Nurturing Next-Generation Talent for

Knowledge-Based, Values-Driven Development

NURTURING NEXT-GENERATION TALENT FOR KNOWLEDGE-BASED, VALUES-DRIVEN DEVELOPMENT.

AKADEMI SAINS MALAYSIA

2023

Nurturing Next-Generation Talent for Knowledge-Based, Values-Driven Development
Academy of Sciences Malaysia 2023

Published by:
Academy of Sciences Malaysia
Level 20, West Wing, MATRADE Tower
Jalan Sultan Haji Ahmad Shah
Off Jalan Tuanku Abdul Halim
50480 Kuala Lumpur Malaysia
www.akademisains.gov.my

Perpustakaan Negara Malaysia Cataloging -In-Publication Data

Nurturing Next-Generation Talent for Knowledge-Based, Values-Driven Development
e ISBN 978-629-7712-06-2

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List of ABBREVIATIONS

10-10 *My*STIE	10-10 Malaysian Science, Technology, Innovation and Economy
3Cs	Complexity, Chaos & Contradiction
8R	Respect, Rethink, Reduce, Reuse, Recycle, Restore, Repurpose and Revitalise
12 MP	Twelfth Malaysia Plan
AI	Artificial Intelligence
AIF	Academy in Factory
AR	Augmented Reality
ASEAN	Association of Southeast Asian Nations
ASM	Academy of Sciences Malaysia
CAE	The Chinese Academy of Engineering
CAS	The Chinese Academy of Sciences
CASTED	The Chinese Academy of Science and Technology for Development
CEO	Chief Executive Officer
CIPD	Chartered Institute of Personnel and Development
ChatGPT	Chat Generative Pre-trained Transformer
CNFM	French National Network of Microelectronics and Nanotechnologies
CoE	Center of Excellence
CO2	Carbon Dioxide
COL	Critical Occupations List
COVID-19	Coronavirus Disease on Year 2019
CPD	Continuing Professional Development
DEI	Diversity, Equity, and Inclusion
DELTAs	Distinct Elements of Talent
DOSM	Department of Statistics Malaysia
DVUCA	Disruptive,Volatile, Uncertain, Complex and Ambiguous
E&E	Electrical and Electronics
EP	Employment Pass
EPU	Economic Planning Unit
ESET	Emerging Science, Engineering, & Technology
ESG	Environmental Social Governance
EU	European Union
EUDiF	EU Global Diaspora Facility
FA	Failure Analysis
FDI	Foreign Direct Investment
FE	Further Education
FGDs	Focus Group Discussions
FinTech	Finance Technology
FMSDC	The Federation Malaysian Skills Development Centre
FuTCoN	Future-ready Talent Collaborative Network
IBBM	Institute of Bankers Malaysia
IBFIM	Islamic Banking and Finance Institute Malaysia
GDP	Gross Domestic Product
GII	Global Innovation Index
GLCs	Government-Linked Companies
GLROs	Government-Linked Research Organisations
HE	Higher Education
HEIs	Higher Education Institutions
HLIs	Higher Learning Institutions
IBSE	Inquiry-Based Science Education
ICT	Information and Communication Technologies
IKBN	Institut Kemahiran Belia Negara
ILMIA	Institute of Labour Market Information and Analysis
ILO	International Labour Organisation
ILP	Industrial Training Institutes
IoT	Internet of Things
IoTs	Institutes of Technology
JSA	Jobs and Skills Australia
KPIs	Key performance indicators
LLCs	Large Local Companies
MEMA	Machinery and Equipment Manufacturers Association of Malaysia
MBOT	Malaysia Board of Technologists
MDEC	Malaysia Digital Economy Corporation

List of ABBREVIATIONS

MIDA	Malaysian Industrial Development Authority
MiGHT	Malaysian Industry-Government Group for High Technology
MITI	Ministry of International Trade and Industry
MNCs	Multinational Companies
MOE	Ministry of Education
MoHE	Ministry of Higher Education
MOSTI	Ministry of Science, Technology and Innovation
MPV	Mata Pelajaran Vokasional
MTDC	Malaysia Technology Development Corporation
MySTEP	Malaysian Short-Term Employment Programme
NGO	Non-Governmental Organisation
NISTEP	National Institute of Science and Technology Policy
NLP	Natural Language Processing
NPSTI	National Policy on Science, Technology, and Innovation
NSFC	National Natural Science Foundation of China
OECD	Organisation for Economic Co-operation and Development
PR	Permanent Residence
PRIs	Public Research Institutions
Protégé	Professional Training and Education for Growing Entrepreneurs
PSDC	Penang Skills Development Centre
PVMA	Program Vokasional Menengah Atas
R&D	Research and Development
RDICE	Research, Development, Innovation, Commercialisation and Economy
REP	Returning Expert Programme
ROV	Return on Value
RP-T	Residence Pass-Talent
S&T	Science and Technology
SDGs	Sustainable Development Goals
SIG	Special Interest Group
SIGIRT	Special Interest Group on Industry-Ready Talent
SL1M	Skim Latihan 1 Malaysia
SMEs	Smal and Medium-Sized Enterprises
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering, and Mathematics
STREAM	Science, Technology, Religion, Engineering, Arts and Mathematics
STI	Science, Technology and Innovation
STIE	Science, Technology, Innovation and Economy
STIs	Science, Technology and Innovations
T-levels	Technical-based qualifications through an industry placement of at least 315 hours
TNB	Tenaga Nasional Berhad
TVET	Technical & Vocational Education and Training
Twelfth Plan	The Twelfth Malaysia Plan, 2021-2025
UAVs	Unmanned Aerial Vehicles
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNITEN	Universiti Tenaga Nasional
VR	Virtual Reality
(VUCA)	Volatile, Uncertain, Complex and Ambiguous
UN-SDGs	United Nations' Sustainable Development Goals
WEF	World Economic Forum
FWA	Flexible Work Arrangement

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ACKNOWLEDGEMENTS

The SIG members would like to express gratitude to ASM and all who have been directly and indirectly involved in preparing this position paper on Nurturing Next-Generation Talent for Knowledge-Based, Values-Driven Development. The SIG also wishes to thank the various stakeholders who contributed to our stakeholder engagements, as follows:

- Engagement with TalentCorp (5 October 2022)
- 1st SIGIRT Stakeholder Engagement Workshop (15 October 2022)
- Focus Group Discussion 1: TVET Institutions and Providers (2 March 2023)
- Focus Group Discussion 2: Talent-Related Government Agency (2 March 2023)
- Focus Group Discussion 3: Public and Private Universities (3 March 2023)
- Focus Group Discussion 4: SMEs and Start-ups (3 March 2023)
- Focus Group Discussion 5: GLCs and MNCs (8 March 2023)
- Roundtable Session with Malaysia Productivity Corporation (21 March 2023)
- Roundtable Session between HRD Corp and Academy of Sciences Malaysia (22 March 2023)
- ASM Special Interest Group (SIG) on Industry-Ready Talent Writing Workshop (8 July 2023)

Special thanks to the panel of external experts who have contributed useful input to the study.

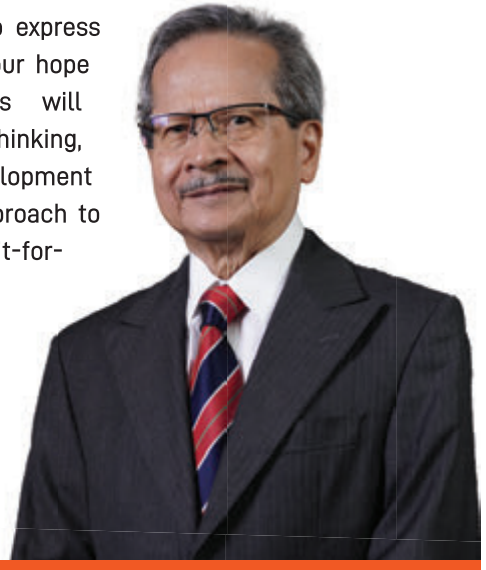
FOREWORD

The world is experiencing unprecedented changes impacting societal, economic, environmental, and governance systems. These changes happening in simultaneity are collectively heralding the post-normal times, characterised by the '3Cs'. 'Complexity' – brought upon by rapid advances in science, technology, and innovation development; 'chaos' – due to the ever-increasing independent variables interacting in many ways in networked complex systems; and 'contradictions' – by the various logical inconsistencies within these complex systems. At the heart of this new era lies knowledge, catalysing a shift from production-centric economies to qualitatively different economies propelled by knowledge. Here, countries compete for high-skilled, knowledge-based talent that can harness advanced technologies and embrace new business models.

The trajectory of Malaysia's future rests on fostering knowledge-based, values-driven talent. Economic prosperity and societal progress now demand a departure from infrastructure-focused development, which overburdens our ecosystem and planet. There is a need to transition to a humanity-centric model in nurturing the 'right talent' with proficiency in science, technology, and innovation (STI) while at the same time conscious of the need to build a future world that is environmentally sustainable. The willingness and desire to learn is central. A shift in mindset is essential, from viewing talent development as a means of enhancing human capital, focusing solely on individuals' economic productivity, to one centred on nurturing individuals who are morally upright, values-based, and adept critical thinkers. These attributes are indispensable for navigating the complexities, uncertainties, and challenges in this emerging talent scenario.

In performing its role as the nation's Thought Leader for science, technology, innovation, and economy (STIE), the Academy of Sciences Malaysia (ASM) gives the highest importance to talent development. The Special Interest Group on Industry-Ready Talent (SIGIRT) has produced this position paper on 'Nurturing Next-Generation Talent for Knowledge-Based Values-Driven Development' to put forward cogent insights into the talent landscape of post-secondary education: its related workforce dynamics, the emerging trends in talent cultivation, and six key recommendations to address our most urgent challenges.

I wish to congratulate our Special Interest Group on Industry-Ready Talent under the joint leadership of Professor Dato' Ir Dr Abdul Rahman Mohamed FASc, Professor Dr Mahendhiran Sanggaran Nair FASc, and Dr Shahidah Mohd Shariff FASc for producing this position paper. This paper has gained deep insights through comprehensive engagements with stakeholders from diverse sectors covering public, private and civil society groups. To all who have contributed to this position paper, I wish to express our deep appreciation. It is our hope that the recommendations will catalyse a strategic shift in thinking, from treating talent development with a business-as-usual approach to developing talent by design, fit-for-purpose, for the knowledge-based economy and values-driven society to come.



YM Academician Datuk Dr Tengku Mohd Azzman Shariffadeen FASc

PREFACE

This position paper on Nurturing Next-Generation Talent for a Knowledge-Based, Values-Driven Development has been developed by the ASM through SIGIRT. The 14 members of SIGIRT consist of representatives from various government agencies, public and private universities, as well as industry captains who have passionately contributed to the position paper.

High-skilled and creative talent in STI is crucial towards driving socio-economic transformation, improving the quality of life of the *rakyat*, and ensuring the nation's competitiveness and sustainability. This position paper also emphasises the importance of "STIE sovereignty", which is the ability to possess and develop scientific know-how, technology, and innovations with minimal reliance on foreign players and non-state actors that are critical for protecting national security, economic security, environmental sustainability, and societal development of the nation. Losing STIE sovereignty makes a nation vulnerable to foreign influence and other external shocks, hindering the local workforce's ability to develop dynamic capabilities and nurture indigenous technologies and innovations. Post-normal times marked by complexity, chaos, and contradictions call for a smart, sharp, and values-driven talent. The development of a smart, sharp, and values-driven talent requires a humanity-centric approach to ensure that value is created for societies, organisations, and individuals. This will foster a holistic and responsible integration of technology within the broader human context with a values-based mindset. Future talent must drive the knowledge economy in Malaysia through humanity-centric, values-driven, nature-based solutions that meet society's needs. This is reflected in the recommendations of the position paper, which are as follows:

1. Recommendation 1: To foresee and futureproof the competitiveness of the Malaysian labour market and industries by conducting a values-based assessment and regularly foreseeing global STIE trends and their impact on Malaysian economic sectors, industries, labour markets, and societal development.

2. Recommendation 2: To formulate the National Critical Competencies and Skills Framework as a single point of reference that harmonises the different skills taxonomies across government ministries and industries.

3. Recommendation 3: To establish a Future-ready Talent Collaborative Network (FuTCoN) to encourage a culture of cross-pollination of ideas and knowledge sharing among scholarship providers, universities, TVET providers, industry, and government-linked research organisations (GLROs) in talent development.

4. Recommendation 4: To establish deep and trans-tech forward schools to provide next-generation skills training across all regions of Malaysia through a consortium model between anchor industry partners, universities, GLROs, and TVET institutions.

5. Recommendation 5: To offer a competitive incentive package to attract high-skilled STI talent, such as tax exemptions for early-career Malaysians working in deep-tech and future skills jobs in Malaysia.

6. Recommendation 6: To attract world-class top STIE talent and a skilled diaspora to enhance local talent development using the Permanent Resident Visa programme and attract the best global talent to use Malaysia as a "test bed" for undertaking their STI endeavours and discoveries and nurturing next-generation planet-friendly industries and STEM talent.

We extend our heartfelt gratitude to YM Academician Datuk Dr Tengku Mohd Azzman Shariffadeen FASc, President of ASM and STI Advisor to the Prime Minister and the Nation, for his unwavering support and invaluable insights. We would also like to thank Professor Emerita Datuk Dr Asma Ismail FASc, Advisor to SIGIRT and ASM's Immediate Past President, for her guidance that has greatly enhanced the quality and comprehensiveness of this position paper. We express our appreciation to the ASM Management and Analysts as well for their valuable contributions in developing this position paper. We also wish to acknowledge our valued stakeholders who have actively participated in workshops, focus group discussions (FGDs), roundtable sessions, and various meetings. A total of 104 stakeholders were engaged in the formulation of this position paper, comprising 48 representatives from ministries and government agencies, 18 representatives from public and private universities, 9 representatives of TVET providers and institutions, and 29 representatives from the private sector, which includes small and medium-sized enterprises (SMEs), large local companies (LLCs), and multinational corporations (MNCs).

ASM hopes that this position paper will serve as a reference to assist the government and key implementing organisations and agencies in aligning higher education with industry demands and successfully implementing talent pipeline development initiatives.

Professor Dato' Ir Dr Abdul Rahman FASc

Dr Shahidah Mohd Sharif FASc

Professor Dr Mahendhiran Sanggaran Nair FASc

EXECUTIVE SUMMARY

The global economy has undergone unprecedented changes over the last 350 years, powered by STI, increased global trade, and greater mobility of people and goods across the globe. The changes in global architecture have intensified over the last five decades due to the digital revolution and, more recently, the artificial intelligence (AI) wave. The digital transformation of the global economy has had a positive spillover impact on smaller economies, such as Malaysia. The increasing use of information and communication technologies (ICT) has enabled firms in the developing world to gain access to the 'information highway.' This, in turn, has helped firms and people enhance their reach to knowledge, resources, and markets. The increasing interconnectivity in global supply chains has enabled labour markets to improve productivity, allowing firms to enhance the richness of their products and services. Thus, enabling firms to transcend their national borders and create greater economies of scale and scope.

While there is a significant positive spillover from the digital and AI revolutions on labour markets and economies across the globe, they have also intensified competition for talent and other resources. This has enabled firms and countries to move up the global innovation and competitiveness value chain. New technologies have also been found to disrupt traditional economic systems, labour markets, and business models. The increasing demand for technology-driven economic systems has also heightened the energy demand, primarily based on fossil fuels. These carbon-based energy sources have increased emissions of CO_2 and other hazardous materials into the atmosphere, contributing to climate change, global warming, and uncertain weather patterns. These factors have had a 'knock-on' impact on the health of humans and all other biological beings on Earth. The world has also experienced an increase in global temperature, volatile weather patterns, and higher incidences of infectious diseases, all of which have adversely affected the health of the planet, people, and livelihoods.

Malaysia, like many other developing economies, grapples with tectonic shifts in the global economy due to disruptive technologies, increased competition from neighbouring countries with larger labour pools, climate change, and health pandemics (such as COVID-19). Additionally, there is a growing demand for firms to comply with Environmental Social Governance (ESG) standards. This new economic order is referred to as the Disruptive, Volatile, Uncertain, Complex, and Ambiguous (DVUCA) world, posing major challenges for smaller economies like Malaysia. This is partly because Malaysia is primarily a 'taker' of STIs from more advanced economies rather than creating its own STIs. Very few local institutions of higher learning and industries are at the forefront of developing technologies and next-generation industries that operate at the higher end of the global STIE value chain.

In the DVUCA world, skilled and creative talent is critical for ensuring STIE sovereignty, where a nation has control over its STI direction in meeting its national development agenda and aspirations. Losing STIE sovereignty will render the nation at the mercy of foreign players and markets. This will hinder the local workforce from building strong dynamic capabilities (absorptive, adaptive, and innovative capabilities) and nurturing indigenous global technologies and global brands.

This report shows that there are strengths in the local STIE ecosystem to nurture talent to enhance local industries' global competitiveness, build strong and competitive domestic supply chains, and power next-generation value-driven and knowledge-intensive industrial sectors. All of which will contribute to the sustainable economic development of Malaysia. Among the key strengths include: Malaysia has a good incentive system (fiscal and non-fiscal) to attract foreign direct investments; a large pool of resources is directed towards education and training; establishment of government

research institutions to undertake strategic R&D; cost of labour and living in Malaysia is relatively cheap compared to more developed countries, which is an attraction for foreign talent to the nation; Malaysia is also one of the largest English speaking countries in the ASEAN region, hence can attract STEM talent to the country; and the nation is also blessed with natural resources that are vital for industrial development, especially in the agriculture and extractive mineral industries. Access to talent, incentives, and natural resources has been an important driver for attracting foreign direct investment into many of the high-tech industries in Malaysia. This has led to an increase in jobs in Malaysia and high economic growth from the 1980s to the last decade.

The report highlights that while the talent ecosystem in Malaysia has made significant progress over the last three decades, it faces major challenges. These challenges include the following: the gap between supply and demand for talent in critical STEM related areas and knowledge-intensive sectors have widened increased; a majority of the workforce have good absorptive capability, but lower levels of adaptive and innovative capabilities, which impact the competitiveness of the local industry players; there are fragmentation in the local talent development ecosystem, where inter-linkages and collaboration between key players in nurturing next-generation creative talent that are knowledge-based and values-driven is weak; there is a lack of foresighting of future STIs and the types of education and training programmes that ought to be in place to support the current and future needs of local industries to move up the global STIE value chain; incentives to attract and retain talent in high demand STEM and knowledge-intensive jobs remains a challenge, as many are 'poached' by other advanced economies – brain drain is a major challenge for the country; local micro and SMEs find it hard to recruit skilled workforce, many prefer to work in larger firms or in countries with more sophisticated STIE ecosystem; mechanisms to ensure knowledge- and technology transfer between local and foreign players is fraught with many challenges, hence there is a "lock-in" to foreign technology and expertise – preventing the development of local expertise in key STI areas; corporate R&D spending is low compared to more advanced economies, hence investment in local R&D talent is relatively weak; and the knowledge sharing culture among local institutions and firms are also relatively low; and inter-sectoral information and knowledge flows were also found to be low, hence the development of talent with multidisciplinary skillset and competencies are hindered. The COVID-19 pandemic also exposed major gaps in the local labour market and talent ecosystem. Low ICT literacy increased underemployment among a large segment of the workforce during the pandemic. Low-tech firms struggled to keep their operations open during the various lockdowns due to the COVID-19 pandemic. Many firms reduced their investments in training and capability development programmes during the pandemic period. These factors adversely impacted the dynamic capability and resilience of the local workforce in mitigating disruptions in the business supply chains and other external shocks to the industrial ecosystems.

This study proposes several recommendations to ensure that the local talent nurtured not only meets the needs of current and future industries but, more importantly, ensures the sovereignty of the nation. In this context, the recommendations will nurture creative talent that develops indigenous STIs, strengthen the competitiveness of the local business supply chains, enable local firms to move up the global competitiveness value chain, spawn new high-value-added nature-friendly industries, and develop global brands and enterprises in key strategic areas where Malaysia has a global competitive advantage. The recommendations are also important for transforming Malaysia into a 'testbed' and a global knowledge network for the development of advanced nature-based technologies and solutions for the global community. Below are six key recommendations to enhance the local talent ecosystem to achieve the above vision.

Recommendation 1: Labour Market and Industry Competitiveness

Foresighting and Futureproofing the Competitiveness of the Malaysian Labour Market and Industries

Conduct values-based assessment and regular foresight into global STIE trends and their impact on Malaysian economic sectors, industries, labour markets, and societal development. The foresighting is undertaken jointly with industry and other stakeholders to map the STIE ecosystems needed to futureproof the talent stock of the country and the competitiveness and sustainability of local firms and industries.

Recommendation 2: Talent Skills Framework

Formulation of the National Critical Competencies and Skills Framework

To streamline and consolidate the National Critical Competencies/Skills Framework as a single point of reference that harmonises the different skills taxonomies across government ministries and industries towards addressing the skills gaps faced at present and in the future by industries in Malaysia.

Recommendation 3: Collaborative Talent Network

Future-ready Talent Collaborative Network (FuTCoN)

Enhance existing industrial and knowledge networks and expand their reach and richness to other industrial and knowledge networks. The knowledge networks comprise all public and private providers of education and training. A careful examination of policies, strategies, and incentives should be in place to encourage a culture of cross-pollination of ideas and knowledge sharing among universities, TVET providers, industry, and government-linked research organisations (GLROs). The latter is critical in providing students and the workforce access to state-of-the-art R&D, teaching, and training facilities. The collaborative talent network should be a structured platform that aims to tackle the challenges associated with university-industry collaborations. It should facilitate collaboration, resource sharing, and the alignment of efforts among universities, industries, and government agencies to develop skilled talent. This initiative is expected to address the skills gap, promote innovation, and enhance graduate employability. The network would develop and govern a database and intelligent systems to match and facilitate talent opportunities in deep tech and future skills.

Recommendation 4: Next-Generation STI Skill Development

Establish Deep and Trans-Tech Forward Schools to Provide Next-Generation Skills Training.
Establish deep and trans-tech forward schools across all regions of Malaysia. The Deep & Trans. Tech Forward Schools will be established through a consortium model between anchor industry partners, universities, GLROs, and TVET institutions. The collaborative partnership is to provide higher technical skills training in deep and translational technology in key areas that are strategic to the Malaysian economy. Funds should be put in place to have an open bidding process to facilitate collaboration and partnerships in key areas across the different localities in the country, strengthening the existing industrial ecosystem and nurturing next-generation economic sectors. This will be key to increasing high-value-added jobs that meet the needs of the various industrial ecosystems across the country.

Recommendation 5: Incentive Scheme for STI Talent

Offer a Competitive Incentive Package to Attract High-Skilled STI Talent
To provide a tax exemption for early-career Malaysians working in deep-tech and future skills jobs in Malaysia for up to 10 years. The tax break would define the nature of the activity performed by STI workers in a company and list the eligible STI areas for exemption. Other incentives include providing options for flexible working arrangements for employees; promoting work-life balance; an industry-led STI jobs guarantee programme; and government-industry job placement programmes.

Recommendation 6: Local Talent Capability Development

Attracting World-Class Top STIE Talent and a Skilled Diaspora to Enhance Local Talent Development
Review and strengthen the current national brain-gain programme. These include using the Permanent Resident Visa programme to attract the best global talent to use Malaysia as a "test bed" for undertaking their STI endeavours and discoveries and nurturing next-generation planet-friendly industries and STEM talent. Other programmes include encouraging local STI diaspora living abroad to build strong global networks that enable knowledge and technology transfer to local firms and supply chains—a key pathway to building strong global STEM talent, products, services, and brands from Malaysia. The stock of STEM talent in the country can be further complemented by introducing a "Work Visa" for foreign students who have completed their studies at a Malaysian institution of higher learning in key STI strategic areas, where there is a major talent shortage. This will increase the talent pool in key STI areas at a rapid pace in a much more cost-effective way.

In summary, this report captures the state of the talent ecosystem in Malaysia amidst the changes taking place in the global economy. The DVUCA world has transformed the global economic architecture and the labour markets. In this new world order, economies must embrace the digital and AI revolution, global competition, adherence to ESG standards, and planetary health considerations. To address these new requirements, there needs to be a major paradigm shift towards a sharp, smart, and value-driven talent competencies. These are critical for nurturing high-value-added and knowledge-intensive, planet-friendly industries. This study identified key strengths and gaps in the Malaysian talent ecosystem and provided recommendations to strengthen the enablers of the talent ecosystem. Strengthening these enablers is important for enhancing the dynamic capabilities (absorptive, adaptive, and innovative capabilities) of the Malaysian workforce. Higher levels of dynamic capabilities in the workforce will enable local industries to transition to higher levels of the global STIE value chain.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CHAPTER 1:
Transformation of the Global Economy and Talent Ecosystem

CHAPTER 1: TRANSFORMATION OF THE GLOBAL ECONOMY AND TALENT ECOSYSTEM

1.1 INTRODUCTION

The global landscape has undergone unprecedented structural changes since the 18th century industrial revolution. Major technological breakthroughs over the last 300 years have transformed every facet of human life. Among the earliest technological changes that led to the transformation was the steam engine from 1784 to 1840 (Schwab, K., 2016). This was followed by electricity from the late 19th century to the early 20th century. It was the source of energy used to power industries, homes, and consumer products. From the 1960s to the 1990s, breakthroughs in capacitors, transistors, and microprocessors unleashed the computer and internet revolutions. In the early 2000s, major progress was made in the development of embedded systems, which increased computational speed and intensity. This enabled the emergence of cyber-physical technologies that integrated computation, networking, and physical systems. This gave rise to the Fourth Industrial Revolution and the emergence of technologies such as the Internet of Things (IoT), artificial intelligence (AI), smart devices, robotics, autonomous vehicles and machines, 3D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing. This unleashed a wide range of new, technology-driven sectors and transformed existing economic sectors.

Over the last 10 years, two major structural shifts have shaped the global economic landscape. Among them is climate change due to the high use of fossil fuels as a source of power for industrial and economic development. This has led to uncertain weather patterns and an increase in extreme temperatures across the globe. The spillover impact of this is an increased incidence of flooding, forest fires, zoonotic diseases, and other natural calamities. These negative spillover impacts are hurting the health of the planet, people, and economy.

During this period, we also saw major breakthroughs in autonomous intelligent systems. Significant research has been undertaken by major companies, governments, and research institutions in digital technologies, which has led to different generations of AI systems making their way into the market. The first-generation AI system undertook simple classification and pattern recognition of information. The second-generation AI system was a little more sophisticated and could handle the complex task of classifying more complex information, building relationships between multiple data structures, and using past information to make predictions and forecast outcomes. While AI systems have made important strides in the human decision-making process, they are still prone to mistakes and anomalies. This AI system tends to be task-specific. Hence, we still need human input and supervision.

Recent advancements in natural language processing (NLP) have resulted in the emergence of sophisticated and versatile language systems. The third generation of AI systems, known as generative AI, can learn and understand human behaviour and reasoning. It can generate new information across various dimensions, such as text, sound, pictures, and many other data structures. Most of the generative AI models use deep learning tools and neural networks to uncover the underlying structure and patterns in multiple datasets. The information generated tends to resemble human-generated results and outputs. An example of such application is ChatGPT, which is used in a wide range of applications. Among them are customer relationship management, language translation, personalisation of content, virtual writing support, summarising lengthy reports, text classification, addressing issues related to unstructured data, and many more applications in engineering, medicine, and life sciences (Ray, 2023). Scientists and industry experts predict that AI systems will evolve to integrate and create large databases of human interactions, behaviours, and experiences. These new systems are envisaged to become on par with human-level intelligence and, in some cases, surpass human intelligence. Future intelligence systems are envisaged to provide broader personalised services based on human intentions, needs, and motivations. As such, they are expected to make major transformations in the labour market. A summary of the different industrial revolutions over the last three hundred years is shown in Figure 1.

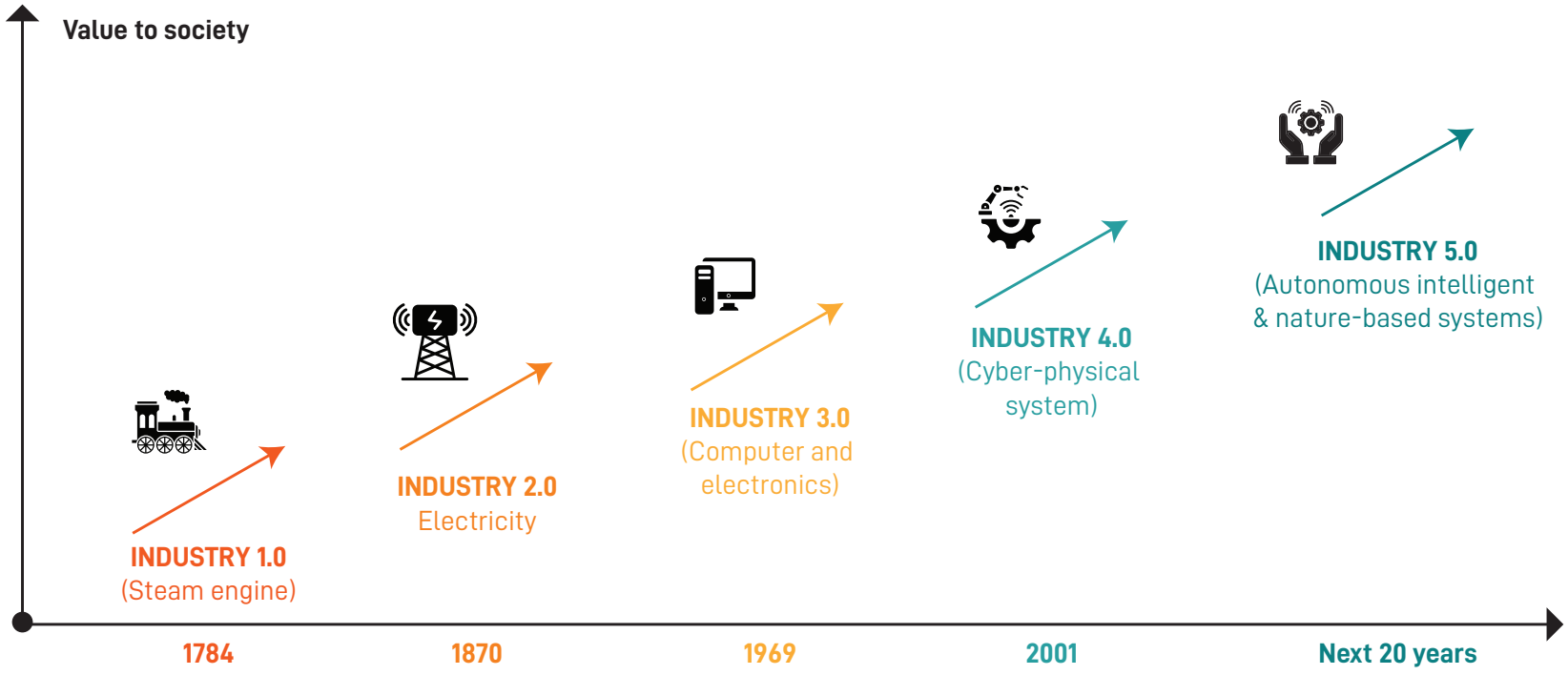
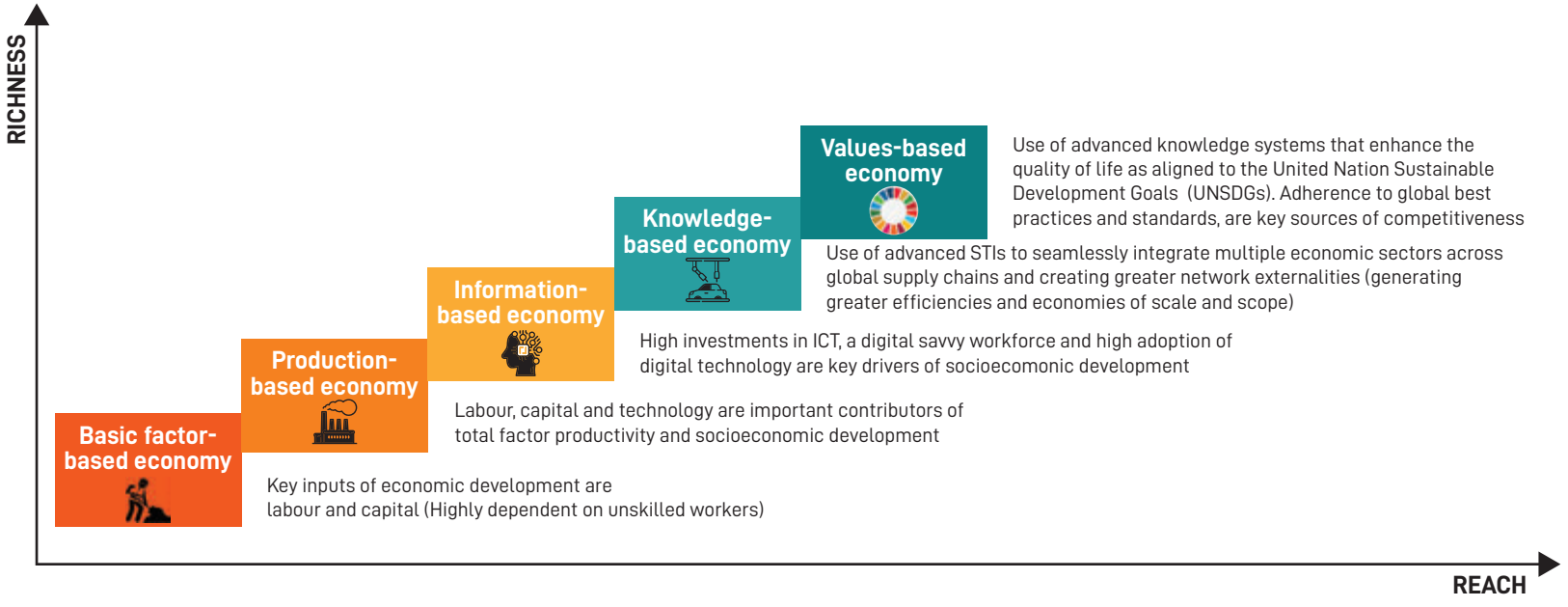


Figure 1: Industrial Transformation from the 1700s to the Present

Source: Values-Based Development and Competitiveness: A Conceptual Analysis. Nair et al., 2022

The intensification of STIs over the last three hundred years has continued to transform economic sectors and labour markets. As the global economy transitions from basic factor-drive economies to production-based economies and then into information, knowledge, and value-driven economies, these have resulted in the emergence of new labour market arrangements and business models. The more recent emergence of new service-sharing platforms powered by AI systems is not only increasing the reach of products and services but also providing a much richer and wider selection of personalised services to people. STIs are also seen as an important enabler of human progress and have a humanising impact on society. The latter includes providing wider and easier access to the various technology platforms and enabling services for a wider segment of the population. Recent technological developments are also seen as key enablers for deepening values-based economic development, where nature-based solutions, jobs, and industries are generated. These new developments are critical for ensuring the sustainable development of human civilisation while ensuring the health of the planet is preserved for future generations. The evolution of the different technological revolutions and their impact on the economy and nature of work are shown in Figure 2.



Note: Reach is the ability to impact a wide spectrum of stakeholders. Richness is improving the quality of the STI, in deepening the impact on productivity, efficiency, competitiveness, and economic development.

Figure 2: Structural Changes in the Economy and Labour Market

Source: Values-Based Development and Competitiveness: A Conceptual Analysis. Nair et al., 2022

While the above-mentioned technological developments have a significant positive spillover impact on the global community, they also increase the demand for new talent competencies. The rapid industrialisation of economies over the last few decades has resulted in demand for technology-savvy talent outstripping the supply of this talent. Many educational institutions are grappling with meeting the needs of industry and society. This has led to several negative externalities, such as talent poaching by major corporations and brain drain from developing countries to more developed economies. This has resulted in a shortage of highly skilled workers among smaller firms and many developing countries.

