovery uses AI to speed up finding and improving new medicines. Algorithms analyse large amounts of data, predict how drugs interact with targets and identify promising candidates quickly and accurately. This method cuts research time and costs while improving drug design, leading to new treatments for many diseases.	Aayush Gupta and Huan-Xiang Zhou
Precision Medicine	Precision medicine is a personalised healthcare approach that uses genetic, environmental and lifestyle information to improve diagnosis and treatment. It focuses on early disease detection and finding biomarkers to tailor therapies to each individual, reducing guesswork in treatment. This approach helps prevent disease and offers more effective care, while also improving public health strategies.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.

Category: Specialist Topics in Medical and Health Sciences		
Technology Candidate	**Description**	**Source**
Telehealth and Remote Patient Monitoring	Telehealth and remote patient monitoring use digital tools to provide healthcare and track patient health outside of clinics. They allow real-time video visits, manage chronic diseases and collect health data continuously through wearables and apps. These technologies improve access to care, lead to better health outcomes and ease pressure on healthcare systems by overcoming distance and other barriers.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.

Division: Earth Sciences

Category: Environmental Sciences and Management		
Technology Candidate	**Description**	**Source**
Autonomous Sustainability Monitoring	Automated Sustainability Monitoring uses sensors, satellite images, machine learning and AI to track sustainability data in real time. It helps businesses and governments manage energy, water, waste and emissions more effectively. Sensors placed across buildings, equipment, or fields collect data, which is sent to a central platform. There, AI analyses it and provides insights to improve environmental performance. These systems can work with or be part of manufacturing control centres and some include satellite imagery for a complete overview.	EIT Manufacturing. (2023). Tech Radar.
Carbon Dioxide Extractor Array	The carbon dioxide extractor array is an advanced system that captures CO_2 from the air on a large scale to help fight climate change. It uses chemical and physical methods like adsorption and membrane separation to remove and store carbon efficiently. When used in industries and energy systems, it helps reduce emissions and supports carbon-neutral goals. This technology plays a key role in carbon removal and climate action.	World Governments Summit. (2019). Technology Radar.

Division: Engineering

Category: Aerospace, Aeronautics and Astronautics Engineering		
Technology Candidate	**Description**	**Source**
Electric Vertical Take-off and Landing Aircraft	Electric vertical take-off and landing aircraft are electric vehicles that take off and land vertically, designed for efficient urban and regional air travel. Using advanced batteries and electric motors, they produce less noise, lower emissions and need less infrastructure than traditional planes. The technology aims to reduce traffic, improve connectivity and support sustainable, scalable air transportation.	Doo, J. T., Pavel, M. D., Didey, A., Hange, C., & Diller, N. P. (2021). NASA Electric Vertical Takeoff and Landing (eVTOL) Aircraft Technology for Public Services–A White Paper. NASA Technical Reports Server.
Low Earth Orbit satellites	Low earth orbit satellites fly at 500 to 2,000 kilometres above Earth, providing fast, low-latency connections ideal for communication, navigation and Earth observation. They support technologies like global internet and real-time monitoring, improving access to data worldwide. Low earth orbit satellite networks are transforming industries by offering reliable, scalable services at lower costs than traditional geostationary satellites.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.

Category: Aerospace, Aeronautics and Astronautics Engineering		
Technology Candidate	**Description**	**Source**
Orbital Launch Site	Orbital launch sites, including land-based spaceports and sea platforms, are facilities built to send payloads into orbit. They support missions like satellite launches and crewed space flights, using advanced infrastructure to ensure efficient launches. Sea-based platforms offer extra flexibility, especially for equatorial launches, which boost payload capacity and save energy. These launch sites are key to expanding access to space and supporting the growing space industry.	Boston Consulting Group. (2023). The growth of the space economy.
Small Satellites	Smallsats and Cubesats are small, lightweight satellites designed for affordable and flexible use in areas like Earth observation, communication and research. Made with modular parts, they are easy to launch and can support many types of missions, from climate tracking to IoT networks. These satellites are helping to open up space access, drive innovation and grow both commercial and scientific satellite services.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.

Category: Biomedical Engineering		
Technology Candidate	**Description**	**Source**
Artificial implantable organs	Artificial implantable organs are high-tech medical devices that mimic the function of real organs, helping patients with organ failure. Made with advanced materials and biocompatible technology, devices like artificial hearts, kidneys and lungs restore essential body functions. They reduce the need for donor organs, ease organ shortages and improve patients' quality of life, marking a major step forward in regenerative medicine and personalised care.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.

Category: Chemical Engineering		
Technology Candidate	**Description**	**Source**
Supercritical Fluid Technology	Supercritical fluid technology uses fluids at high temperature and pressure, above their critical point, where they act like both liquids and gases. In this state, the fluid can dissolve substances like a liquid and move through materials like a gas. SCF is used in processes like extraction, drug delivery and green chemistry. Carbon dioxide (CO_2) is the most common SCF because it's safe, effective and easy to control.	Clarivate. (2025). Derwent Innovations Index on Web of Science. Clarivate. (2025). Innography IP Intelligence Software.

Category: Civil Engineering		
Technology Candidate	**Description**	**Source**
3D Printed Architecture	Three-dimensional printed architecture uses large 3D printers to build structures layer by layer from digital designs, often with concrete or recycled materials. This method, also called additive manufacturing in construction, helps address urban challenges like the need for affordable, sustainable housing by cutting labour costs, speeding up construction and reducing material waste.	Cappra Institute. (2024). Data Thinking Radar.
Building Information Modelling	Building Information Modelling creates and manages digital models of buildings and infrastructure, helping to unify construction and urban planning. These models provide accurate, shared information across all project stages from design to construction to operation. The technology improves efficiency, reduces errors, supports teamwork and promotes sustainable building practices.	Cappra Institute. (2024). Data Thinking Radar.
Urban Irrigation	Urban irrigation helps cities deal with heat, air pollution and flooding. It now goes beyond parks to include rooftops and roads. Using sprinklers, drip lines and smart tech like sensors and cloud systems, it uses water efficiently. Rooftop systems keep plants healthy, which cools buildings, while roadside irrigation reduces dust and cools streets. Moist soil also absorbs rain better, helping to prevent floods.	Cappra Institute. (2024). Data Thinking Radar.

Category: Computer Engineering		
Technology Candidate	**Description**	**Source**
4D Printing	4D printing is an evolution of 3D printing where materials are programmed to change shape or properties over time when exposed to external stimuli like heat, light, or moisture. It is used in fields such as healthcare, aerospace and smart textiles, enabling dynamic and adaptive products.	World Governments Summit. (2019). Technology Radar.
Additive Manufacturing	Additive manufacturing, or 3D printing, builds objects layer by layer from digital designs. It starts with a digital model, which is sliced into layers and materials like plastics, metals, or ceramics are added one layer at a time. This process supports fast prototyping, reduces waste, allows complex shapes and makes it easier to customise products.	EIT Manufacturing. (2023). Tech Radar.
Chiplet	Chiplet is a modular semiconductor design approach where smaller chips are combined into a single package to improve performance and flexibility. This innovation addresses the growing complexity of chip manufacturing, enabling scalable solutions for high-performance computing and AI applications.	World Governments Summit. (2019). Technology Radar.
Holographic 3D Printing	Holographic 3D printing uses light-based techniques to produce complex 3D structures with exceptional precision and speed. This technology is particularly impactful in creating medical devices, aerospace components and rapid prototyping with unparalleled accuracy.	World Governments Summit. (2019). Technology Radar.
Industrial 3D Printing	Industrial 3D printing involves large-scale additive manufacturing to produce durable, intricate components for sectors like aerospace, automotive and healthcare. It enhances efficiency, reduces material waste and enables customised production, revolutionising traditional manufacturing processes.	World Governments Summit. (2019). Technology Radar.
Neuromorphic Chip	Neuromorphic chip is a type of computer chip designed to mimic the neural structure and functioning of the human brain. These chips use artificial neurons to perform computations, aiming to replicate the brain's efficiency in processing information and learning from experiences.	World Governments Summit. (2019). Technology Radar.

Category: Electrical and Electronic Engineering		
Technology Candidate	**Description**	**Source**
On-body and Off-body Sensors	These sensors track data from the body or nearby environment. On-body sensors, like fitness trackers and health patches, are worn to measure things like heart rate, glucose levels, or activity. Off-body sensors work around the user to monitor air quality, temperature, or movement. Together, they support better health monitoring, personalised care and smarter living spaces.	M. Usman, M. R. Asghar, I. S. Ansari and M. Qaraqe, "Security in Wireless Body Area Networks: From In-Body to Off-Body Communications" in IEEE Access, vol. 6, pp. 58064-58074, 2018
Optical Sensor Arrays	Optical sensor arrays use light to detect and measure physical, chemical, or biological changes. They combine multiple sensors that monitor changes in light intensity, colour, or polarisation. Types include surface plasmon resonance, fluorescence, fibre optic and interferometric sensors. These arrays are used in environmental monitoring, healthcare and industry because they are highly sensitive, work in real time and can measure many things at once. They play a big role in precision medicine and smart sensing systems.	Clarivate. (2025). Derwent Innovations Index on Web of Science. Clarivate. (2025). Innography IP Intelligence Software.

Category: Energy Resources and Engineering		
Technology Candidate	**Description**	**Source**
Clean Hydrogen	Clean hydrogen is hydrogen made using eco-friendly methods, like electrolysis powered by renewable energy (green hydrogen) or processes that capture carbon emissions (blue hydrogen). It serves as a versatile energy source and raw material with little or no greenhouse gas emissions. Clean hydrogen is important for reducing carbon in tough sectors like heavy industry, aviation and shipping and also helps with energy storage and balancing the power grid.	Yin, L. (2024). Clean as Water: a Hydrogen-Fueled Future. Harvard Technology Review.
Decentralised Energy Grid	A decentralised energy grid is a power system that works independently from a central grid. Unlike traditional factories that rely on a central grid making them vulnerable to outages and inefficiencies, the technology uses local energy sources like solar panels and wind turbines near the factory. This setup improves efficiency, cuts energy loss during transmission and boosts energy security for manufacturing plants.	EIT Manufacturing. (2023). Tech Radar.
Integrated Autonomous Energy Grid	The integrated autonomous energy grid is a smart energy system that automatically balances supply and demand in cities. It uses AI and machine learning to monitor and manage energy from renewables like solar and wind alongside traditional sources. By adjusting to changes in energy use and production, it ensures a steady, reliable supply while reducing waste and dependence on fossil fuels.	Cappra Institute. (2024). Data Thinking Radar.
Long Duration Energy Storage Systems	Long-duration energy storage systems supply energy for hours or days, helping manage renewable energy's ups and downs. They include: • Mechanical storage, like pumped hydro and flywheels • Thermal storage, which saves heat or cold for later use • Electrochemical storage, such as lithium-ion and flow batteries • Chemical storage, using hydrogen and synthetic fuels These systems improve energy reliability, balance the grid and support renewable energy use.	Stanford Emerging Technology Review. (2023). A report on ten key technologies and their policy implications. Stanford University.

Category: Energy Resources and Engineering		
Technology Candidate	**Description**	**Source**
Long-Range Wireless Energy Transmission	Energy can be transmitted safely and reliably over long distances using electromagnetic waves. The system uses a transmitting antenna, relay panels and a metamaterial antenna that converts the waves into direct current. Energy travels in focused long-wave beams between transmitters, preventing loss or stray radiation. Compared to expensive and complex cables, wireless transmission is more cost-effective and easier to maintain. It can power remote areas like islands, farms, communities, refugee camps and mobile hospitals and in the future, it could even send energy between Earth and space.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.
Ocean Wave Energy Technology	Ocean wave energy technology captures the power of ocean waves to produce electricity. It uses devices like buoys, floats, or underwater structures that convert the waves' up-and-down motion into electrical energy. These systems work mainly offshore where waves are strongest, using methods like floating point absorbers or oscillating water columns that use air pressure from waves. This renewable energy source can generate a lot of power with little environmental harm, helping reduce fossil fuel use and promote sustainable energy.	Clarivate. (2025). Derwent Innovations Index on Web of Science. Clarivate. (2025). Innography IP Intelligence Software.
Onshore and Offshore Wind Turbines	Wind turbines generate electricity by capturing wind energy. Onshore turbines are placed on land and are cheaper and easier to install, making them common for land projects. Offshore turbines are in water, usually near coasts or open seas, where winds are stronger and steadier, so they produce more energy. However, they cost more to install and maintain because of tough marine conditions. Both types are essential for moving toward clean, renewable energy.	Foster, W., & Foster, W. (2024). The Future of wind Energy: Emerging trends and technologies. Energy Warden - Energy Warden.
Perovskite Solar Cell	Traditional silicon solar cells work well but can be expensive and don't get much better over time. Perovskite solar cells are a new kind of solar panel made from special crystals with lead or tin. In labs, they've shown they can be very efficient sometimes better than silicon. They are made by putting very thin layers on a surface using cheap methods, which makes them lighter and bendable. This makes them good for use in cities. These cells soak up sunlight, which makes tiny particles called electrons move and create electricity. A big plus is that they can catch more types of sunlight, even on cloudy days, so they work better in different weather.	Cappra Institute. (2024). Data Thinking Radar.
Piezoelectric Nanogenerator	The piezoelectric nanogenerator is a micro-energy harvester that converts mechanical energy, such as vibrations or movements, into electrical energy. It operates using piezoelectric materials, which generate electricity under mechanical stress. These devices are crucial in powering low-energy electronics like wearable devices, biomedical sensors and IoT nodes. Piezoelectric nanogenerators enable self-sufficient, battery-free systems, advancing sustainable energy solutions for portable and remote applications.	World Governments Summit. (2019). Technology Radar.
Sewage Harvested Energy	Sewage harvested energy technology transforms wastewater treatment facilities into energy sources by harnessing energy from organic matter in sewage. Through methods such as microbial fuel cells and anaerobic digestion, wastewater is converted into biogas or electricity. This approach not only reduces waste but also provides a sustainable energy source for urban areas and industrial facilities, making it a cornerstone of waste-to-energy initiatives.	World Governments Summit. (2019). Technology Radar.
Small Modular Reactors	Small modular reactors, or "mini nuclear reactors," provide clean and reliable energy that helps cut down fossil fuel use and pollution. They make electricity like big nuclear plants but are smaller and safer. Because of their size, this reactor can be used near factories or in remote places where energy is hard to get. They work by using a controlled nuclear reaction inside a small, sealed unit to make heat. This heat creates steam that turns turbines to produce electricity. It gives manufacturers easy access to efficient and safe energy close to their sites.	EIT Manufacturing. (2023). Tech Radar.