Unfortunately, intrastate conflicts and geopolitical tensions in recent years have disrupted the talent supply chain, with 66.5 million people displaced and presumably more than 10,000 scientists in exile (UNESCO TWAS, 2018). Furthermore, the recent COVID-19 crisis and the war between Ukraine and Russia have increased the number of people living in extreme poverty (INSEAD, 2022), thereby heightening global inequalities. These challenges have a significant impact on the global talent landscape and would significantly reduce the developing world's capacity to achieve several of the Sustainable Development Goals (SDGs), including SDGs 4 (quality education), 5 (gender equality), 8 (decent work and economic growth), and 10 (reduced inequalities).

The increasing interconnectedness of the global economy over the last few years has led to positive spill-over impacts, which include greater diffusion of information and knowledge, mobility of goods and services, and trade. They have also led to negative spill-over impacts, such as increased competition for resources and markets. Increased connectedness also has increased volatility in global markets; any volatility in one market will reverberate to other markets very quickly. For example, greater

interconnectivity in the global community has led to faster transmission of health pandemics across the globe in recent years. Figure 3 shows that since the 1950s, the global economy has undergone exponential growth in wealth, measured by the gross domestic product (GDP). The growth trajectory is attributed to several factors. Among them are rapid technological developments. This led to the information and computer technology (ICT) revolution that paved the way for a digital economy, enabling an internet-worked world. Significant R&D investments in science, engineering, and other related areas played a key role in spawning new frontier technologies, sectors, and jobs. Improvements in technology have enabled greater mobility of people, data, goods, and services. This led to a positive spill-over effect across multiple economic sectors, allowing economic agents to achieve greater economies of scale and scope.

The other important factor that contributed to global economic development was trade liberalisation through bilateral and multilateral trade agreements between countries. The greater liberalisation of the global economy due to technology and global trade has intensified competition for talent and a skilled workforce. Integrated global supply chains and markets increased the risk of the contagion effect, cybercrime, and transmission of digital and biological viruses. Thus, while the global economy has seen rapid wealth accumulation, economic growth has become more volatile over the years, as shown in Figure 3. Increased volatility and uncertainty have a major impact on the global labour market, especially concerning talent development, mismatch in the supply and demand of workforce for industries, and the brain-drain problem. The problem is further exacerbated by greater market pressures for compliance with environmental and social governance (ESG) standards, human rights, planetary health considerations, and meeting the 17 UNSDGs.

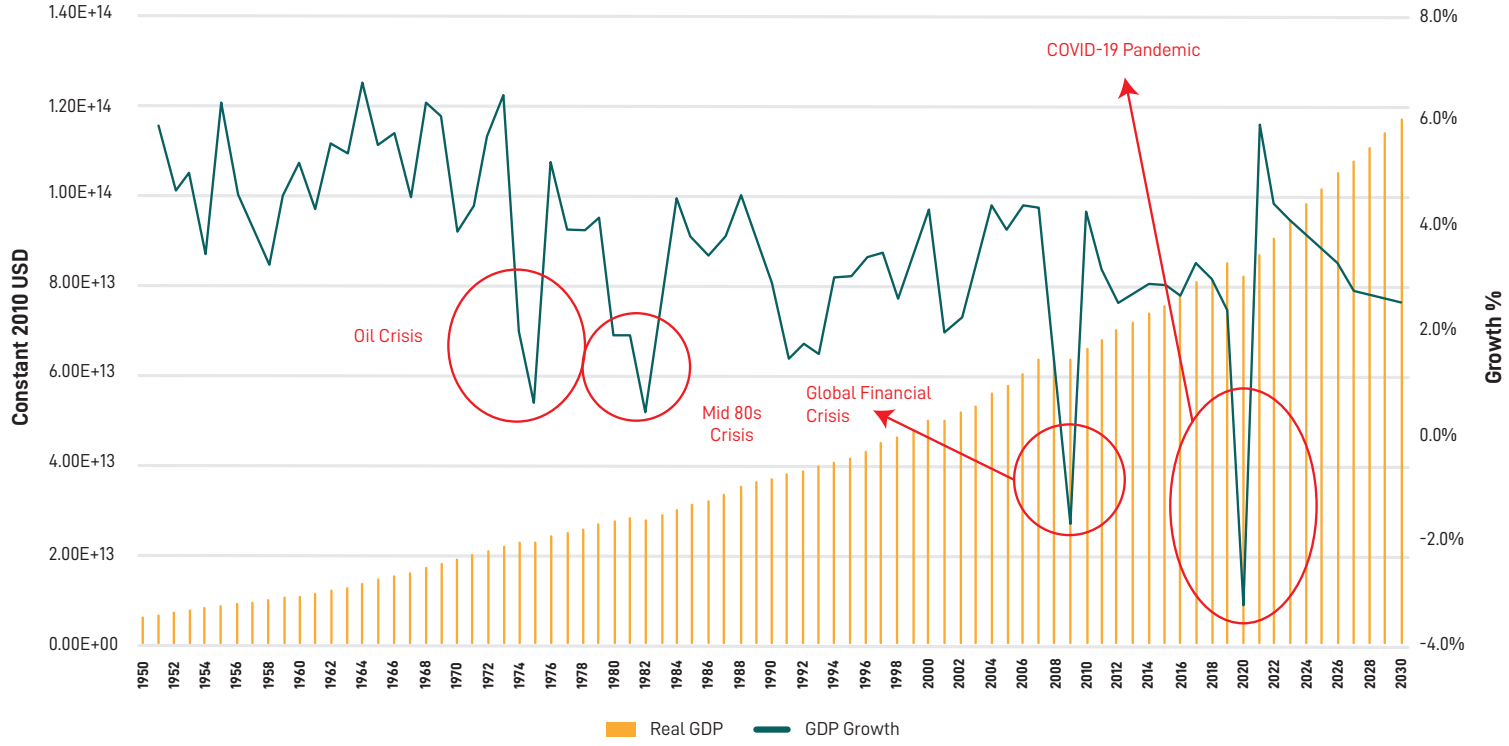


Figure 3: World Real GDP and Economic Growth, 1950–2030

Source: Science Outlook 2020: Unlocking the Future. ASM, 2021

Despite the agile technological transformation seen in major economic powerhouses, the brunt of the challenges faced by the rapid economic transformation are among developing and less-developed economies. This has been further exacerbated by the disruptions in global supply chains due to trade disputes and the recent COVID-19 pandemic. The International Labour Organisation (ILO) indicated that low-income, lower-middle-income, and upper-middle-income economies would have experienced setbacks in their recoveries in early 2022. Lack of financial resources will prevent many of these countries from investing in education and training. A concern of these nations is "learning poverty"—the inability of children to acquire the necessary skillsets that are relevant to functioning in a modern economy. A study by the World Bank shows that the percentage of children who cannot read and understand simple text by age 10 has increased by up to 70% (World Bank Group, 2021). Further, school dropout increased by up to 35%, especially among adolescents (Centre for Global Development, 2022) during the pandemic. In tertiary education, the quality of teaching and learning as well as the accessibility to academic-driven international mobility during the pandemic posed a major challenge for institutions of learning and students (UNESCO, 2022). The pandemic has not only affected the education sector but has also impacted gender disparities, disabled and rural communities' well-being, employment, and the global labour market dynamics. Increasing disparities in resources among richer and poorer economies have further increased global talent competition in favour of more developed economies. Even when developing countries intensify their investments in talent development to increase the supply of skilled workers, increasing global competition for talent has resulted in the migration of talent to more developed countries that provide better remuneration, career prospects, and quality of life.

The current Industrial Revolution, together with the socioeconomic aftermath of the COVID-19 pandemic and the ongoing crises, exhibits a new phenomenon in the talent landscape as values, connectivity, and sustainability take precedence. The current DVUCA world is exacerbated by the increasing complexity of the global economy. The global talent landscape is constantly evolving and adapting to technological advancements, globalisation, and societal demands. Nonetheless, the current DVUCA world is facing more challenges as AI and the humanisation of the current Industrial Revolution integrate into the talent ecosystem. These changes are replacing traditional jobs, and the workforce requires new skills and occupational competencies to sustain current economic sectors.

Another key factor that is transforming the global economic landscape is the impact of economic development on global warming and climate change. Many industries and human activities are reliant on fossil fuels. These contribute to greenhouse gas emissions. Studies have shown that socioeconomic development powered by a carbon-based energy source has increased the nine planetary indicators (CO_2 emissions, phosphorus, nitrogen, water consumption, blue water consumption, and water). An increase in the nine biophysical indicators will have an adverse impact on the health of the planet (refer to Figure 4). This will have a "knock-on" impact on the health of the people, the productivity of the workforce, and the health of the economies. The brunt of the erosion of planetary health boundaries is felt in many developing economies, as many of them do not have the resources to undertake planetary health mitigation and adaptation initiatives. As such, the future of industrial development and job creation must give attention to planetary health considerations to ensure the sustainability of economic sectors and labour markets. These include transitioning existing industries to be more environmentally friendly and creating new planetary health-friendly industrial sectors. These will require investments in next-generation talent that will support existing industries to make the transition and spawn new economic sectors that are planet-friendly.

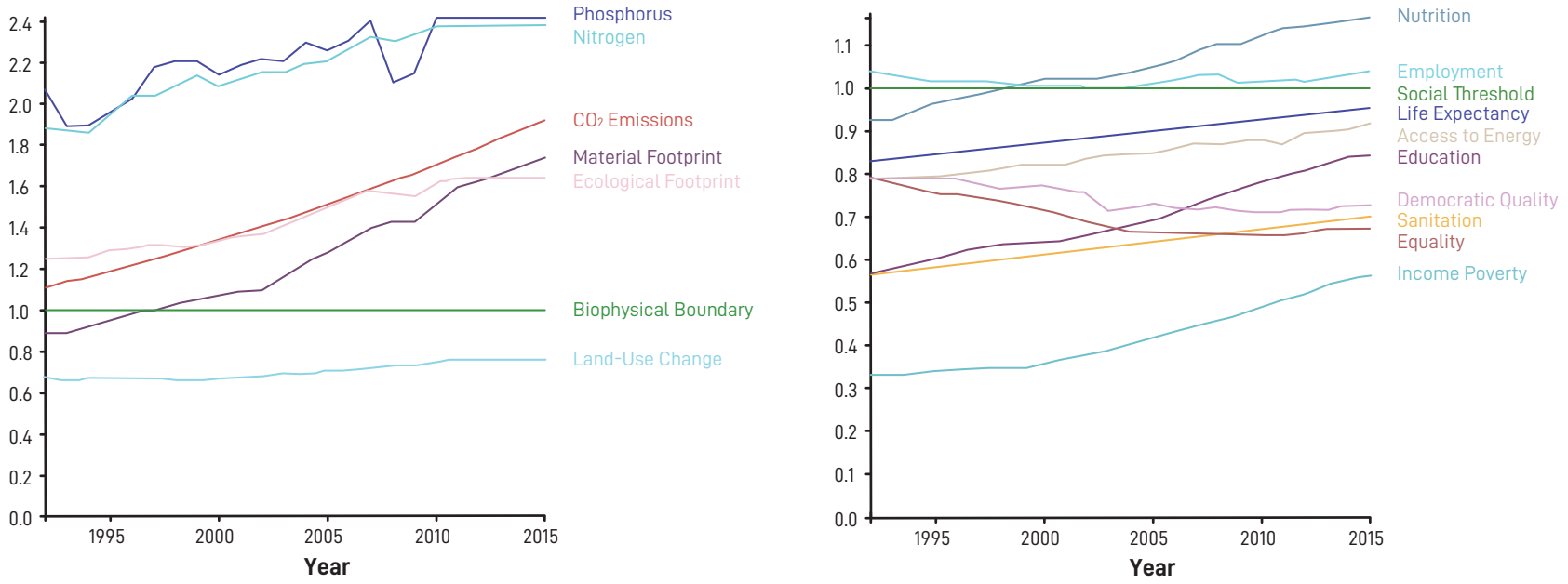


Figure 4: Global Trends in Biophysical and Socioeconomic Indicators

Source: Fanning et al., 2022, O'Neil et al. 2018. Data Source: Leeds, 2023

In the next sections of the report, we examine the state of the talent ecosystem amidst the challenges and opportunities faced by the global community in an increasingly DVUCA world. The section will discuss the changing talent requirements globally due to rapid technological developments, especially the emergence of artificial intelligence and the increasing demand for compliance with environmental, social, and governance (ESG) standards. The changing global landscape will highlight the gaps in the supply and demand of talent across the globe and the measures taken by governments, industry players, and other stakeholders to ensure the sustainable development of institutions, communities, and economies.

1.2 THE STATE OF TALENT: EDUCATION AND EMPLOYABILITY OF TALENT GLOBALLY

In this section, we will examine the state of the global labour market amidst the structural changes taking place in the global architecture, powered by developments in STI. Here, we examine the types of employment that created states of unemployment and underemployment. Figure 5 shows the pattern of unemployment in selected countries from 1960 to 2020. The figure shows that unemployment rates are linked to business cycles in these countries, and in many developed countries, they persist at over 5%. The unemployment rate increased to double digits during the COVID-19 pandemic in 2020. Figure 5 highlights the unemployment rate in the selected countries for those with basic and advanced education. The figure shows that increasingly, the economies in these countries require higher education qualifications and competencies. Workers with a basic education were found to be more likely to be unemployed than their counterparts with more advanced qualifications. This trend is not surprising, as the economies in these countries transition to become more technology- and knowledge-driven; many labour-intensive jobs are being replaced by more skilled jobs and automated workplace environments.

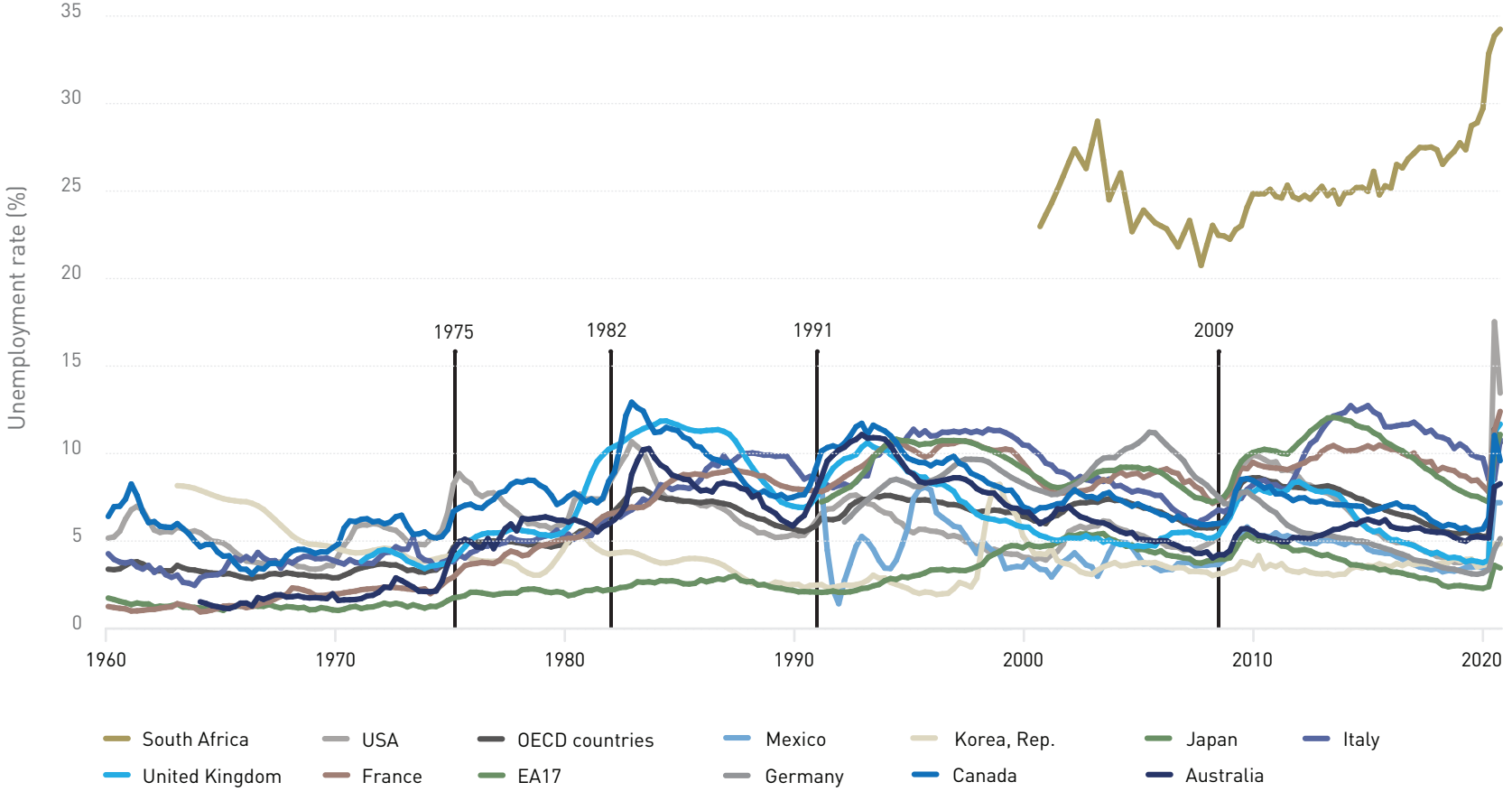


Figure 5: Unemployment Rate in Selected Countries from 1960-2020

Source: The Future of the Jobs Report 2020. WEF, 2020

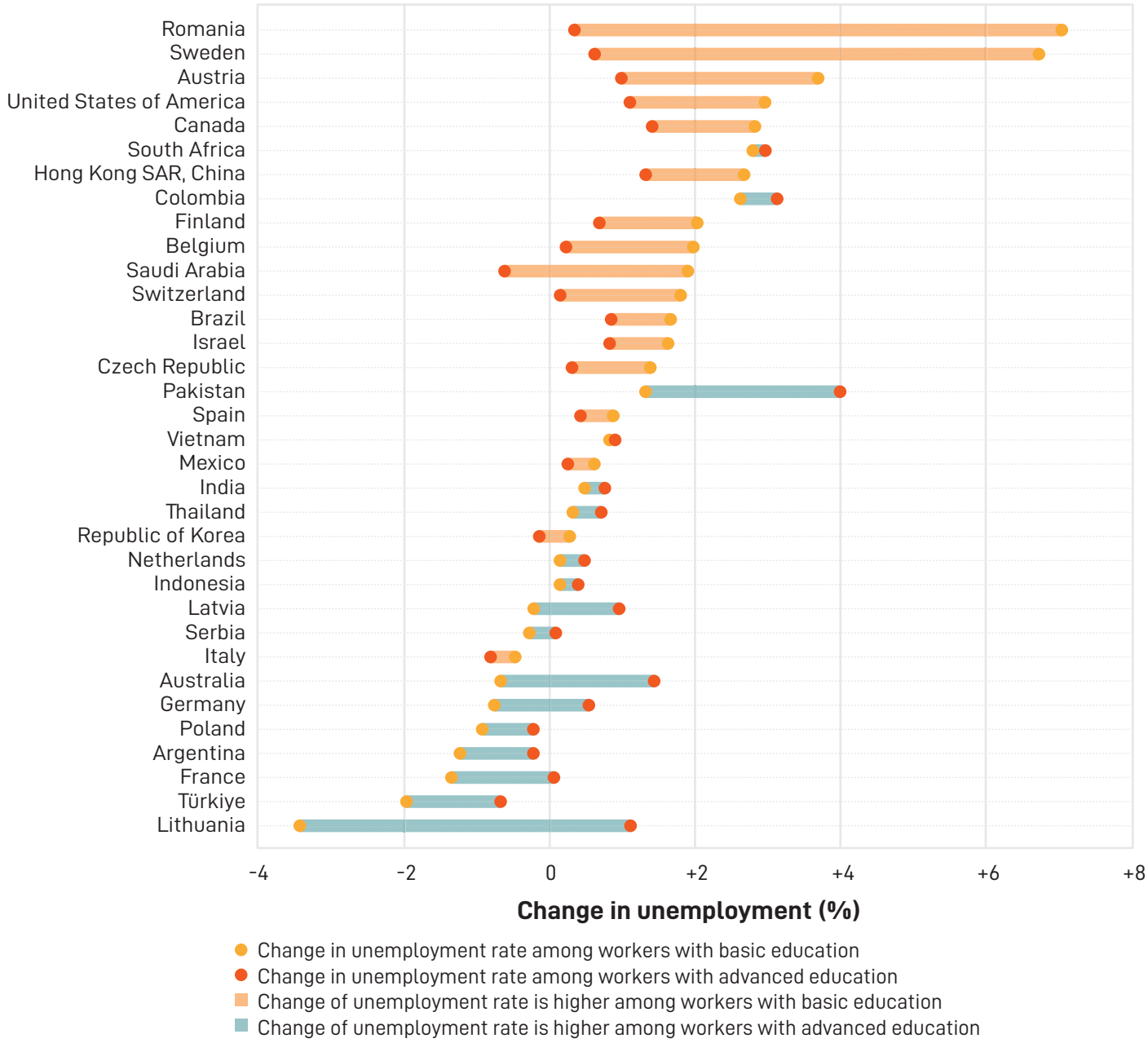


Figure 6: Change in Unemployment by Economy and Education Level, 2019-2021

Source: The Future of the Jobs Report 2023. WEF, 2023

At the height of the pandemic (Figure 6), most countries reported an increased change in unemployment, affecting moderately talented people with advanced education (near 0 to +2) and severely talented people with basic education (mostly -2 to +4). Unemployment among those with basic education is more than doubled compared to those with advanced education, making the poor poorer as the economies in these countries rev up to become more technology- and knowledge-intensive. In terms of advanced education, the rate of women enrolled in and graduating from tertiary education increased between 2013 and 2019, but globally, women are still underrepresented in the STEM field (WEF Future of Jobs Report, 2023). During the pandemic, more women lost their jobs than men, bringing gender parity in labour force participation to 62.9% (WEF Global Gender Gap Report). The study also found that youth unemployment was also high, and this was due to lower education levels and career experience.

Even though the mass majority were involuntarily released from employment (layoffs, reduced working hours) due to the recent COVID-19 pandemic and the global economic challenges, a growing fraction voluntarily left (quit) during the "Great Resignation" period (The Malaysian Reserve, September 21, 2023). The top five reasons for leaving previous employment are lack of career development and advancement, inadequate total compensation, uncaring and uninspiring leaders, a lack of meaningful work, and unrealistic work expectations (McKinsey, 2022). Furthermore, only 35% of those who quit their jobs within the previous two years remained in the same industry globally. In the finance and insurance industry, for instance, 65% of employees changed industries or did not return to the workforce. The exodus in the public and social sectors was even more significant, reaching 72%. These losses may have long-lasting effects on the travel, healthcare, and consumer retail industries, which the pandemic has severely impacted. At least 18% of respondents who resigned decided never to work again (McKinsey, 2022).

Meanwhile, sectors that were in decline pre- and during the COVID-19 pandemic in the OECD countries were accommodation, food services, and leisure; manufacturing and consumer; wholesale and consumer goods; supply chain and transportation; media; entertainment; and sports (World Economic Forum, 2020 and WEF 2023) (Figures 7 and 8). At the time, the increase in job employment was primarily in information technology and digital communications; professional services; education and training; health and healthcare; and the government and public sector. It was unsurprising as there was severe social inactivity as well as the adoption of more automation and internet use during the COVID-19 lockdowns.

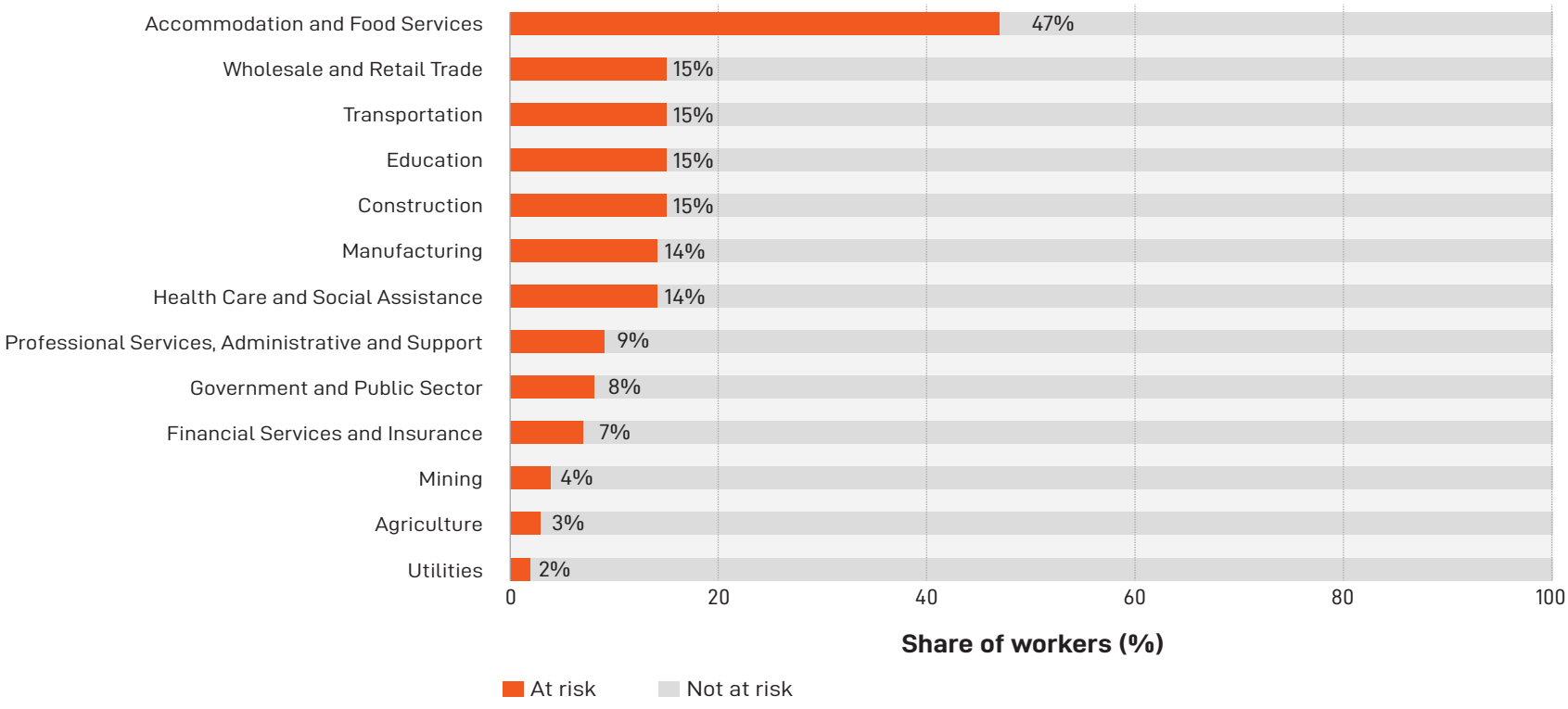


Figure 7: Workers at Risk of Unemployment by Sub-Industry

Source: The Future of the Jobs Report 2020. WEF, 2020

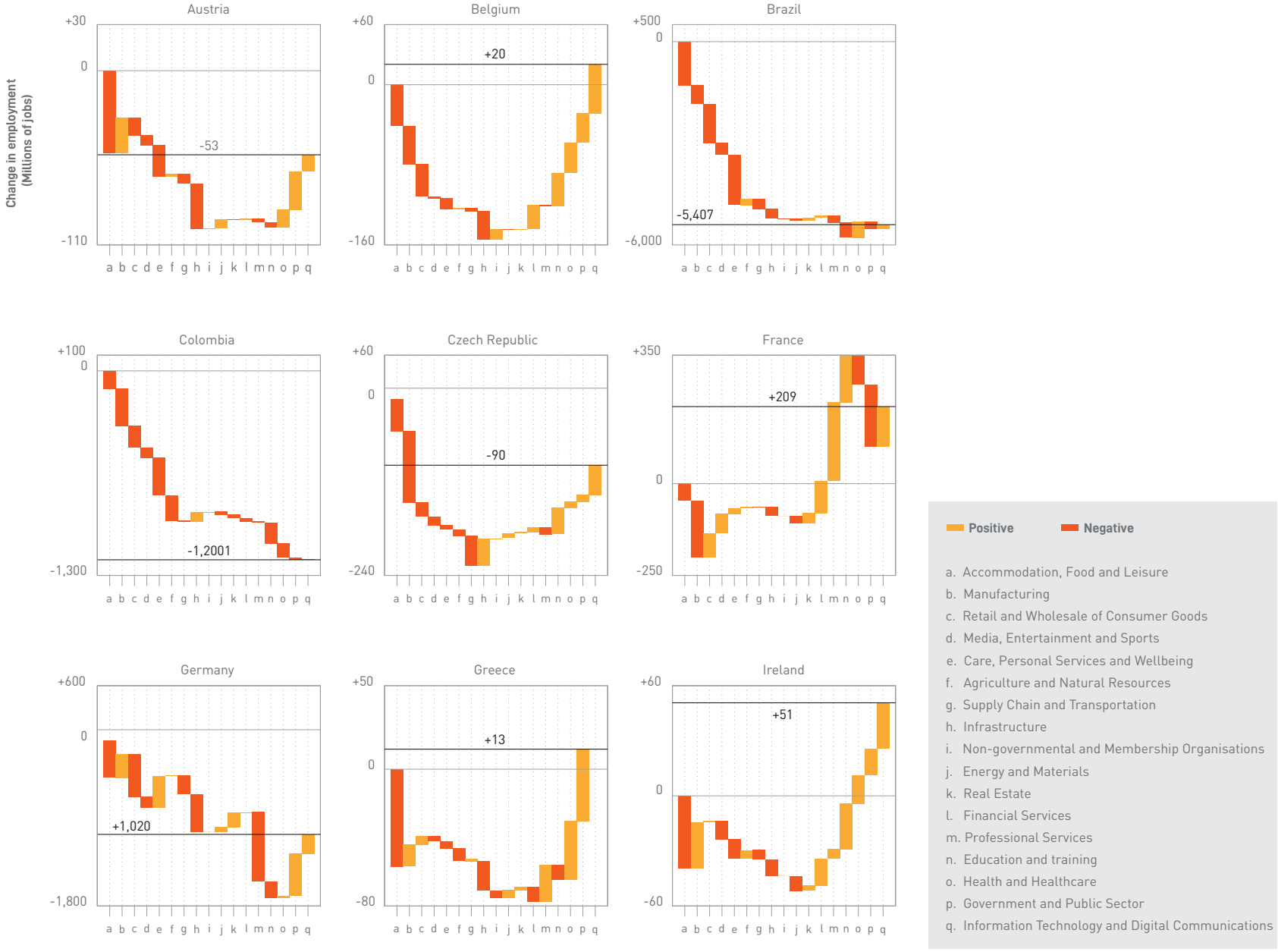


Figure 8: Change in Employment by Sector in Selected Countries (2019-2021)

Source: The Future of the Jobs Report 2023. WEF, 2023

In recent times, COVID-19 has had a major impact on labour market dynamics. The health pandemic highlighted the vulnerability of the global labour market, especially those that remained traditional with physical workplaces. Many with automated work environments and smart factories were able to weather the storm of COVID-19. During this period, there was significant investment in digital technologies, a transformation of business models, and the emergence of a larger learner workforce, which was primarily driven by higher education and competencies. As many companies reduce their workforce, there are fewer opportunities for displaced workers to return to the workforce. This hiring trend is observed in seven major economies: Australia, China, France, Italy, the United Kingdom, Singapore, and the United States (Figure 9). At the end of February 2020, the employment rate in China fell to a record low of -47% year-over-year. The decline was more pronounced in France and Italy, reaching -70% and -64.5%, respectively, by mid-April 2020. While there were some semblances of a recovery in employment growth, most of the job creation was in areas that primarily required digital and other key competencies for a more knowledge-intensive labour market. Increasing demand for skilled workers has put pressure on the labour market in many countries, especially developing countries. Many of the colleges, universities, and training centres were unable to provide the necessary skills to meet the needs of a fast-changing industry post-pandemic. These mismatches are due to the long duration of talent unemployability or skill being void (skill obsolescence); talent lack of skills (skill gap); seeking the right talent (skill shortages); and talent skills beyond or below the job scope (over/under-skilling) (ILO, 2013; ILO, 2022). The above labour market patterns highlight that the changes in the underlying structure of the economy towards more knowledge- and values-centric economic development models require a different type of talent and workforce. These new workforce requirements are highlighted in the next section of this report.

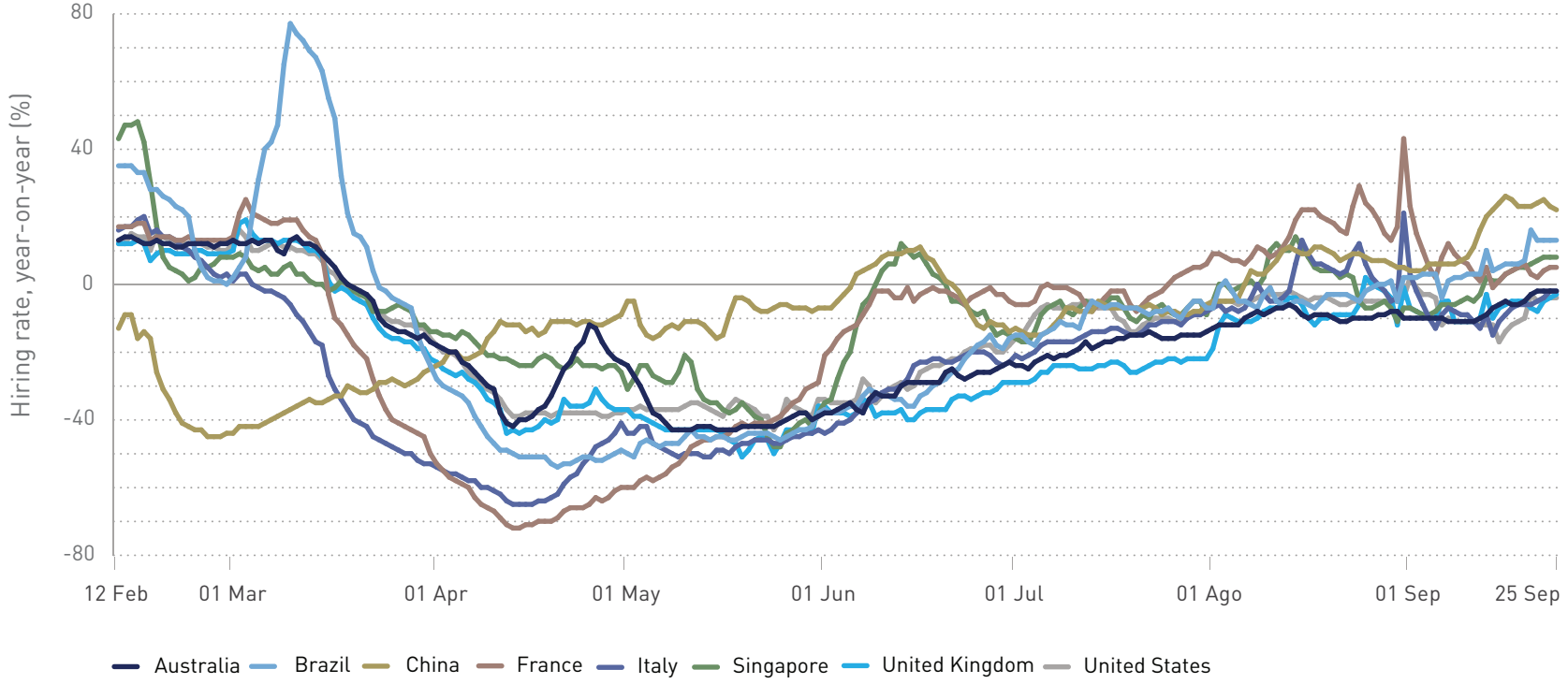


Figure 9: Hiring Rate Trends in Selected Countries, February-October 2020

Source: The Future of the Jobs Report 2020. WEF, 2020

1.3 EMERGING SKILLS

The global economic landscape and the labour market have made major structural changes over the last century. The traditional economy (as shown in Figure 10, left panel) relied primarily on the strength of vertical leadership-administrators to lead groups of subordinates; systems already in place; internal, closed innovation; emphasis on qualifications from the conventional education system; specialists of niche technical skills; performance of production yield; and in-silo ways of business. The transition into the knowledge economy saw the expansion of the use of information technology and open innovation ecosystems. The knowledge economy entails horizontal leadership-leadership that focuses on collaboration and co-creation—and leveraging the value of network externalities. This new economy also puts a focus on competencies rather than paper qualifications; values-based development is anchored in values-based development aligned to the UNSDGs and planetary health initiatives. Economic competitiveness in value-based economic development will require several competencies, which include cognitive, interpersonal, self-leadership, and digital skills, as outlined by McKinsey (2021) in Figure 11.

Figure 10: The Transformational Shift in Talent in the Traditional Economy to the Knowledge-Based Economy

Source: ASM Analytics, 2023

Cognitive

Critical thinking
- Structured problem solving
- Logical reasoning
- Understanding biases
- Seeking relevant information

Planning and ways of working
- Work-plan development
- Time management and prioritisation
- Agile thinking

Communication
- Storytelling and public speaking
- Asking the right questions
- Synthesising messages
- Active listening

Mental flexibility
- Creativity and imagination
- Translating knowledge to different contexts
- Adopting a different perspective
- Adaptability
- Ability to learn

Interpersonal

Mobilising systems
- Role modeling
- Win-win negotiations
- Crafting an inspiring vision
- Organisational awareness

Developing relationships
- Empathy
- Inspiring trust
- Humility
- Sociability

Teamwork effectiveness
- Fostering inclusiveness
- Motivating different personalities
- Resolving conflicts
- Collaboration
- Coaching
- Empowering

Self-leadership

Self-awareness and self-management
- Understanding own emotions and triggers
- Self-control and regulation
- Understanding own strengths
- Integrity
- Self-motivation and wellness
- Self-confidence

Entrepreneurship
- Courage and risk-taking
- Driving change and innovation
- Energy, passion, and optimism
- Breaking orthodoxies

Goals achievement
- Ownership and decisiveness
- Achievement orientation
- Grit and persistence
- Coping with uncertainty
- Self-development

Digital

Digital fluency and citizenship
- Digital literacy
- Digital collaboration
- Digital learning
- Digital ethics

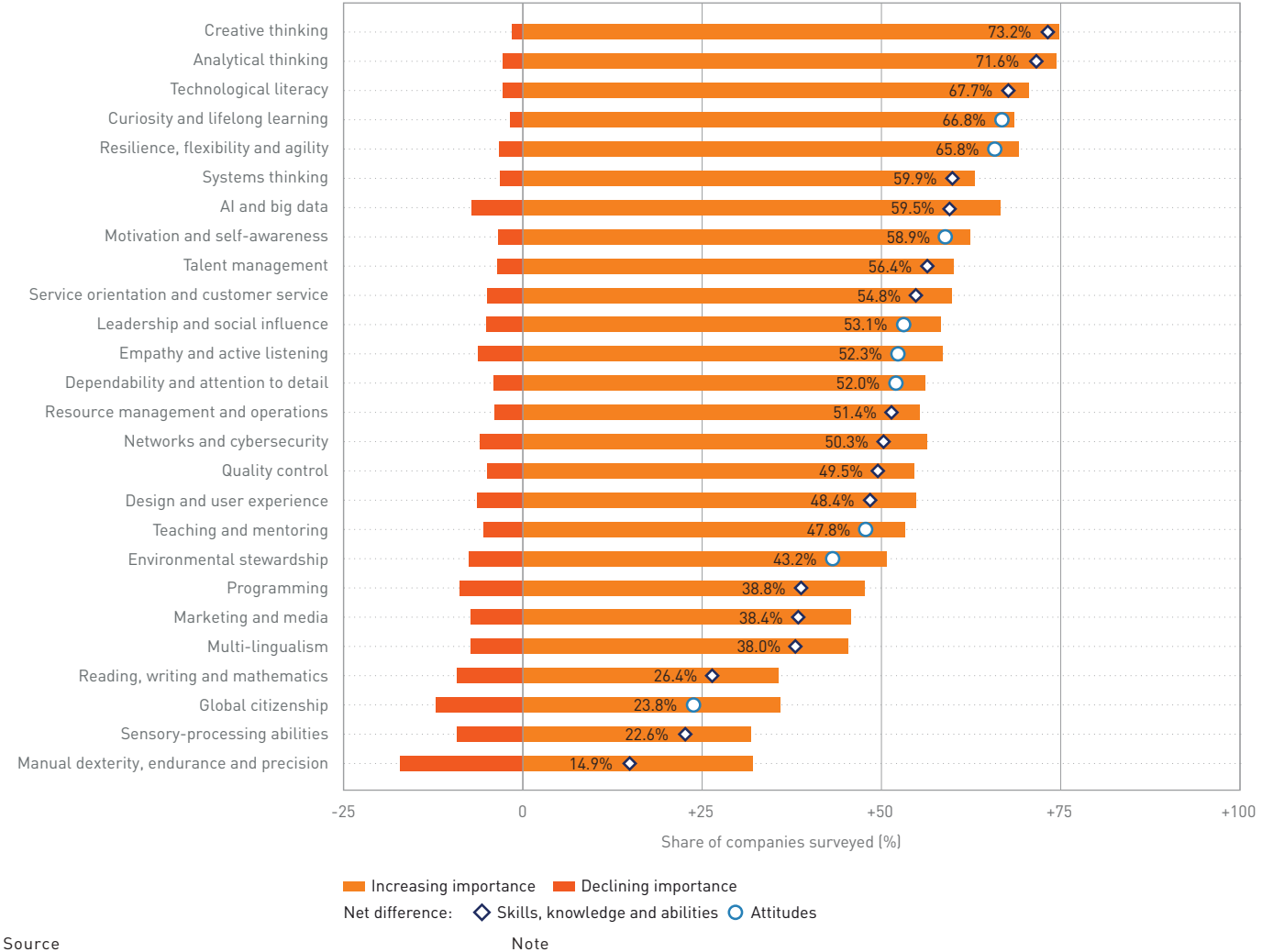
Software use and development
- Programming literacy
- Data analysis and statistics
- Computational and algorithmic thinking

Understanding digital systems
- Data literacy
- Smart systems
- Cybersecurity literacy
- Tech translation and enablement

Figure 11: 2021 McKinsey's 56 DELTAs across 13 Skill Groups and Four Categories

Source: Defining the Skills Citizens Will Need in the Future World of Work. McKinsey & Company, 2021

A more recent study by the World Economic Forum (WEF) on the Future of Jobs Report (Figure 12) shows that among the top 10 of 26 skills focused primarily on high cognitive skills, self-leadership, and digital skills, followed by interpersonal skills (WEF, Talent 2023). Also, the distribution of skills and attributes important to self-efficacy, teamwork, and ethics varies depending on the sectors of the industry (Figure 13, WEF Talent 2023). Taken together, empowering these skills and attributes should be integrated into the mainstream education system, in the open learning platforms, and within the reskilling and upskilling training within the industry and government agencies.



Source

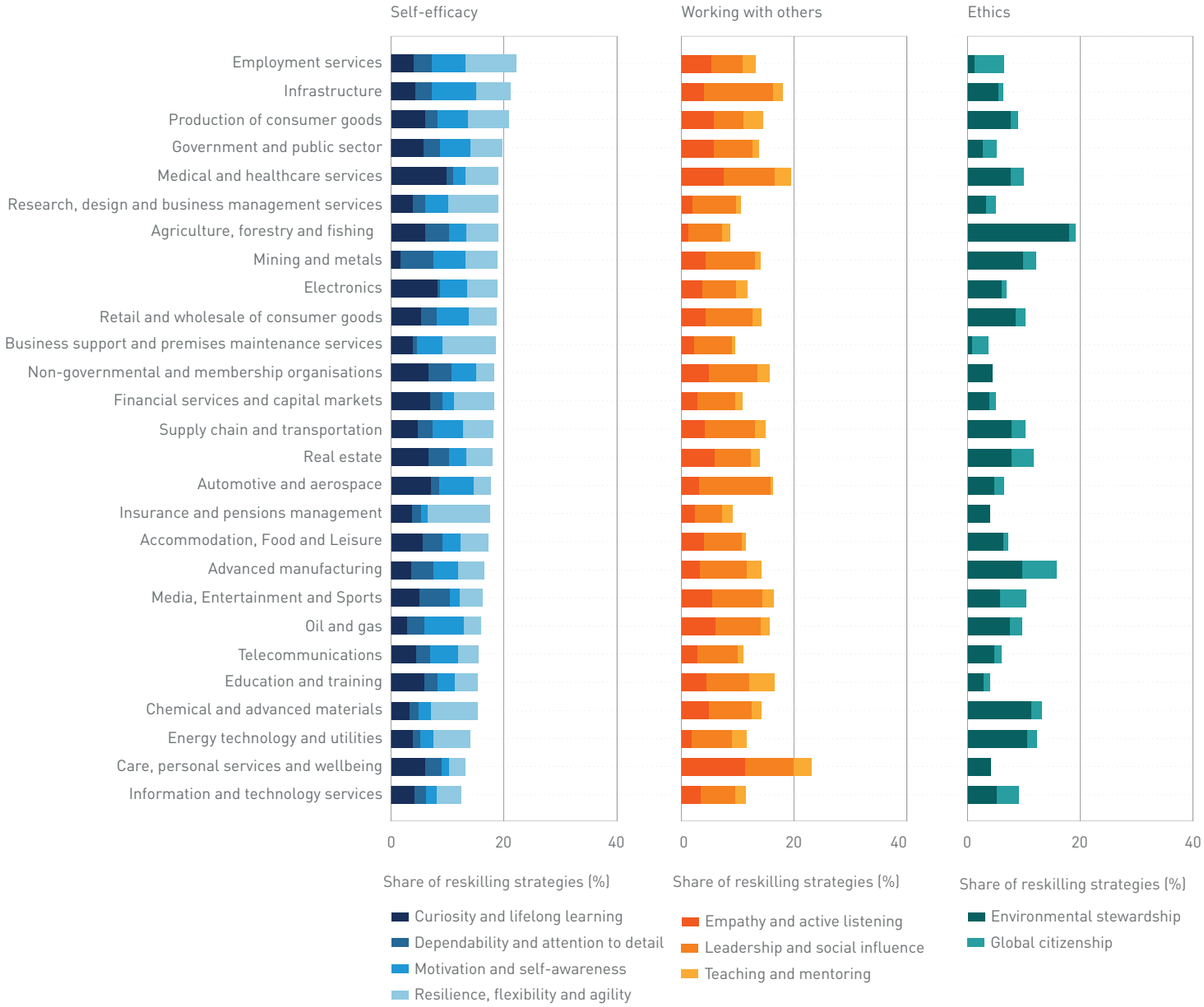
World Economic Forum, Future of Jobs Survey 2023.

Note

The Future of Jobs Survey uses the World Economic Forum's Global Skills Taxonomy. The share of companies which consider skills to be of stable importance to their workers is not plotted.

Figure 12: Skills Required for the New Economy

Source: The Future of the Jobs Report 2023. WEF, 2023



Source

World Economic Forum, Future of Jobs Survey 2023.

Note

The Future of Jobs Survey uses the World Economic Forum's Global Skills Taxonomy.

Figure 13: Skills and Reskilling Strategies being Prioritised for 2023–2027 by Organisations Surveyed

Source: The Future of the Jobs Report 2023. WEF, 2023

Navigating through the DVUCA world will require a different set of skills, which comprise sharp (technical) skills, smart (soft) skills, and a values-based mindset. This mindset is critical for creating a better return on value (ROV) for all stakeholders in the ecosystem. This mindset is anchored on a mindset that does not take a "zero-sum game" between economic development and the sacred quality of nature (the environment). The ROV mindset must include nature as an important stakeholder in the economic development equation. In this context, the health of the planet is directly related to the health of people and the economy. (Figure 14). Herein, this ROV mindset primarily revolves around the 8R-centric philosophy: respect, rethink, reduce, reuse, recycle, restore, repurpose, and revitalise. The 8R philosophy incorporates more nature-centric and humanistic values in its derivation of value for society. The benefits of the ROV mindset span all industries and economic sectors. It is envisaged that, given the changes taking place in society and the demand for more sustainable economic development, the ROV will be a way of life in many countries. Consumers are increasingly going to demand more sustainable production processes and supply chains. Firms that can meet the growing demand for nature-centric consumer markets will be able to enhance their global competitiveness and comparative advantage.

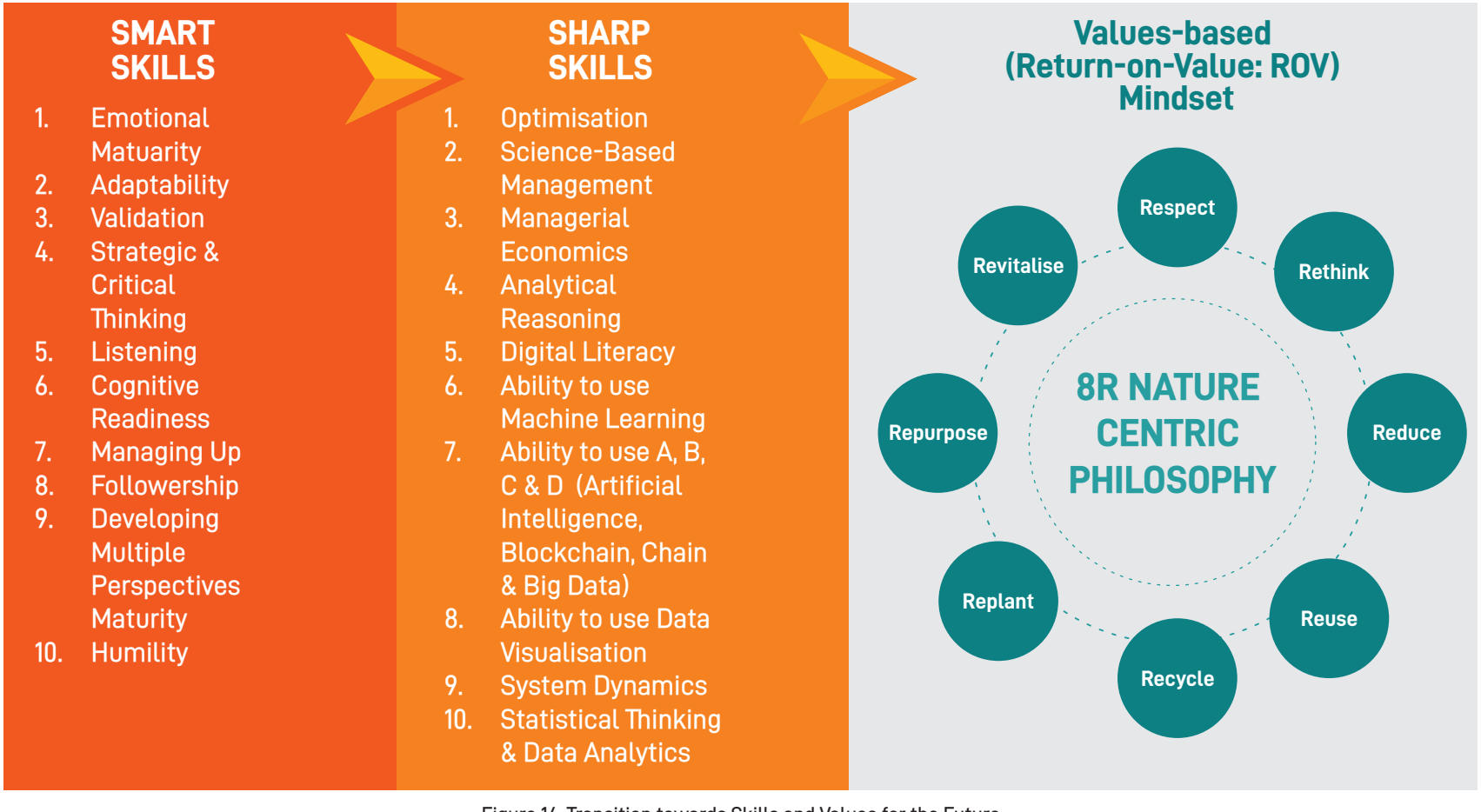


Figure 14: Transition towards Skills and Values for the Future

(Source: Adapted from The Skills of The Future are Smart and Sharp! Professor Loredana Padurean, 2021 and Values- Based Development and Competitiveness: A Conceptual Analysis. Institute for Global Strategy and Competitiveness, SUNWAY University, 2022)

A key driver for the global competitiveness of economies is the ability to nurture, attract, and retain talent that is technologically savvy to power next-generation nature-friendly industries. These include firms that can meet global demands for products and services that meet global environmental and planetary health standards. These would mean countries nurturing the next-generation workforce that possesses smart and sharp skills, including a values-based mindset.

To ensure the workforce has adequately qualified people in key technological areas, it is important for countries to intensify the supply of talent that not only meets the current needs of industry but also enables them to move up the global innovation value chain. More importantly, this talent should play a key role in spawning new industries that create value-added jobs and contribute to the wealth of the country. Malaysia, like many developing countries, grapples with providing an adequate supply of talent to meet the needs of industry in a rapidly changing global economic environment.

The talent needed for the industry is congruent with the talent pipeline in high schools in the country. Increasingly converging technological platforms and their integrating impact on multiple sectors of the economy, social systems, and human systems are making it difficult for education and talent planners to curate programmes that meet the needs of key competencies. Many of the jobs today require a workforce that has skills and competencies that are multidisciplinary and transdisciplinary. Currently, in many countries across the globe, including Malaysia, the education systems stream high school students into science, technology, engineering, and mathematics (STEM) and non-STEM areas of study. While streaming helps students build strong disciplinary-centric skillsets, it prevents them from acquiring a more holistic education, which covers smart and sharp skills, including nurturing a values-based mindset. Many of the jobs of the future will require ambidextrous talent—that is, having sound discipline-specific technical knowledge and a broad set of knowledge that enables them to apply their technical knowledge in a wide range of applications that impact industries and broader society. Intellectual ambidexterity is critical for talent to generate greater ROV for themselves, their organisation, and society.

1.4 FUTURE TALENT AND JOBS IN DEMAND

The industrial landscape has changed significantly over the last three hundred years as the global economy transitions from a production-based economy to a more knowledge-driven economy. As such, the dynamics in the industry-talent relationship, too, have changed over the period. The increasing use of automation and knowledge systems in the work environment has reduced the amount of work time used for routine and redundant functions. In many countries that embraced the knowledge economy, the number of working hours declined, but productivity continued to soar. Figure 15 shows that in many developed countries, the number of work hours decreased from a high of more than 50–60 hours per week in the 18th century to close to 30–40 hours per week in 2019. This downward trend is anticipated to continue as AI and robotics become mainstream in many factories and industrial settings.

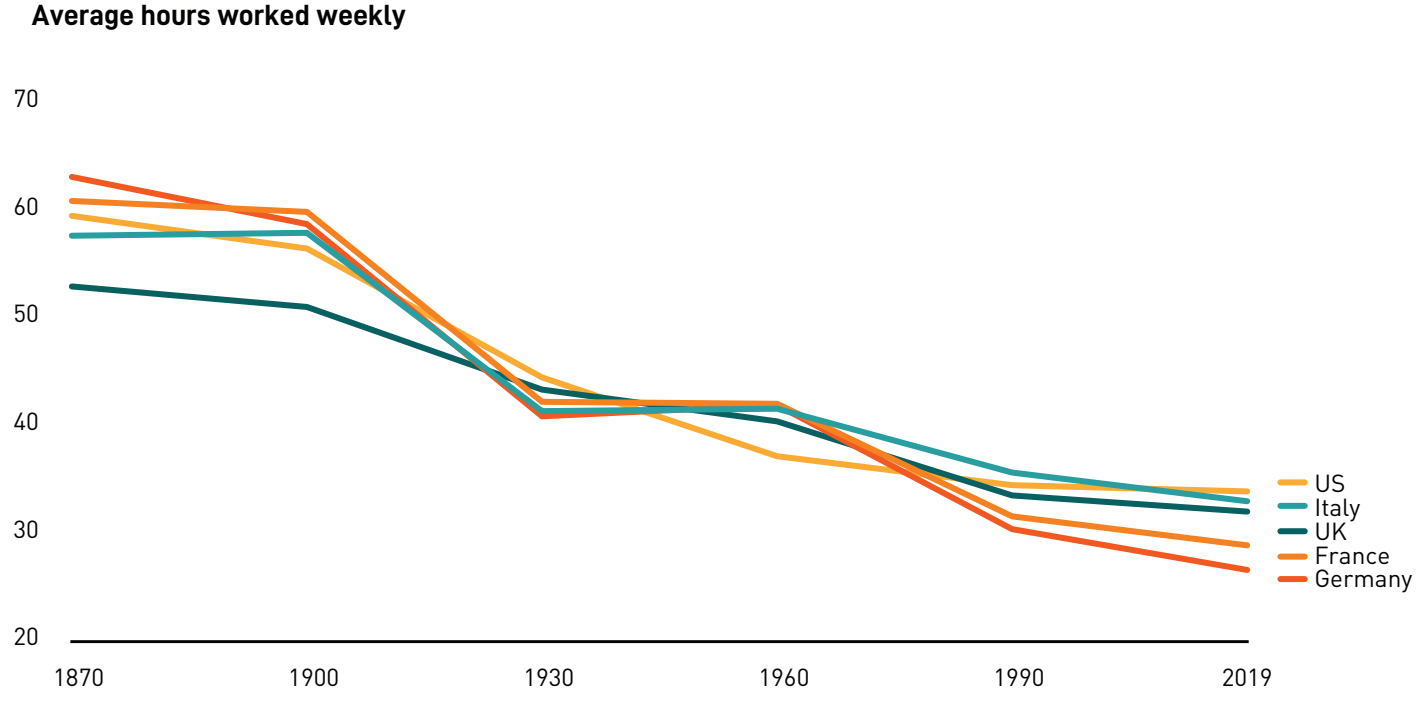


Figure 15: Work Hours Reduced with Rising Prosperity

Source: The Working Future: More Human Not Less. Bain & Company, 2022

An interesting trend is emerging as people and firms gain access to vital technology and knowledge that empower them to extend their reach for knowledge, resources, and markets and their ability to generate greater richness by creating a more incentive-compatible work environment to generate greater ROV for themselves and the stakeholders they represent. The ROV values are congruent among skilled workers. The values of skilled workers have shifted from "survival mode" to seeking "meaning" for their work. Figure 16 shows that the proportion of workers in many developed countries who view their jobs as "just a way of earning money" is relatively lower than in developing countries. In essence, in the new economy, companies are advised to create greater value for their workers and become talent makers rather than talent takers. Increasingly, the competition for skilled talent has intensified. To attract these skilled workers, organisations will also have to take an ROV-driven approach to their operations.

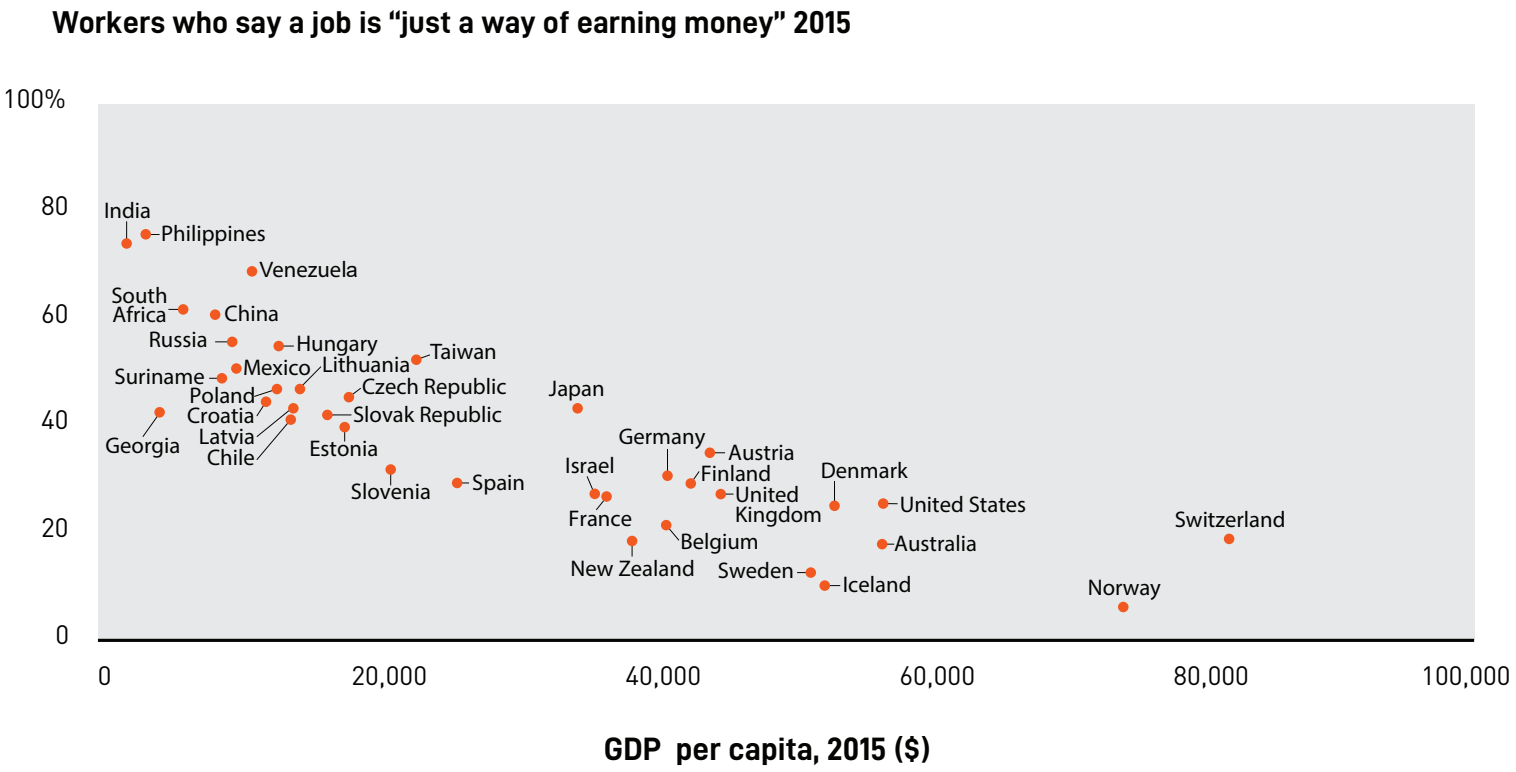
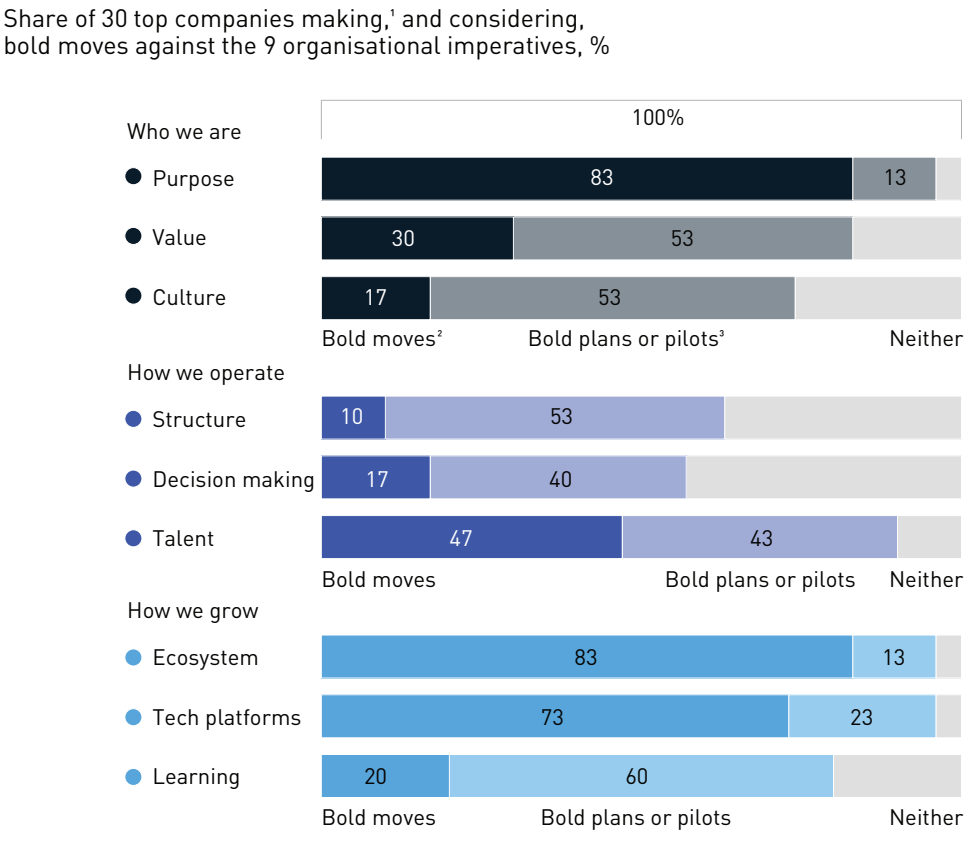


Figure 16: Percentage of Workers Across Countries that Say a Job is "Just a Way of Earning Money"

Source: The Working Future: More Human Not Less. Bain & Company, 2022

To attract a skilled workforce, future-ready companies will be required to share three important characteristics: clarity on their purpose, values, and culture; pivot on speed and simplicity of structure, decision-making, and talent; and prosper by delving into new ecosystems, technology platforms, and capacity to learn (McKinsey, 2021). Among the 30 highest-performing companies in the United States, 90% of them are engaging in bold talent-related actions and plans (Figure 17, McKinsey, 2021). Herein, talent is viewed as the scarcest company's resource, and a 3-point talent strategy is taken into consideration: types of "right" talent, ways to attract them, and ways to capitalise on them effectively towards the company's identity. Internal corporate culture (MIT Sloan Management Review, 2022) matters as it can determine the success of the talent strategic plan. Sense of life purpose at the workplace; internal talent mobility for high-impact initiatives; diversity and inclusive experiences; continuous learning; and a humanised work culture are among the corporate cultures and identities that contribute to heightened work performance by talent and an increment in company shareholders' profitability (McKinsey, 2021).

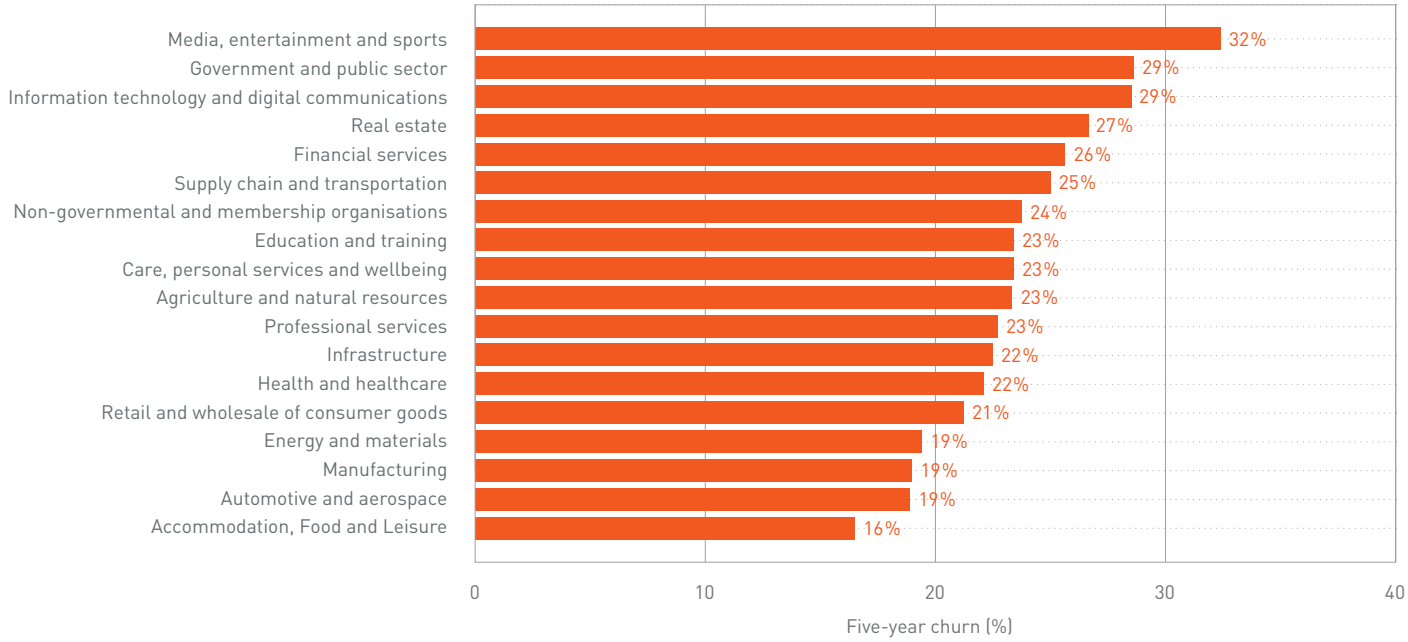


[1]To acknowledge that industries have different market fundamentals and face different headwinds and tailwinds, top 10 industries are measured by their average economic prot between 2015–19. We then selected the top 3 companies from each industry by the same metric.
[2]Bold moves defined as: 1) Company among the first to adopt a given practice; 2) the practice is unique and not copied elsewhere; or 3) the practice has been scaled across >50% of the company.
[3]Bold plans defined as: Company is actively planning or piloting a bold move as defined above.
Source: McKinsey Organization Practice; McKinsey Strategy & Corporate Finance Practice

Figure 17: US Top 30 Companies' Bold Actions Against Nine Imperatives

Source: Organizing for the Future – Nine Keys to Becoming a Future-Ready Company. McKinsey & Company, 2021

Technology and values are going to shape the labour market churn, which entails the old jobs being replaced by new ones. A recent study shown in Figure 16 shows the technologies that are likely to be adopted by 2027 are closely related to the jobs with varying demands by 2027. As per the industry sector, media, entertainment, and sports, as well as information technology and digital communication, will see a major labour market churn, whereby digitalisation and AI will make tedious jobs within these sectors obsolete and new technology-driven jobs emerge. Among the least labour-market churn are accommodation, food, and leisure; automotive and aerospace; manufacturing; as well as energy and materials (Figure 18). Patterns of technological adoption vary between industries and will likely impact the job market. Therefore, individuals, businesses, and policymakers need to comprehend how technology will affect the labour market to adequately prepare for the future of work.



Source

World Economic Forum, Future of Jobs Survey 2023.

Source

Labour-market churn refers to the total expected job movement - including both new roles being created and existing roles destroyed - as a proportion of current employment. This excludes situations where a new employee replaces someone in the same role.