Category: Environmental Engineering		
Technology Candidate	**Description**	**Source**
Adaptive Processing of Recycled Materials	This innovation solves the challenge of maintaining consistent product quality when using recycled materials, which often have variable properties. Traditional manufacturing processes struggle with these fluctuations, leading to inconsistent results. Adaptive Processing overcomes this by using sensors, computer vision, real-time data analytics and artificial intelligence to assess the quality of incoming recycled materials. It then automatically adjusts key parameters like temperature, pressure and feed rates, ensuring the manufacturing process optimally adapts to the specific characteristics of the reclaimed materials.	EIT Manufacturing. (2023). Tech Radar.
Carbon Capture, Utilisation and Storage	Carbon Capture, Utilisation and Storage, also known as carbon capture and storage, addresses excess carbon dioxide emissions, a major contributor to environmental impact. This technology captures CO_2 from industrial processes like fossil fuel combustion or cement and steel production. It can also absorb CO_2 directly from the atmosphere using direct air capture systems. The captured CO_2 is then used in applications like enhanced oil recovery or converted into valuable byproducts, such as concrete. Additionally, the CO_2 can be safely stored underground, preventing it from re-entering the atmosphere and worsening climate change.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.
Decentralised Wastewater Treatment	Decentralised wastewater treatment systems treat wastewater close to its source, instead of relying on large sewer networks. These systems use technologies like membrane bioreactors, constructed wetlands and anaerobic digesters to efficiently clean wastewater. By processing pollutants and organic matter on-site, they produce treated water that can be safely released into the environment or reused for non-potable purposes like irrigation and industrial use.	Cappra Institute. (2024). Data Thinking Radar.
Direct Air Capture	Direct air capture is a technology that removes carbon dioxide directly from the air to help fight climate change. It uses chemical or physical processes, like solid sorbents or liquid solvents, to capture CO_2, which can then be stored underground or reused in products like synthetic fuels, carbonated drinks, or building materials. The technology is a scalable solution that supports efforts to reduce emissions, aiming for net-zero or negative carbon emissions.	Lux research
Green Cement	Green cement is an eco-friendly alternative to traditional Portland cement, aimed at reducing the carbon footprint of cement production. Traditional cement manufacturing emits large amounts of CO_2 due to its reliance on fossil fuels and the calcination process. Green cement reduces these emissions by using alternative materials like fly ash, slag and silica fume, along with renewable energy and advanced technologies like carbon capture and alkali-activated binders. It plays a key role in sustainable construction, balancing environmental impact with strength and durability.	Lorea, C; Sanchez, F; Torres-Morales, E. 2024. Green Cement Technology Tracker, Version May 2024 (05/2024), Stockholm, Dataset
Green Steel	Green steel aims to solve the environmental issues of traditional steel production by reducing carbon emissions and resource use. It uses new methods like hydrogen-based reduction and carbon capture to cut emissions. Additionally, it replaces fossil fuels with cleaner energy, such as green hydrogen, which helps reduce greenhouse gases, save energy and lower dependence on non-renewable resources.	Lorea, C; Sanchez, F; Torres-Morales, E. 2024. Green Cement Technology Tracker, Version May 2024 (05/2024), Stockholm, Dataset

Category: Interdisciplinary Engineering		
Technology Candidate	Description	Source
Autonomous Mobile Robots	Autonomous mobile robots work independently inside factories or warehouses to transport materials and products. Unlike older Automated guided vehicles that had to follow fixed tracks, these robots use sensors, cameras and AI to understand their surroundings and navigate freely. They have detailed maps and can move accurately without needing special tracks or conveyors. These robots can carry items from one spot to another without human help and safely move around workers and machines without changing the factory setup.	EIT Manufacturing. (2023). Tech Radar.
Autonomous Unmanned Aerial Vehicles	Autonomous unmanned aerial vehicles are drones that fly and work by themselves using smart sensors, AI and navigation systems. They can be used for many tasks like surveillance, delivery, farming and disaster help. These drones are accurate, efficient and flexible. They help industries save money, gather better data and make quick decisions, creating new possibilities in many fields.	Gartner. (2024). The Gartner 2024 Hype Cycle for Emerging Technologies.
Biomimicry	Biomimicry, also called biomimetics, solves manufacturing problems by copying ideas from nature. It helps make products more sustainable, efficient and better designed. By learning from how nature works, we can save resources, use less energy and create less waste. For example, copying spider silk's strong but light structure can help make tougher and lighter materials for airplanes or safety equipment.	EIT Manufacturing. (2023). Tech Radar.
Exoskeleton	Exoskeletons, or exosuits, are used to improve worker safety and well-being, as they aid humans when doing heavy work or compensate for physical and motor deficiencies. Exoskeletons work by providing external support to the wearer, augmenting their strength, endurance and overall physical capabilities.	EIT Manufacturing. (2023). Tech Radar.
Graphene Cytobot	A nanoscale bio microrobot is made by covering a dormant bacterial spore with tiny particles called graphene quantum dots. This coating makes the spore electrically conductive and lets us control it remotely without changing its natural features. The robot uses the cell's tiny structures and machines to create responsive devices at the nano level. It can be controlled using magnetic systems and a precise electromechanical microscope stage.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.
Humanoid general-purpose robot	The humanoid general-purpose robot helps with problems like labour shortages and repetitive, hard tasks in manufacturing. These robots move like humans and can be programmed to do many jobs, such as putting together small parts, welding with precision and checking product quality. This helps lower production costs and makes products more consistent.	EIT Manufacturing. (2023). Tech Radar.
Human-robot Collaboration	Collaborative robots, or cobots, help factories meet the need for better precision, efficiency, flexibility and safety. Unlike traditional robots that work alone and can be risky, cobots work safely side-by-side with people. They use smart technology like sensors and AI to adjust to their surroundings and work together with humans, making the workplace safer and more efficient.	EIT Manufacturing. (2023). Tech Radar.
Low-code/No-code Robot	The low-code/no-code robot uses easy software that doesn't need complicated programming, so anyone can use it even without tech skills. It works with simple tools like touchscreens and user-friendly designs to help robots and people work together smoothly. Some newer robots can even learn by copying how humans do tasks.	EIT Manufacturing. (2023). Tech Radar.
Robot Caregiver	These robots use machine learning and vision to help elderly people and those with disabilities in their daily lives. They learn and adapt to each person's needs by understanding gestures, speech and body language. Using this technology, the robots can recognise how people move and feel, so they can offer personalised help and suggest activities that fit each person better.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.

Category: Interdisciplinary Engineering		
Technology Candidate	**Description**	**Source**
Robotic Swarm	Robotic swarm technology uses many small, smart robots that work together to complete difficult tasks. Inspired by how animals like bees and ants work as a group, these robots talk to each other and coordinate using smart programs. They are useful in areas like search and rescue, farming and manufacturing, where teamwork helps them do jobs better than one robot alone. This technology makes operations more efficient, flexible and strong in changing situations.	World Governments Summit. (2019). Technology Radar.
Self-Driving Bus	Self-driving buses, also called autonomous shuttles, use smart technology like AI, sensors and machine learning to drive without a human driver. They have tools like LiDAR, radar, cameras and GPS to help them move safely through busy city streets. These buses constantly gather and understand information around them to make quick decisions, like slowing down, avoiding obstacles and following traffic rules, so passengers have a smooth and safe ride.	Cappra Institute. (2024). Data Thinking Radar.
Soft Robot	Soft robots are flexible machines made from bendable materials that imitate living things. They are great at moving through delicate spaces and doing jobs like medical tasks, search-and-rescue, or flexible manufacturing. Because they can change shape and adapt, they're perfect for work that needs careful precision and flexibility.	World Governments Summit. (2019). Technology Radar.

Category: Manufacturing and Industrial Engineering		
Technology Candidate	**Description**	**Source**
Antimicrobial Packaging	Antimicrobial packaging integrates active agents into materials to inhibit the growth of bacteria, fungi and other harmful microorganisms, extending the shelf life of food, pharmaceuticals and other perishables. Using advanced coatings, nanotechnology and biodegradable polymers, it ensures safety, reduces waste and addresses contamination risks. This innovative packaging is pivotal in maintaining supply chain integrity while enhancing consumer health and sustainability.	ITONICS Innovation. (2024). Technology Radar.
Distributed Manufacturing	Distributed manufacturing fixes problems like high shipping costs, long wait times and few options for customising products. It uses smart tech like the Internet of Things, cloud computing, AI and sometimes 3D printing to set up smaller factories closer to customers. This means products get made nearby, so shipping costs and pollution go down. It also lets companies make things faster and with more choices for customers. It helps the environment and lets small local businesses sell to more people, which helps the economy grow.	EIT Manufacturing. (2023). Tech Radar.
Machinery as a Service	Machinery as a service lets companies rent machines instead of buying them, so they don't have to pay a lot of money upfront or for repairs. They only pay for what they use, usually with a subscription or pay-as-you-go plan. The machines have sensors that send data, so companies can watch and control them online from anywhere. This makes it easier for smaller companies to use smart, energy-saving machines without owning them. This technology also helps companies change what they do quickly and supports cleaner, greener manufacturing.	EIT Manufacturing. (2023). Tech Radar.
Manufacturing Data Space	Manufacturing data spaces create a secure, shared platform where manufacturers collect and organise data from sensors, machines and production lines. This enables easy data sharing across the supply chain and better collaboration. By providing tools for analysis, it helps predict equipment issues, improve quality and optimise processes leading to greater efficiency, less downtime and cost savings. This approach supports faster decision-making, drives innovation and helps manufacturers adapt to changing markets, making it vital for the future of manufacturing.	EIT Manufacturing. (2023). Tech Radar.

Category: Material Sciences and Technology		
Technology Candidate	**Description**	**Source**
Advanced Composite Materials	Advanced composite materials combine high-strength fibres, such as carbon or glass, with lightweight matrices to deliver exceptional mechanical properties. Renowned for their durability, stiffness and resistance to environmental factors, these materials are used in aerospace, automotive and renewable energy applications. Advanced composites enable weight reduction, energy efficiency and enhanced performance, driving innovation in high-performance engineering and sustainable design.	ITONICS Innovation. (2024). Technology Radar.
Auxetic Material	Auxetic materials expand laterally when stretched, unlike conventional materials. Their unique mechanical properties make them suitable for protective equipment, biomedical devices and aerospace applications, offering superior performance under stress.	World Governments Summit. (2019). Technology Radar.
Biobased Materials	Bio-sourced materials, or biobased materials, are derived from renewable resources like plants, agricultural products and waste. They address sustainability and resource scarcity by converting biological sources into materials like bioplastics, biofuels, textiles and building materials. Examples include extracting cellulose, starch, or oils from plants, fermenting microorganisms to produce compounds and growing mycelium as a leather alternative. These materials offer eco-friendly solutions across various industries.	EIT Manufacturing. (2023). Tech Radar.
Biosensor	Smart sensor technology involves sensors that detect and measure physical phenomena (like temperature, motion, or light) and process data in real-time, often triggering actions based on that data. Integrated with communication capabilities, these sensors send information to networks for analysis and automation, enabling smarter decision-making. Used in applications like smart homes, industrial automation and healthcare, smart sensors are key to the Internet of Things (IoT), helping optimise processes, improve efficiency and reduce human intervention.	Swiss Department of Defense. (2019). The Future of Supply Chain.
Carbon-Cement Supercapacitor	Carbon-cement supercapacitors are an ingenious blend of cement, water and carbon black. When combined, these materials create a supercapacitor with a high internal surface area, allowing for significant energy storage capacity. The process involves the water forming a network of branching openings within the cement as it cures, with carbon black migrating into these spaces to form conductive structures. Once soaked in an electrolyte, these structures enable the material to function as a supercapacitor, storing and discharging energy efficiently.	Cappra Institute. (2024). Data Thinking Radar.
Circular Batteries	Circular batteries are designed for sustainability, emphasising reuse, refurbishment and recycling throughout their lifecycle. Unlike traditional batteries that are discarded, these are built for easy disassembly and component recovery, reducing reliance on virgin materials and minimising environmental impact. This approach extends battery lifespan through second-life applications and efficient recycling, supporting a more sustainable energy system.	Cappra Institute. (2024). Data Thinking Radar.
Carbon Nanotube	Carbon nanotubes are cylindrical nanostructures known for their exceptional strength, electrical conductivity and thermal properties. They are widely applied in electronics, advanced materials and energy storage systems, driving innovation in multiple industries.	World Governments Summit. (2019). Technology Radar.
Elastocalorics	Traditional cooling systems are energy-hungry and contribute to greenhouse gas emissions. Elastocalorics offer a cleaner, energy-efficient alternative by using materials that change temperature under mechanical stress to absorb or release heat. Unlike systems with harmful refrigerants, elastocaloric technology relies on solid materials, making it safer and more environmentally friendly.	Cappra Institute. (2024). Data Thinking Radar.