Figure 18: Labor Market Churn by Industry

Source: The Future of the Jobs Report 2023. WEF, 2023

Rehiring opportunities also shifted based on the industry. The global talent outlook is evolving rapidly with significant changes in the job market, workforce demographics, and disruptive technologies. According to WEF's The Future of the Jobs Report 2023, it is predicted that 69 million new occupations could emerge from now until 2027. These jobs will be more tailored to the changing division of labour between humans, machines, and algorithms. Figure 18 demonstrates the top job movement in industry. There is a distinct emergence of new roles within industries, and the nature of these roles reflects the pattern of innovation and growth in multiple industries. When it comes to specific jobs with the most structural churn and net growth of labour forces, agricultural equipment operators (agriculture sector), AI and machine learning specialists (advanced technology sector), sustainability specialists (environment sector), digital transformation specialists (digital access sector), and vocational education teachers (education sector) top the job market opportunities (Figure 19).

A recent WEF study projected that from 2013 to 2027, structural labour-market churn from 2023 to 2027, and projected net growth or decline in employment is from 2023 to 2027 in millions of employees. However, with the emergence of new digital-based jobs, it is anticipated that 83 million jobs will be replaced, and 14 million jobs will be displaced due to this transformation. Several jobs, including data entry clerks, administrative and executive secretaries, accounting, bookkeeping and payroll clerks, accountants and auditors, and others, will experience a decline in demand due to the redundancy of humans and automation of tasks (WEF, 2023).

Figure 19: Projected Churn and Net Growth/Decline of Employment by Occupation, 2023-2027

Source: The Future of the Jobs Report 2023. WEF, 2023

The knowledge economy is powered by new STI breakthroughs, and applications from the innovations from the STIs will not only create new industries but also be the source of productivity for other sectors of the economy. All of which are expected to create new jobs for the economy. By 2025, it is anticipated that nine out of 10 jobs in demand worldwide will be STEM/STI-related (WEF 2020 Future of Jobs, Figure for Job Landscape). These positions and occupations will emphasise the skills and competencies necessary to develop and effectively employ digital technology and AI systems. The challenges foreseeable between 2023 and 2027 by the industry players include the skills gap and getting the "right" talent (59.7% and 53.4%, respectively); the skills gap and insufficient understanding of opportunities within the organisations' leadership (37.3% and 32.6%, respectively); an outdated or rigid regulatory framework (41.9%); and limited investment capital (37.2%). (WEF, 2023).

To embrace a more STI-driven economy, firms are investing in learning and training on the job (81.2%) as well as accelerating the automation of processes (80.0%) (WEF, 2023). Another key strategy employed by firms' global reach to markets is to increase the diversity in their talent pool. These include ensuring gender diversity and cross-cultural competencies by employing people of diverse ethnic groups. Studies have shown diversity boosts profitability. A study by McKinsey showed that between the top-quartile and the bottom-quartile (refer to Figure 20), 1,000 large companies from 15 countries showed 36% above average profitability when there was ethnic and cultural diversity, while 25% above average profitability when there was gender diversity on their executive board (McKinsey, 2020). The WEF reported that 2/3 of companies surveyed have diversity, equity, and inclusion (DEI) programmes, and this is more prominent in large companies with more than 50,000 employees; 92% of these large companies have diversity, equity, and inclusion (DEI) programmes (WEF, 2023). Most of these organisations (79%) support women, followed by youth (67.7%) in their DEI programmes (Figure 18).

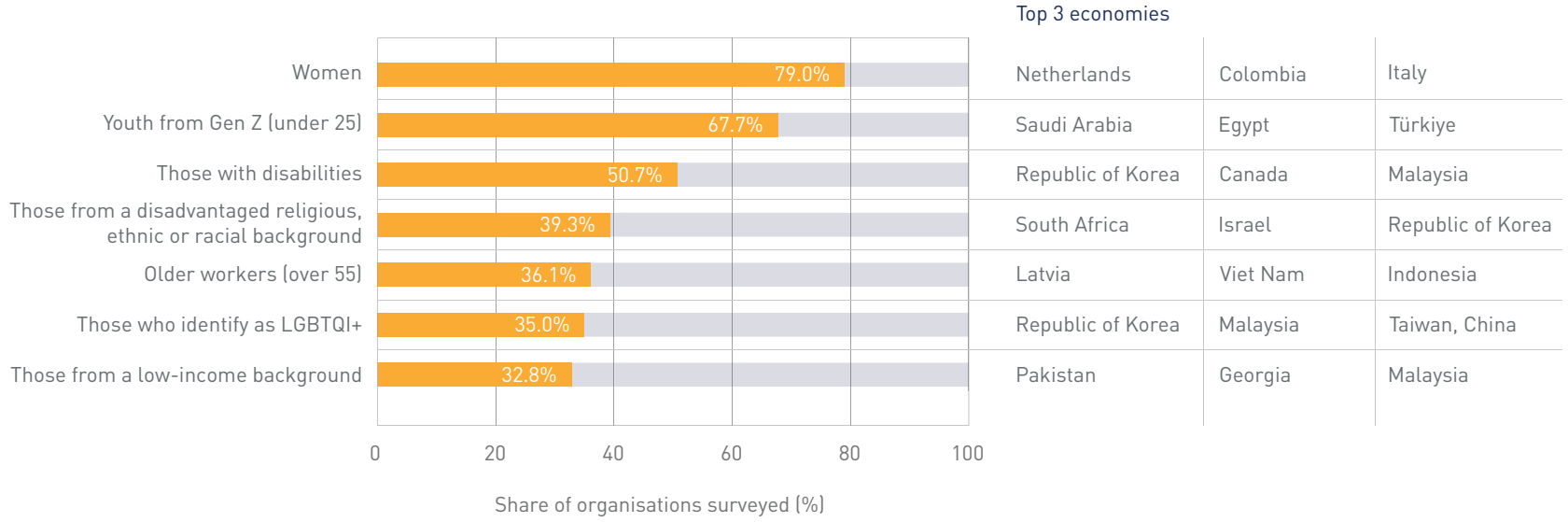


Figure 20: Diversity, Equity and Inclusion (DEI) Priority Groups, 2023-2027

Source: The Future of the Jobs Report 2023. WEF, 2023

1.5 TRANSFORMATION OF THE MALAYSIAN ECONOMY AND LABOUR MARKET

Throughout history, scientific advancement and invention have spurred socioeconomic transformations that have substantially improved living conditions. Emerging technology and innovation policies can be crucial in promoting inclusivity and growth (OECD, 2017). In the early 1960s, the agricultural industry was the driving force of Malaysia's agrarian-based economy. Since the 1980s, the manufacturing and services sectors have dominated the Malaysian economy. This sector is increasingly becoming automated and knowledge-intensive. Increasingly, the Malaysian economy is veering towards a more values-driven economy. A more values-driven economy is focused on a more humanised economy, where there is a greater impetus to ensure a more equitable distribution of wealth to all segments of the population. These include the development of rural and underserved regions of the country and ensuring inclusive economic development that lifts the socio-economic development of marginalised communities in the country. There is also a greater push towards ensuring economic development, taking into consideration the 17 UNSDGs. These include giving due consideration to the health of the planet, people, and the economy. The transition of the Malaysian economy is shown in Figure 21.

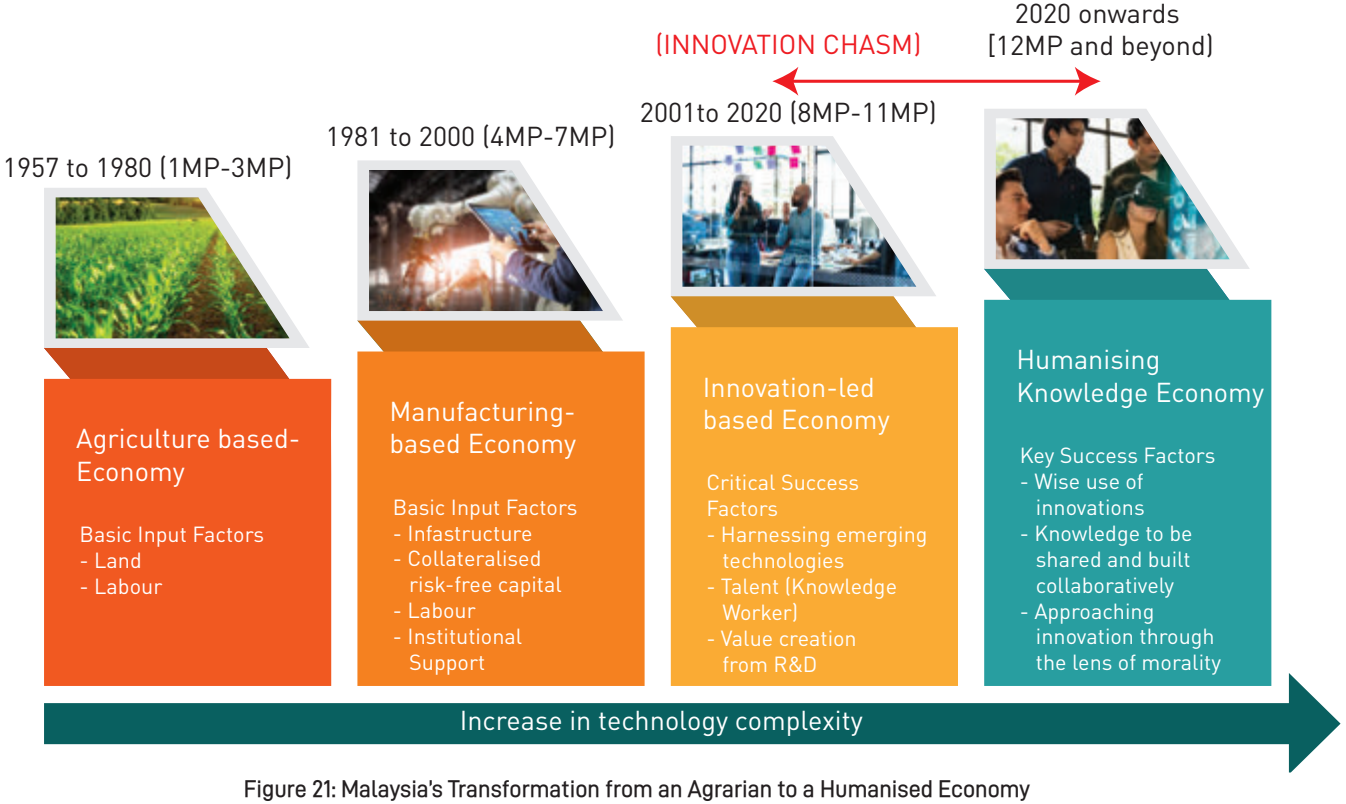


Figure 21: Malaysia's Transformation from an Agrarian to a Humanised Economy

Source: Adapted from Science & Technology Foresight Malaysia 2050: Emerging Science, Engineering, & Technology (ESET) Study. ASM, 2017

Since independence, Malaysian wealth, as measured by the gross domestic product (GDP), has increased significantly, as shown in Figure 22. While the Malaysian economy experienced unprecedented growth for the first three decades since independence due to the transition of the economy from an agrarian to a manufacturing-driven economy, economic growth has become more volatile for several reasons. Among them are competition from other countries with

a larger labour pool, increasing labour costs in Malaysia due to a smaller labour market, and lower adoption of technology in many sectors of the economy. The latter has prevented Malaysia from moving up the global value chain. The other factor that has exacerbated the volatility in GDP growth rates is the fact that the Malaysian economy has become more integrated with the global supply chain. Hence, any volatility or shocks in other countries or the global supply chain are felt by the Malaysian economy. The problem is further magnified due to inherent weaknesses in the Malaysian industrial ecosystem that hinder its resilience to these global shocks. These include a lack of technological sophistication in the many industrial ecosystems to pre-empt potential shocks to their ecosystems and put in adaptive and mitigative strategies to dampen the impact of the shocks on the economy.

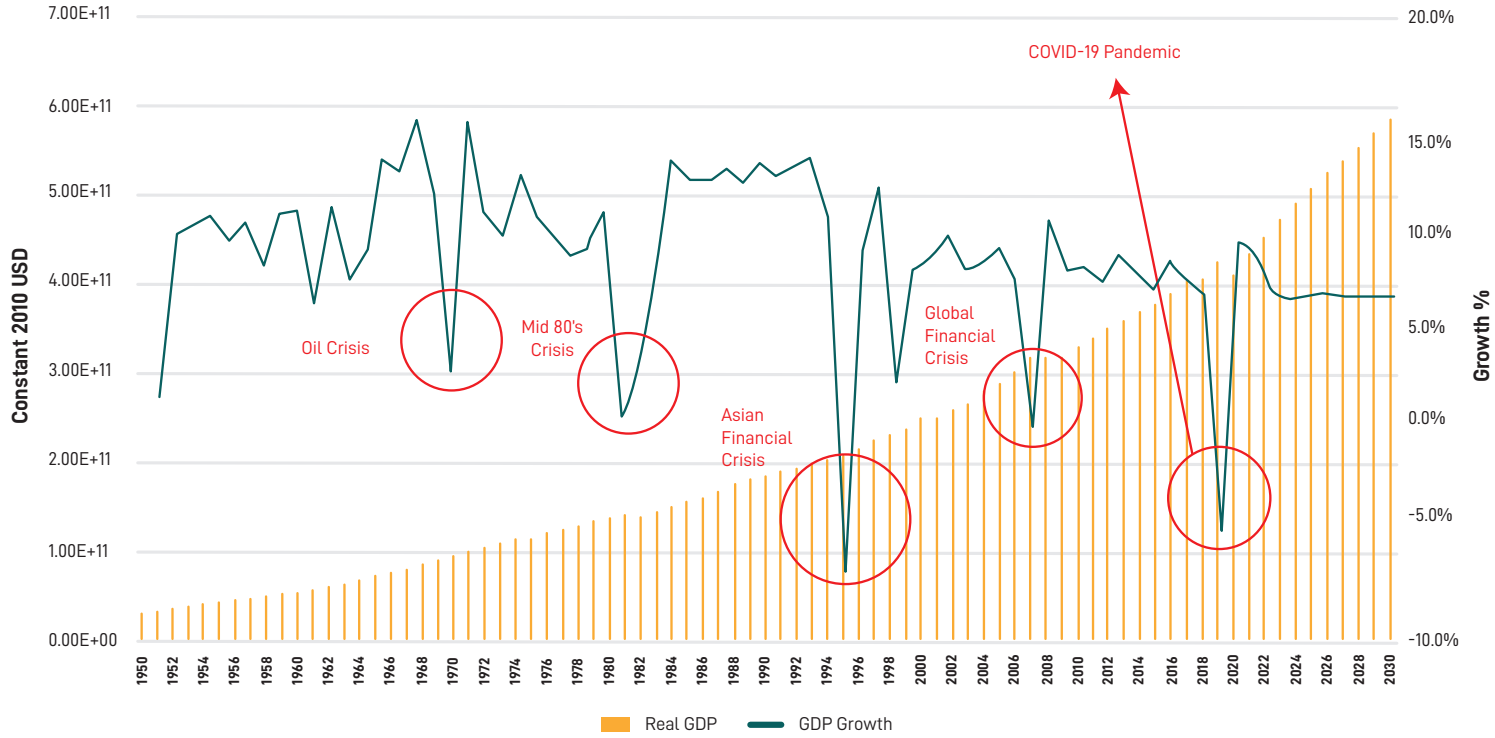


Figure 22: Malaysia's GDP and Economic Growth (1957 – 2029)

Source: Science Outlook 2020: Unlocking the Future. ASM, 2021

To sustain Malaysia's global competitiveness, the government continues to integrate STI as an economic growth driver into its transformation initiatives. This would enable Malaysia to soon become a high-tech nation with a high income and a developed nation built on knowledge and competitiveness. Industry 4.0's rapid technological evolution necessitates that the nation integrates innovations into its industries to remain globally competitive.

Based on the WEF's The Future of the Jobs Report 2023, Malaysia recorded 78% labour force participation with a 16.8 million working-age population. Only 63% and 20% have secondary and tertiary education attainment, respectively. The unemployment rate is 3%, affecting those with basic and advanced education alike; this rate is below the unemployment rate of the Organisation for Economic Co-operation and Development (OECD) area at 4.8% as of March 2023 (WEF Talent, 2023 and OECD 2023). The Department

of Statistics Malaysia reported that of those who fell into the outside labour force category in March 2023, 43.5% remain unemployed due to household and family responsibilities (which culturally fall on females more than male family members), while 40.6% are undergoing schooling and training (DOSM, 2023). Meanwhile, underemployment, or talent who are unwillingly taken up lower-skill and lower-pay than their education attainment, recorded 879,100 skill-related underemployment in Q1 2023, the second highest recorded since underemployment statistics recorded in Q1 2017 (DOSM, 2023). In terms of business practices that support talent pool availability, Malaysia is fairly above average on diverse talent pools and Diversity, Equity, and Inclusion (DEI) programmes; reskilling and upskilling opportunities; about the global average on employee health and well-being; and below par than the global average on offering higher wages, talent progression and promotion, internal communication strategy, people-and-culture metrics, and reporting (WEF Talent, 2023).

Increasingly, the Malaysian economy is becoming technology- and knowledge-intensive. Software engineering-related industries have the highest likelihood of technology adoption and job creation within Malaysian companies (Figures 23 and 24). Digital and artificial intelligence-performed tasks are slowly replacing a significant portion of human-performed duties. The extent of disruption will vary depending on a worker's occupation and skill set.

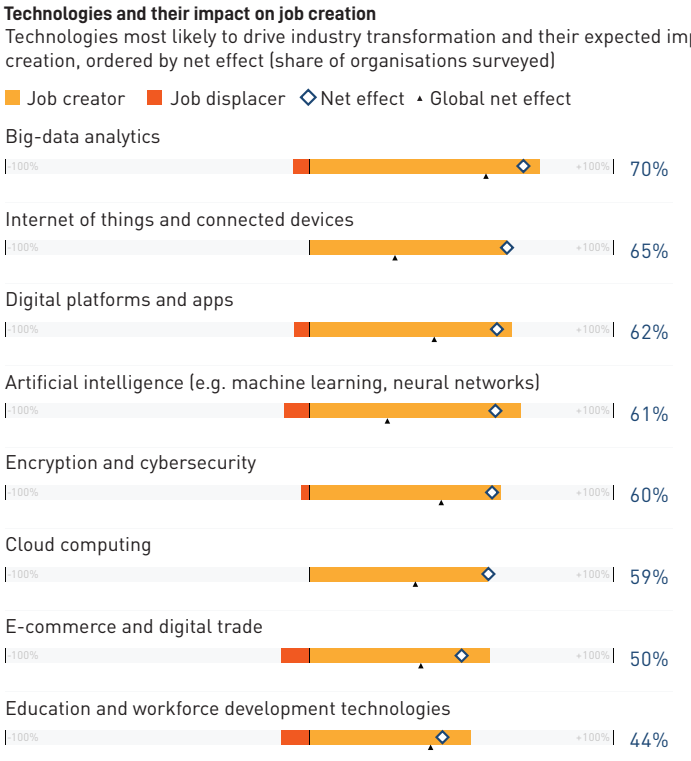


Figure 23: Technology Adoption among Companies in Malaysia

Source: The Future of the Jobs Report 2023. WEF, 2023

The rapid technology revolution sweeping across the labour market in Malaysia is transforming supply-and-demand jobs. Project managers and business development professionals recorded 56% and 45% churn in Malaysia compared to 25% and 24% global churn (Figure 24). Primarily manual duties such as clerical and administrative roles can be redundant when automation, digitalisation, and artificial intelligence are becoming mainstream in Malaysian companies.

Role outlook

Churn in five years

Five-year structural labour-force churn (percent)

25%

Global 23%

Key roles for business transformation

Roles most selected by organisations surveyed (as either growing, stable or declining), ordered by net role growth, and their net growth and structural churn (percent)

Figure 24: Malaysia's Economy and Global Churn in Five Years

Source: The Future of the Jobs Report 2023. WEF, 2023

Due to changes in technology adoption and emerging jobs projected in Malaysia and in response to COVID-19 pandemic mitigation, an impressive 86% of employers intend to automate problem-solving tasks. A comparable proportion of employers anticipate hiring new permanent employees with skills pertinent to emerging technologies. The same proportion anticipates existing workers to acquire skills on the job (Figure 25).

Figure 25: Malaysian Employers' Responses on Shifting Skills Need

Source: The Future of the Jobs Report 2020. WEF, 2020

Innovation is an important factor in raising the income level of countries. Malaysia is currently in the 36th position of 223 countries in the Global Innovation Index (GII) 2022 (see Figure 26). Malaysia's rank in the talent-related pillars, Human Capital Research and Business Sophistication, was 38th and 41st, respectively. The Human Capital and Research pillar measures talent supply indicators, while the Business Sophistication pillar measures talent demand indicators. In both pillars, Malaysia's rank and score are well below the average of the Top Ten countries in GII 2022.

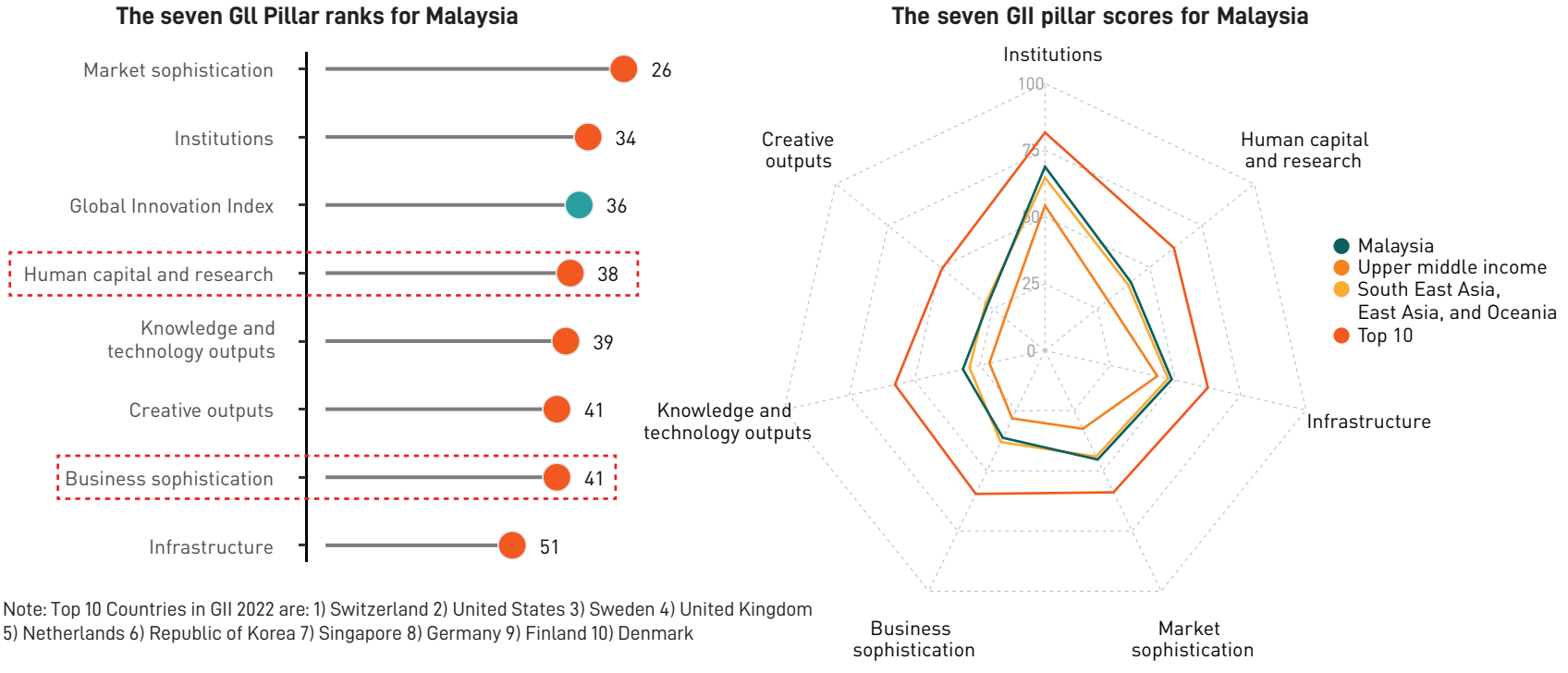


Figure 26: Malaysia's Ranking in the Global Innovation Index (GII) 2022

Source: Global Innovation Index 2022 – Malaysia Profile. WIPO, 2022

The state of Malaysia's STIE ecosystem consists of several players; among them are public research institutions (PRIs), higher learning institutions (HLIs), venture capital, and accelerators in the ecosystem. Collaboration and cooperation between these institutions and the private sector have been a driving force for the nation's economic growth. It served well in transforming Malaysia from an agrarian middle-income country into an innovation-based upper-middle-income country. Malaysia's STIE ecosystem has consistently performed well among upper-middle-income countries, placing second behind China in the rankings of the GII but below the average performance of the Top 10 ranked companies.

Malaysia ranks 38 out of 223 nations in the "Human capital and research" pillar, faring better than the average score among upper-middle-income Southeast Asian, East Asian, and Oceanic nations. However, in the demand-side categories of the "business sophistication" pillar, Malaysia is ranked 41st. In both pillars, Malaysia's performance was much lower than the average score of the top 10 nations in GII 2022. Figure 27 below illustrates a more detailed score for the GII pillars.

Supply-Side Related Pillar

	Human capital and research		41.0	38	◆
2.1	Education		47.8	74	
2.1.1	Expenditure on education, % GDP		3.9	78	
2.1.2	Government funding/pupil, secondary, % GDP/cap		20.2	56	
2.1.3	School life expectancy, years		13.3	79 ○	
2.1.4	PISA scales in reading, maths and science		430.9	48	
2.1.5	Pupil-teacher ratio, secondary		11.1	40	
2.2	Tertiary education		48.7	13 ●	◆
2.2.1	Tertiary enrolment, % gross		42.6	74	
2.2.2	Graduates in science and engineering, %		38.9	3 ●	◆
2.2.3	Tertiary inbound mobility, %		7.5	33	◆
2.3	Research and development (R&D)		26.7	38	◆
2.3.1	Researchers, FTE/mn pop.	🕘	2,184.7	38	◆
2.3.2	Gross expenditure on R&D, % GDP	🕘	1.0	40	◆
2.3.3	Global corporate R&D investors, top 3, mn USD		0.0	38 ○	◇
2.3.4	QS university ranking, top 3*		58.0	16 ●	◆

NOTES: ●indicates a strength; ○ a weakness; ◆an income group strength; ◇an income group weakness; * an index; † a survey question. 🕘 indicates that the economy's data are older than the base year

Demand-Side Related Pillar

	Business sophistication		36.3	41	◆
5.1	Knowledge workers		32.9	62	
5.1.1	Knowledge-intensive employment, %	🕘	28.2	52	
5.1.2	Firms offering formal training, %	🕘	18.5	83 ○	
5.1.3	GERD performed by business, % GDP	🕘	0.5	41	
5.1.4	GERD financed by business, %	🕘	38.2	45	
5.1.5	Females employed w/advanced degrees, %	🕘	14.7	52	
5.2	Innovation linkages		31.2	37	◆
5.2.1	University-industry R&D collaboration†		53.6	36	◆
5.2.2	State of cluster development and depth†		59.1	29	◆
5.2.3	GERD financed by abroad, % GDP	🕘	0.1	43	
5.2.4	Joint venture/strategic alliance deals/bn PPP$ GDP		0.1	22	◆
5.2.5	Patent families/bn PPP$ GDP		0.2	48	
5.3	Knowledge absorption		44.7	27	◆
5.3.1	Intellectual property payments, % total trade		1.0	38	
5.3.2	High-tech imports, % total trade		29.4	4 ●	◆
5.3.3	ICT services imports, % total trade		2.0	37	
5.3.4	FDI net inflows, % GDP		2.0	72	
5.3.5	Research talent, % in businesses	🕘	15.8	57 ○	

Figure 27: Malaysia's Scores in the Global Innovation Index 2022 Pillars

Source: Global Innovation Index 2022 – Malaysia Profile. WIPO, 2022

The GII 2022 has identified that both the "Human Capital and Research" and "Business Sophistication" pillar scores are "income group weaknesses." Malaysia performs well in the "Tertiary Education" sub-pillar (e.g., in terms of graduates in science and engineering). Some indicators of Malaysia performing well in GII 2022 include the share of all tertiary-level graduates in STEM as a percentage of all tertiary-level graduates and the average score of the top three universities according to the QS world university rankings. This shows that Malaysia's HLIs have done well in producing the supply of STEM talent for the country and that, institutionally, universities are well structured to play this role. However, a further deep dive into Malaysia's STEM enrolment shows a worrying decline over the last ten years. In the "human capital and research" pillar, Malaysia ranks 38 out of 223 countries. It performs well above the average score of upper-middle-income, Southeast Asian, East Asian, and Oceanic countries. However, Malaysia's score in the human capital and research pillar (supply side) and business sophistication (demand side) is far below the average score of the Top 10 countries in GII 2022.

Monash Malaysia commissioned a survey on business sentiment among Malaysian business leaders from companies operating in Malaysia from 2017 to 2020. This longitudinal survey provides valuable insights into the changes taking place in the business environment in the country and the pressures faced by Malaysian firms (Nair et al., 2020). On average, 600 industry captains were interviewed per year for the sample period. In 2020, 61% of the participating companies were small, 21% were large, and 18% were medium-sized. Privately owned businesses make up the majority of the study's sample (68%). About 15% of the companies were family-run, 10% were publicly listed companies, 5% were affiliated with the government, 1% were foreign-owned, and 1% were non-profit organisations.

Based on this survey, business leaders' top three concerns are global economic uncertainty, the increasing cost of doing business, and the current depreciation, which adds further to the cost of business (refer to Figure 28). They were of the view that both threats and opportunities to their business operations have increased over the years and will continue to be high over the next 3 years (refer to Figure 29). The business leaders also informed us that the source of competition for the business will come from new and emerging industry players, many with very sophisticated technology (refer to Figure 30). To address the competitive nature of the business environment over the period from 2017 to 2020, firms' focus is to manage their costs and, at the same time, increase their market reach to increase revenue. These would require significant resources invested in digital technology, staff training, and talent development, especially Industry 4.0 technologies (refer to Figure 31).

Thinking about the next 12 months, which of the following issues are you most concerned will impact your business prospects?

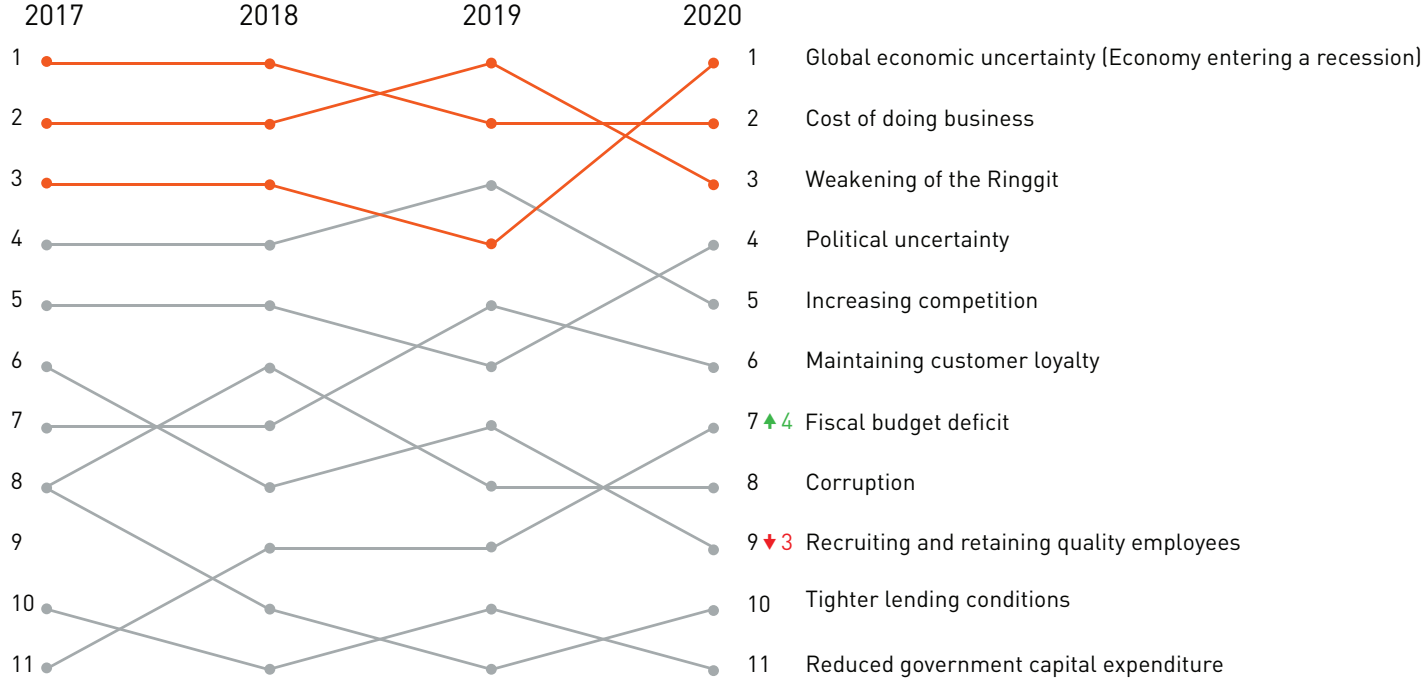


Figure 28: Concerns of Business Leaders

Source: Business Sentiment 2020/2021 Survey. Nair et al., 2020

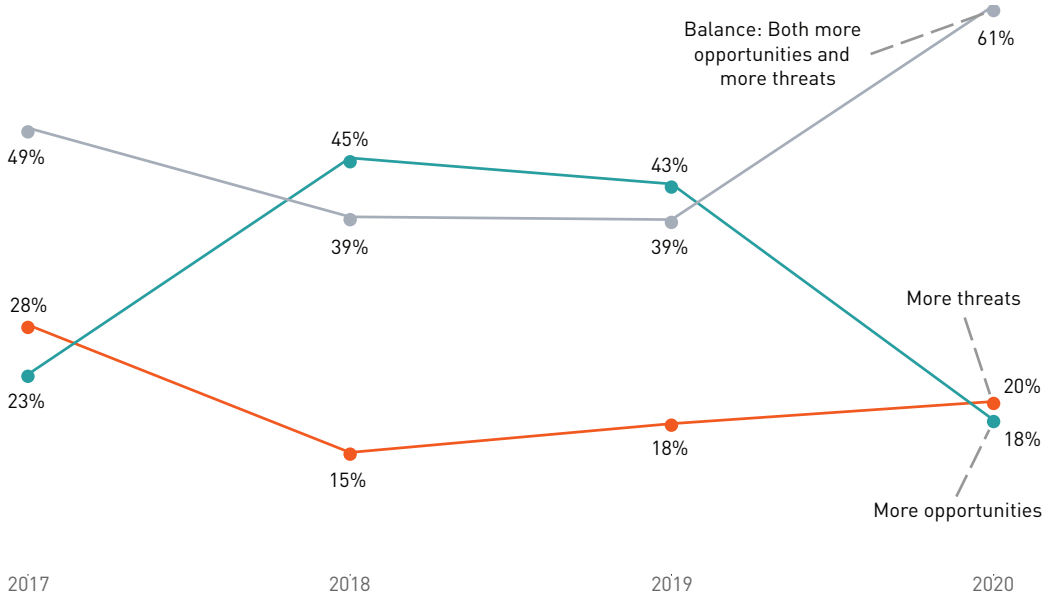


Figure 29: Opportunities and Threats for Businesses

Source: Business Sentiment 2020/2021 Survey. Nair et al., 2020

Over the next 3 years, how likely is it that your company will compete in new industry sector(s) other than the current one(s)?