Category: Material Sciences and Technology		
Technology Candidate	**Description**	**Source**
Graphyne	Graphyne is a carbon-based material with a unique lattice structure, offering properties similar to graphene but with enhanced flexibility and tuneable electronic characteristics. It has potential applications in advanced electronics, nanotechnology and energy storage.	World Governments Summit. (2019). Technology Radar.
High Performance Thermoplastics	High-performance thermoplastics are a class of polymers engineered to withstand extreme temperatures, chemicals and mechanical stress while maintaining lightweight and flexible characteristics. Used in industries like aerospace, healthcare and electronics, these materials enhance product longevity and reliability. Their recyclability and adaptability make high-performance thermoplastics integral to sustainable manufacturing and advanced material science.	ITONICS Innovation. (2024). Technology Radar.
Superhydrophobic Coatings	Superhydrophobic coatings are surface treatments that repel water and reduce friction by creating ultra-water-resistant surfaces with nanoscale structures. These coatings prevent corrosion, fouling and icing while enhancing self-cleaning properties, making them valuable in sectors ranging from electronics to aviation. Superhydrophobic technologies optimise efficiency and durability, offering transformative solutions for a range of industrial and consumer applications.	ITONICS Innovation. (2024). Technology Radar.
Metamaterials	Metamaterials can be formed from traditional materials that are easy to find in any natural environment. They are engineered structures designed to interact with electromagnetic radiation. These structures are very small, usually smaller than the wavelength of the radiation they are interacting with. These so-called meta-atoms can interact with the electric and magnetic components of light in a way that natural atoms do not, giving metamaterials unusual properties.	Innovate UK. (2023). Welcome to the UK's 50 Emerging Technologies.
Mycological Biopolymers	Mycological biopolymers use fungi, mainly mycelium, the root-like part of fungi, to produce sustainable, biodegradable materials. Growing in controlled environments, mycelium forms natural polymers that can be shaped into foams, packaging, textiles and more. These materials offer a renewable, eco-friendly alternative to plastics and synthetics, with uses in packaging, construction, fashion and agriculture. Mycological biopolymers support sustainable manufacturing and help reduce environmental impact by replacing non-biodegradable products.	Clarivate. (2025). Derwent Innovations Index on Web of Science. Clarivate. (2025). Innography IP Intelligence Software.
Quantum Compass	The quantum compass, also known as a quantum gyroscope or inertial navigation system, leverages quantum mechanics to detect motion with exceptional precision. It measures small changes in atomic states caused by movement to determine orientation and position without relying on external signals like GPS. Unlike GPS, which can be disrupted, the quantum compass operates independently, making it ideal for environments like tunnels, dense cities, or underwater. It uses cold atoms or quantum particles that react sensitively to motion, translating these reactions into highly accurate navigation data, offering a reliable solution when GPS is unavailable.	Cappra Institute. (2024). Data Thinking Radar.
Self-Healing Materials	Self-healing materials are specially designed substances that can repair damage on their own, without human help. They offer a smart solution to the costly and time-consuming problem of maintaining infrastructure like roads, bridges and buildings in urban areas. These materials work by automatically reacting when damage occurs. For example, self-healing concrete may contain tiny capsules filled with a repair agent. When cracks appear, the capsules break and release the agent, which seals the cracks. Other materials use systems similar to blood vessels to deliver healing substances to the damaged area.	Cappra Institute. (2024). Data Thinking Radar.

Category: Material Sciences and Technology		
Technology Candidate	**Description**	**Source**
Solar Glass	Solar glass, also known as photovoltaic windows or solar windows, are advanced building materials that incorporate thin layers of photovoltaic cells within the windowpanes. These cells convert sunlight into electricity, providing a dual function of allowing natural light to enter buildings while simultaneously generating renewable energy. The technology works through the integration of transparent solar cells, which can be embedded within the glass or applied as a coating. These cells capture sunlight and convert it into electrical energy, which can be used to power the building or fed back into the grid.	Cappra Institute. (2024). Data Thinking Radar.
Solid State Lithium-Ion Battery	Solid-state lithium-ion batteries are an advanced type of battery that use solid materials instead of liquid electrolytes. This key change improves safety, energy density and battery life. They charge faster, last longer and store more energy than traditional lithium-ion batteries, making them ideal for electric vehicles, renewable energy systems and portable devices. Because they're more stable and efficient, solid-state batteries are expected to play a major role in the future of clean energy and electric mobility.	World Governments Summit. (2019). Technology Radar.

Division: Applied Sciences and Technology

Category: Bioinformatics		
Technology Candidate	**Description**	**Source**
DNA Data Storage	DNA data storage encodes digital data into synthetic DNA strands, offering far greater storage density and durability than traditional media like hard drives. It drastically reduces physical space and energy use 33 zettabytes of data could fit in less than the size of a ping-pong ball, making it a promising solution for future data demands.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.
Portable DNA Sequencer	A portable DNA sequencer is a compact device that allows on-site analysis of genetic material, enabling rapid and accessible genomic insights. This technology is widely used in healthcare, forensic science, agriculture and biodiversity studies, empowering researchers and professionals with real-time data for decision-making.	World Governments Summit. (2019). Technology Radar.

Category: Biotechnology		
Technology Candidate	**Description**	**Source**
Alternative-protein Production	Alternative-protein production, including cultivated meats, involves innovative techniques such as cell cultivation and fermentation to produce protein-rich foods without traditional livestock farming. This technology addresses environmental concerns, animal welfare and global food security, offering sustainable, scalable protein alternatives. Cultivated meats represent a revolution in food science, promising reduced greenhouse gas emissions and resource use compared to conventional meat production.	Samad, A., Kim, S. ... Joo, S. (2024). Revolutionizing cell-based protein: Innovations, market dynamics and future prospects in the cultivated meat industry. Journal of Agriculture and Food Research, 18, 101345.
Bioremediation	Bioremediation technology uses microorganisms to reduce, eliminate, contain or transform contaminants present in the soil, water and air. The growth of naturally occurring microbes could encourage or augmented, or the system could rely on a combination of natural and engineered microorganisms.	Swiss Department of Defense. (2019). The Future of Supply Chain.

Category: Biotechnology		
Technology Candidate	**Description**	**Source**
Cell therapy 2.0	Cell therapy 2.0 introduces advanced techniques to harness innate immune cells, precision-engineer cell behaviours and deliver therapies directly in vivo. These innovations improve therapeutic efficacy, reduce side effects and expand the scope of cell-based treatments for cancer, autoimmune diseases and regenerative medicine. By integrating precise control and novel delivery methods, Cell Therapy 2.0 enhances the potential of cellular interventions for personalised healthcare.	Bashor, C.J., Hilton, I.B., Bandukwala, H. et al. Engineering the next generation of cell-based therapeutics. Nat Rev Drug Discov 21, 655–675 (2022).
Cytotoxic Therapeutic	Cytotoxic therapeutic technology uses substances that specifically kill harmful cells, especially cancer cells, by damaging their DNA or disrupting cell division. Delivered via chemotherapy, targeted therapies, or antibody-drug conjugates, these treatments are key in fighting tumours but can also affect healthy cells, so side effects must be managed carefully.	Clarivate. (2025). Derwent Innovations Index on Web of Science. Clarivate. (2025). Innography IP Intelligence Software.
Genomic Vaccines	Genomic vaccines use engineered RNA or DNA sequences to instruct cells to produce specific antigens, triggering a targeted immune response. This platform enables rapid development, adaptability to emerging pathogens and scalable manufacturing. Exemplified by mRNA-based COVID-19 vaccines, genomic vaccines are transforming infectious disease prevention and therapeutic interventions, heralding a new era in precision medicine.	Malaysian Industry-Government Group for High Technology (MIGHT). (2023). Malaysian Technology Strategic Outlook 2023/2024: Space, Energy & Healthcare Sectors.
Programmable Cells	Programmable cells are bio-engineered cells designed to perform specific tasks by integrating chemical switches into their genetic circuits. These switches allow the cells to sense their environment, make decisions and execute actions based on pre-defined logical functions. This innovative technology leverages synthetic biology to create living cells that can carry out complex functions autonomously.	Innovate UK. (2023). Welcome to the UK's 50 Emerging Technologies.
Stabilised mRNA Therapeutics	Stabilised mRNA therapeutics improve the durability and effectiveness of mRNA treatments by using chemical modifications and delivery systems that prevent degradation and boost protein production in cells. Methods like codon optimisation, cap structure changes and lipid nanoparticle delivery help ensure the mRNA reaches target cells and works efficiently. This approach has enabled rapid advances in vaccines (like COVID-19), cancer therapies and gene treatments, offering faster, scalable and personalised medical solutions.	Clarivate. (2025). Derwent Innovations Index on Web of Science. Clarivate. (2025). Innography IP Intelligence Software.
Wastewater Bioplastic	Wastewater bioplastic is a biodegradable plastic made from organic waste in wastewater. Microbes feed on methane and other byproducts from wastewater treatment, while yeast helps convert them into longer-chain PHAs (bioplastics). Using organisms like Cryptococcus curvatus and Pseudomonas putida, this plastic is eco-friendly, naturally breaks down, captures greenhouse gases during production and turns waste into a valuable product, supporting a circular economy.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.

Category: Food Technology		
Technology Candidate	**Description**	**Source**
Active Packaging	Active packaging integrates advanced materials and technologies into traditional packaging to interact with the contents or environment. By including features like oxygen scavengers, antimicrobial agents, or freshness indicators, it prolongs shelf life and ensures product safety. Widely used in the food, pharmaceutical and consumer goods industries, active packaging addresses the need for smarter, more responsive packaging solutions in global supply chains.	World Governments Summit. (2019). Technology Radar.
Edible Packaging	Edible packaging uses biodegradable, food-safe materials like seaweed, starch, or proteins to create packaging that can be eaten or safely decomposed. This innovation provides a sustainable alternative to plastic, reduces waste and environmental pollution and meets the increasing consumer demand for eco-friendly products. Widely applicable in the food and beverage industries, edible packaging supports a circular economy by minimising packaging waste.	World Governments Summit. (2019). Technology Radar.

Category: Geoinformation		
Technology Candidate	**Description**	**Source**
Geospatial Artificial Intelligence	Geospatial artificial intelligence combines AI with geographic data to analyse spatial patterns, optimise resource management and inform decision-making. Used in urban planning, disaster response and environmental monitoring, the technology enhances precision and scalability in geospatial analytics. This technology transforms how organisations understand and interact with complex spatial systems, driving innovation in fields like agriculture, transportation and public health.	EIT Manufacturing. (2023). Tech Radar.

Category: Geomatics		
Technology Candidate	**Description**	**Source**
Hyperspectral Imaging	Hyperspectral imaging is an advanced remote sensing technology that helps manage urban resources and infrastructure more efficiently. Unlike regular cameras that see only red, green and blue, the technology captures hundreds of narrow light bands, giving detailed information about materials and conditions. This technology allows cities to detect air pollutants, identify building materials and monitor plant health in parks with high precision. By providing more accurate and timely data than traditional methods, the hyperspectral imaging improves decision-making in areas like environmental monitoring, infrastructure maintenance and public safety.	Innovate UK. (2023). Welcome to the UK's 50 Emerging Technologies.

Category: Information and Communication Technology		
Technology Candidate	**Description**	**Source**
6th-Generation Wireless	The 6th-generation wireless technology, or the next frontier in wireless communication, is poised to revolutionise the manufacturing industry. 6G operates by harnessing the terahertz frequency band, providing data transfer speeds and latency reductions beyond what 5G can achieve. This is accomplished through advanced technologies like photonic communication, AI-driven network optimisation and the integration of satellite communication.	EIT Manufacturing. (2023). Tech Radar.
AI Mentor	AI mentors are intelligent systems designed to guide and support users in personal or professional development. By leveraging machine learning and natural language processing, they offer tailored advice, personalised learning experiences and continuous feedback, transforming education, career coaching and self-improvement.	World Governments Summit. (2019). Technology Radar.
Augmented Reality Workforce Assistance	Augmented reality workforce assistance enhances problem-solving on the shop floor by blending the physical world with a digital layer of information. It addresses challenges in tasks like assembly, maintenance and training by overlaying crucial data onto the real world via AR-enabled devices, such as smart glasses. Depending on the manufacturer's needs, ARWA can display text, images, or 3D visuals and even control physical IoT-enabled machines or structures through virtual interactions.	EIT Manufacturing. (2023). Tech Radar.
Augmented reality	Augmented reality overlays digital content, like images or sounds, onto the real world through devices like smartphones, tablets, or augmented reality glasses. By enhancing the physical environment with virtual elements, augmented reality creates immersive experiences in fields like gaming, education, retail and healthcare. It bridges the gap between the digital and physical worlds, offering interactive and contextually relevant information in real time.	Swiss Department of Defense. (2019). The Future of Supply Chain.
Blockchain of Things	The convergence of the Internet of Things and Blockchain ensures data integrity and security in IoT applications by creating decentralised, tamper-proof systems. The Blockchain of Things integrates IoT devices with blockchain networks, recording data in a transparent and immutable ledger. For manufacturers, this ensures reliable, authentic data exchange between devices and facilities, reducing the risk of data manipulation and unauthorised access. For customers, it enhances supply chain transparency, guaranteeing product authenticity and promoting fair trade practices.	EIT Manufacturing. (2023). Tech Radar.
Cognitive Twin	The cognitive twin is an advanced version of the digital twin, offering real-time digital replicas of manufacturing systems like factory floors or production lines, enhanced with cognitive abilities. It incorporates memory, perception and attention to improve precision, efficiency and adaptability in operations. By leveraging cognitive design, it allows systems to store, process and understand data contextually, enabling smarter decision-making and real-time adjustments in manufacturing processes.	EIT Manufacturing. (2023). Tech Radar.
Cybersecurity Mesh Infrastructure	Cybersecurity mesh infrastructure is a modern cybersecurity approach that enables distributed enterprises to secure decentralised assets, like hybrid and multi-cloud environments. It integrates solutions such as firewalls and cloud-based security services to address the growing network vulnerabilities from remote work and cloud migration. As cybercrime costs surge to USD 6 trillion annually, cybersecurity mesh offers fast deployment and seamless collaboration between security tools, enhancing overall protection.	Gartner. (2024). The Gartner 2024 Hype Cycle for Emerging Technologies [Webinar].
Digital Twins	A digital twin is a virtual replica used to optimise product lifecycles and simulate real-world performance. The create-build-sustain approach enables continuous product or service optimisation even after its physical counterpart is built. Enabled by Machine Learning and IoT, Digital Twins are reducing costs and improving efficiency across industries. However, their effectiveness requires the digital replica to be integrated throughout the entire value chain.	Swiss Department of Defense. (2019). The Future of Supply Chain.

Category: Information and Communication Technology		
Technology Candidate	**Description**	**Source**
Direct-to-handset Satellite Connectivity	Direct-to-handset satellite connectivity allows satellite networks to provide cellular and broadband services directly to standard mobile devices without requiring specialised hardware. It leverages advancements in low Earth orbit satellite constellations to deliver seamless connectivity in areas lacking terrestrial infrastructure, such as rural regions, oceans, or disaster zones. This technology bridges the digital divide, enabling uninterrupted communication and internet access for underserved populations.	McKinsey & Company. (2024, August 10). Technology trends outlook 2024.
Edge Cloud Computing	Edge cloud computing decentralises data processing by moving computation and storage closer to the data source, reducing latency and enhancing real-time performance. This hybrid model combines the scalability of cloud resources with the speed and efficiency of edge networks. Edge cloud computing is essential for powering latency-sensitive applications such as autonomous vehicles, smart cities and industrial IoT, delivering faster and more resilient systems.	McKinsey & Company. (2024, August 10). Technology trends outlook 2024.
Edge Computing	Edge computing addresses the challenge of data latency and bandwidth limitations in traditional centralised cloud-based systems, which rely on distant data centres. This solution involves processing data as close as possible to its source, usually at the "edge" of the network, through localised devices and servers. Doing so significantly reduces the time it takes for data to travel to the cloud and back, solving the critical issues of real-time decision-making and reducing network congestion.	EIT Manufacturing. (2023). Tech Radar.
Federated Machine Learning	Federated machine learning is a decentralised approach to training AI models where data remains localised on devices or servers and only model updates are shared. This ensures data privacy and reduces transmission costs while enabling collaborative learning across distributed datasets. Federated learning is critical in domains like healthcare and IoT, where data sensitivity and real-time processing are paramount, offering scalable and secure AI solutions.	Gartner. (2024). The Gartner 2024 Hype Cycle for Emerging Technologies [Webinar].
Generative Artificial Intelligence and Agentic Artificial Intelligence	Generative artificial intelligence and agentic artificial intelligence combines content creation with autonomous decision-making. Early generative systems focused on creating new outputs from text and images to 3D designs through data generation and translation such as turning sketches into photorealistic renders or datasets into natural-language insights. With the addition of advanced reasoning capabilities these systems have evolved into agentic AI that not only generating content but also setting goals, planning, making decisions and acting independently based on what they create. This shift allows AI to move from simply producing ideas to executing tasks in real-world settings such as manufacturing, healthcare, robotics and mobility.	Munich Re/ ERGO Business Technology. (2025). Tech Trend Radar 2025.
High-altitude Platform Systems	High-altitude platform systems are aerial vehicles, such as balloons or drones, operating in the stratosphere (20–50 km above sea level). They provide cost-effective communication, surveillance and monitoring over large areas, especially in remote regions. The technologies offer a flexible alternative to satellites, equipped with solar power, autonomous navigation and high-capacity communications technologies.	World Economic Forum. (2024, June 25). Top 10 emerging technologies of 2024.
Industrial Internet of Things	The industrial internet of things addresses issues like inefficiency, downtime and quality control by connecting physical devices, machinery, robots and vehicles with sensors, software and network connectivity. This network allows data exchange, enabling real-time monitoring, control and seamless interaction between devices.	EIT Manufacturing. (2023). Tech Radar.
Industrial Metaverse	The metaverse in manufacturing involves virtualising facilities and processes, from design to training and operations. It uses 3D modelling, extended reality and simulation to create virtual replicas of factories and machinery. This immersive, shared virtual space allows real-time interaction and collaboration among teams and stakeholders, regardless of location.	EIT Manufacturing. (2023). Tech Radar.

Category: Information and Communication Technology		
Technology Candidate	**Description**	**Source**
Internet of Things Device Edge	IoT device edge involves processing data locally on or near IoT devices instead of sending it to the cloud. This reduces latency, improves real-time decision-making and optimises bandwidth by transmitting only essential data. It allows devices to react instantly to change and function even without cloud connectivity. For instance, a smart sensor can detect temperature changes and immediately trigger a response, like adjusting a thermostat, without sending all data to the cloud.	McKinsey & Company. (2024). Technology trends outlook 2024.
Low- and No-Code Platforms	Low-code and no-code platforms enable users to create applications with minimal or no coding through visual interfaces and drag-and-drop features. This reduces development time, costs and time-to-market. Powered by artificial intelligence, big data and application programming interfaces, these platforms are ideal for building simple applications. However, they still need further development to support highly complex, custom solutions.	McKinsey & Company. (2024). Technology trends outlook 2024.
Machine Vision	Computer vision, or AI-based image recognition, enhances quality control by inspecting products on assembly lines for defects. It captures images or videos, analyses them for inconsistencies and triggers corrective actions in real-time. This reduces errors and ensures high-quality products. The same technology is used in Automated Guided Vehicles, Cobots, robots and worker safety monitoring, enabling machines to interpret visual data and respond accordingly.	EIT Manufacturing. (2023). Tech Radar.
Metro Edge / High Performance Data Storage and Data Centres	Metro edge data centres are decentralised infrastructure located near urban hubs, designed to process and store data closer to end-users. Unlike traditional data centres, they prioritise low-latency, real-time analytics and high-speed processing. These centres use edge computing, AI and high-performance storage to meet the demands of 5G, IoT and data-heavy applications. They provide scalable, energy-efficient and secure solutions for managing both structured and unstructured data, supporting modern digital services.	McKinsey & Company. (2024). Technology trends outlook 2024.
Microservices and Application Programming Interfaces	Microservices and Application Programming Interfaces are key technologies for scalable, flexible applications. Microservices break down apps into smaller, independent services focused on specific tasks, enabling faster development and scaling. Application Programming Interfaces act as the communication layer, allowing these services to interact. Together, they create modular, reusable systems, ideal for building complex, distributed applications.	McKinsey & Company. (2024). Technology trends outlook 2024.
Middleware	Middleware acts as a bridge between hardware and software in manufacturing, enabling seamless communication and data exchange between systems like sensors, controllers and enterprise software. As manufacturers modernise their IT architecture, middleware plays a key role in integrating diverse technologies. It ensures smooth data flow, enabling real-time monitoring, control and decision-making for operators and engineers on the factory floor.	EIT Manufacturing. (2023). Tech Radar.
Mixed Reality	Mixed Reality blends augmented reality and virtual reality, creating environments where physical and digital elements interact seamlessly. Using mixed-reality headsets, users can engage with both real-world and virtual objects simultaneously. This technology is key for applications like training simulations, collaborative design and immersive storytelling, offering an interactive way to explore complex data or environments.	Swiss Department of Defense. (2019). The Future of Supply Chain.
Mobility as a Service	Urban areas struggle with traffic, pollution and inefficient transport systems. Mobility as a Service addresses these issues by integrating different transport options public transit, ridesharing, bike-sharing and car rentals into a single on-demand platform. It allows users to plan, book and pay for various services through one app, transforming urban mobility.	Cappra Institute. (2024). Data Thinking Radar.

Category: Information and Communication Technology		
Technology Candidate	**Description**	**Source**
Neuromorphic Computing	Neuromorphic computing imitates the human brain's structure and function using artificial neurons and synapses. It enables low-power, parallel processing, making it ideal for tasks like pattern recognition and adaptive learning. This approach offers significant gains in energy efficiency and cognitive abilities for AI applications.	PwC. (2024). Emerging Technologies.
Predictive Maintenance	Predictive Maintenance uses data and advanced analytics to forecast equipment failures, allowing for timely repairs and eliminating unnecessary scheduled maintenance. By integrating sensors, IoT devices and machine learning, this technology continuously monitors equipment performance, collecting data on factors like temperature and vibration. Machine learning then detects patterns and anomalies, triggering alerts when maintenance is needed.	EIT Manufacturing. (2023). Tech Radar.
Proof-of-Stake Blockchain	As energy use and scalability concerns grow, traditional Proof-of-Work blockchain models are proving unsustainable for modern cities due to their high computational and electricity demands. Proof-of-Stake offers a more efficient, eco-friendly alternative by selecting validators based on the amount of cryptocurrency they stake as collateral, rather than relying on energy-intensive problem-solving. This shift greatly reduces energy consumption, making Proof-of-Stake blockchain more suitable for sustainable urban applications.	Cappra Institute. (2024). Data Thinking Radar.
Quantum communication	Quantum communication leverages the principles of quantum mechanics to enable highly secure data transmission. Unlike classical communication systems, it uses quantum bits (qubits) and phenomena like quantum entanglement and superposition to encode and transmit information. This approach makes eavesdropping detectable, as any attempt to intercept quantum information disrupts its state.	McKinsey & Company. (2024). Technology trends outlook 2024.
Quantum computing	Quantum computing uses quantum mechanics like superposition and entanglement to process data in ways that classical computers cannot. Unlike traditional computers that use binary (0s and 1s), quantum computers use qubits, which can represent multiple states at once, allowing for far greater processing power in certain tasks. This technology is expected to transform industries by solving complex problems that are too difficult for today's most advanced computers.	Hopkins, B., Lo Giudice, D., Harrington, P., Khater, Z., Cser, A., Goetz, M., Le Clair, C., Matzke, P., Pattisall, J., & Liu, S. (2024). The top 10 emerging technologies in 2024. Forrester.
Quantum key distribution / Quantum Security	Quantum key distribution is a subset of quantum communication specifically designed to enhance cybersecurity. It uses quantum mechanics to generate and share encryption keys that are theoretically unbreakable. These keys are transmitted via quantum channels, ensuring that any interception attempt is instantly identifiable. This technology is particularly valuable in protecting sensitive data in sectors like banking, healthcare and critical infrastructure. As quantum computers pose a future threat to classical encryption, quantum key distribution is emerging as a cornerstone of quantum-resistant security systems.	McKinsey & Company. (2024). Technology trends outlook 2024.
Quantum sensing	Quantum sensing uses the unique properties of quantum physics like superposition and entanglement to make highly accurate measurements of things like time, gravity, magnetic fields and motion. These sensors are much more precise than traditional ones and enable advances in areas such as navigation (e.g. quantum gyroscopes), medical imaging and environmental monitoring. They also support cutting-edge research, including detecting gravitational waves and studying new materials.	McKinsey & Company. (2024). Technology trends outlook 2024.

Category: Information and Communication Technology		
Technology Candidate	Description	Source
Responsible AI	Responsible AI, or Ethical AI, tackles bias and the "black box" issue in AI systems, ensuring decisions are fair and transparent. In manufacturing, it helps AI make unbiased choices in areas like hiring, resource management and supply chains. This is done by embedding ethical guidelines into AI algorithms and using explainable models so decisions can be understood and checked. Responsible AI also protects data privacy and security, especially for sensitive customer and production information.	Boston Consulting Group. (2023). The growth of the space economy.
Spatial Computing	Spatial computing blends the physical and digital worlds, enabling smooth interaction between people, machines and 3D spaces. It uses sensors like cameras, depth sensors, trackers and GPS to capture real-time data about the environment and the user's movements. This data is processed with computer vision and spatial mapping to create a digital model of the physical space called a spatial map or point cloud helping the system understand the layout and features of the surroundings.	Cappra Institute. (2024). Data Thinking Radar.
Synthetic Data	Synthetic data is computer-generated data that looks and behaves like real-world data but doesn't contain personal or sensitive information. It's created by AI models trained on actual data like customer records or factory output in secure environments. These models learn patterns and relationships, then generate new data that keeps the same characteristics. Synthetic data can be numbers, images, or videos and is used to safely develop and test Big Data tools. Common methods include deep learning, generative adversarial networks (GANs) and statistical sampling.	EIT Manufacturing. (2023). Tech Radar.
Virtual Reality	Virtual reality is a technology that immerses users in a fully digital world, either real or imagined. Using devices like headsets, controllers and sensors, virtual reality creates an interactive 3D experience by blocking out the physical surroundings. Users can see, hear and sometimes feel the virtual environment. It is used in entertainment, education, healthcare and training to provide engaging and immersive experiences.	Swiss Department of Defense. (2019). The Future of Supply Chain.
Web 3.0	Web3, also called the decentralised or blockchain web, is the next evolution of the internet. Unlike Web2, which relies on central platforms controlled by big tech, Web3 gives more control to users and creators. It uses technologies like blockchain, smart contracts and machine learning to make the internet more open, secure and efficient. Web3 is closely tied to decentralised finance (DeFi) and fintech apps (dApps), emerging as trust in traditional institutions declines. More industries are exploring how to adapt to this growing and influential technology.	Information Services Group. (2024). Emerging Technology Consulting Solutions for Enterprises. ISG.
Wi-Fi 6 and 7	Wi-Fi 6 and Wi-Fi 7 are advanced wireless technologies that provide faster speeds, lower delays and greater capacity than earlier Wi-Fi versions. Wi-Fi 6 boosts performance in crowded places like offices and stadiums, while Wi-Fi 7 offers ultra-low latency and better support for things like 8K streaming, AR/VR and industrial IoT. These upgrades help meet the growing needs of more devices and data-heavy applications.	McKinsey & Company. (2024). Technology trends outlook 2024.
Wi-fi Sensing	Wi-Fi sensing helps cities monitor their environment in real time using existing Wi-Fi networks. Unlike traditional sensors or cameras that need extra infrastructure and upkeep, Wi-Fi sensing collects and transmits data through wireless signals already in place. This makes monitoring cheaper, easier and more energy-efficient, helping urban planners manage city life more effectively.	Cappra Institute. (2024). Data Thinking Radar.
Zero-trust Architecture	Zero-trust architecture is a cybersecurity model based on the idea of "never trust, always verify." It means no user or device is trusted automatically, even inside a secure network. Instead, every access request is checked with tools like multi-factor authentication, identity checks and strict access controls. It also uses techniques like micro-segmentation to limit how far attackers can move within a system. This approach helps prevent data breaches and insider threats, making it ideal for today's connected and remote-friendly IT environments.	McKinsey & Company. (2024, August 10). Technology trends outlook 2024.