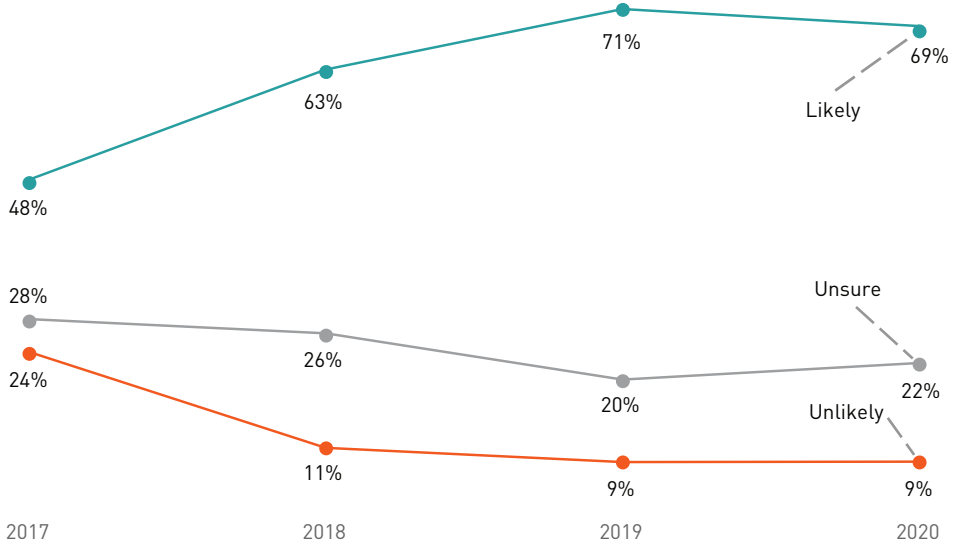
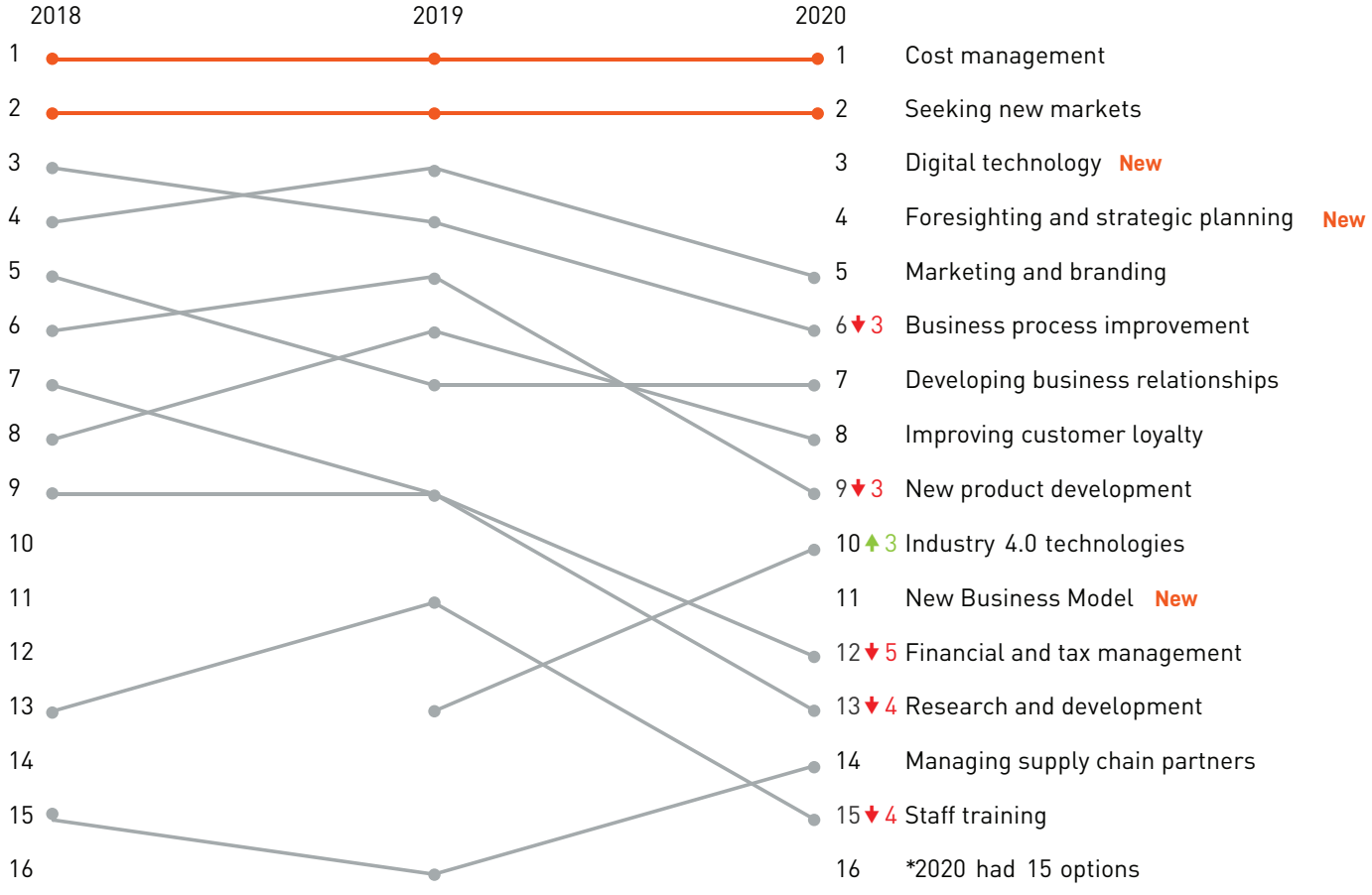


Figure 30: Sources of Competition for Businesses Operating in Malaysia

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

In the next 12 months, which of the following areas will you be spending more time and resources on?



Note: Only options that have increased/decreased by 3 ranks or more between 2018-2020 have been highlighted.
2020 only had 15 options. Ranks from previous years might have changed due to changes in options.
Top 3 options in 2020: Cost management (30%); Seeking new markets (30%); Digital technology (28%)
Top 3 options in 2019: Cost management (35%); Seeking new markets (29%); Marketing and branding (27%)
Top 3 options in 2018: Cost management (36%); Seeking new markets (33%); Business process improvement (24%)

Figure 31: Investment Priorities for Businesses

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

Business leaders recognise the importance of STIs in giving them competitiveness and comparative advantage in an increasingly DVUCA world. In 2020, ASM developed the 10–10 Malaysian Science, Technology, Innovation, and Economic (10–10 *My*STIE) development framework. The development framework provides a systematic way of deepening the impact of 10 global technologies on the 10 socioeconomic drivers of Malaysia (as shown in Figure 32). This framework was subsequently adopted by the Twelfth Malaysia Plan. Business leaders engaged by the study team informed that among the STIs listed in the 10-10 *My*STIE, the top three technologies are 5G technology, cybersecurity and encryption technology, and AI systems (as shown in Figure 33).

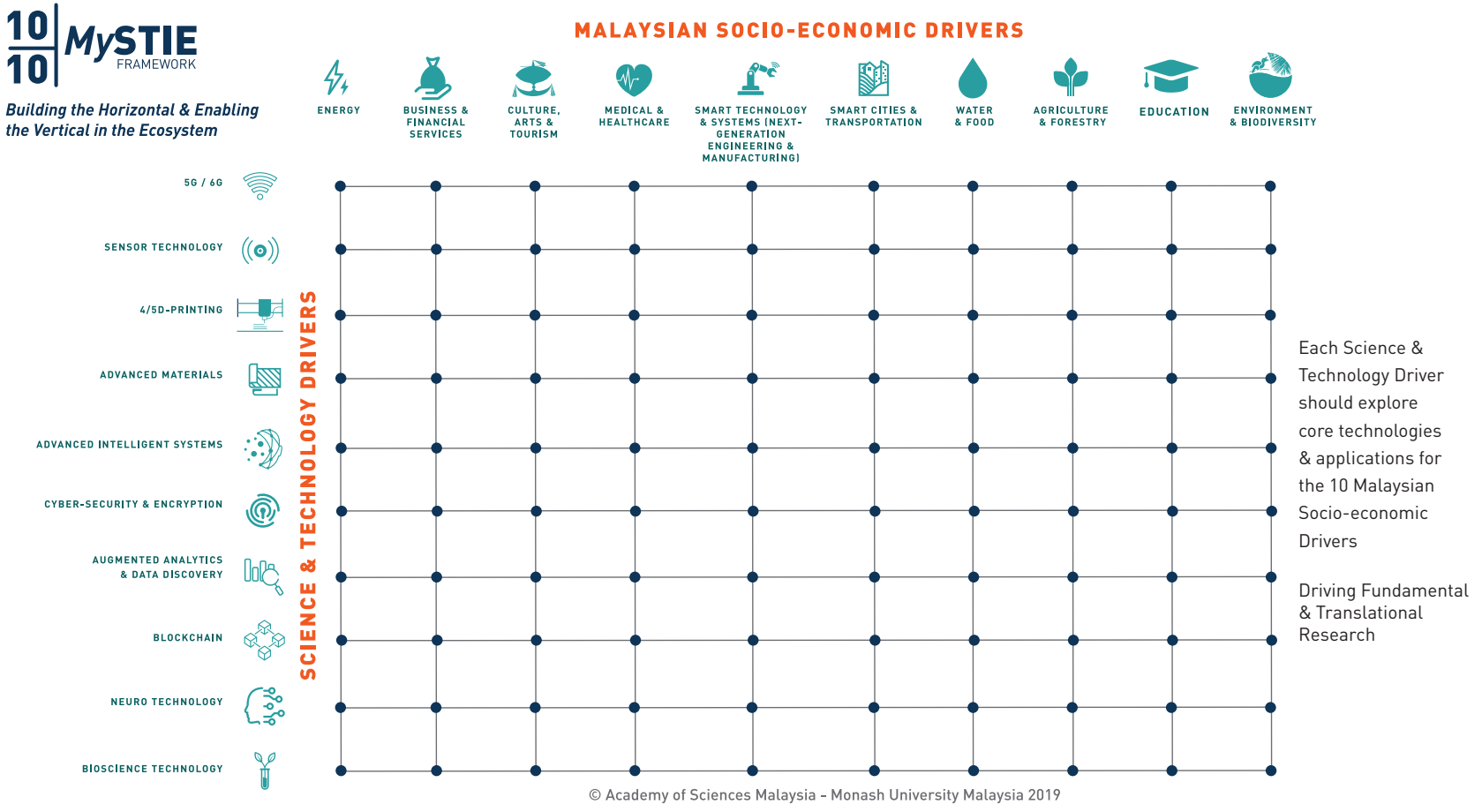


Figure 32: 10-10 Malaysian Science, Technology, Innovation and Economy (*My*STIE) Framework

Source: 10-10 MySTIE Framework. ASM, 2021

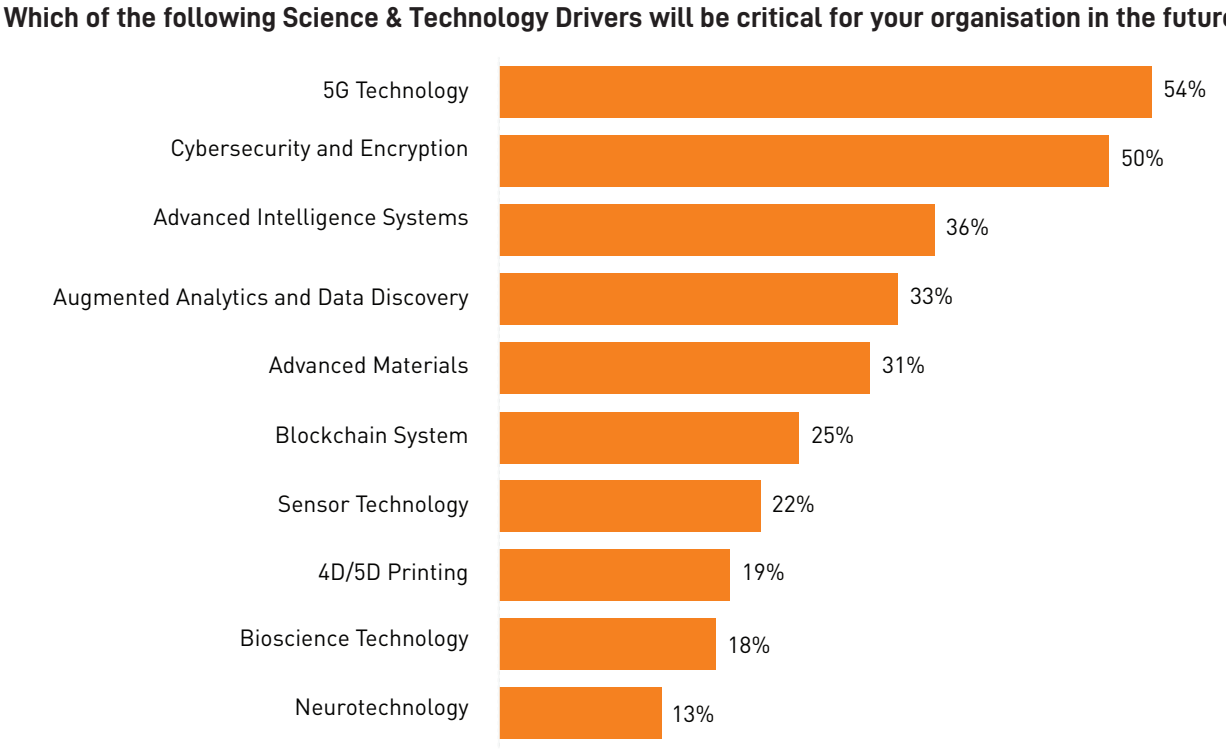


Figure 33: The 10 S&T Drivers that are Important for Organisation

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

More careful analysis shows that the top three Industry 4.0 technologies being used by firms are digital payment technologies, mobile technologies to engage customers, cloud services, and cybersecurity systems (refer to Figure 34). These technologies are critical for firms to refine their business models. Among the three top business transformations firms undertook were establishing cooperation with technology partners to strengthen their business models, expand business operations, and diversify their products and services (refer to Figure 35).

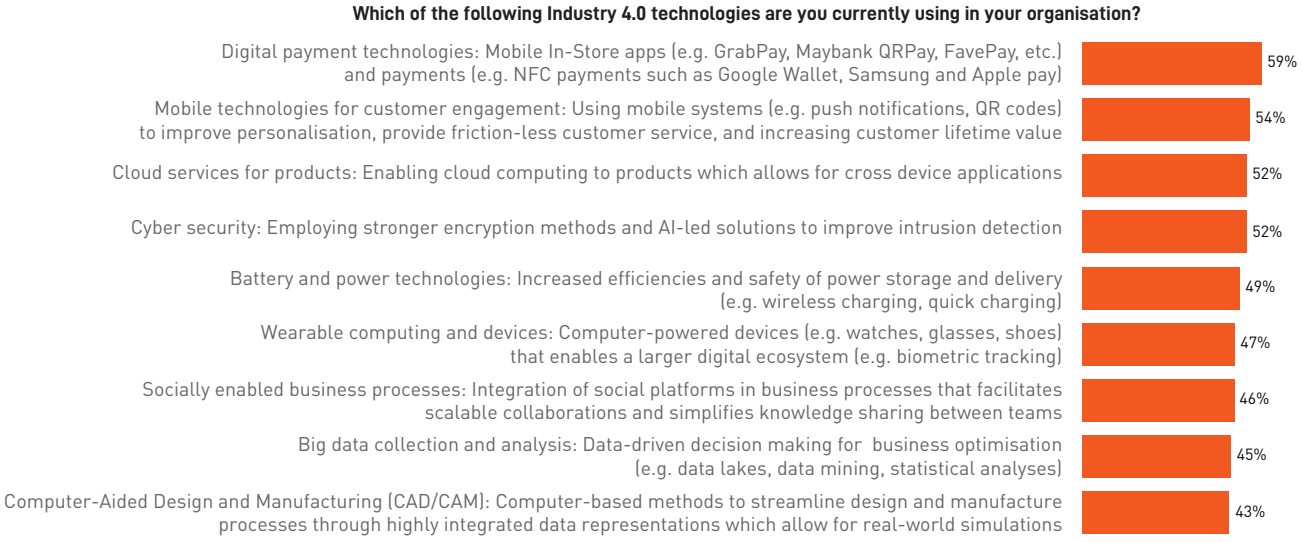


Figure 34: The Types of Digital and Industry 4.0 Technologies Used by Businesses

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

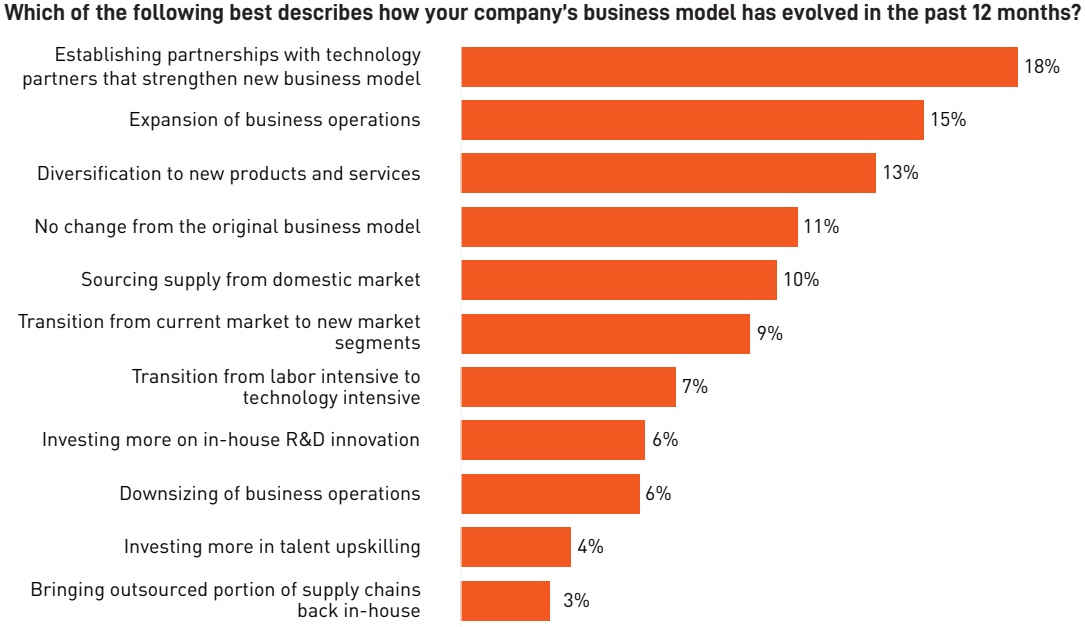
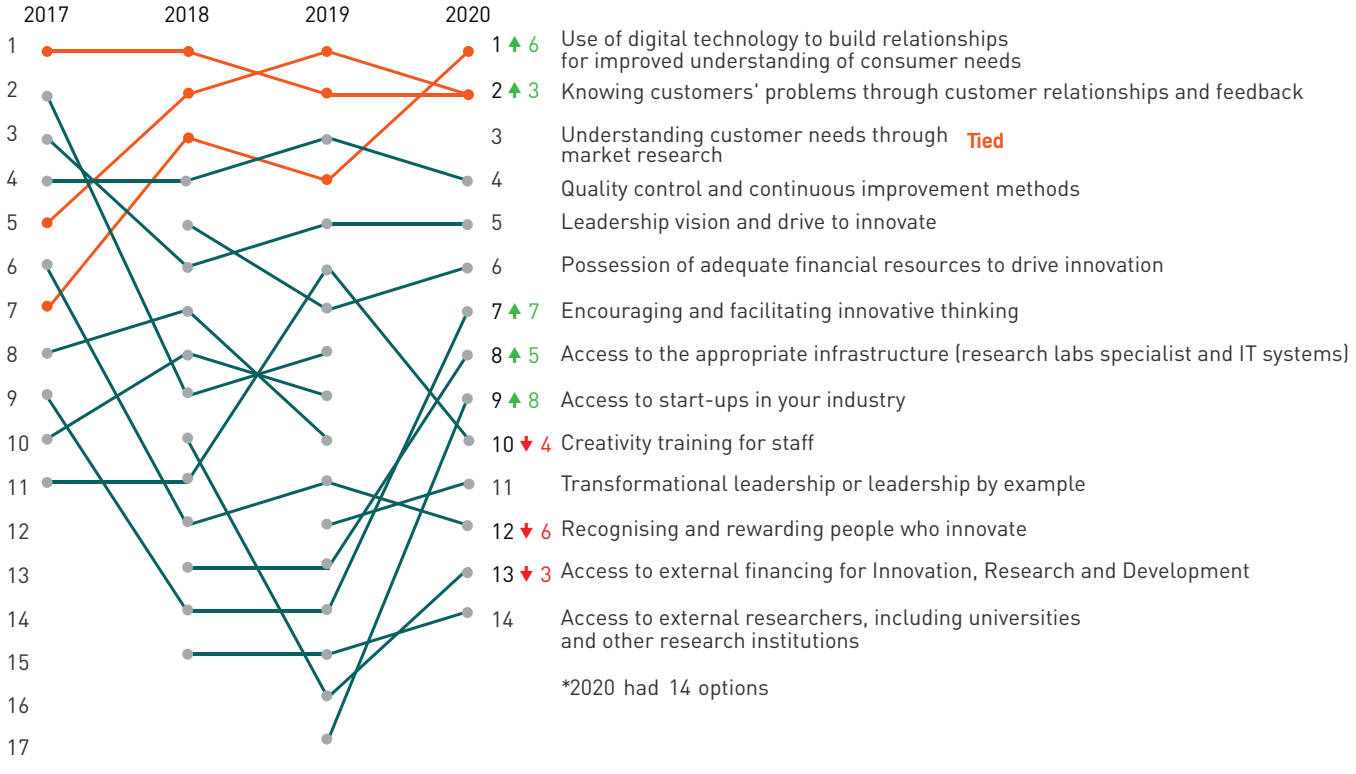


Figure 35: Business Model Evolution

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

Firms realise that to remain competitive, they need to invest in building their innovative capabilities. Interestingly, the top factors that help firms build innovative capabilities are investments in Industry 4.0 technologies (digital technologies) that will provide good market intelligence and management of their customers (refer to Figure 36). Market intelligence is critical for firms to develop strategies and policies to improve their services. These will enable them to increase and retain their customers' markets.

What are the top contributors to your company's ability to innovate?



Note: Only options that have increased/decreased by 3 ranks or more between 2017-2020 have been highlighted. 2020 only had 14 options. Ranks from previous years might have changed due to changes in options.
Top 3 options in 2019: Understanding customer needs through market research; Knowing customers' problems through customer relationships and feedback; Quality control and continuous improvement methods.
Top 3 options in 2018: Knowing customers' problems through customer relationships and feedback; Understanding customer needs through market research; Use of digital technology to build relationships for improved understanding of consumer needs.
Top 3 options in 2017: Knowing customers' problems through customer relationships and feedback; Depth of specialist knowledge and skills of people; Leadership vision and drive to innovate.

Figure 36: Contribution to Innovative Capability

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

The survey results show that firms that have fully implemented Industry 4.0 technologies have higher revenue compared to those that have partially implemented or have not implemented these technologies (refer to Figure 37). While adopting Industry 4.0 technologies has the potential to increase the economic outlook of firms, many have challenges in implementing these technologies. The top three challenges are financial constraints, a lack of training and capability programmes, and weak technological infrastructure and support systems (refer to Figure 38).

When compared with the previous 12 months, would you say your company's estimated gross revenue for the next 12 months will be:

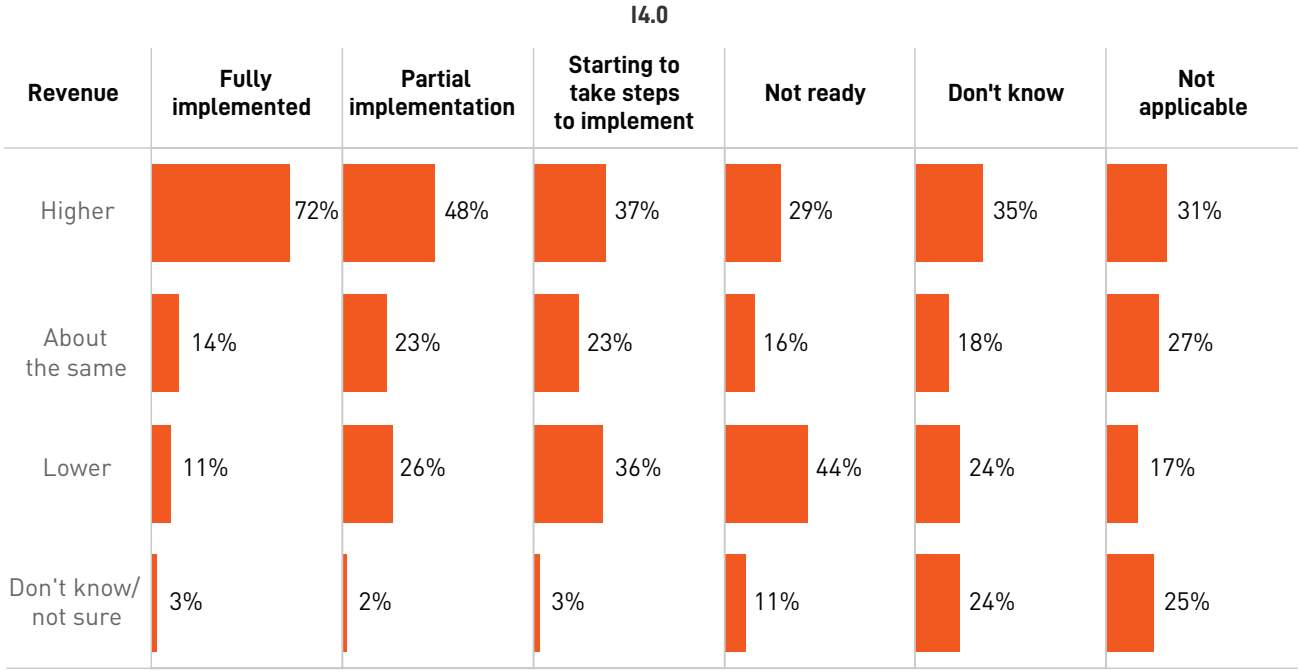
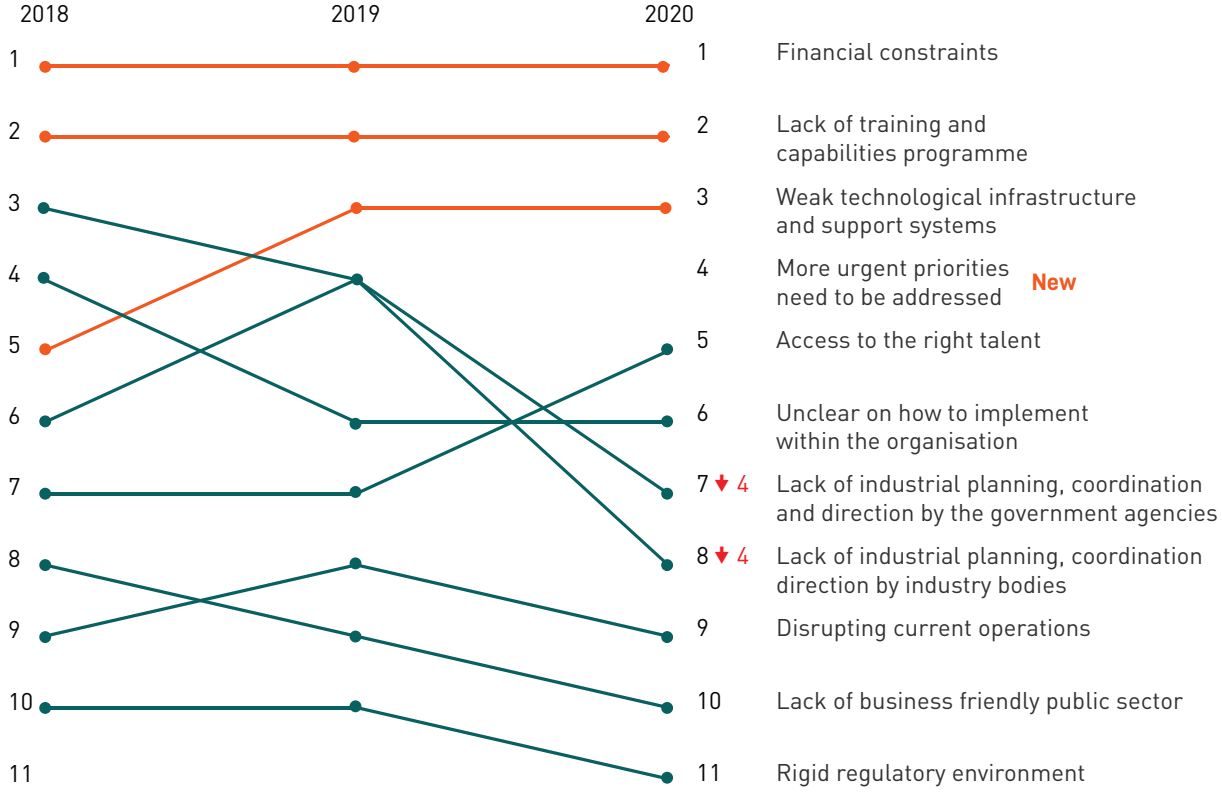


Figure 37: Impact of Implementing Industry 4.0 of Firm Revenue

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

What are the challenges in implementing Industry 4.0?
(Note: Industry 4.0 refers to the trend of automation and data exchange in technologies. It represents the digital transformation of processes across various industries and include the internet of things (IoT), cyber-physical systems, smart manufacturing, cloud computing, artificial intelligence, real-time data feedback and analysis, etc.)



Note: Only options that have increased/decreased by 3 ranks or more between 2018-2020 have been highlighted.
Ranks from previous years might have changed due to changes in options.
Top 3 options in 2019: Financial constraints; Lack of training and capabilities programme; Weak technological infrastructure and support systems
Top 3 options in 2018: Financial constraints; Lack of training and capabilities programme; Lack of industrial planning, coordination and direction by industry bodies.

Figure 38: Challenges of Implementing Industry 4.0 Technologies

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

As mentioned above, one of the challenges faced by the industry is a lack of training and capability development programmes that help firms adopt Industry 4.0 technologies. In this context, business leaders opined that universities must prioritise their education and training programmes to meet the demands of the industry (see Figure 39). These areas include advancing Industry 4.0 capabilities, establishing training programmes tailored for the industry, improving graduates' employability, and fostering collaboration between academia and industry. These findings can be attributed to a significant discrepancy between the supply and demand of graduates with strong competencies in Industry 4.0 technologies. Business leaders believe that fostering robust collaboration between academia and industry will significantly contribute to addressing the supply-demand talent gap and reducing graduate unemployment.

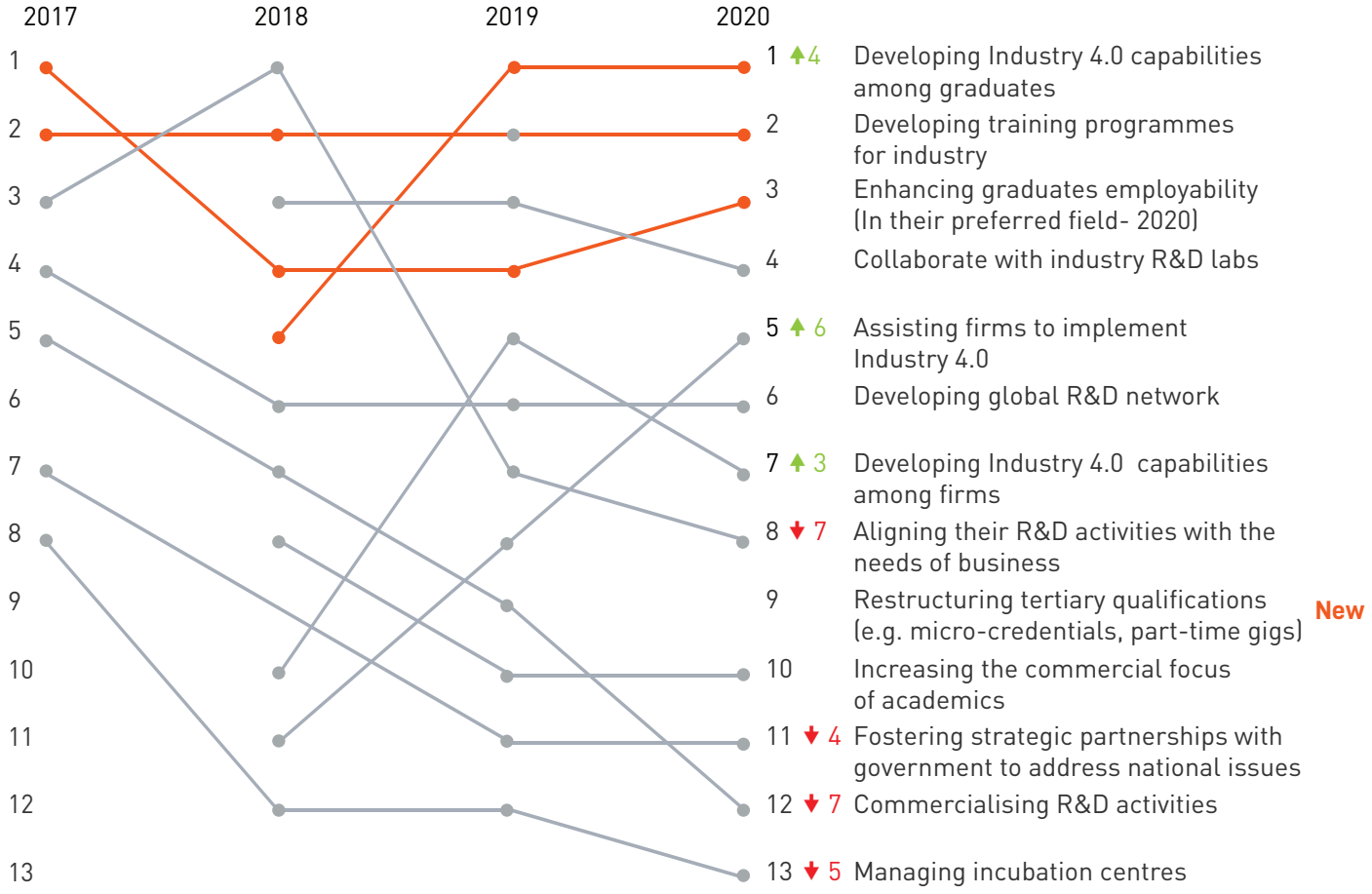


Figure 39: Future Priorities for Malaysian Universities, 2017 -2020

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

A more recent study by ASM (2021) shows that the wealth of the country (GDP) has increased from 2000 to 2019 (Figure 40). The STI ecosystem of the country improved from 2000 to 2010; however, there was no significant improvement in the STI ecosystem from 2010 to 2019. The study also found that there was very little improvement in societal development from 2000 to 2019. The more concerning trend is that there was a significant degradation of the environment from 2000 to 2019. The study by Fanning et al. (2022) using the Doughnut Social Planetary Boundaries Framework shows that most developed countries have improved the quality of life of their citizens at the expense of breaching the biophysical boundaries for emissions of hazardous materials in the environment. They have also increased their material footprint and reduced their ecological footprint. Figure 41 shows the biophysical and social indicators for Malaysia from 1992 to 2015. The figures show that Malaysia has breached the biophysical boundaries for most environmental indicators, while many of the social indicators remain below social thresholds. A study by ASM (2021) showed that over the period from 1992 to 2020, the cumulative cost due to degradation of the environment was estimated to be RM7.8 billion. The welfare cost of breaching planetary health boundaries related to premature deaths was RM947.2 billion, which is close to 3% of GDP loss per year (refer to Figure 42). The above analysis suggests that much of the economic development over the last three decades has been at the expense of the health of the planet, people, and the economy.