Category: Medical Technology		
Technology Candidate	**Description**	**Source**
Brain Chip Implant	Brain chip implants are small, biocompatible devices placed in the brain to interact with neural signals. They can record, stimulate, or alter brain activity to help treat conditions like Parkinson's disease and epilepsy, restore senses such as vision or hearing, or enhance brain function. These implants work by detecting electrical signals from neurons, processing this information and sending precise electrical pulses to specific brain areas. This technology offers new possibilities for treating brain disorders, improving neuroprosthetics and developing direct brain-to-computer communication.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). tech detector.
Health Monitoring Skin Patch	The health monitoring skin patch is a wearable device designed to continuously track physiological metrics such as heart rate, hydration, or glucose levels. Using advanced biosensors and wireless communication, these patches provide real-time data for personalised healthcare and fitness management. They empower users with actionable health insights and support medical professionals in remote monitoring, making them a vital tool in preventative healthcare.	World Governments Summit. (2019). Technology Radar.
Implantable Sensor	Implantable sensors are miniature devices embedded within the human body to monitor and regulate physiological conditions. These sensors provide continuous data on parameters like glucose levels, neural activity, or organ health, enabling precise diagnostics and interventions. Implantable sensors revolutionise personalised medicine by offering minimally invasive, real-time monitoring solutions.	World Governments Summit. (2019). Technology Radar.
Medical Nanobot	Medical nanobots are microscopic robots engineered to perform precise tasks within the human body. These nanobots can target specific cells for drug delivery, repair tissues, or eliminate harmful pathogens at a cellular level. They hold immense potential in precision medicine, enabling minimally invasive treatments, rapid diagnostics and revolutionary therapies for complex diseases like cancer.	World Governments Summit. (2019). Technology Radar.
Medical Tricorder	The medical tricorder is a portable, all-in-one diagnostic device inspired by science fiction, designed to rapidly analyse health metrics non-invasively. It uses advanced sensors and AI to provide real-time insights into a patient's condition, offering a transformative solution for remote healthcare, early detection and personalised treatment.	World Governments Summit. (2019). Technology Radar.

Division: Social Sciences

Category: Education		
Technology Candidate	**Description**	**Source**
Sensing Classroom	The sensing classroom integrates sensors and AI to create smart learning environments that monitor factors like student engagement, environmental conditions and learning progress. This data-driven approach enhances teaching strategies and student outcomes, fostering more effective and personalised education.	World Governments Summit. (2019). Technology Radar.
Smart Classroom	Smart classroom technology uses digital tools to make learning more interactive, personalised and effective. It includes things like interactive whiteboards, tablets, online learning platforms and AI tools that adapt lessons to each student's needs. Teachers can use real-time data to give instant feedback and improve student progress. These tools also support virtual learning, group work and multimedia lessons, helping students stay engaged and learn in ways that suit them best. The goal is to create a modern, flexible classroom that supports better teaching and learning.	Clarivate. (2025). Derwent Innovations Index on Web of Science. Clarivate. (2025). Inography IP Intelligence Software.

APPENDIX E: LIST OF STEM SKILLS AND ESSENTIAL SKILLS

List of STEM skills

STEM Area: Artificial Intelligence and Data Technologies		
STEM Skill	**Definition**	**Source**
Applied Data Science	This skill involves applying scientific methods, mathematics, programming and domain knowledge to extract insights from both structured and unstructured data. It includes using algorithms and machine learning for predictive modelling and communicating results through data visualisation to support innovation and informed decision-making.	Adapted by MIGHT from myMahir Platform, 2025 and Industrial Skills Framework, 2022.
Artificial Intelligence and Machine Learning Modelling	This skill involves developing systems and algorithms that mimic human intelligence to perform tasks such as perception, reasoning and decision-making. It includes using machine learning techniques and statistical models that allow systems to learn from data, make predictions or decisions and continuously improve without explicit programming.	Adapted by MIGHT from Industrial Skills Framework, 2022.
Cloud Computing	This skill involves designing, deploying and managing on-demand computing resources such as servers, storage, databases, networking and software delivered over the internet. It aims to enhance business performance, security, innovation and operational efficiency. This includes evaluating and implementing cloud solutions to support scalable, flexible and secure IT system.	Adapted by MIGHT from Future Skills Framework for the Malaysian Financial Sector, 2024 and Singapore Skill Framewor, 2016.
Data Analytics and Visualisation	This skill involves interpreting and analysing data using statistical, mathematical and computational techniques to uncover patterns, trends and inefficiencies. It includes transforming insights into clear, engaging visual formats using narrative techniques and digital tools to support informed decision-making, communicate key messages and drive improvements across organisational and production environments.	Adapted by MIGHT from myMahir Platform, 2025 and Industrial Skills Framework, 2022.
Data Engineering	This skill involves designing, building and maintaining scalable data infrastructure and pipelines to collect, process, store and integrate data from various sources. It includes developing stable workflows to ensure efficient data transformation and accessibility, supporting analytics, AI systems and data-driven business objectives.	Adapted by MIGHT from myMahir Platform, 2025 and Industrial Skills Framework, 2022.
Data Governance	This skill involves establishing and implementing policies, standards and regulations to ensure data quality, privacy, security and accessibility throughout its lifecycle. It includes overseeing proper data handling, advising on compliance and addressing data breaches within complex and evolving organisational contexts.	Adapted by MIGHT from Future Skills Framework for the Malaysian Financial Sector, 2024 and myMahir Platform, 2025.
Generative AI and Large Language Models	This skill involves developing, fine-tuning and deploying generative AI models and large language models to automate and enhance tasks such as content creation, language understanding and decision support. It includes applying prompt engineering, managing training data, evaluating outputs and implementing responsible AI practices to ensure ethics, minimise bias and maintain compliance.	IBM. (2023). What is generative AI and large language models (LLMs).

STEM Area: Computational and Physical Sciences		
STEM Skill	**Definition**	**Source**
Aerospace Systems Maintenance and Integration	This skill involves applying aircraft maintenance practices and system integration procedures, in accordance with technical manuals, safety protocols and organisational standards. It includes ensuring safe operations within aircraft, hangar and workshop environments, using tools and equipment effectively, accurately interpreting engineering drawings and supporting quality assurance by utilising knowledge of APQP (Advanced Product Quality Planning) and PPAP (Production Part Approval Process).	Adapted by MIGHT from Singapore Skill Framework, 2016 and myMahir Platform, 2025.
Computational Modelling and Simulation	This skill involves developing, selecting and applying statistical techniques, algorithms and advanced computational methods to create virtual models that replicate real-world systems or scenarios. It includes simulating behaviours, interpreting data and using modelling techniques to analyse specific issues, generate insights and support data-driven decision-making.	Adapted by MIGHT from Singapore Skill Framework, 2016, myMahir Platform, 2025, Australian Skills Classification, 2021 and Malaysia National Skills Registry, 2021.
Kinematic Modelling	This skill involves the mathematical representation of motion without considering forces. It combines geometry, algebra and computational methods to predict and simulate an object's position and velocity over time.	Adapted by MIGHT from Industrial Skills Framework, 2022.
Mathematical and Statistical Modelling	This skill involves applying mathematical concepts and statistical techniques to represent, analyse and solve real-world problems across various fields, including engineering, IT, medicine, data science and commerce. It encompasses developing abstract models, performing quantitative and probabilistic analysis, interpreting data and using computational tools to make predictions and informed decisions.	Adapted by MIGHT from Industrial Skills Framework, 2022, myMahir Platform, 2025 and Malaysia National Skills Registry, 2021.
Quantum Science and Engineering	This skill involves the study of matter and energy at atomic and subatomic levels, governed by the principles of quantum mechanics such as superposition and entanglement. It forms the foundation for emerging technologies like quantum computing, communication and sensing, with transformative potential across fields such as cryptography, medicine and materials science.	University of Delaware. (2024). Quantum Science and Engineering.
Space Systems Engineering	This skill involves the interdisciplinary application of systems engineering to design, integrate and manage complex space missions. It includes coordinating subsystems such as propulsion, power, thermal control and communications, as well as performing critical tasks like calculating orbital trajectories for satellite deployment.	Adapted by MIGHT from O*NET, 2025.

STEM Area: Digital Security and Cyber Defence		
STEM Skill	**Definition**	**Source**
AI Governance	The skill involves the processes, standards and safeguards designed to ensure that AI systems and tools are safe, ethical and aligned with societal values. AI governance frameworks direct the research, development and application of AI to promote safety, fairness and respect for human rights, ensuring responsible and accountable AI usage.	Muchi, T. & Stryker, C. (2024). What is AI Governance? IBM.
Cybersecurity	This skill involves protecting digital systems and data by applying frameworks and practices to prevent, detect, respond to and recover from cyber threats. It includes ensuring regulatory compliance, securing interconnected environments and implementing measures such as encryption, penetration testing and secure system design.	Adapted by MIGHT from myMahir Platform, 2025, Industrial Skills Framework, 2022 and Singapore Skill Framework, 2024.
Data Governance	This skill involves establishing and implementing policies, standards and regulations to ensure data quality, privacy, security and accessibility throughout its lifecycle. It includes overseeing proper data handling, advising on compliance and addressing data breaches within complex and evolving organisational contexts.	Adapted by MIGHT from Future Skills Framework for the Malaysian Financial Sector, 2024 and myMahir Platform, 2025.
Network and Computer Systems Administration	This skill involves configuring, maintaining and optimising computer networks and systems, including LANs, WANs, servers and IT infrastructure, to ensure performance, security and availability. It includes monitoring system health, managing user access, diagnosing and resolving technical issues and supporting reliable operations across both physical and virtual environments.	Adapted by MIGHT from myMahir Platform, 2025 and O*NET, 2025.

STEM Area: Energy and Engineering Infrastructure		
STEM Skill	**Definition**	**Source**
Advanced Installation, Maintenance and Reliability Engineering	The skill involves the installation, maintenance and optimisation of mechanical systems using engineering practices that prioritise safety, reliability and performance. This encompasses deploying and validating cathodic protection systems, carrying out routine servicing and minor repairs and implementing reliability strategies to minimise downtime and prolong the lifespan of equipment.	Adapted by MIGHT from Industrial Skills Framework, 2022 and Australian Skills Classification, 2021.
Civil and Structural Engineering Management	This skill involves managing the planning, design, construction and maintenance of infrastructure projects by integrating engineering principles with management practices. It ensures that projects are completed on time, within budget and to the required standards. This field includes key aspects such as project scheduling, cost estimation, quality control and regulatory compliance.	Adapted by MIGHT from Ullah, N. (2024). Role in Management Civil Engineering. Medium.
Digital and Control Systems Engineering	This skill involves the design and implementation of systems that utilize digital computers and controllers to manage dynamic processes. It integrates principles from control theory, electronics and computer science to create systems capable of processing discrete signals and executing control algorithms. This enables precise and adaptive management of complex systems across various industries.	Adapted by MIGHT from ScienceDirect. (2017). Digital control system – an overview. In ScienceDirect Topics.
Electrical and Electronics Systems	This skill involves the design, development and maintenance of electrical and electronic systems by applying principles of electricity, electronics and electromagnetism. It encompasses creating and testing components such as circuits, microcontrollers and communication systems.	Adapted by MIGHT from U.S. Bureau of Labor Statistics. (2024). Electrical and Electronics Engineers. Occupational Outlook Handbook.

STEM Area: Energy and Engineering Infrastructure		
STEM Skill	**Definition**	**Source**
Marine and Offshore Engineering	This skill involves the design, construction, operation and maintenance of marine vessels and offshore structures by applying multidisciplinary engineering principles to ensure safety, reliability and sustainability in maritime and offshore environments.	Adapted by MIGHT from SkillsFuture Singapore. (2018). Skills Framework for Marine and Offshore.
Mechatronic Systems Integration and Design	This skill involves integrating mechanical, electrical, electronic and software components to design and develop intelligent mechatronic systems. It applies interdisciplinary engineering principles to create efficient, precise and adaptive solutions capable of performing complex tasks through seamless hardware-software interaction.	Adapted by MIGHT from Tech Briefs. (2009). Mechatronic System Integration and Design.
Process and Automation Control	This skill involves designing, implementing and managing hardware, software and systems to monitor, regulate and automate industrial processes for optimal safety, efficiency and quality. It includes applying instrumentation, sensors, actuators, control elements, real-time data, DCS, SCADA and loop control technologies across both continuous and batch operations.	Adapted by MIGHT from International Society of Automation. (2025). Process Automation and Control.
Renewable Energy Systems Engineering	This skill involves designing, developing and managing systems that harness renewable energy sources such as solar, wind, hydro and biomass to generate sustainable and efficient power. It requires integrating engineering principles with environmental considerations to optimise energy production, storage and distribution.	Adapted by MIGHT from New England Institute of Technology. (2023). Sustainability in Action: Renewable Energy Engineering.

STEM Area: Environmental and Sustainability		
STEM Skill	**Definition**	**Source**
Environmental Management	This skill involves developing and implementing comprehensive frameworks for environmental management systems, which include policies, standards and procedures, to ensure compliance with environmental regulations and promote sustainable practices within the organisation.	Adapted by MIGHT from myMahir Platform, 2025.
Geospatial Analytics	This skill involves collecting, analysing and visualising spatial data using technologies such as Geographic Information Systems (GIS), satellite imagery and remote sensing. It supports decision-making in fields like agriculture and environmental management by enabling the monitoring of crop health, mapping ecosystems and climate patterns and evaluating soil and water conditions.	Adapted by MIGHT from Industrial Skills Framework, 2025 and O*NET, 2025.
Green Chemistry and Sustainability	This skill involves designing safer chemical products and processes that minimise the use of hazardous substances, reduce environmental impact and improve resource efficiency, all while aligning with broader sustainability goals across various industries.	Adapted by MIGHT from United Nations Environment Programme. (2021). Green and Sustainable Chemistry: Framework Manual.
Life Cycle Assessment	This skill involves understanding Life Cycle Assessment which enables the evaluation of the environmental impact of field service activities and the identification of areas for improvement.	Adapated by MIGHT from myMahir Platform, 2025.
Waste and Hazardous Material Management	This skill involves the safe handling, treatment and disposal of waste and hazardous materials using validated processes and risk-based approaches. It ensures protection of human health, safety and the environment through rigorous risk assessments, regulatory compliance and sustainable waste management practices across industries.	Adapated by MIGHT from myMahir Platform, 2025.

STEM Area: Food Security and Agricultural Systems		
STEM Skill	**Definition**	**Source**
Agricultural Management	This skill uses scientific, technological and business strategies to improve farming operations. This involves leveraging agri technologies, applying Good Agricultural Practices, managing biosecurity risks and ensuring compliance with regulations to boost productivity and promote sustainability.	Adapted by MIGHT from Industrial Skills Framework, 2022, Singapore Skill Framework, 2016 and Malaysia National Skills Registry, 2021.
Food Engineering and Processing	This skill involves applying engineering principles to the design, optimisation and management of food production systems including processing, packaging, distribution and storage while integrating microbiology, chemistry and engineering knowledge to ensure food safety, quality and operational efficiency.	Adapted by MIGHT from Eurofins Scientific. (2024). Understanding Food Science Disciplines – What is Food Engineering?
One Health and Zoonotic Disease Management	An integrated approach that fosters collaboration between the human, animal and environmental health sectors to prevent, detect and manage diseases that can be transmitted between animals and humans (zoonoses), with the goal of improving overall health outcomes.	Adapted by MIGHT from Centres for Disease Control and Prevention. (2025). About One Health and Zoonotic Diseases.
Precision Agriculture	The use of advanced technologies such as drones, sensors and artificial intelligence to gather and analyse farm data. This enables accurate, efficient and sustainable management of resources and farming practices.	Adapted by MIGHT from Industrial Skills Framework, 2022 and Singapore Skill Framework, 2016.
Sustainable Farming	The creation of organisational sustainability goals, policies and plans, followed by the implementation of sustainable farming practices. This ensures that farming is conducted using best practices and protocols that prioritise clean energy, optimise water efficiency and minimise pollution and environmental impact.	Adapted by MIGHT from Singapore Skill Framework, 2016.

STEM Area: Healthcare and Biomedical Sciences		
STEM Skill	**Definition**	**Source**
Biomedical Product Development and Engineering	This skill involves the integration of engineering principles with biological and medical knowledge to design, develop and maintain medical devices and technologies. It focuses on addressing healthcare challenges through technological innovation, including areas like medical device design, diagnostic imaging and therapeutic interventions.	Adapted by MIGHT from Wilson, S. (2025). Biomedical Product Design & Development. University of Kansas Bioengineering Program.
Clinical and Medical Practice	This skill combines scientific evidence, thorough treatment plans and ongoing research. This method aims to improve health outcomes while ensuring adherence to the highest ethical principles and regulatory guidelines.	Adapted by MIGHT from myMahir Platform, 2025 and Malaysia National Skills Registry, 2021.
Diagnostic and Imaging Expertise	This skill involves capturing, interpreting and analysing diagnostic images using a range of imaging technologies to support accurate assessment and decision-making. It also encompasses computer-aided design (CAD) modelling skills, including the creation, manipulation and analysis of digital models for design, visualisation and simulation purposes.	Adapted by MIGHT from myMahir Platform, 2025.
Good Laboratory Practice Management	This skill involves a quality system that ensures the integrity, consistency and reliability of non-clinical laboratory studies through standardised procedures, thorough documentation and regulatory compliance. It is essential for generating credible data in areas such as chemical safety, environmental testing and pharmaceutical research.	Adapted by MIGHT from U.S. Environmental Protection Agency (EPA). Good Laboratory Practices Standards Compliance Monitoring Program.

STEM Area: Healthcare and Biomedical Sciences		
STEM Skill	**Definition**	**Source**
Multi-omics Integrated Analysis	This skill involves a comprehensive approach that integrates data from various biological domains such as genomics, transcriptomics, proteomics and metabolomics to uncover complex molecular interactions and pathways. This integration provides a deeper understanding of the flow of biological information from genotype to phenotype, improving the accuracy of disease diagnosis, prognosis and the development of targeted therapies.	Adapted by MIGHT from Subramanian, I., Verma, S., Kumar, S., Jere, A., & Anamika, K. (2020). Multi-omics data integration, interpretation and its application. Bioinformatics and Biology Insights.
Patient-Focused Services	This skill emphasises an integrated care approach that combines early detection, compassionate support and evidence-based clinical management. It is designed to ensure timely intervention, enhance patient experiences and promote sustained well-being across the continuum of care.	Adapted from Singapore Skill Framework, 2016, myMahir Platform, 2025 and LinkedIn Talent Insight, 2025.
Pharmaceutical Sciences	This skill combines the compounding and manufacturing of pharmaceutical products, patient-centered care and clinical research. It focuses on optimising the quality, safety and efficacy of drugs to improve therapeutic outcomes and advance healthcare solutions.	Adapted from myMahir Platform, 2025, LinkedIn Talent Insight, 2025 and Singapore Skill Framework, 2016.
Synthetic Biology	This skill involves the engineering of biological systems to create new functions or redesign existing ones for practical applications in fields such as medicine, agriculture and sustainability. It integrates biological science with engineering principles to design custom organisms, biological parts, or devices.	Adapted by MIGHT from National Human Genome Research Institute. (2019). Synthetic biology.

STEM Area: Materials Science and Advanced Manufacturing		
STEM Skill	**Definition**	**Source**
Advanced Materials Engineering	This skill involves applying principles of materials science and engineering to develop, process and test advanced materials with enhanced properties such as high strength, durability, thermal stability and electrical conductivity, for use in specialized applications across various industries.	Adapted by MIGHT from U.S. Bureau of Labor Statistics. (2024). Materials Engineers. Occupational Outlook Handbook.
Material Science	This skill involves investigating the properties, behaviour and performance of materials, which guides the selection and design of lightweight, durable structures for drones.	Adapted by MIGHT from Industrial Skills Framework, 2022.
Surface and Packaging Engineering	This skill involves designing, developing and evaluating surface treatments and packaging systems that improve product protection, functionality and visual appeal. It includes selecting suitable materials, applying surface technologies and ensuring compliance with industry standards.	Adapted by MIGHT from Creopack. (2025). What is a Packaging Engineer and What Do They Do?

STEM Area: Smart Systems and Digital Transformation		
STEM Skill	**Definition**	**Source**
Embedded Systems Development	This skill involves designing, developing and maintaining embedded systems that integrate hardware and software to perform real-time, dedicated functions. It includes system architecture, programming, interface and sensor integration, control implementation and testing to ensure reliable performance throughout the system's lifecycle, often operating without traditional operating systems.	Adapted by MIGHT from myMahir Platform, 2025, Singapore Skill Framework, 2016 and Industrial Skills Framework, 2022.
IoT Systems and Applications	This skill involves designing, implementing and maintaining interconnected devices and sensor networks that collect and exchange data in real-time to drive automation, predictive maintenance and operational efficiency. It includes integrating computing systems, equipment and machines within a networked environment to deliver targeted, data-driven solutions.	Adapted by MIGHT from myMahir Platform, 2025, O*NET, 2025 and Singapore Skill Framework, 2016.
Programming and Coding	This skill involves developing the technical capabilities to understand, design and write instructions for computers in the form of software programs to achieve desired outcomes. It includes using programming languages and coding techniques to create functional and efficient software solutions.	Adapted by MIGHT from Singapore Skill Framework, 2016 myMahir Platform, 2025 and Industrial Skills Framework, 2022.
Software Development and Testing	This skill involves designing, developing and testing software applications using development methodologies, computer science principles and testing techniques. It includes creating systematic test plans to ensure that the software aligns with design specifications and meets quality standards.	Adapted by MIGHT from Future Skills Framework for the Malaysian Financial Sector, 2024 myMahir Platform, 2025 and Singapore Skill Framework, 2016.
System Architecture and Design	This skill involves defining, designing and managing the structure, components and interactions of IT systems and digital platforms to meet business and user requirements. It includes developing system blueprints, selecting appropriate technologies and aligning infrastructure, applications, data and integration layers such as APIs, databases and cloud services.	Adapted by MIGHT from Future Skills Framework for the Malaysian Financial Sector, 2024 and myMahir Platform, 2025.
UX Engineering	This skill involves combining user experience design principles with front-end development skills to build interactive, accessible and technically feasible user interfaces. It includes prototyping UI components, implementing design systems, ensuring accessibility standards and translating design concepts into responsive, production-ready code.	Adapted by MIGHT from myMahir Platform, 2025 and Singapore Skill Framework, 2016.

STEM Area: Strategic Planning and Risk Management		
STEM Skill	**Definition**	**Source**
Applied Research and Development Management	This skill involves the strategic planning and oversight of research efforts focused on solving real-world problems and developing new products, technologies, or processes. It includes coordinating resources, teams and timelines to translate scientific knowledge into practical, market-ready innovations.	Adapted by MIGHT from National Science Foundation (NSF). (2022). Definitions of Research and Development: An Annotated Compilation of Official Sources.
Emergency and Disaster Preparedness	This skill involves planning, coordinating and executing strategies to prevent, mitigate and respond to crises or disasters. It emphasises ensuring the safety of people and assets, maintaining regulatory compliance and enabling the swift recovery and continuity of operations.	Industrial Skills Framework, 2022 and myMahir Platform, 2025.

STEM Area: Strategic Planning and Risk Management		
STEM Skill	**Definition**	**Source**
Energy Trading and Hedging Strategies	This skill involves managing risk and optimising value in energy markets through the use of financial instruments such as futures, options and swaps. It focuses on stabilising costs, securing profits and protecting against basis risk, delivery disruptions and price volatility to ensure reliable and efficient energy portfolio management.	Adapted by MIGHT from Academy Flex. (2025). Energy trading and hedging strategies.
Quality, Health, Safety and Compliance Management	This skill involves implementing and managing systems that uphold quality standards, health and safety regulations and environmental compliance. It focuses on identifying and mitigating occupational risks, driving continuous improvement initiatives and ensuring that operations align with ethical principles and regulatory requirements to protect people, products and the environment.	Adapted by MIGHT from Pouillard, N. (2024). QHSE: Definition, profession and quality, health, safety and environment management.
Strategic Technology Planning	This skill involves developing and steering long-term technology strategies that align with organisational goals, drive innovation and enhance overall performance. It includes identifying emerging technologies, assessing associated risks, setting strategic priorities and creating technology roadmaps that ensure security, scalability and a sustained competitive advantage.	Adapted by MIGHT from Future Skills Framework for the Malaysian Financial Sector, 2024 and myMahir Platform, 2025.
Technology Risk Management	This skill involves identifying, assessing and mitigating risks associated with existing and emerging technologies. It includes implementing structured processes for risk monitoring, review and reporting, as well as establishing proactive governance frameworks to safeguard systems, ensure regulatory compliance, strengthen resilience and maintain operational continuity.	Adapted by MIGHT from Securities Commission Malaysia. (2024). Guidelines on Technology Risk Management.
Workplace Safety and Health Management	This skill involves developing and implementing systems, frameworks and practices to identify, assess and control workplace hazards. It focuses on ensuring regulatory compliance, fostering a culture of safety and health and creating a sustainable work environment that protects the well-being of all employees.	Adapted by MIGHT from Industrial Skills Framework, 2022 and myMahir Platform, 2025.

List of Essential skills

Essential Skill	Definition	Source
Adaptability and Resiliency	Navigate through the unexpected, respond positively to evolving challenges and recover from setbacks with flexibility and resilience.	Developed by MIGHT and adapted from Future Skills Framework for the Malaysian Financial Sector, 2024 and Singapore Skill Framework, 2016.
Analytical and Critical Thinking	Ability to analyse, interpret and draw conclusions.	Developed by MIGHT and adapted from Future Skills Framework for the Malaysian Financial Sector, 2024.
Collaboration and Teamwork	Managing relationships and working effectively with others to achieve goals.	Developed by MIGHT and adapted from Singapore Skills Framework, 2016, Malaysia National Skills Registry, 2021 and Future Skills Framework for the Malaysian Financial Sector, 2024.
Communication	Convey and exchange thoughts, ideas and information effectively through various mediums and approaches.	Developed by MIGHT and adapted from Singapore Skill Framework, 2016.
Creative and Transdisciplinary Thinking	Apply concepts from multiple disciplines by synthesising knowledge and insights to guide decisions, foster cooperation and drive continuous improvement, while adopting diverse perspectives to connect ideas across fields and generate innovative solutions and improvements.	Singapore Skill Framework, 2016.
Digital and Technology Literacy	Leverage digital technology tools, systems, software and hardware across work processes and activities to solve problems, drive efficiency and facilitate information sharing.	Developed by MIGHT and adapted from Singapore Skill Framework, 2016 and Future Skills Framework for the Malaysian Financial Sector, 2024.
Ethics and ESG Awareness	To practice professional integrity by ensuring innovations align with societal values and organisational policies while also understanding the principles of sustainable development and the implications of Environmental, Social and Governance (ESG) factors on the organisation.	Developed by MIGHT and adapted from Industrial Skills Framework, 2022 and Future Skills Framework for the Malaysian Financial Sector, 2024.
Foresight and Futures Thinking	Systematic participatory process, involving future intelligence gathering and building visions for the medium to long term future and aimed at informing present-day decisions and mobilising join actions.	Developed by MIGHT, 2018.
Innovative Thinking and Problem Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.	Developed by MIGHT and adapted from Future Skills Framework for the Malaysian Financial Sector, 2024 and Malaysia National Skills Registry, 2021.
Learning Agility	Deploy different learning approaches which enable continuous learning across different contexts to drive self-development and the achievement of long-term career goals.	Singapore Skill Framework, 2016

APPENDIX F: PRIORITISATION OF STEM SKILLS

Assessing the Attractiveness and Feasibility of STEM Skills for Malaysia's Future Economic Value

The study identified 58 STEM skills with the potential to contribute to Malaysia's future economic value; however, their applications vary significantly. It is therefore essential to prioritise those with the greatest potential impact. In this context, the aim of prioritisation is to reduce the initial list of STEM skills to a set of prioritised skills that are most relevant against the applied criteria (adapted from UNIDO, 2005). To achieve this, a two-round Delphi survey was conducted to assess these skills based on their relevance to new and emerging industries, their potential economic impact in terms of job creation, wage growth and productivity and the anticipated demand over the next 10 to 15 years to enhance Malaysia's global competitiveness. The assessment also considered the readiness of the existing ecosystem to develop and deploy these skills, including the availability of training programmes and institutions, as well as their integration into current industries and ecosystems.

DELPHI METHOD TO GATHER INSIGHTS AND ACHIEVE CONSENSUS

The Delphi methodology was adopted to systematically gather expert insights and achieve consensus on the prioritisation of STEM skills most critical for Malaysia's future economic value.