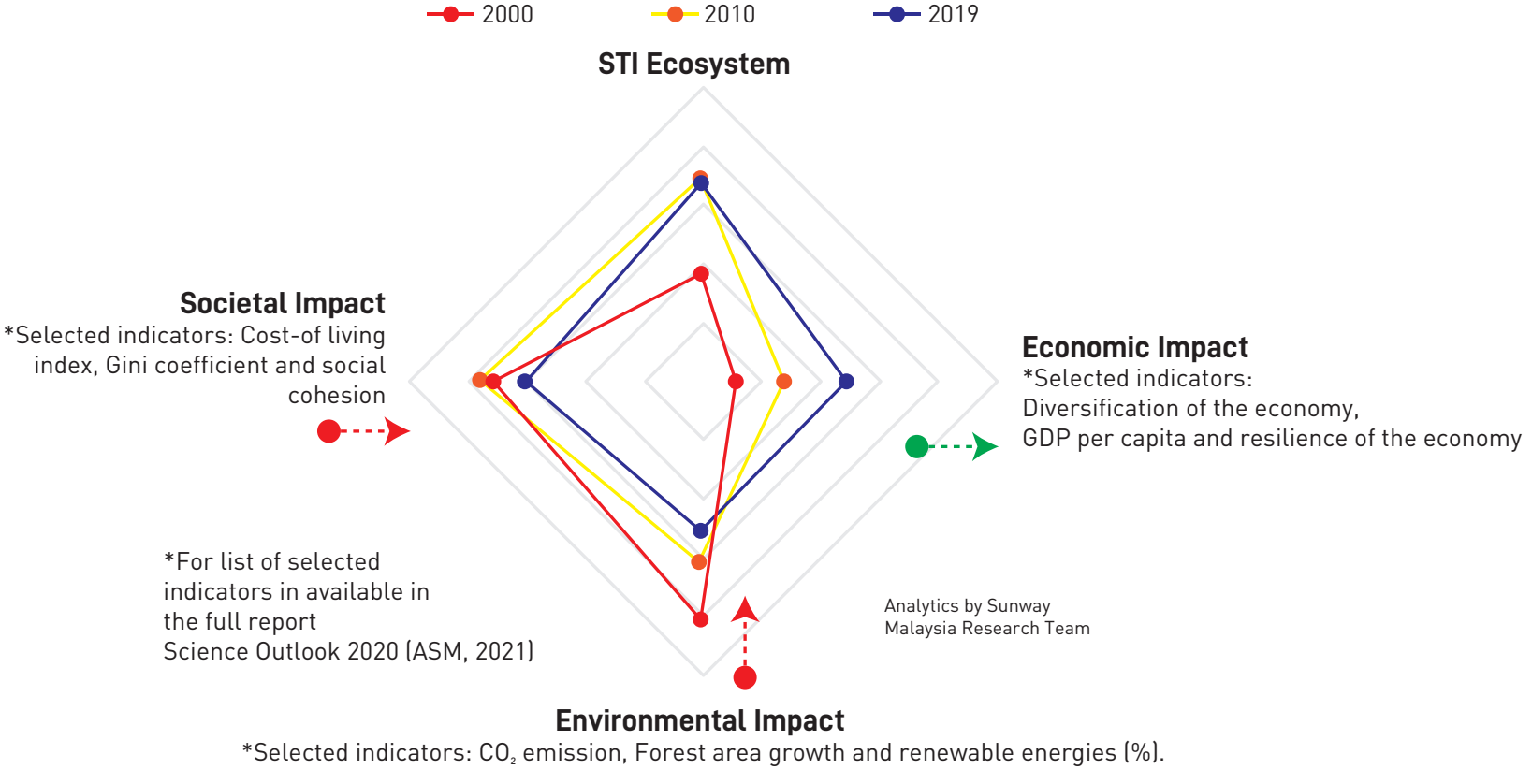


Figure 40: Malaysia's State of Development of the STI Ecosystem and Economic, Social and Environmental Impact, 2000-2019

Source: Science Outlook 2020: Unlocking the Future. ASM, 2021

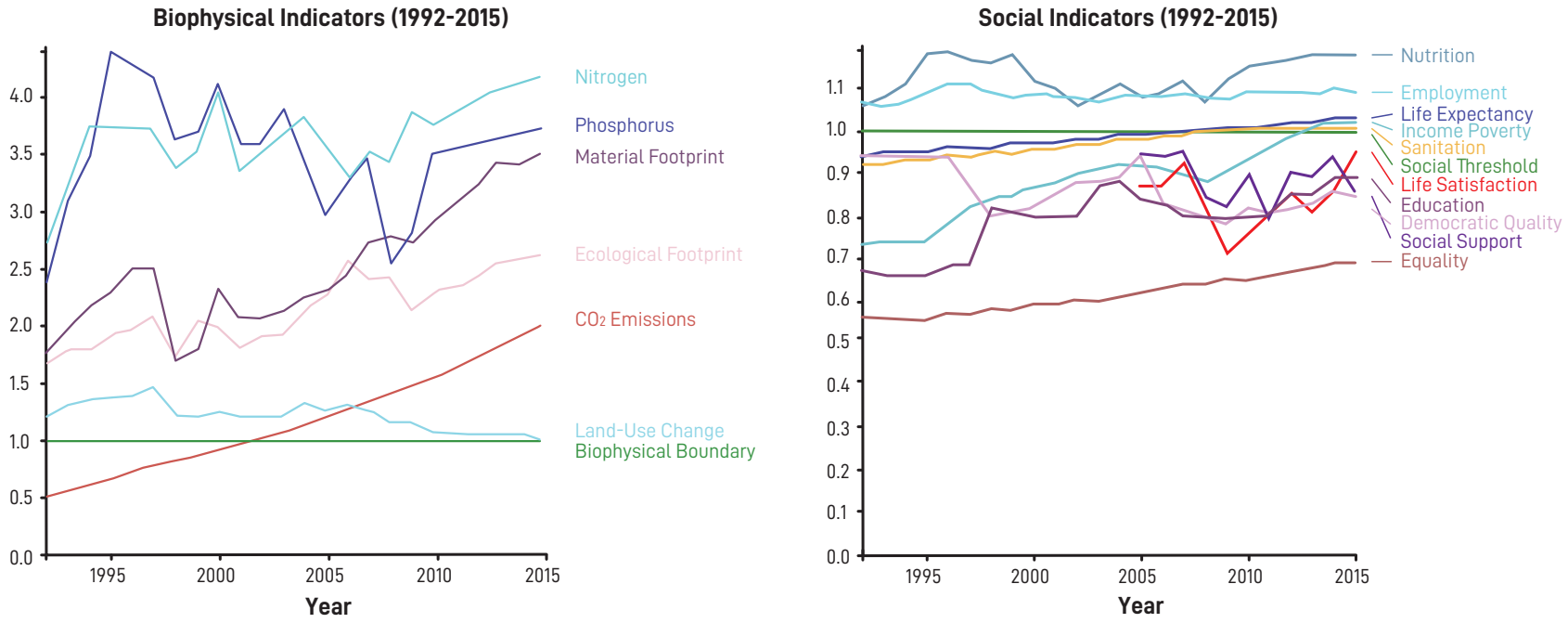


Figure 41: Biophysical Boundary and Social Threshold for Malaysia 1992-2015

Source: Fanning et al., 2022, O'Neil et al. 2018. Data Source: Leeds, 2023

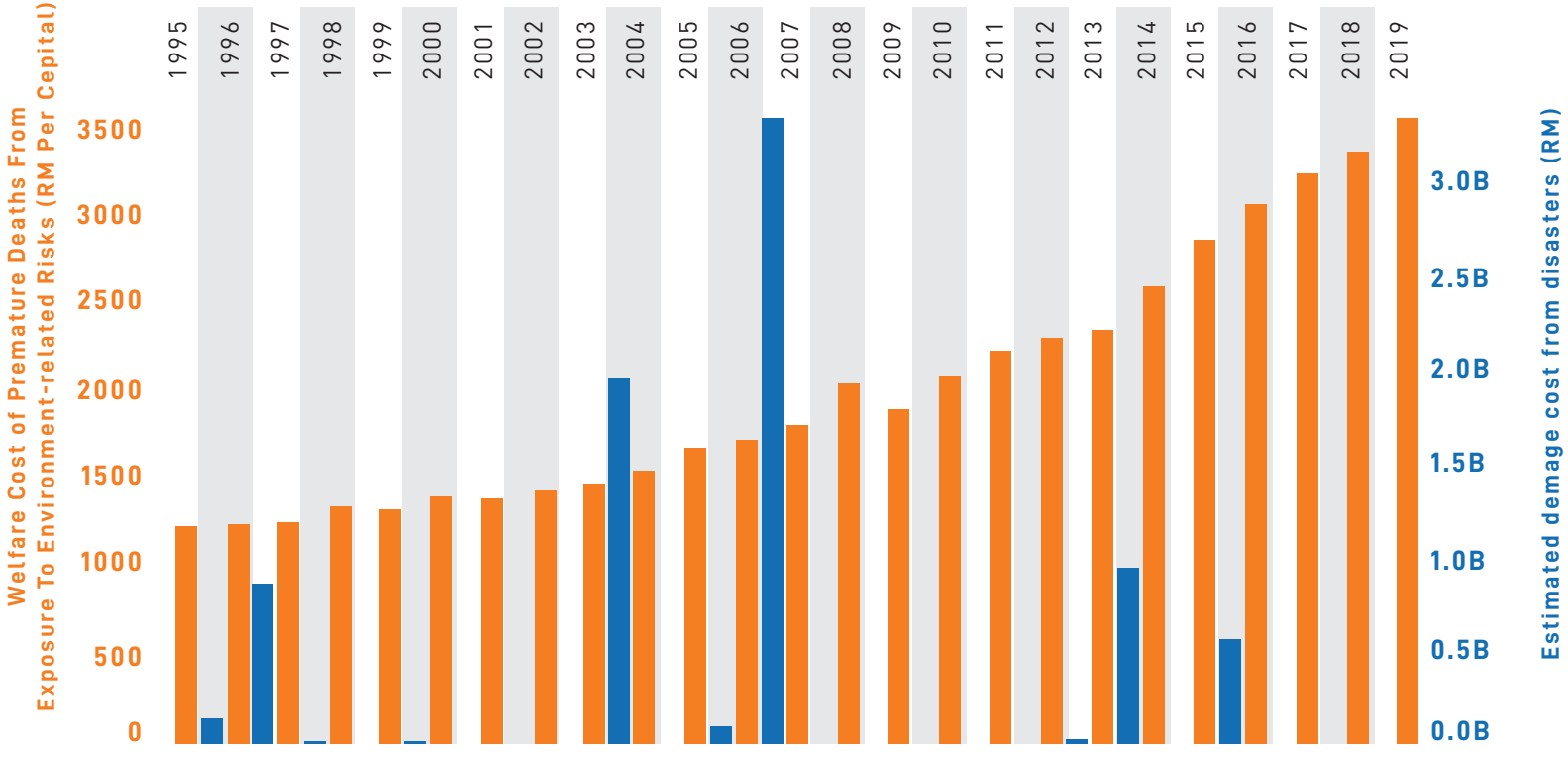


Figure 42: Estimated Cost of Environmental Related Cost in Malaysia, 1995-2019

Source: Science Outlook 2020: Unlocking the Future. ASM, 2021

Business leaders recognise the increasing demand from consumers and the global markets for firms to adhere to global environmental, social, and governance (ESG) best practices. These will require many of them to invest in technology and talent that will enable them to meet global ESG standards (refer to Figure 43). To compete in the global market, they will need to invest in talent that helps develop innovative ESG-compliant technologies, create a culture of sustainability, increase sustainability, and integrate reporting.

Figure 43: Sustainability Practices Among Firms Operating in Malaysia

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

The discussions highlight the transformations taking place in the global economy and the challenges and opportunities experienced by firms in Malaysia. While the Malaysian government has introduced several measures to help firms and the workforce keep pace with the changes in the global economy, there is increasing concern about the knowledge gap between firms in the ecosystem and industries in Malaysia. In some of the metrics, the gap between Malaysian, regional, and more developed economies has increased. Many local firms are unable to cope with the pace of technological change and do not have the resources and talent to keep pace with the developments to build their competitiveness and resilience. This challenge was further worsened during the COVID-19 pandemic and the increasing need to comply with global ESG requirements. Upgrading the technology ecosystem and skillset of staff in transforming their processes, product development, and business models will require substantial investments in talent and capability development.

In the next section, the national talent landscape and the strengths and gaps in the ecosystem will be discussed, specifically in the types of talent needed to transform Malaysia into a high-technology nation and values-driven economy. These include the talent needed to strengthen the development and utilisation of indigenous high technology to drive sustainable knowledge-based industries, which will require new economic models that nurture multi-stakeholder partnership models to enable local industries to continuously move up the global innovation value chain. This will also require the empowerment of local talent to increase R&D contributions in key impact areas and translate these R&Ds into tangible industrial and business outcomes. All of which will have a positive impact on the economy and create a greater return on value (ROV) for the *rakyat*.

CHAPTER 2:
NATIONAL TALENT LANDSCAPE

CHAPTER 2: NATIONAL TALENT LANDSCAPE

2.1 TRANSFORMATION OF THE NATIONAL TALENT ECOSYSTEM

Since independence, the Malaysian government has invested heavily in education, covering pre-school to tertiary education. In the 1950s and 1960s, the government recognised the necessity of cultivating competent talent to facilitate and sustain the country's economic expansion. As a result, several public universities were established to offer comprehensive and specialised education to foster the development of professionals in various disciplines. In the 1990s, the Private Higher Educational Institutions Act of 1996 provided an alternative to the offerings of public universities, thereby facilitating the expansion of private higher education institutions. Private institutions emerged and offered specialised courses and innovative teaching methods, enhancing the talent ecosystem. The establishment of both public and private universities has produced healthy competition and encouraged institutions to improve their educational offerings and overall quality.

However, while significant progress has been made, obstacles remain, such as the issue of investing in talent that may not align with industry needs, which is changing at a rapid pace. The government's objective to create a professional workforce and eventually become a high-tech nation in 2030 relates to Malaysia's rapid increase in higher education institutions (MOSTI, 2020). Although around 5.36 million graduates from public and private universities graduated in 2020 (DOSM, 2020a), there remains a gap between the demand for this trained workforce and the supply. Only 3 million of the 5 million graduates work in highly skilled occupations, demonstrating a skill mismatch.

As the past trend for graduates holding non-graduate jobs reported a double-digit growth of 11% per year between 2001 and 2016, skills mismatch has been a persistent problem in Malaysia (DOSM 2001–2016). This warrants careful consideration from an economic standpoint, given the significant amount of human capital spending that has been allocated to the educational sector. When many recent graduates are unemployed, it suggests that talent are underutilised and resources are inefficiently used. Therefore, it is necessary to consider systemic problems that underlie the country's skills mismatch.

Considering that a skilled workforce is critical for the economic prosperity of the country, it is vital to address the gaps in the talent ecosystem and put in place the best interventions to address Malaysia's talent mismatch. While the current talent management strategy offers a remedy for the skills mismatch in the labour market, it tends to address the symptoms as opposed to the structural gaps in the talent ecosystem. The skills mismatch requires more careful analysis and a responsible agency to address the structural impediments within the national labour market and talent ecosystem. The issue with the current ecosystem is that we lack sufficient data to support government policy decisions in meeting manpower demand for an increasingly technology-driven and knowledge-intensive economy. It is essential to develop a 'whole-of-nation' approach to closing the supply-demand talent gap with an effective implementation strategy. This will require an institutional framework that is well-coordinated and includes all key players in designing the talent ecosystem that not only meets the current needs of the economy but also powers local industries to up the global innovation and competitiveness value chain.

In this chapter, the national talent ecosystem mapping is undertaken in the context of the structural changes taking place in the global economy. This assessment is undertaken in the context of rapid technological innovation, including a greater drive towards incorporating issues related to UNSDGs and planetary health considerations. As the Malaysian economy embraces the Fourth Industrial Revolution, more digital employment opportunities are being created (Darussaman, 2020). On the other hand, many industries that are dependent on traditional technologies and cheap labour will have to create way more technology-savvy industries. According to LinkedIn, the number of opportunities for emerging technology specialists in the Malaysian job market increased from January 2017 to July 2021. Five STEM-related careers will be in demand in Malaysia in the next five years, according to a new report by LinkedIn (2022), as shown in Table 1.

Table 1: STEM-Oriented Jobs in Demand in Malaysia

Source: LinkedIn Jobs on the Rise in 2022. LinkedIn, 2022

	Jobs in Demand	Median Years of Experience
1.	Geographic Information Systems Analyst	1
2.	Medical Laboratory Scientist	1
3.	Information Technology Associate	1.5
4.	Fraud Analyst	2.7
5.	Data Engineer	4.7

All these positions require less than five years of prior experience. This suggests that this expertise is in high demand, as 90% of those employed in these positions had a bachelor's degree or higher. It is envisaged that by 2025, Malaysia will experience a shortage of 3,700 highly skilled talent, and this is likely to deteriorate to 93,000 by 2030. Due to a lack of highly skilled individuals, the cost to the Malaysian economy will be close to USD6.10 billion (Korn Ferry, 2018). These trends will result in Malaysia taking a longer period to realise its vision of being a high-tech nation with a developed economy. The more challenging issue for the Malaysian labour market is the ability to upskill the workforce to adopt digital skills that will enable them to participate in the new technology-savvy economy. Increasing knowledge of ESG and planetary health requirements is also going to be a core competency the workforce will be required to have in the new economy. Good knowledge of ICT and ESG standards is going to be critical for opening new employment opportunities and spawning new environmentally friendly industries in Malaysia.

2.2 BEHAVIOURAL MINDSET, TRENDS OF THE FUTURE CAREER

The fast-changing business environment has resulted in an alarming gap in the supply and demand of talent needed by the Malaysian economy. The nature of the supply-demand gap has changed significantly over the last decade. A study conducted by Nair et al. (2020), involving 600 senior business leaders from companies operating in Malaysia, showed that industry and university collaboration is critical in cultivating talent that meets the needs of the economy. These entrants into the workforce are not only required to have the necessary technical competencies but also nurture smart and sharp skills, including a value-based mindset. The top three skills the workforce needs are critical thinking skills, ICT know-how, and personal confidence (refer to Figure 44). The business leaders also identified teamwork capability, leadership skills, and good proficiency in English and the national language as essential. They were also of the view that entrepreneurial acumen, a sound understanding of the commercial landscape, and market intelligence are the essential skills university graduates should possess. The increasing adoption of new digital platforms by firms will consequently lead to a rise in the demand for graduates with proficient ICT skills. Similarly, increasing adoption of ESG requirements by the markets will also increase demand for graduates and a workforce with a sound understanding of issues related to UNSDGs and planetary health.

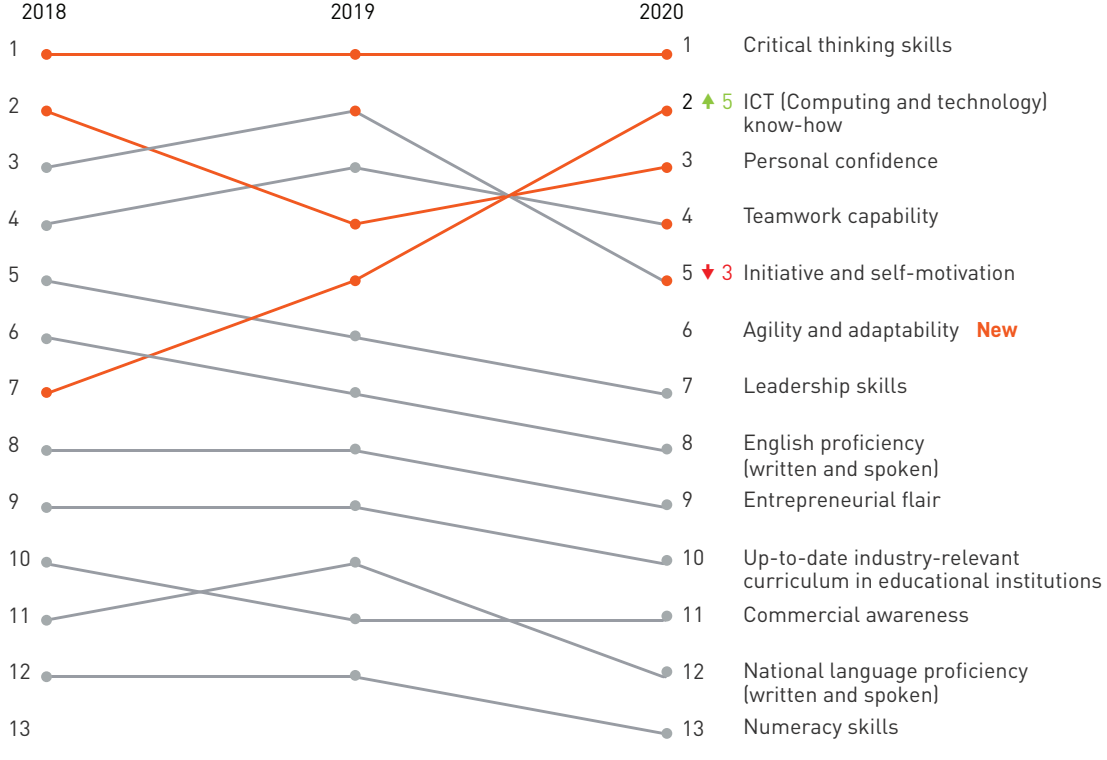
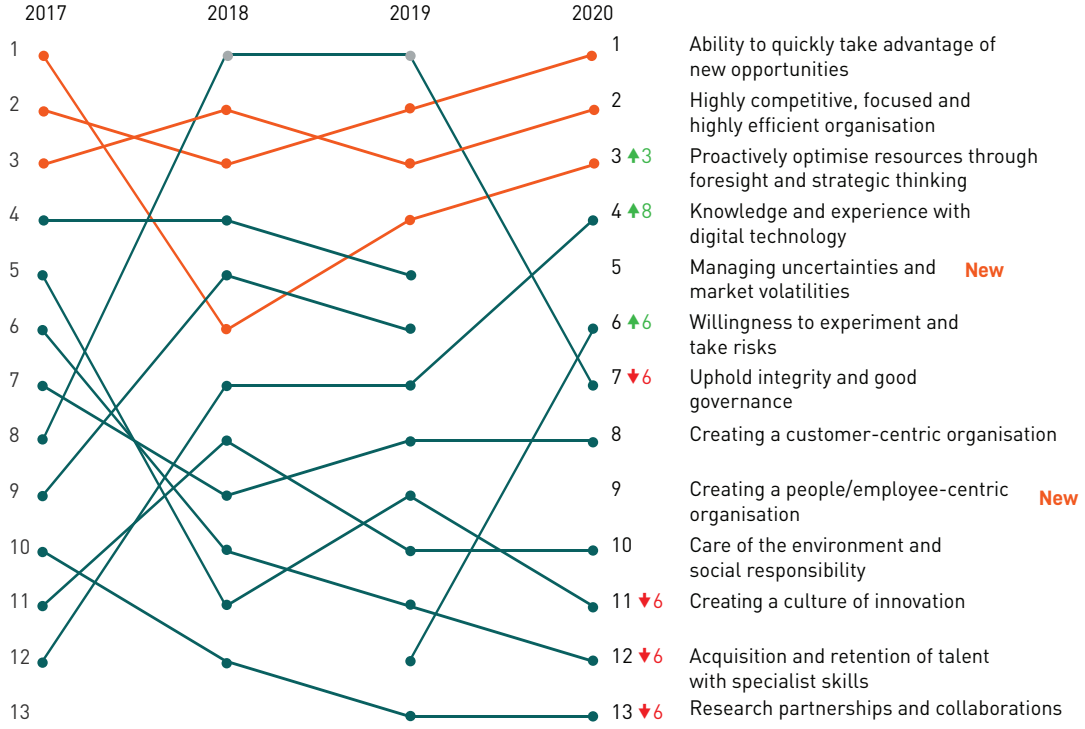


Figure 44: Top Graduate Skills in Demand, 2018-2020

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

The business leaders also opined that the current and future economic landscape will require a workforce with sound leadership that will be able to navigate through the DVUCA economic environment. In 2020, they were of the view that the top three leadership skills required by firms include the following: the ability to respond quickly to new opportunities; nurture a high-performance culture; the ability to be focused and efficient in driving a competitive organisation; and being proactive in using resources optimally to achieve the objectives of the firm (refer to Figure 45). This will require them to have a sound understanding of strategic thinking methods and foresight approaches to help firms mitigate risks due to uncertain and volatile market conditions, including preparing for adherence to global best practices related to the UNSDGs and planetary health.



Note: Only options that have increased/decreased by 3 ranks or more between 2017-2020 have been highlighted. 2020 only had 13 options. Ranks from previous years might have changed due to changes in options.
Top 3 options in 2019: Uphold integrity and good governance; Ability to quickly take advantage of new opportunities by creating an agile and adaptive organisation; Highly competitive, focused and highly efficient organisation.
Top 3 options in 2018: Uphold integrity and good governance; Highly competitive, focused and highly efficient organisation; Ability to quickly take advantage of new opportunities by creating an agile and adaptive organisation.
Top 3 options in 2017: Proactively managing the business environment through strategic foresight and thinking; Ability to deal with change by creating an agile and adaptive organisation; Highly competitive, focused and highly efficient organisation.

Figure 44: Leadership Skills Required to Navigate in a DVUCA World

Source: Monash Business Sentiment 2020/2021 Survey. Nair et al., 2020

The above discussion highlights that the future workforce will require a wide range of skillsets that will help them not only manage uncertainties but also have the skillset to pre-empt these uncertainties and build more resilient business enterprises. More importantly, the future workforce must have the skillsets to develop new pathways and directions for organisations to navigate through a highly competitive and turbulent economic environment. These include having the technical competence, entrepreneurial acumen, and market intelligence to power next-generation industries that comply with ESG requirements and meet the needs of society.

2.3 TALENT DEVELOPMENT POLICIES AND INITIATIVES IN MALAYSIA

STIE governance in Malaysia consists of various national councils, federal ministries, agencies, universities, and research institutions that contribute to policy planning, decision-making, implementation, and funding (OECD, 2016). The STIE governance has given rise to many policies, strategies, and roadmaps that have set targets for a highly skilled STEM talent workforce. The mapping of active STI-related policies has grown from 47 to 51 from 2017 to 2022 (Figure 46). Below are some policies on high-skilled STEM talent formulated over five years. This requires coordination across the 27 federal ministries.

54 Active STI-related policies & roadmaps
11 National Councils (chaired by PM)
21 National Councils (chaired by respective Ministers)
26 Government-linked Research Organisation (GLRO)/Public Research Institutes (PRI)/Intermediaries
350+ Entities including:

- Ministries
- Agencies/Departments/Research Institutes/Statutory Bodies/Foundations/ Platforms/Companies under Respective Ministries
- Institutions of Higher Learning/Centres of Excellence/Incubators
- State Governments & Federal Territories
- Business Enterprises
- Civil Societies/NGOS

NATIONAL BUSINESS LANDSCAPE

1,429,397 registered local businesses in 2022 (SSM, 2022).
Among these, 1,226,494 (~97%) are micro, small and medium-sized enterprises (MSMEs) (SME Corp, 2022)
753 establishments are listed in Bursa Malaysia's main market out of which 47 are in the technology sector (Bursa Malaysia, 2022).
5,227 start-ups in Malaysia as of January 2023 (Tracon, 2023) Percentage of companies that do innovation 5%

Figure 45: STI Governance and National Business Landscape

Source: Updated based on Science Outlook 2017 (ASM, 2019), Ongoing GLRO 1.0 Study (ASM, 2022) and RDICE Roadmap

Malaysia has implemented policies, roadmaps, and proper planning to elevate the STI ecosystem and enable the nation to create the crucially required economic, societal, and environmental transformations. To achieve the status of a developed and high-tech nation, policymakers recognise that coordination of STI policies at all levels of the government is crucial for the effective implementation of STI policies to deepen their impact on economic development.

The Twelfth Malaysia Plan emphasised that if Malaysia wants to become a high-income and high-tech nation, it must absorb new technologies and endeavour to build and develop its technologies. To stimulate economic expansion, infrastructure must be reinforced while future talent is nurtured. The education system must develop skilled and competent human resources to satisfy industry demand. The focus will be on enhancing the entire education system and addressing the issue of mismatches with the employment market.

The following section presents a snapshot of employment targets in selected technology policies and roadmaps (Figure 47). Eight out of 14 S&T policy documents under the Ministry of Science, Technology, and Innovation (MOSTI) quantified the projected number of STIE talent needed. From these eight documents, 255,438 STIE talent are projected by 2030.

National Advanced Material Technology Roadmaps and *Pelan Hala Tuju Teknologi dan Produk Nano Negara* aim to produce 170,000 and 30,000 STEM-related job opportunities by 2030. By 2025, Malaysia's Artificial Intelligence Roadmap aims to produce 339 data analysts, 263 data engineers, 259 software engineers, 432 data scientists, 205 product engineers, and 171 AI architects. However, can Malaysia reach the targets with declining STEM enrolment trends in secondary and post-education? Since 2017, STI-related policies have increased from 47 to 54. However, despite these policies, it would be difficult to achieve the targets if enrolments in STEM-related courses in high school and university continue to decline.

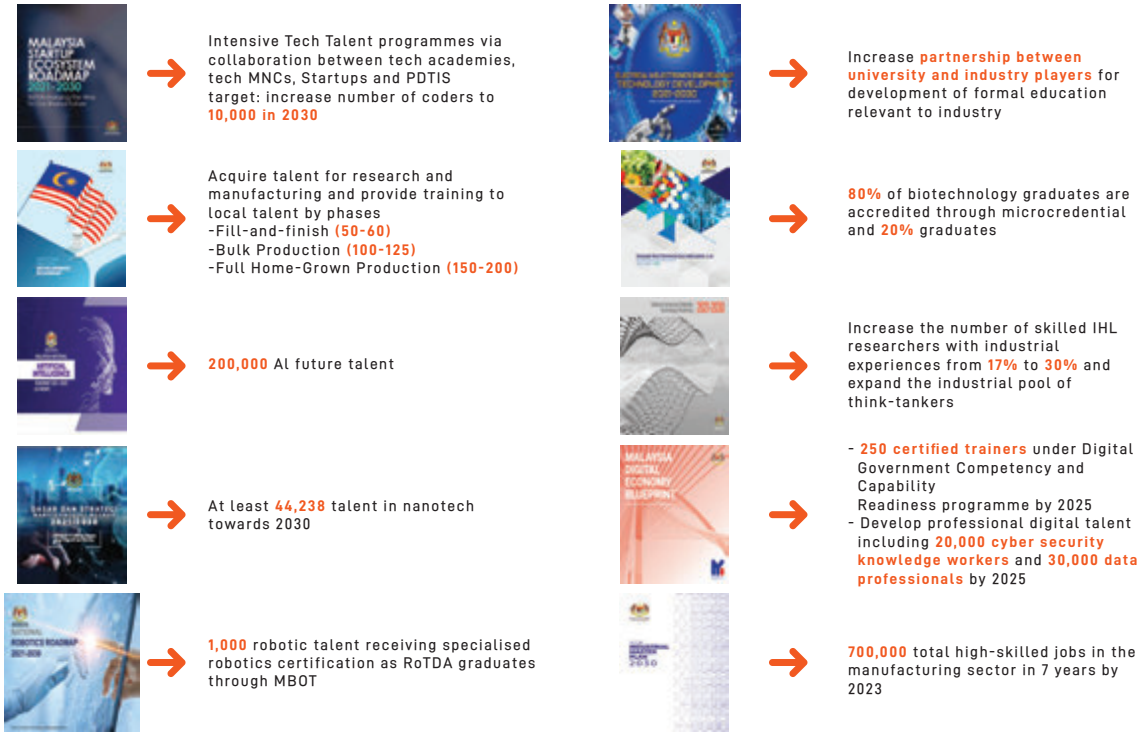


Figure 46: Employment Targets in Science and Technology Policies & Roadmaps

Source: ASM Analytics, 2023

60k skilled & semi - skilled talent by 2030

35% high - skilled workers in manufacturing sector by 2025

Establish **Transport Centre of Excellence** (CoE) at existing HEIs to cater for transport related programmes and R&D

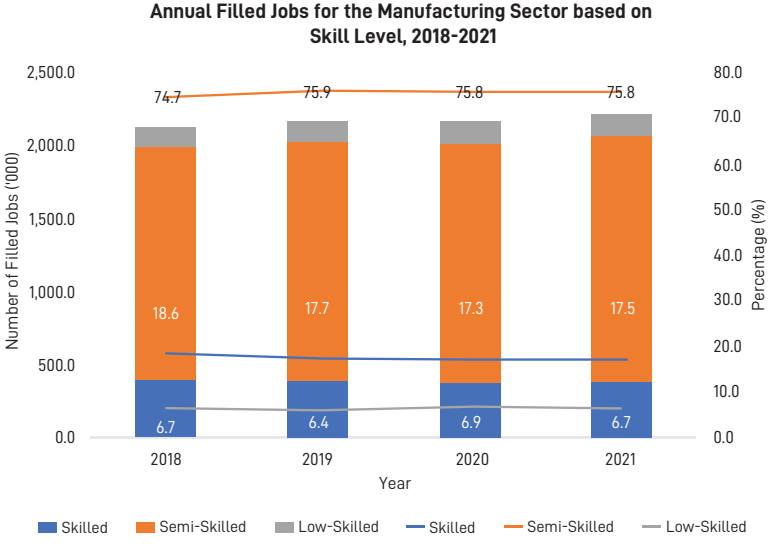
Majority of the sectoral policies emphasise on **future - proofed talent development** as well as **reskilling & upskilling** of existing workforce to meet future demands

- **200 RSET** (Researchers, Scientists, Engineers & Technologists) per 10k workforce by 2030
- **80% STEM graduates employed** by 2030
- Increasing innovation - based **technopreneurs to 75%** by 2030

- Develop professional digital talent including **20k cyber security knowledge workers & 30k data professionals by 2025**
- **Top 20 under the Knowledge & Technology pillar** in the Global Innovation Index

Figure 47: STIE Policies to Future Proof the Talent

Source: ASM Analytics, 2023



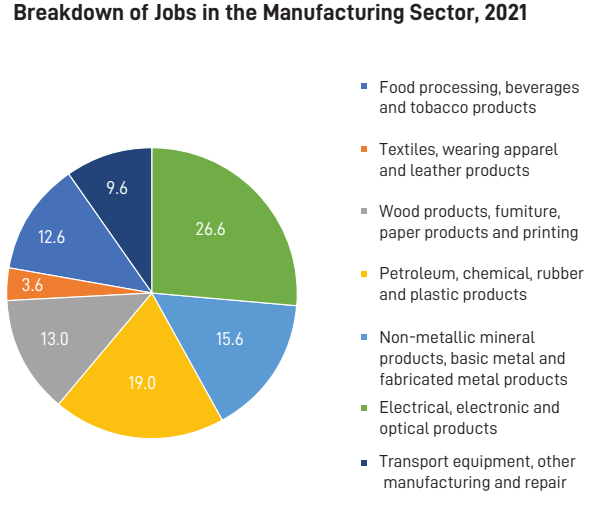


Figure 48: Job Trends in Manufacturing Sector

Source: Analysed by ASM from DOSM's 2nd Quarter Employment Statistics 2022

2.4 POLICY TARGETS FOR HIGHLY SKILLED TALENT AND CURRENT INITIATIVES IN IMPROVING MALAYSIA'S TALENT VALUE CHAIN

A country can be considered a high-technology nation when the degree of cutting-edge technology becomes a critical driver of productivity. Towards this end, Malaysia aims to advance the creation and application of homegrown, advanced technologies to support a sustainable STI-based economy. Empowering local talent, R&D in essential industries, legislation and regulations favouring STI development, and modernising the technological infrastructure, mainly digital technology, will support this effort. The National Policy on Science, Technology, and Innovation (NPSTI) 2021–2030 aims for Malaysia to become a high-tech nation by 2030 (Figure 50). To achieve this, the policy will champion indigenous technologies, strategic areas in research and development (R&D), and an enabling regulatory ecosystem.