The UNIDO Technology Foresight Manual (2005) defined that Delphi method is based on structural surveys and makes use of the intuitive use of the intuitive available information of the participants, who are mainly experts. Therefore, it delivers qualitative as well as quantitative results and has beneath it explorative, predictive even normative elements. Delphi is an expert survey in two or more "rounds" in which in the second and later rounds of the survey of the results of the previous rounds are given feedback. Therefore, the experts' answers from second round are under the influence of their colleagues' opinion. Thus, the Delphi method is a "relatively strong structured group communication process, in which matters, which naturally unsure and incomplete knowledge is available, are judged upon by experts", (Hader and Hader, 1995). This Delphi method is particularly suitable for addressing complex, future-oriented issues such as identifying emerging skills, as it leverages the knowledge of diverse experts through iterative rounds of evaluation and feedback.

By using this approach, the study assessed the attractiveness and feasibility of the initial list of STEM skills, ensuring that the prioritisation of STEM skill reflects both current realities and future needs for Malaysia's economic growth, workforce development and global competitiveness.

The Delphi survey engaged Malaysian academics, educators and training providers, industry leaders, human resource professionals, policymakers and researchers to ensure a comprehensive understanding of Malaysia's future STEM talent needs.

- **Academics** played a key role in innovating curricula, developing future-ready learning programmes and fostering collaborations to bridge skill gaps.
- **Educators and training providers** contributed by delivering practical, industry-relevant programmes and ensuring that learning pathways remain accessible and adaptable to evolving workforce demands.
- **Human resource professionals** offered expertise in talent acquisition, development and retention, ensuring a competitive and adaptable workforce.
- **Industry leaders** provided insights into emerging technological trends, skill demands and the practical requirements of future industries.
- **Policymakers** contributed by aligning workforce strategies with national economic and educational goals, anticipating technological and industry shifts.
- **Researchers** supported the process by generating evidence-based insights, analysing future trends and validating the relevance of STEM skills to Malaysia's long-term development.

In Round 1 of the Delphi survey, 58 STEM skills across 10 STEM areas were assessed by the respondents. A total of 754 responses were collected from 411 individuals, drawn from the 2,500 targeted participants across Malaysia.

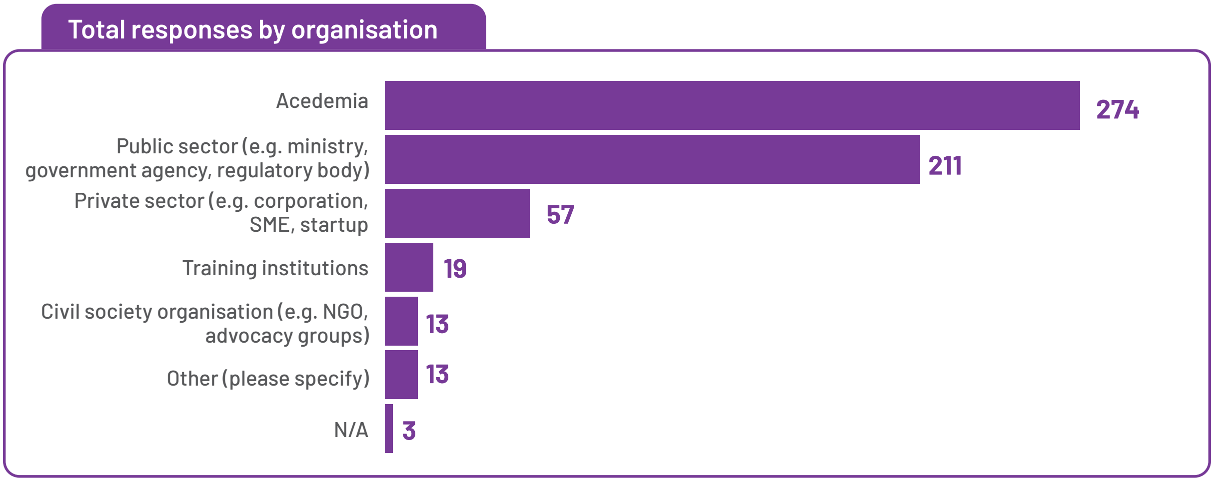

Figure F-1: Breakdown of responses by organisation type in Round 1.

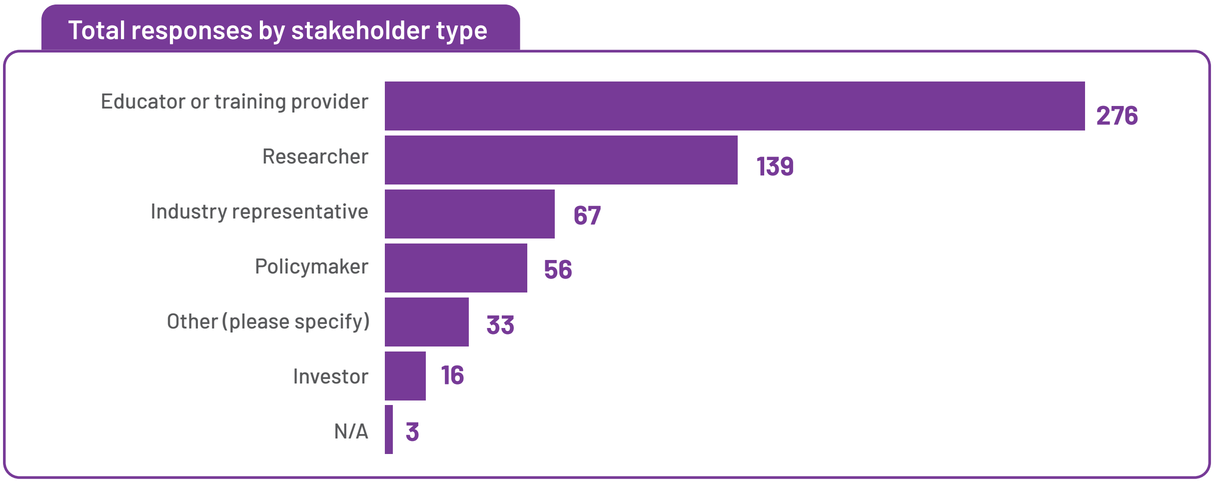

Figure F-2: Breakdown of responses by stakeholder type in Round I.

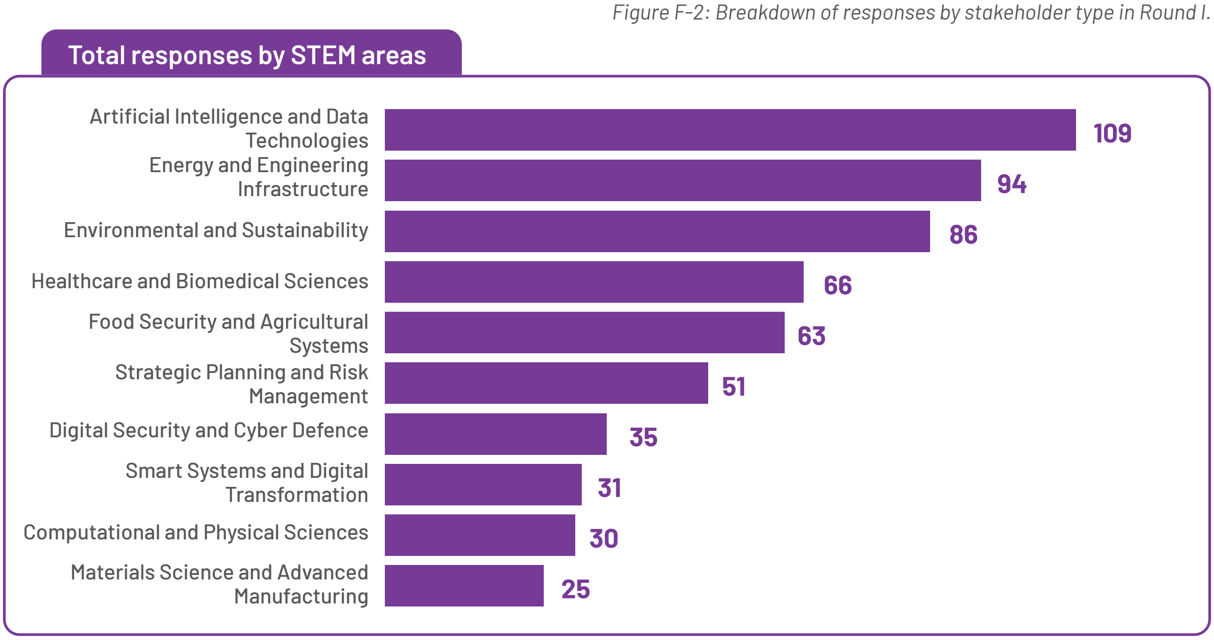

Figure F-3: Artificial Intelligence and Data Technologies garnered the highest number of responses in Round 1.

Following established Delphi methodology (Hsu & Sandford, 2007; Keeney et al., 2011), it is generally recommended that each item receive between 5 and 12 expert assessments to ensure statistical robustness and reliable group consensus. Consensus in Delphi studies is typically indicated when both the Standard Deviation (SD) and Interquartile Range (IQR) fall below 1.0. These thresholds signal a high degree of agreement among respondents and minimal variability in ratings, thereby enhancing the credibility of results by minimising the influence of outlier opinions and reinforcing a strong central tendency.

Applying these criteria, a subset of 40 skills, each rated by at least five experts and demonstrating SD and IQR values under 1.0 was shortlisted for reassessment in Round 2. This subsequent round garnered 379 responses (70% response rate), enabling further refinement and validation of the initial findings. However, 18 skills in Round 2 failed to meet the minimum threshold of five expert assessments and were consequently excluded from further analysis. This exclusion aligns with best practices in Delphi methodology, as inadequate expert input may undermine the reliability of the consensus and the overall validity of the findings (Okoli & Pawlowski, 2004).

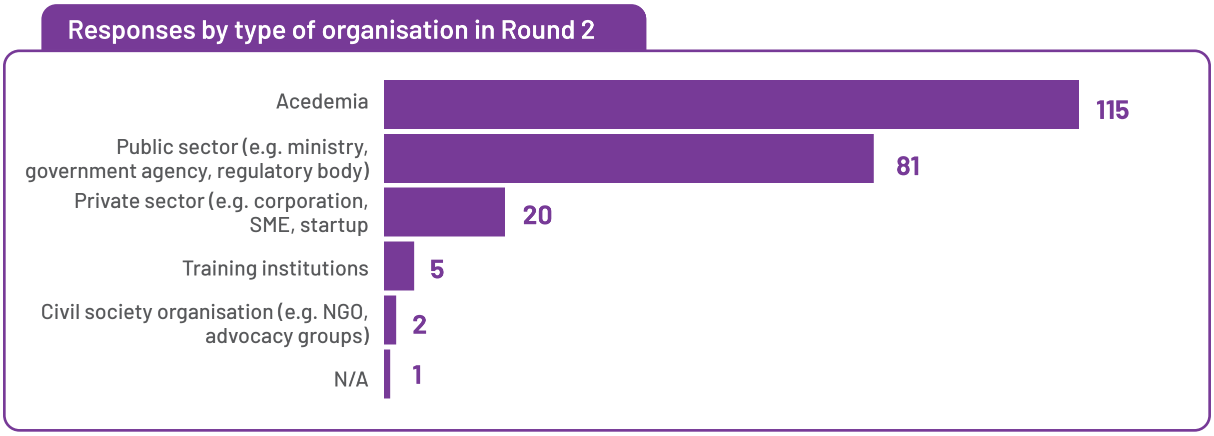

Figure F-4: Breakdown of responses by organisation type in Round 2.

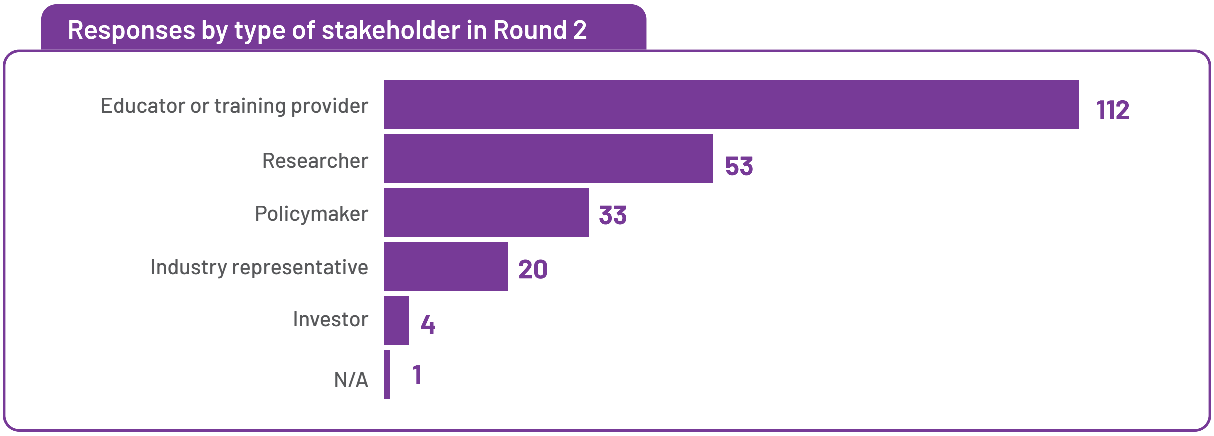

Figure F-5: Breakdown of responses by stakeholder type in Round 2

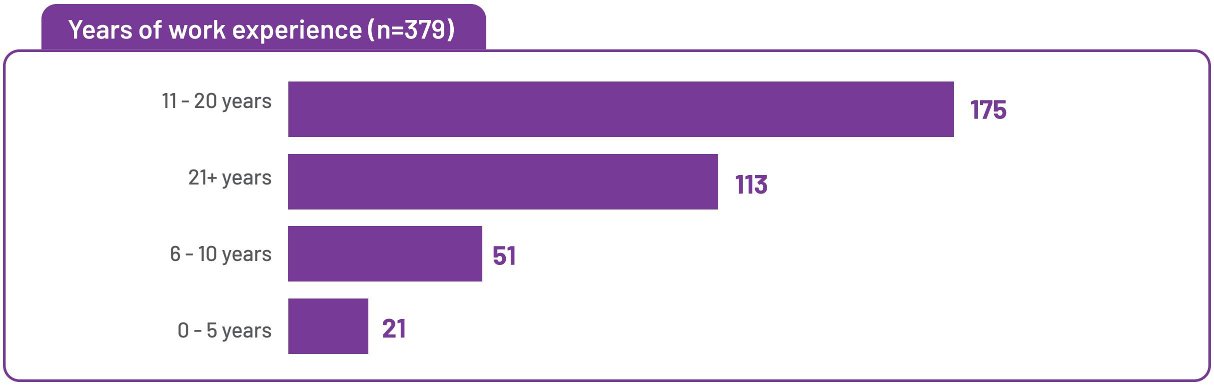

Figure F-6: Years of work experience of respondents, based on Round 2 responses.