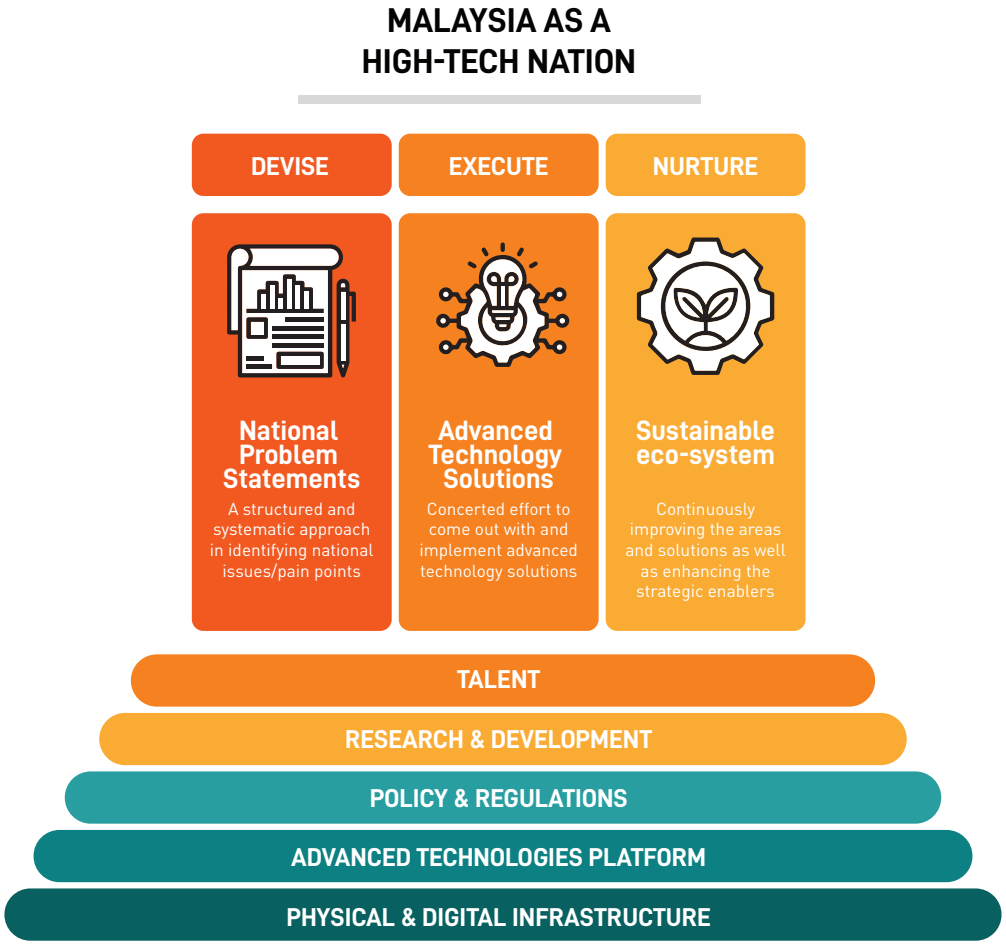


Figure 49: NPSTI 2021-2030 Framework Towards a High-Tech Nation

Source: National Policy on Science, Technology, and Innovation (NPSTI) 2021-2030. MOSTI, 2020

The Ministry of Education created a policy known as the 60:40 Policy in 1967 (Malaysia, 1967). According to this policy, 40% of students will enroll in art streams, and 60% will be in science or technical streams. The Higher Education Planning Committee's 1967 Statement Report was the foundation for this strategy. The Malaysian Education Development Plan (PPPM) 2013–2024 has since altered it to a 60:40 STEM: non-STEM ratio (MOE, 2013). At least 60% of students in the STEM fields are the target of this policy. Despite almost a decade of this 60:40 policy's execution, it was discovered that the targeted ratio was quite far from the planned aims (see Figure 51). Compared to the percentages of graduates from STI-based programmes, the trend of the graduate distribution showed that Malaysian universities had produced more diploma, degree, and postgraduate degree graduates in humanities disciplines, including literature, social science, business, and law (MOHE, 2019).

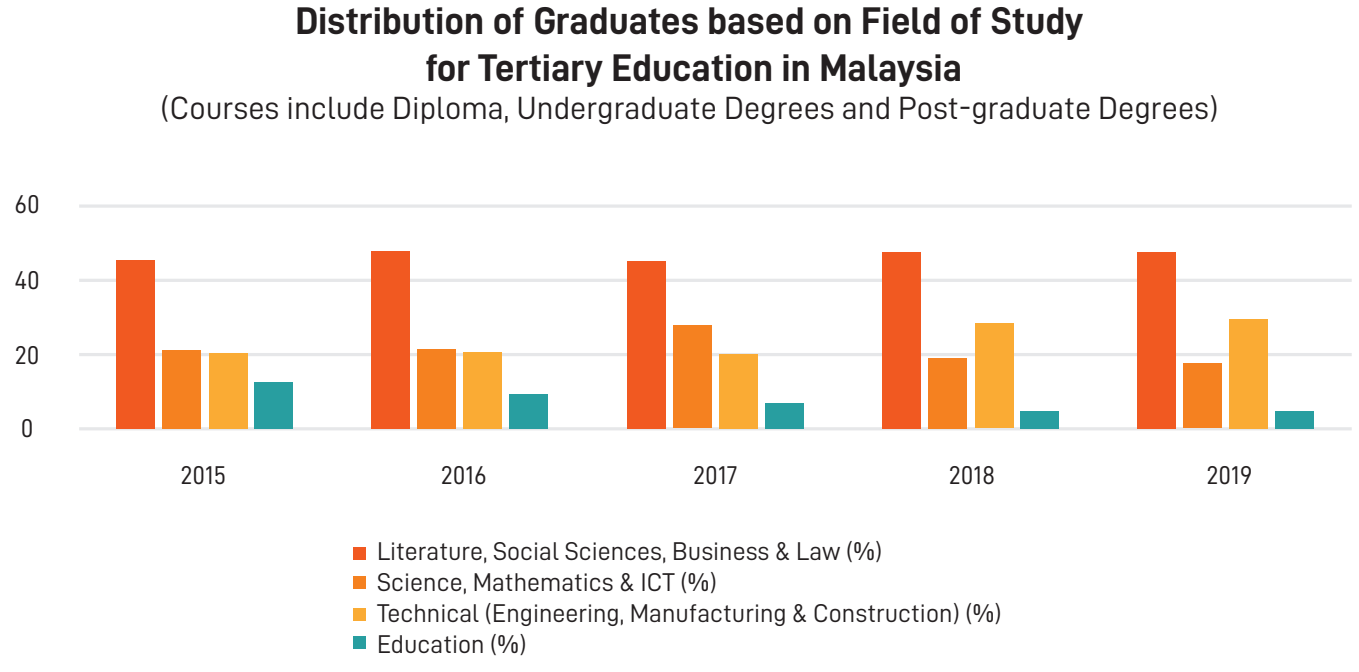


Figure 50: Distribution of Graduates based on the Field of Study for Tertiary Education in Malaysia

Source: Analysed by ASM from MOHE 2015 -2019 data

The trends highlighted above are concerning because employment related to the Fourth Industrial Revolution would require sound STEM knowledge and a highly skilled workforce (Ras et al., 2017). If this persists, Malaysia might not be able to develop a highly employable workforce, and it might take a lot longer to realise its goal of becoming a high-technology and knowledge-intensive country. As a result, there is a significant disconnect between supply-side decisions that affect universities and the demand-side policy directions determined by economic growth and industrial development.

Recent statistics on talent employability in Malaysia also show a gap between supply and demand for a skilled workforce. Although public and private institutions have graduated millions of individuals, skill mismatch has been a problem in Malaysia. The trend of graduates working in non-graduate jobs registered an annual double-digit growth of 11% between 2001 and 2016 (DOSM 2001-2016) (Figure 51), and it still does today (Figure 52).

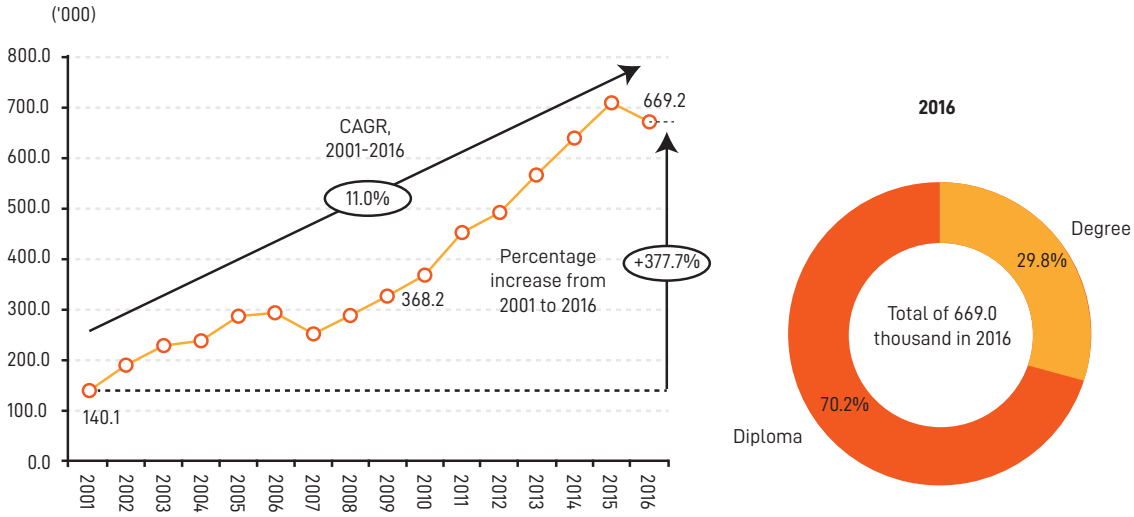
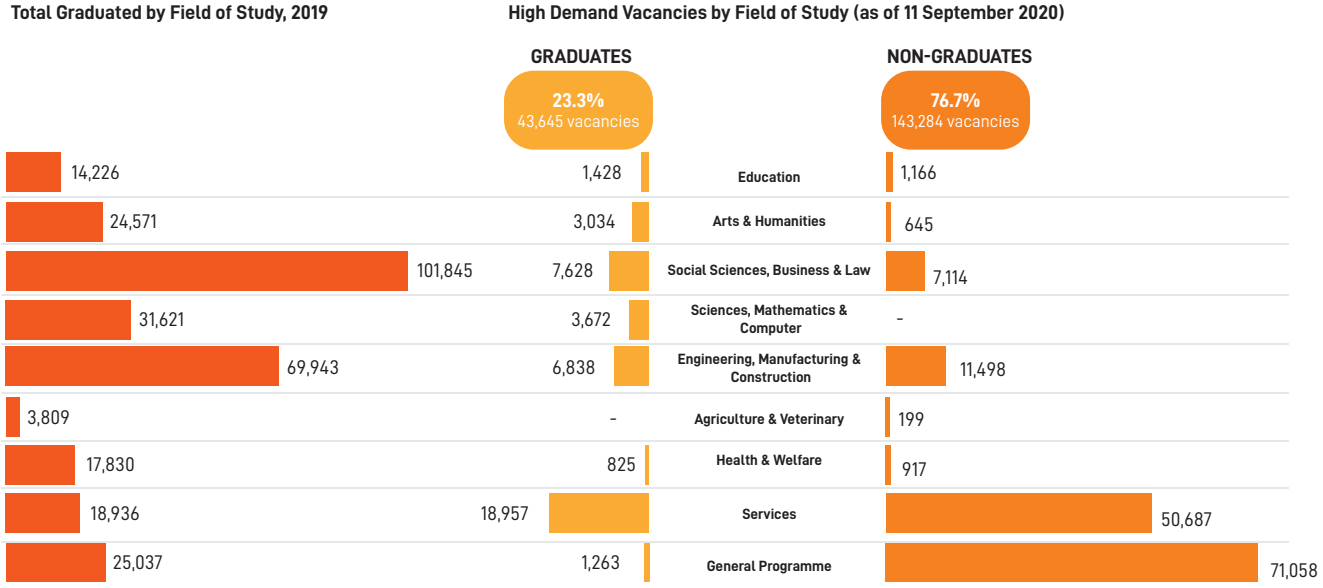


Figure 51: Past Trend of Graduate Match Incidences (2001 – 2016)

Source: Graduate Mismatch in the Labour Market. Darusman, 2020



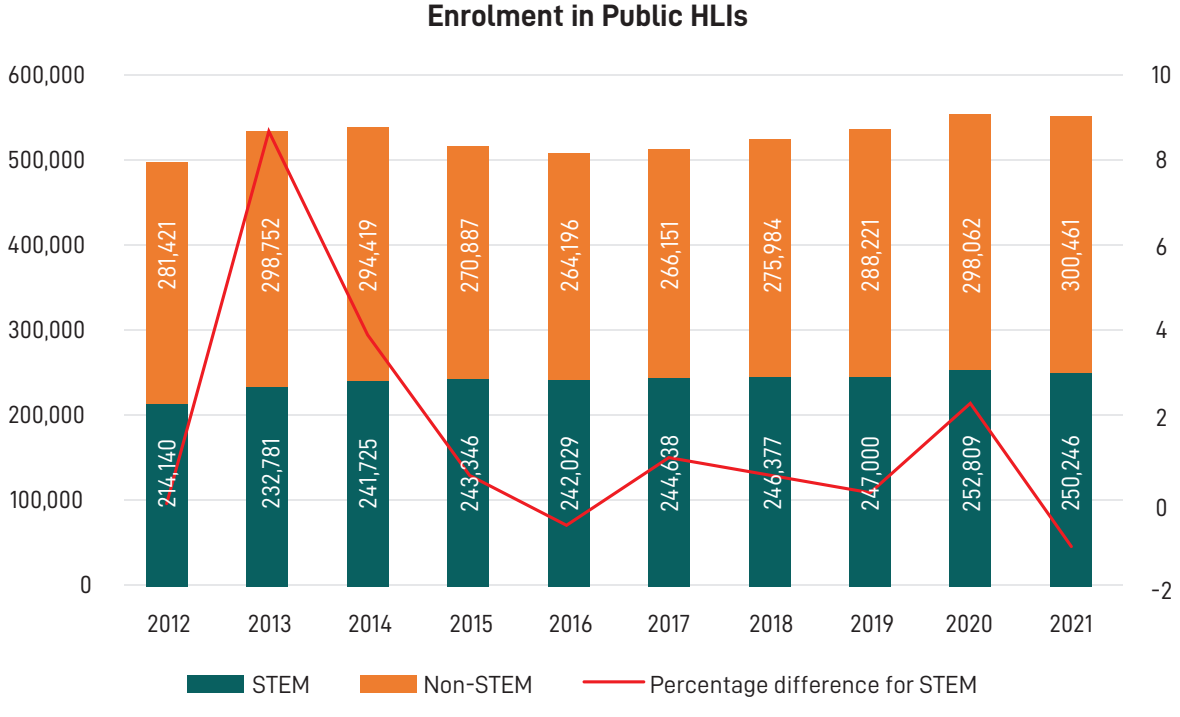
Source: Graduate Tracer Study, Ministry of Higher Education (MOHE)
Source: Top 100 Vacancies for Graduates and Non-Graduates from MyFutureJobs

Figure 52: Supply and Vacancies by Field of Studies

Source: Graduate Mismatch in the Labour Market. Darusman, 2020

More digital employment is being generated in Malaysia as the country enters the Fourth Industrial Revolution at full speed (Darussaman, 2020). It is also reported that nearly nine outof ten expanding job demands are STEM-related (WOE, 2020). Between 2018 and 2021, the number of students enrolling in STEM courses at public universities decreased significantly.

Figure 53 shows the enrolment of STEM and non-STEM students in public universities from 2012 to 2021. Enrolment in STEM courses at public HLIs has generally been consistent from 2012 to 2021, despite a significant increase of 8.7% (2012–2013) and a significant decline of -1.01% (2020–2021). STEM enrolment at public HLIs is still higher than in private HLIs because public HLIs are often more established and have a more robust STEM-related infrastructure.



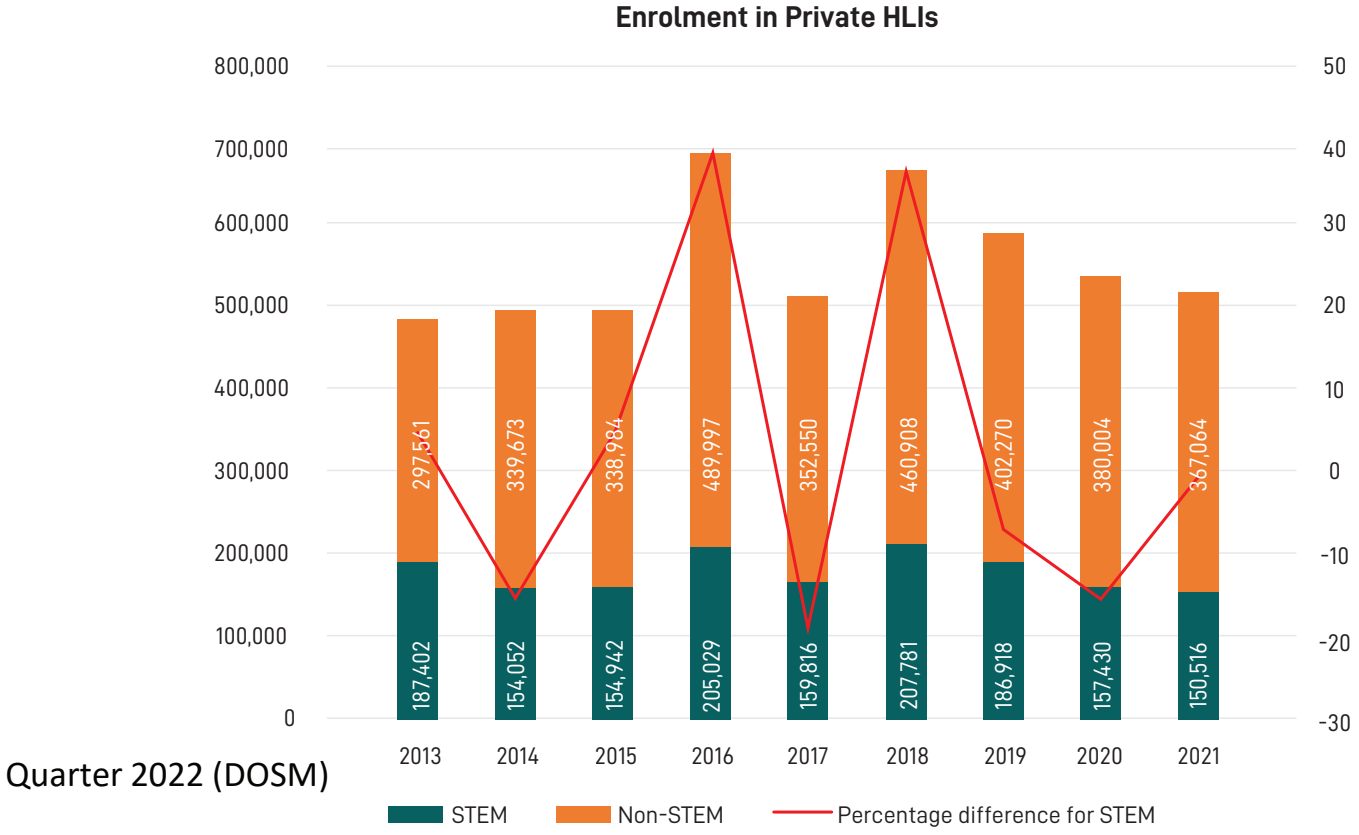
*data for Malaysian citizens only
Note: Absence of data for General Programmes in 2012
Classification of data:
STEM – Science, Mathematics & Computing, Engineering, Manufacturing & Construction, Agriculture & Veterinary, Healthcare & Welfare
Non-STEM – General Programmes, Education, Arts & Humanities, Social Sciences, Business & Law, Services

Figure 53: STEM vs non-STEM Enrolment in Public Universities (2012-2021)

Source: ASM Analytics, 2023

The enrolment in STEM and non-STEM programmes at private universities from 2013 to 2021 is shown in Figure 54. The percentage of students enrolled in STEM courses at private HLIs fluctuated between 2013 and 2021. Beginning in 2018, enrolment has maintained a consistent downward trend until 2021, falling from 460,908 students in 2018 to 367,064 students in 2021, a decrease of 20.36%. The highest total enrolment in private HLIs was in 2016, when 695,026 STEM students were enrolled. Considering annual trends, enrolment in non-STEM courses is more significant in public and private HLIs. In 2015, the enrolment rate

for STEM-related courses was 46% and 30% in public and private HLIs, respectively. Non-STEM courses have lower capital and infrastructure requirements (investments in laboratories, specialised equipment, or technical support personnel), which makes them more profitable for private institutions and colleges. Consequently, private HLIs provide more placements for non-STEM courses, and public HLIs tend to offer more STEM-related placements. The latter is because public HLIs have existed longer and possess the necessary infrastructure and talent to support STEM research and education. Nonetheless, the diminishing number of STEM-interested students is concerning, as STEM courses are less popular than non-STEM subjects. This disparity is cause for concern, as the future competitiveness of the Malaysian economy is dependent on a skilled workforce, especially talent in STEM knowledge. STEM knowledge such as digital technologies, generative AI, biotechnology, and nanotechnology is critical for strengthening existing economic sectors, spawning new industries, and creating new high-income jobs.



Quarter 2022 (DOSM)

Figure 54: STEM vs non-STEM Enrolment in Private Universities (2013-2021)

Source: ASM Analytics, 2023

At the federal level, there have been active efforts to enhance Malaysia's talent value chain. Certain government-linked enterprises (GLCs) have established postsecondary learning institutes to train workers in specific areas to maintain the talent pool in their respective industries. These GLCs include Petroliam Nasional Berhad (PETRONAS), a major oil and gas company based in Malaysia that created Universiti Teknologi Petronas in 1997 as part of its social

responsibility to support national development and attract more talent to the oil and gas sector. Similarly, Tenaga Nasional Berhad (TNB) established Universiti Tenaga Nasional (UNITEN) in 1999 to support the growth of the nation's potential, particularly in engineering and management.

To foster a knowledgeable and skilled technical workforce, the Ministry of Education introduced Technical and Vocational Education and Training (TVET) in 2011. The same year, TalentCorp was founded to bring skilled Malaysians living abroad together to meet the nation's expanding skilled labour shortages. Another strategy for developing Malaysia's expertise in analysing labour market trends and solving new human capital issues was the establishment of the Institute of Labour Market Information and Analysis (ILMIA) under the purview of the Ministry of Human Resources during the 10th Malaysia Plan. By creating soft skills training programmes like Skim Latihan 1Malaysia (SL1M) for graduates (now known as PROTÉGÉ, MySTEP, etc.), the government has also transformed the way it approaches the development of talent.

Many organisations have launched various talent enhancement programmes to offer on-the-job and industry-relevant training for different economic sectors. For instance, TalentCorp's Structured Internship Programme was created to give university students and young people enrolled in TVET real-world work experience. Additionally, a new strategy to improve students' experience in the industry through a degree apprenticeship is included in the policy outline promoted by the Malaysia Education Blueprint 2015–2025 (Higher Education). Through its 2u2i programmes, undergraduate students' study on campus for two years before working as interns in particular industries for an additional two years.

Another strategic initiative to boost the number of Malaysian talent is the introduction of the Returning Expert Programme (REP), which was initiated to persuade Malaysian talent who had established expertise abroad to return home and contribute their knowledge and skills.

The National STEM Scientific Centre was formed in 2018 to integrate IBSE into STEM teaching and learning and to offer Continuing Professional Development (CPD) for STEM teachers in Malaysia. This is one of the initiatives to help Malaysia reach its goal of having a ratio of 60:40 science to non-science students. Industries have also made some efforts to overcome the issue of talent mismatch. Forward School was founded in 2020 to produce talent with industry-ready skills for the quickly developing digital sector.

Despite the numerous programmes listed above, it appeared that current interventions only "treated the symptoms" rather than offering a solution for a skills mismatch in the labour market. It is crucial to evaluate the impact of some of these activities and provide an accurate diagnosis of the situation.

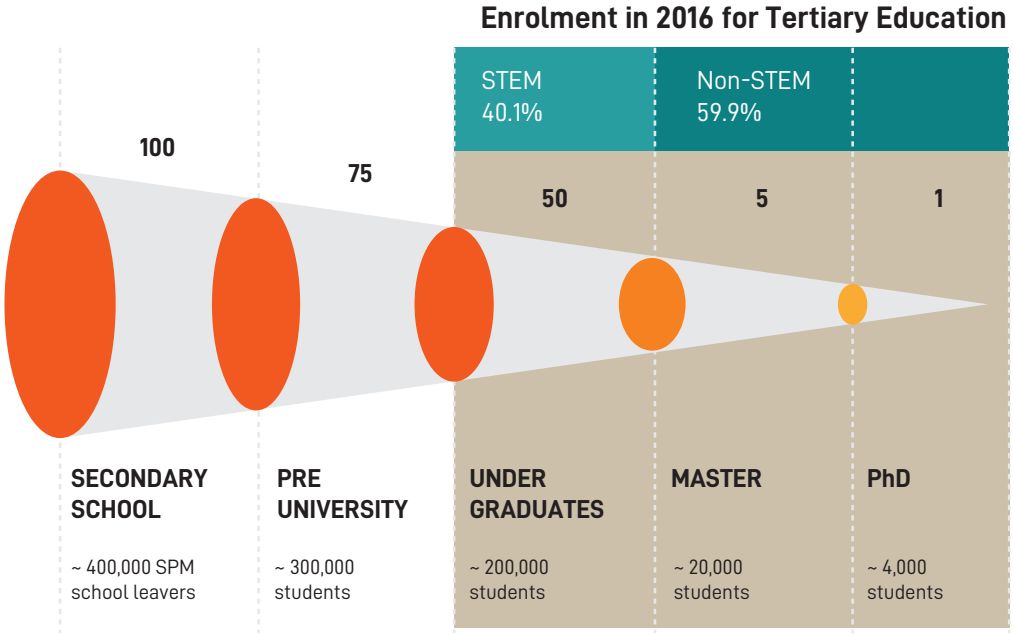
2.5 KEY DYNAMICS IN THE TALENT ECOSYSTEM

As the global economy and labour market endure significant upheavals and shocks, such as worldwide pandemics, rising interest rates, trade wars, and supply-chain disruptions, there is a growing sense of urgency to upskill and reskill Malaysia's workforce. This revolutionary shift is achieved by adopting a "skills-focused approach" and creating a collaborative mindset among our talent to fill high-skilled positions caused by the COVID-19 pandemic displacement. This entails evaluating candidates for open positions based on their skill set rather than their prior experience or qualifications. This depicts the characteristics of the "traditional economy" and the transition to the "knowledge economy." In the knowledge economy, talent is characterised as innovative, people-oriented, and less concerned with administrative tasks. This is because, as the development of emerging technologies progresses, the role of human talent will become increasingly centred on human-to-human interactions requiring a high degree of emotional connection while repetitive routine work becomes automated.

Several critical issues in the talent ecosystem can affect organisations, individuals, and Malaysian society. Consequently, it is essential to cultivate a pool of skilled individuals who can contribute to the nation's economic progress and development. The following section describes Malaysia's overall talent pipeline, which ensures a steady supply of skilled individuals to support the country's economic development and competitiveness.

2.5.1 MALAYSIA'S TALENT PIPELINE

A study by ASM in 2017 shows that approximately 400,000 Malaysian students graduate from secondary school annually, with 50% pursuing university degrees. On average, 10% of these graduates pursue a master's degree, whereas 90% enter employment. One-fifth of these master's degree holders enrol in PhD courses to continue the pathway. One PhD graduate is produced per 100 high school graduates. The concerning trend is that only about 40% of students at the university level are engaged in STEM courses (see Figure 55 below). Note: All figures have been rounded up for ease of illustration.

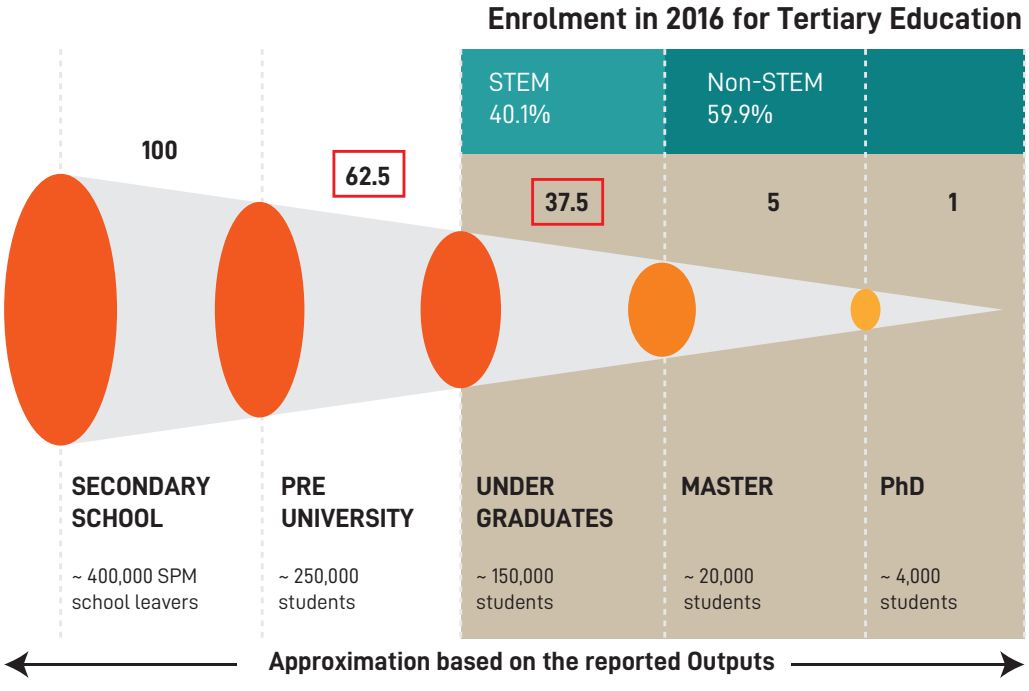


1. STEM: Science, Mathematics & Computer, Engineering, Manufacturing & Construction, Agriculture & Veterinary, Health & Welfare
2. Non-STEM: Education, Arts & Humanities, Social Science, Business and Law, Services, General Programmes

Figure 55: Malaysia's Overall Talent Pipeline in 2016

A comparable analysis to update the previous total talent pipeline was conducted in 2021 (refer to Figure 56). The reported enrolment in STEM courses at the tertiary level decreased from 40.1% in 2016 to 37.5% in 2021. Despite similar values observed for school leavers (approximately 400,000) as well as masters (20,000) and PhD (4,000) graduates produced across the two years, the number of pre-university (300,000 to 250,000) and undergraduate (200,000 to 150,000) students produced in 2021 appears to decrease significantly. In 2021, 100 high school graduates will produce 63 pre-university students (down from 75 in 2016), of whom 38 will complete their undergraduate courses (a decrease from 50 in 2016). Notable is the worrisome trend of fewer than 40% of school leavers finishing their college education in 2021, with only 37.5% enrolling in STEM-related courses. In the long term, if this gradual loss in the talent pipeline

is not adequately addressed, there will be a progressive reduction in the Malaysian pool of STEM talent, resulting in either stagnation or deterioration in our efforts to become a high-technology nation within the next decade.



*Calculated average of Public and Private HLIs undergraduate enrolment
**Tertiary Education Field of studies categorisation based on Science Outlook 2017:
1. STEM: Science, Mathematics & Computer, Engineering, Manufacturing & Construction, Agriculture & Veterinary, Health & Welfare
2. Non-STEM: Education, Arts & Humanities, Social Science, Business and Law, Services, General Programmes

Figure 56: Malaysia's Overall Talent Pipeline in 2021

Source: Science Outlook 2017. ASM, 2018

Over the years, Malaysia has significantly advanced in cultivating its talent pipeline. The country has made substantial investments in education, including vocational training and skill-building programmes, to produce a STEM and non-STEM workforce that is skilled and adaptable to shifting market demands. Nevertheless, despite the progress made, challenges remain in Malaysia's talent pipeline, including a skills gap in certain areas and a skills mismatch. Figure 57 highlights the most significant challenges faced by the Malaysian talent ecosystem, in particular, the supply-demand talent mismatch. The figure shows that there are systemic weaknesses in the enablers of the talent ecosystem (8i enablers of the ecosystem). Weaknesses in the 8i-enablers of the talent ecosystem adversely impact the labour market; in particular, policymakers and industry players cannot foresee the current talent and competencies needed for fast-changing economic sectors. They also face challenges in attracting, developing, and retaining talent. The challenges within the talent ecosystem are numerous and varied, and they can have implications for organisations, individuals, and society. The Malaysian talent ecosystem faces several challenges that impact its overall development and hinder local players from moving up the global innovation value chain.

8 Internationalisation

- **Poaching of high-skilled global talent** has intensified due to global shortage of talent in critical STEM-related areas. This has increased brain drain for countries such as Malaysia.
- Lack of skilled workforce will adversely impact **foreign direct investment and domestic investments** in the country
- Mechanism for ensuring **knowledge and technology transfer** between foreign and local players are weak, hence Malaysian workforce tend to build strong absorptive capability, but lower levels of adaptive and innovative capabilities.
- **Stringent immigration rules** prevent global talent and highly skilled workforce to reside in Malaysia and contribute to the talent ecosystem of the country

7 Interaction

- **Industries and states are competing for the same declining talent pool,** where industry/states that have a thriving industry will poach high-skilled talent.
- High-end industries facing **difficulty in filling vacancies for niche/specialised talent** that have the right competencies and attitude
- Lack of **knowledge sharing** among multiple institutions and organisations in developing a more cohesive talent development strategy for high-technology, knowledge-intensive and values-driven economy.

1 Infrastructure

- Public universities are **required to be more self-sustaining,** and not many are able to maintain their STI infrastructure, affecting quality of teaching & learning and R&D activities.
- **Lack of sharing** of university and public research institutes (PRIs) infrastructure with external stakeholders.
- HLIs are **unable to provide practical training and lab experience** to all students that are required by industry
- **Lack of Deep Tech and Future Skills start-ups** to absorb STEM talent as knowledge workers

2 Infostructure

- **Low utilisation** of digital skills and ICT literacy among micro and SMEs, marginalised communities and people from rural areas.
- **Low awareness** on the impact and potential of Generative AI systems on enhancing productivity and performance of workforce and organisations.
- **Poor classification of jobs** eg. Gig Economy workers are not classified as 'high-skilled' workers, eliminating the chances to be eligible for training to upskill

Challenges in Malaysia's Talent Ecosystem. 8i Ecosystem Analysis

6 Integrity

- **Rigidity of the current governance** act as a barrier for transformative changes in the education syllabus as well as creating gaps in recruiting the right talent.
- **Incongruence of governance platforms** and implementors in talent development across ministries, agencies, HLIs and industry players.
- Talent-related policies and initiatives are **focused on skills mismatch** but not on skills gap and **future skills** to power next-generation industries and jobs.
- **Policy inconsistency and no follow through** on past STEM talent development plans. Lack of continuous tracking, monitoring and refinements of strategies to achieve talent targets for the nation

5 Intellectual Capital

- **High youth unemployment and underemployment rate** due to lack of Deep Tech and Future Skills jobs opportunity outside academia (19.6% of PhD graduates in natural sciences, mathematics and statistics were able to secure employment)
- Lack of clear STEM career path and **commensurate remuneration** (~97% industry in Malaysia are SMEs)
- **Enrolment in STEM courses** in public and private institutes of higher learning (HLIs) have been **on the decline.**
- **Low attractiveness** of TVET programmes among youth and students
- **High cost** capability development programmes that prepare students and workforce for a high-tech and knowledge-intensive economy (power the nation's Industry 4.0 aspirations)

3 Incentives

- Lack of fax incentives for **early career development and progression in STI-based areas**
- **Lack of encouragement from parents** to pursue STEM courses at the higher education level due to **low high-paying job prospect**
- Opportunities for talent with technical skills is **not lucrative/attractive** (eg higher pay, flexible schedule etc.)-leading to brain-drain to other countries that are more developed.
- **Low incentives** to nurture next-generation start-up, technopreneurs and innopreneuers the startup ecosystem is fragmented.