In Round 2, the average mean and median for all 40 STEM skills were calculated for both attractiveness and feasibility parameters, with SD and IQR falling below 1.0. These thresholds indicate a high level of agreement among respondents and minimal variability in ratings, thereby enhancing the credibility of the results by reducing the influence of outliers and reinforcing a strong central tendency. The agreed prioritised STEM skills were then plotted in the attractiveness–feasibility matrix to determine their ranking positions as reflected in Figure F-7.

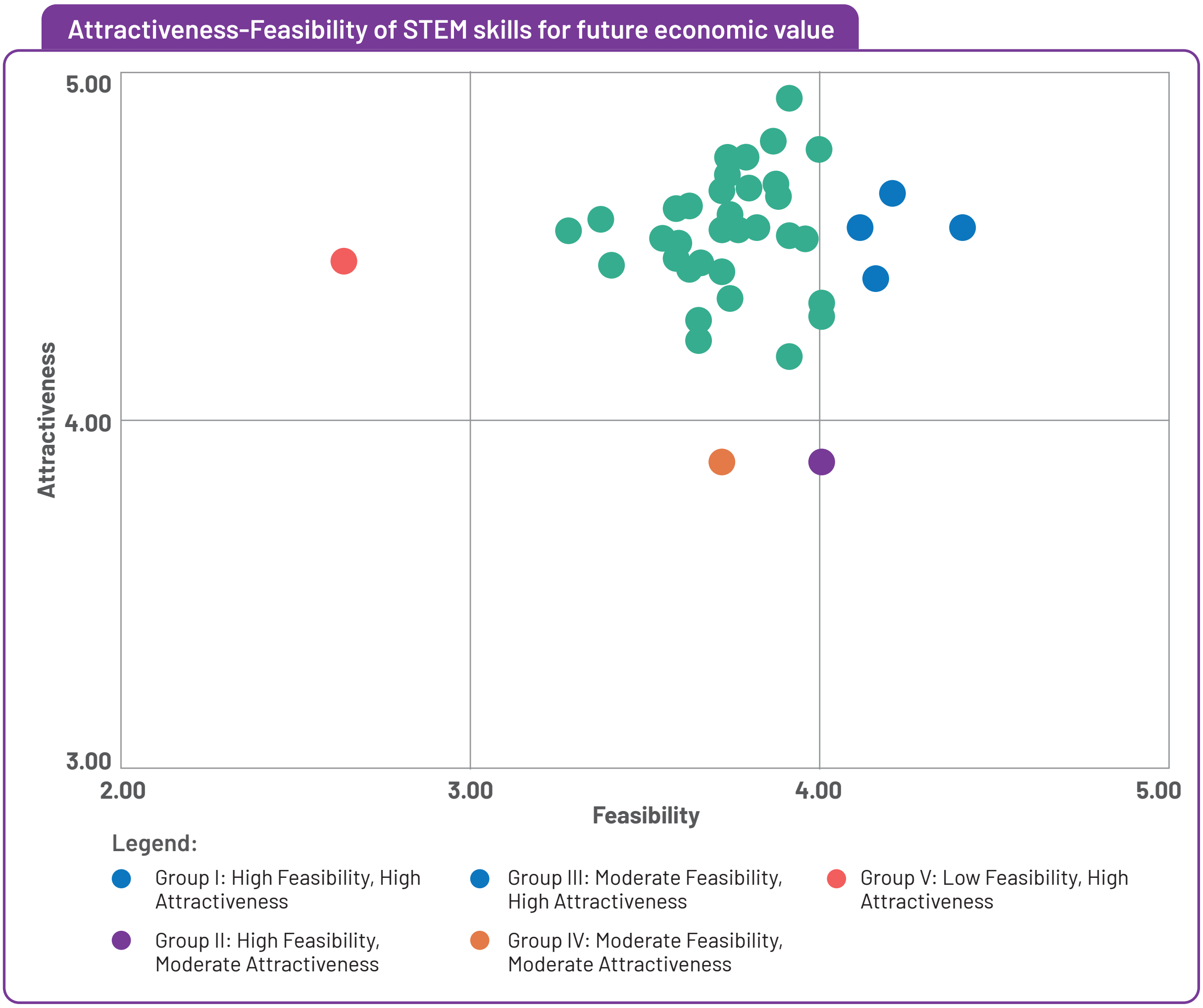

Figure F-7: Attractiveness-Feasibility of STEM skills for future economic value.

APPENDIX G: LIST OF STAKEHOLDERS

1076 Stakeholders Engaged

373 Government representatives

Survey		
Tech	Delphi 1	Delphi 2
119	166	81

189 Industry representatives

Survey		
Tech	Delphi 1	Delphi 2
83	45	20

481 Academia & Research representatives

Survey		
Tech	Delphi 1	Delphi 2
65	172	115

25 Training Institutions

Survey		
Tech	Delphi 1	Delphi 2
0	20	5

8 Civil Society Organisations

Survey		
Tech	Delphi 1	Delphi 2
1	5	2

6 Stakeholder Engagements

5 External Review & Validation

66 Ministries & Agencies

76 Industry & Government Linked Companies

5 Professional Bodies & Associations

5 Training & Skill Development Institutions

35 Academia & Higher Learning Institutions

19 Government Research Institutes

Academia & Higher Learning Institutions

1. ADMAL Aviation College
2. Monash University Malaysia
3. Multimedia University
4. Ibrahim Sultan Polytechnic
5. Ungku Omar Polytechnic
6. International Islamic University Malaysia
7. Islamic Science University of Malaysia
8. National Defence University of Malaysia
9. National University of Malaysia
10. Northern University of Malaysia
11. PETRONAS University of Technology
12. Putra University Malaysia
13. Sultan Idris Education University
14. Technical University of Malaysia Malacca
15. Tenaga Nasional University
16. Tun Hussein Onn University of Malaysia
17. Tunku Abdul Rahman University
18. University of Kuala Lumpur
19. University of Malaya
20. University of Malaysia Kelantan
21. University of Malaysia Pahang Al-Sultan Abdullah
22. University of Malaysia Perlis
23. University of Malaysia Sabah
24. University of Malaysia Sarawak
25. University of Malaysia Terengganu
26. University of Science Malaysia
27. University of Technology Malaysia
28. Sunway University
29. Taylor's University
30. UCSI University
31. UNITAR International University
32. University of Cyberjaya
33. University of Nottingham Malaysia
34. University of Technology Sarawak
35. University Malaya STEM Centre
36. Xiamen University Malaysia

Government Ministries

1. Ministry of Agriculture and Food Security
2. Ministry of Defence Malaysia
3. Ministry of Digital
4. Ministry of Economy
5. Ministry of Education
6. Ministry of Energy Transition and Water Transformation
7. Ministry of Entrepreneur and Co-operatives Development
8. Ministry of Finance
9. Ministry of Health
10. Ministry of Home Affairs
11. Ministry of Higher Education
12. Ministry of Human Resource
13. Ministry of International Trade and Industry
14. Ministry of Natural Resources and Environmental Sustainability
15. Ministry of Plantation and Commodities
16. Ministry of Science, Technology & Innovation
17. Ministry of Youth and Sports
18. Public Service Department
19. Prime Minister Department

Government Agencies

Federal level

1. Academy of Sciences Malaysia
2. Angkatan Tentera Malaysia
3. Bank Pembangunan Malaysia Berhad
4. Bioeconomy Corporation
5. CyberSecurity Malaysia
6. Construction Industry Development Board Malaysia
7. Department of Atomic Energy
8. Department of Chemistry Malaysia
9. Department of Environment
10. Department of Fisheries Malaysia
11. Department of Irrigation and Drainage Malaysia
12. Department of Mineral and Geosciences Malaysia
13. Department of Polytechnic and Community College
14. Department of Statistic Malaysia
15. Department of Skills Development
16. Department of Standards Malaysia
17. Indah Water Consortium
18. Institute of Public Security of Malaysia
19. Invest Selangor
20. Malaysia Digital Economy Corporation
21. Malaysia Forest Fund
22. Malaysian Cocoa Board
23. Malaysian Investment Development Authority
24. Malaysian Palm Oil Board
25. Malaysian Pepper Board
26. Malaysian Productivity Corporation
27. Malaysian Qualifications Agency
28. Malaysian Research Accelerator for Technology and Innovation
29. Malaysian Rubber Board
30. Malaysian Space Agency
31. Medical Device Authority
32. Manpower Department
33. National Digital Department
34. National Science Centre
35. National Kenaf and Tobacco Board
36. Northern Corridor Implementation Authority
37. Royal Police Malaysia
38. SEDA Malaysia
39. Talent Corporation Malaysia Berhad

State level

1. Chief Minister's Department of Sabah
2. Department of Agriculture Sarawak
3. Kedah State Government
4. Pahang State Education Department
5. Sarawak Digital Economy Corporation
6. Sarawak Forestry Corporation
7. Sabah Forestry Department
8. Sabah State Computer Services Department

Government Research Institutes

1. Construction Research Institute of Malaysia
2. Collaborative Research in Engineering, Science & Technology
3. Defence Science & Technology Research Institute
4. Forest Research Institute Malaysia
5. Institute for Public Health
6. Institute for Medical Research
7. Institute for Strategic and International Studies Malaysia
8. Institute for Youth Research Malaysia
9. Khazanah Research Institute
10. Malaysian Agricultural Research and Development Institute
11. Malaysian Institute of Pharmaceuticals and Nutraceuticals
12. Malaysian Institute of Microelectronic Systems Berhad
13. Malaysian Institute of Road Safety Research
14. Malaysian Nuclear Agency
15. National Institutes of Biotechnology Malaysia
16. National Institute of Health
17. National Water Research Institute of Malaysia
18. SIRIM Berhad
19. Maritime Institute of Malaysia

Industry & Government-Linked Companies

1. Advansoft Sdn Bhd
2. Aerodyne
3. AirAsia Magic
4. Agribolics Technology Sdn Bhd
5. Applied Agricultural Resources Sdn Bhd
6. Arex Precision Manufacturing (M) Sdn Bhd
7. Bonanza Venture Holdings Sdn Bhd
8. Brightstar Oils Sdn Bhd
9. Chip Hong Rubber Sdn Bhd
10. Composites Technology Research Malaysia Sdn Bhd
11. Continental Automotive Components Malaysia
12. Critical Manufacturing Malaysia Sdn Bhd
13. CTRM Aero Composites Sdn Bhd
14. Cyberview Sdn Bhd
15. Datasonic Group Berhad
16. Dindings Poultry Development Centre Sdn Bhd
17. Dream Edge
18. Dreamaze Sdn Bhd
19. Durabon Sdn Bhd
20. DZUKI Consultancy and Training
21. Easypack Machinery Sdn Bhd
22. eMooVit Technology Sdn Bhd
23. Favelle Favco Cranes (M) Sdn Bhd
24. FGV R&D Sdn Bhd
25. First Solar Malaysia Sdn Bhd
26. Forward Energy Sdn Bhd
27. Fuji Electric (M) Sdn Bhd
28. Green Point Precision (M) Sdn Bhd
29. Harimic (Malaysia) Sdn Bhd
30. HeiTech Padu Berhad
31. HICOM Automotive Manufacturers (Malaysia) Sdn Bhd
32. HICOM Holdings Berhad
33. Ideasparq Robotics Sdn Bhd
34. Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT) JBC
35. IOI Edible Oils Sdn Bhd
36. IOT SATA Sdn Bhd
37. Johor Petroleum Development Corporation
38. Laurelcap Renewable Energy
39. Lim Chin Kiong M&E Sdn Bhd
40. Malaysian Chamber of Mines
41. McDermott Asia Pacific Sdn Bhd
42. Mechmar Boiler Sdn Bhd
43. Mobula Reseaarch Sdn Bhd
44. Mycron Steel CRC Sdn Bhd
45. NanoMalaysia Berhad
46. Ngo Chew Hong Oils & Fats (M) Sdn Bhd
47. ON Semiconductor
48. Padiberas Nasional Berhad
49. PETRONAS
50. Proxima Technologies Plt
51. Prym Consumer Malaysia Sdn Bhd
52. Rufaida Medical Systems Sdn Bhd
53. S.E.H. Malaysia Sdn Bhd
54. Sarawak Oil Palms Berhad
55. SD Guthrie
56. Shin-etsu (Malaysia) Sdn Bhd
57. SilTerra Malaysia Sdn Bhd
58. Silicon Creation Sdn Bhd
59. SME Corporation
60. Solid Lab Sdn Bhd
61. Sony EMCS (Malaysia) Sdn Bhd
62. Southern Steel Berhad
63. Spirit AeroSystems Malaysia
64. Specific Resources Sdn Bhd
65. Superiorwealth
66. SWA Shipping Sdn Bhd
67. Tenaga Nasional Berhad
68. Texas Instruments Malaysia
69. Timuer Permai Holdings Sdn Bhd
70. Unipeq Sdn Bhd
71. United Plantations Bhd
72. Universal Nutribeverage Sdn Bhd
73. Ugeo Solutions
74. Via Scientia Sdn Bhd
75. Wasco Thermal Sdn Bhd
76. Yamagata (Malaysia) Sdn Bhd

Training & Skill Development Institutions

1. National Youth Skills Institutes
2. Corridor Training & Consultancy
3. Petronas Leadership Centre
4. Sarawak Skills
5. MIMOS Academy

Professional Bodies & Associations

1. Board of Geologist Malaysia
2. International Rubber Research Development Board
3. Malaysia Association for Information Systems
4. Malaysia Rail Industry Corporation
5. Technological Association Malaysia

APPENDIX H: REFERENCES

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