4 Institution

- Multiple institutions are responsible for talent development in the country lack coordination in meeting STEM talent in the country.
- Public universities and HLIs are **required to be more self-sustaining,** conflicting with their mandate, affecting quality of teaching and learning
- Competitive nature of private education and **high cost of investment** in STEM infrastructure- many private HLIs focus on non-STEM programmes and lack of sharing of education and research infrastructure with other institutions.
- **Inadequate facilitation** to students on **all possible opportunities** for further education and training in emerging areas of study, future jobs and building of sharp and smart skills
- Scholarship providers are not in touch with the **changing demands for future-of-work, hence** many continue to fund educational programmes that prepare students for "Sunset Industries"

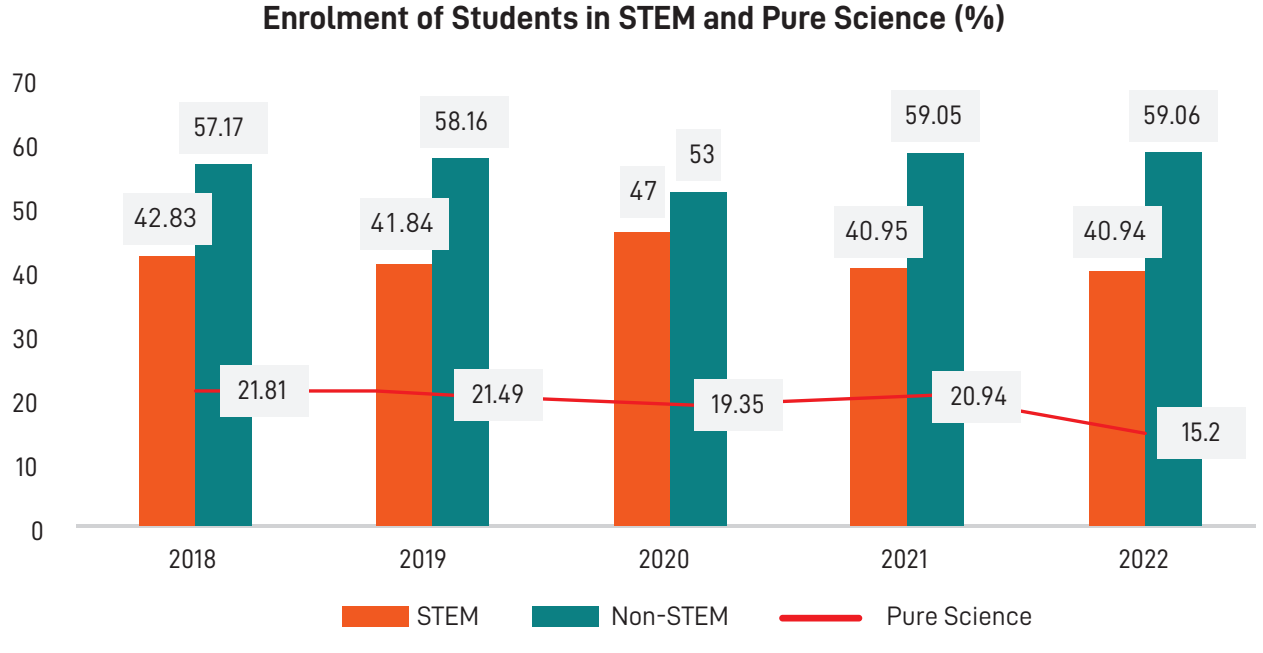
Figure 57: Challenges in Malaysia's Talent Ecosystem

Source: ASM Analytics, 2023

2.5.2 STEM ENROLMENT

Since 1967, Malaysia has implemented a strategy known as the 60:40 policy to enrol 60% of secondary school students in the science stream and enhance their knowledge and expertise in science and technology while enrolling the remaining 40% in the art stream. Even though this 60:40 policy has been in effect for about half a decade, empirical evidence shows that the intended ratio was exceptionally far from the planned objectives. It is more alarming that the current percentage has been declining (Esther & Noraini, 2007; Yong & Fatin, 2015). Even in developed nations, the number of students enrolled in science courses is declining. Due to the absence of high-paying employment prospects, parents do not encourage their children to pursue STEM courses in higher education. This is also one of the causes that discourage students from choosing the science or technical stream.

There is a perception that students' knowledge and comprehension of science influence their enrollment in science courses. In Malaysia, it has become apparent that fewer students are opting to study in the science stream. Compared to the arts field, the number of students participating in STEM programmes is declining, and the gap is broad (see Figure 58).



Legend:
* Students enrolled in Science stream, MPV, PVMA programme, Technology, Technical, Skills, Skills Programme Year 2 and VCM Year 2 Programme
** Students enrolled in STEM package A, STEM package B, STEM package C, take only additional mathematics subject, take any two subjects of STEM elective (Applied Science and Technology) and Vocational College Year 1 programme.
Data Source: MOE 2018-2022. Data is private and confidential

Figure 58: Enrolment of Form 4 Students in STEM and Pure Science Courses

Source: Analysed by ASM from MOE 2018 – 2022 data

The percentage of Form Four students enrolled in STEM has declined from 42.83% (2018) to 40.94% (2022), while the percentage of students enrolled in non-STEM courses has climbed from 57.17% (2018) to 59.06%. (2022). In addition, only 15.2% of STEM students will focus on pure science in 2022. The sudden drop in STEM student enrolment, particularly in pure science courses, is becoming a downward trend, causing great concern for the future talent pool in Malaysia. The reasons for the decline in STEM student enrolment include the following:

a) Lack of understanding of prospects and career paths in STEM/ STI
b) There are more challenges to enrolling in postsecondary science programmes.
c) Science education is too theoretical.
d) Students' attitudes and interests are positive, but they lack confidence in STEM subjects and perceive them to be difficult.
e) Inconsistent quality of teaching and learning.
f) Lack of encouragement from teachers or counsellors.
g) Peers or parents do not favour science education.
h) Popularisation of STEM (media)
i) High investment in STEM (reference book, laboratory, and equipment)
j) Teaching and learning approaches are not captivating, and the infrastructure is not conducive to learning.
k) Limited and outdated infrastructure; and
l) Science subjects are perceived as being difficult compared to arts and non-science subjects.

2.5.3 YOUTH UNEMPLOYMENT

In general, unemployment is defined as the proportion of the unemployed labour force actively seeking employment. Therefore, the unemployment rate is the proportion of unemployed individuals in the total labour force. The unemployment rate is a lagging indicator that fluctuates in response to economic conditions rather than predicting them. As a result, it is usual to anticipate that the unemployment rate will climb in times of poor economic health, when jobs are scarce, and decrease in times of robust economic growth.

In Malaysia, based on the unemployment rate by age group from 2017 to the second quarter of 2022, the 15-to-24-year-olds consistently contributed the most (11% in Q2 2022), followed by the 25-to-34-year-olds (3.9% in Q2 2022) (Figure 59). A similar trend could be observed based on the graduates' unemployment rate from 2017 to 2021 (see Figure 60). In this regard, graduates are individuals aged 15 or older with the highest certificate obtained from universities, colleges, polytechnics, or equivalently recognised bodies after at least two years of study. The percentage of unemployed youth graduates was reported to be greater than the national unemployment rate in 2021 (15.7% for the 15–24 age group and 4.9% for the 25–35 age group).

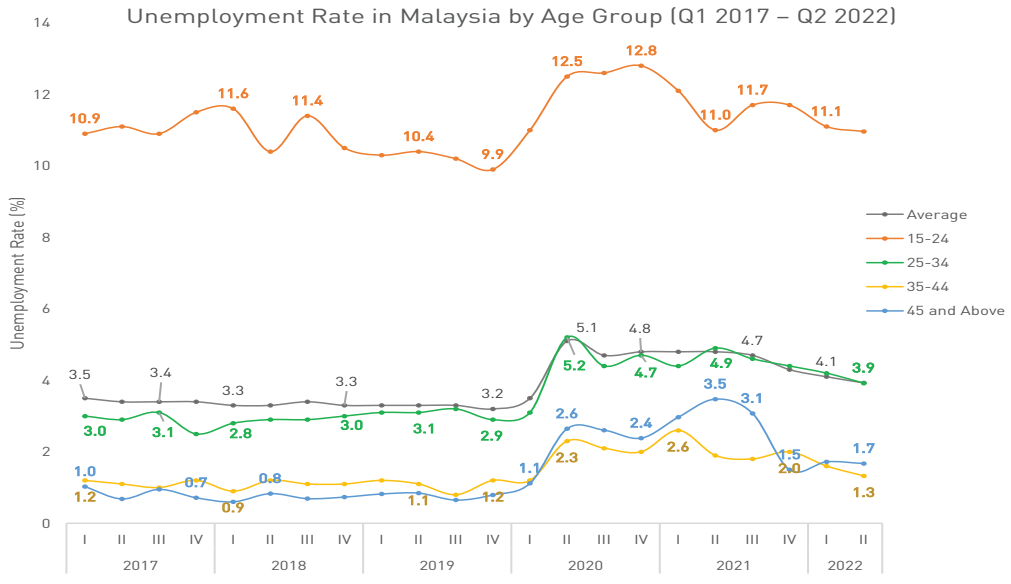


Figure 59: Unemployment Rate in Malaysia by Age Group (Q1 2017 – Q2 2022)

Source: Analysed by ASM from DOSM's Labour Force Survey Report 2017-2022

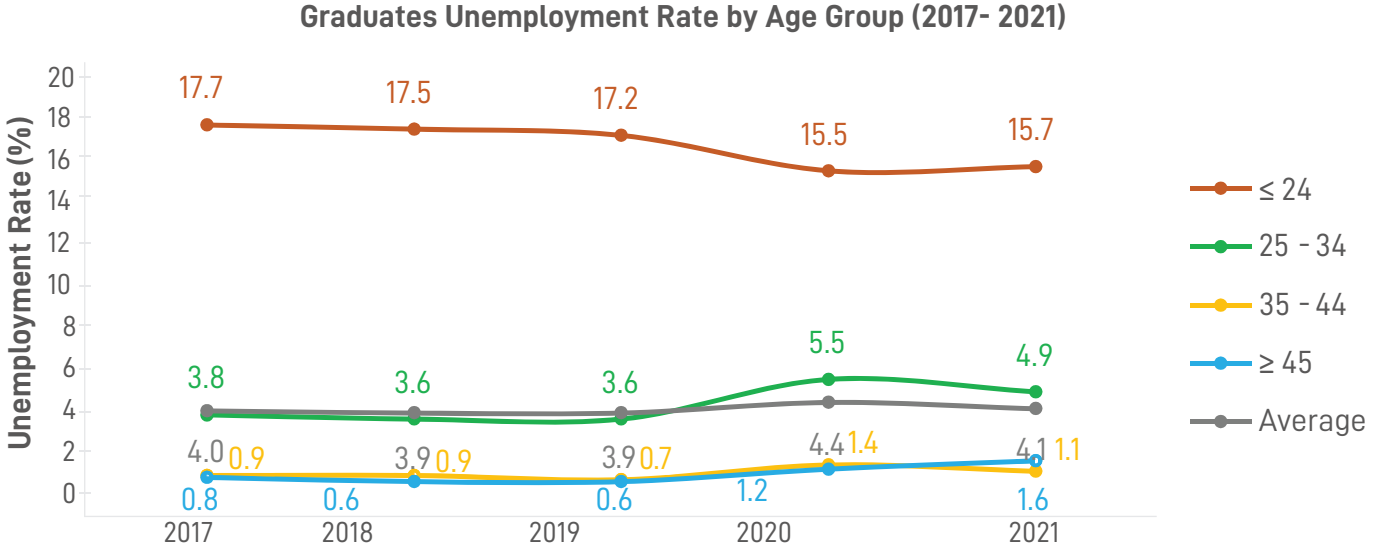


Figure 60: Graduates Unemployment Rate by Age Group (2017 – 2021)

Source: Analysed by ASM from DOSM's Labour Force Survey Report 2017-2022

In contrast, the general and graduate unemployment rates for older age groups (35–44 and over 62) are consistently lower than the Malaysian unemployment rates in both categories. It may be deduced that Malaysian youths have the most difficulty finding employment despite their desire to be employed. Due to its considerable impact on the nation's long-term economic growth and development, reducing the number of unemployed young people should be a top priority.

2.5.4 YOUTH SKILL-RELATED UNDEREMPLOYMENT

The term "skill-related underemployment" refers to the disparity between employees' qualifications and the skill requirements of their jobs. Skill-related underemployment happens when graduates are forced to accept semi-skilled or low-skilled jobs due to a lack ofskilled positions on the job market or a mismatch between the potential employee's qualifications and the employer's actual requirements.

Malaysia also experiences skill-related underemployment, which measures those with tertiary education employed in low- and semi-skilled jobs. The number of graduates accepting positions that do not match their skills will compensate for the slowing demand for skilled professions. Like the unemployment rate, the youth age groups constitute the bulk of underemployed individuals due to their lack of skills (Figure 61). Despite a decrease in skill-related under employment for the 15–24 age group from Q1 (69.6%) to Q2 (58.1%) in 2022, more than half of this age group's employed workforce might be classified as overqualified for their position.

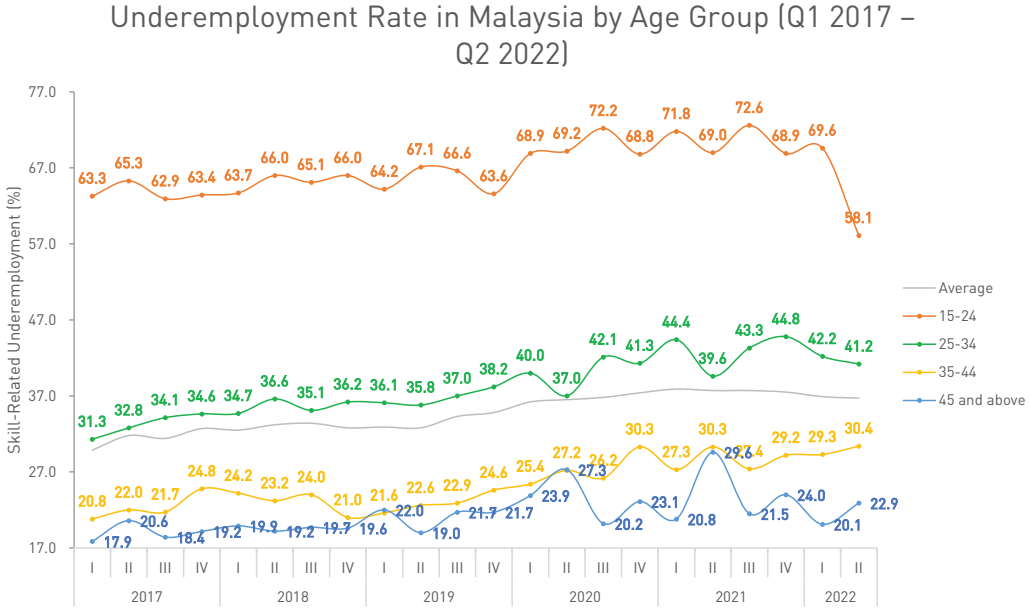
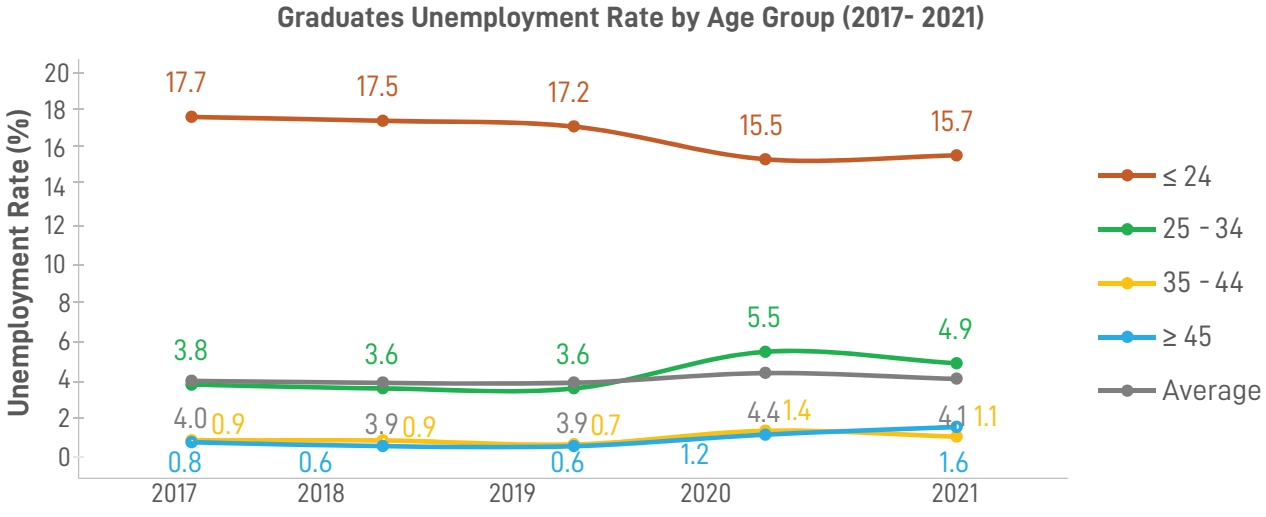


Figure 61: Underemployment Rate in Malaysia by Age Group (Q1 2017 – Q2 2022)

Source: Analysed by ASM from DOSM's Labour Force Survey Report 2017-2022

COVID-19 also led to a considerable increase in skill-related underemployment among graduates aged 15 to 24, with a 23.5% increase between 2019 and 2020 (Figure 62).



Source: Labour Force Survey Report, Malaysia, 2nd Quarter 2022 (DOSM)

Figure 62: Graduates' Skill Underemployment by Age Group (2017 – 2021)

Source: Analysed by ASM from DOSM's Labour Force Survey Report 2017-2022

In summary, when examining the trends in unemployment and skill-related underemployment, it is evident that youths are not only facing difficulties in securing employment but even when employed, their qualifications and skills are not fully capitalised. This is particularly worrying given that the 15–24 age group contributes the least to the labour force despite having the highest unemployment and skill-related underemployment. Consequently, prompt action is required to address the underlying and structural challenges in the labour market due to the various shifts taking place in the global economy. The systemic structural changes in the labour market have been exacerbated by the COVID-19 pandemic. The health pandemic brought the global supply chain to a screeching halt and transformed jobs, the workplace environment, and industrial structure. Firms and organisations that invested in appropriate technology and talent development before and during the pandemic were able to weather the pandemic and other global destabilising factors.

2.5.5 DIVERSITY AND EQUAL OPPORTUNITY

Industry leaders believed that diversity and equal opportunities were needed for firms to enhance their innovative capabilities and competitiveness. Diversity and equal opportunities provide firms with diverse thoughts, ideas, and organisational management in a DVUCA world. The percentage of business leaders who were of the view that diversity and equal opportunities are important priorities for organisational development increased from 78% to 89% in 2019 and 2020, respectively (refer to Figure 63). Close to a total of 82% of the firms are committed (both strongly and somewhat committed) to improving diversity and equal opportunities.

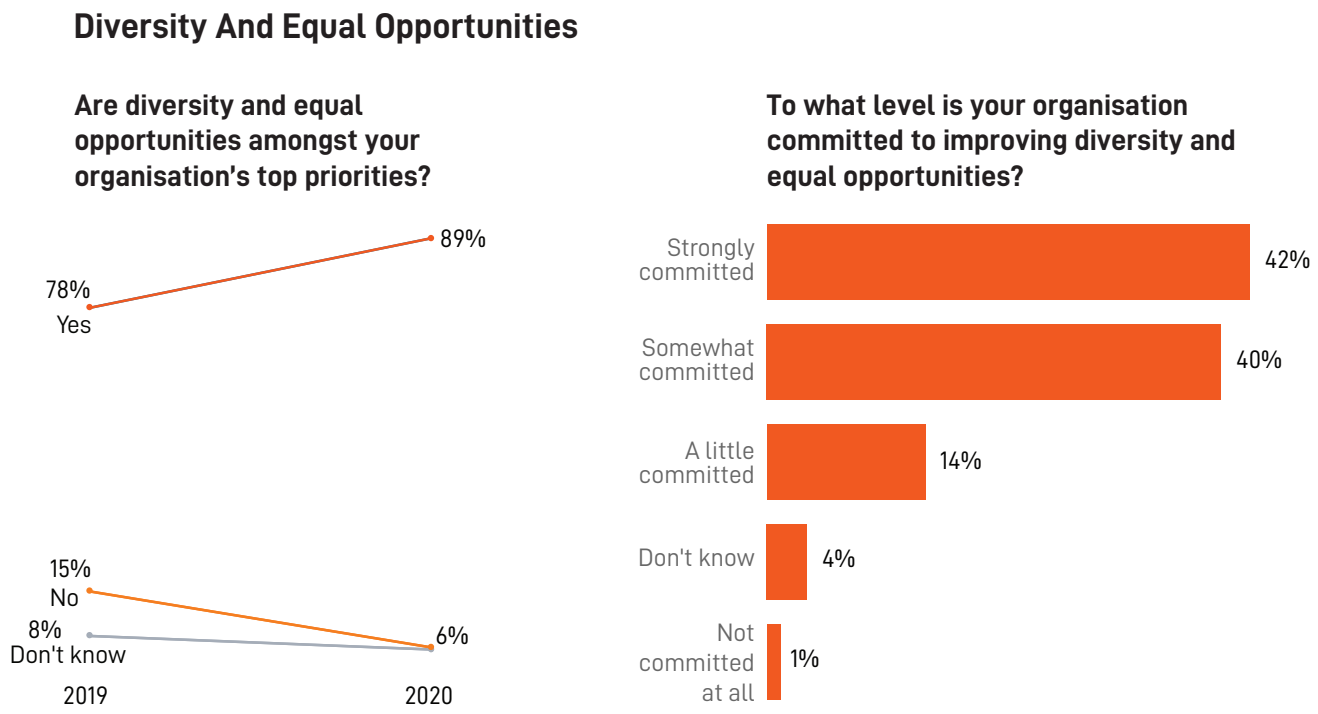


Figure 63: Diversity and Equal Opportunities

Source: Business Sentiment 2020/2021 Survey. Nair et al., 2020

A challenge confronting the Malaysian talent ecosystem is women's participation in the employment sector. Women's participation in the workforce and contributions to the nation's economic growth have been progressively acknowledged. Despite these efforts, women continue to face obstacles in the Malaysian job market, including a paucity of representation in leadership positions. According to the Business Sentiment Survey conducted by Monash University in 2020 (Nair et al., 2020), 22% of managerial positions were held by women, indicating that women are more likely to occupy intermediate management positions than executive positions. This percentage decreases as one ascends the corporate ladder (senior manager: 17%, vice president: 14%, senior vice president: 12%) but then rises at the C-suite (14%) and board level (18%) (see Figure 64 below).

Women In Leadership

Please indicate the estimated percentage of women holding key positions in your organisation

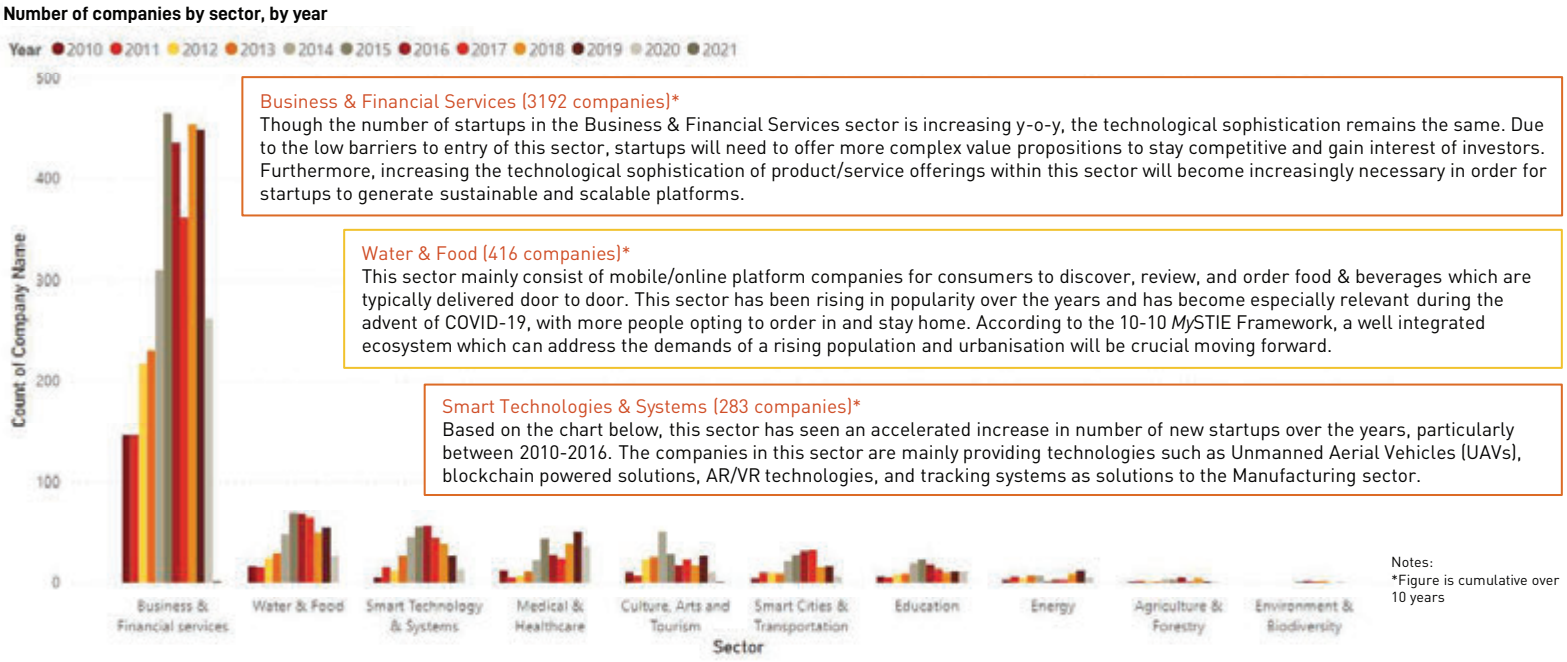
Figure 64: Women in Leadership Positions, (2019 – 2020)

Source: Business Sentiment 2020/2021 Survey. Nair et al., 2020

2.5.6 ROLE OF SMEs AND START-UPS IN THE TALENT ECOSYSTEM

SMEs face several challenges concerning the talent ecosystem. The SME sector is increasingly recognised as a significant contributor to the global economy and a major employer. In a dynamic, volatile, uncertain, complex, and ambiguous (DVUCA) environment, access to talent that enables small businesses to undertake major transformations will be a significant obstacle for small businesses in 2020. This includes talent with critical thinking skills and self-assurance to operate effectively during severe supply chain disruptions. Most business leaders view ICT literacy and new digital technologies as crucial for their companies during these challenging times (Nair et al. 2020).

Start-ups are another business segment that plays a crucial role in the talent ecosystem. They serve as incubators for new ideas, technologies, and businesses. Start-ups often have a culture of innovation and risk-taking, attracting a different type of talent than established organisations. They also offer employees the opportunity to work on cutting-edge projects and technologies, which can be incredibly rewarding and help build careers. Startups are seen to have grown exponentially over time. With numerous successful businesses from Asia, Malaysia has long been recognised as one of the world's most promising developing technology startup hubs. Malaysia is noted for having a strong focus on digital technology compared to its neighbours. This interest in technology fosters innovation, which produces more successful Malaysian entrepreneurs. Figure 65 illustrates Malaysia's distribution of start-ups by the ten socioeconomic drivers.



Note: The mapping of startups to sectors was based on Tracxn database and was done on a best effort basis, referring to the 10-10 *My*STIE economic drivers as a guide. Accuracy of data collected is allowed for errors to be less than 5%

Figure 65: Malaysia's Distribution of Startups by Volume Based on the Socioeconomic Sector

Source: Malaysia Startup Ecosystem Roadmap 2021 – 2030. MOSTI, 2021

A mapping of more than 4000 start-ups in Malaysia (based on the Tracxn database) was performed using the 10-10 *My*STIE framework's ten socio-economic sectors. It reveals that Business & Financial Services (3192 companies), Water & Food (416 companies), and Smart Technologies & Systems (283 companies) have the largest pool of companies, respectively (see Figure 66).

While the number of start-ups in these regions indicates an interest in the sector, this is mostly attributed to the low entry barrier for companies to establish operations. However, most of these firms rely on low technology and simplicity. The following highlights the focus of each socio-economic sector:

Business & Financial Services: Although the number of start-ups in the business and financial services industry is expanding year over year, the technological complexity has not changed. Due to the low barriers to entry in this industry, businesses will need to deliver increasingly complicated value propositions to remain competitive and attract investors' interest. Additionally, improving the technological sophistication of product and service offerings in this industry will become increasingly critical for entrepreneurs to develop sustainable and scalable platforms.

Water & Food: This industry is dominated by mobile and online platform businesses that enable consumers to discover, review, and order food and beverages that are typically delivered to their doorsteps. This industry has gained prominence over the years and has become increasingly crucial during the COVID-19 pandemic as more individuals choose to order in and remain at home. According to the 10-10 *My*STIE Framework a well-integrated ecosystem that can meet the needs of a growing population and urbanisation will be essential for this industry.

Smart Technologies & System: This industry has experienced a rapid increase in new startups, particularly between 2010 and 2016 (see Figure 66). The companies in this sector primarily provide the manufacturing industry with technology such as unmanned aerial vehicles (UAVs), blockchain-powered solutions, AR/VR technologies, and tracking systems.

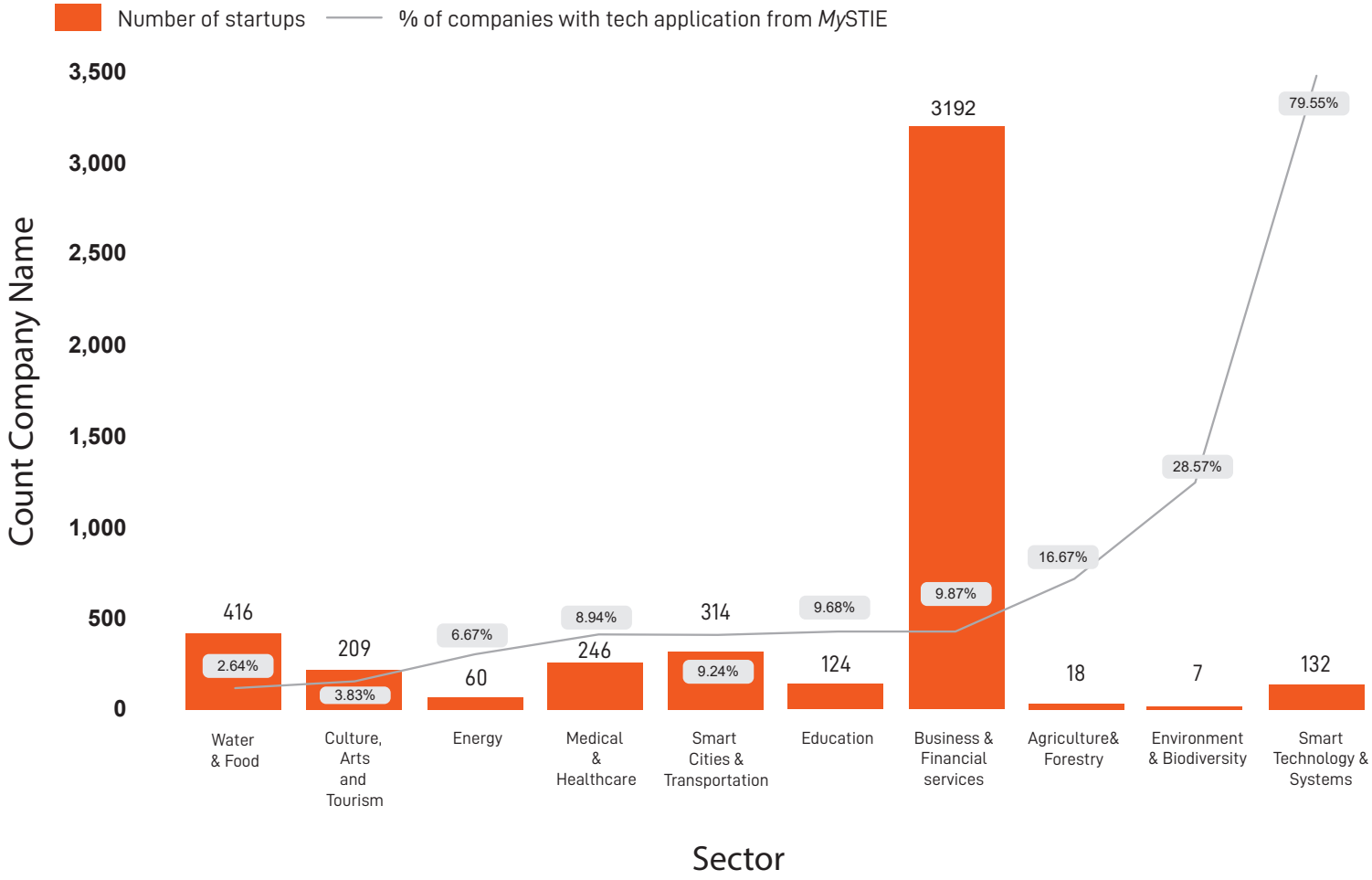


Figure 66: Malaysia's Distribution of Startups by Socioeconomic Drivers and Focus on S&T Drivers

Source: Malaysia Startup Ecosystem Roadmap 2021 – 2030. MOSTI, 2021

Figure 66 shows that the Smart Technology & Systems, Environment & Diversity, and Agriculture & Forestry sectors are the most prolific users of the 10-10 *My*STIE Framework's science and technology drivers. 105 startups in Smart Technology & Systems leverage S&T drivers, which include artificial intelligence, autonomous systems, AR/VR, blockchain, cloud computing, IoT, and smart systems. There are limited startups in Environment & Diversity and Agriculture & Forestry. However, most firms in these sectors leverage S&T drivers, i.e., blockchain, cryptocurrency, artificial intelligence, and IoT. Although business and financial services have the highest number of startups (3192 companies), only 9.87% adopt S&T drivers. This suggests that the pool of companies in Malaysia are platform-oriented firms that are not driven by STIE's S&T drivers. In moving forward, Malaysia needs to promote start-ups that are innovators in deep tech, which concentrates on future skills anchored on the technologies outlined in the 10–10 *My*STIE Framework.

2.5.7 INTERNATIONAL TALENT

Poaching for highly skilled global talent has become increasingly complex and intensive in the global labour market. Malaysia, like all other developing countries, has experienced a brain drain in key economic sectors and STI-driven sectors. In search of a better standard of living and quality of life, higher-paying positions, and access to cutting-edge technology, recruiting global talent with advanced skills has become a significant challenge in building a sustainable talent ecosystem in Malaysia. The talent pool has become increasingly diversified and dispersed due to globalisation and technological improvements, making it more challenging for organisations to train, attract, and retain talent in a rapidly changing economic landscape. In addition, the rivalry for top talent has intensified as more industries recognise the value of a highly qualified labour force in enhancing their global competitiveness.

2.5.8 FINANCING OF TALENT

The Malaysian government allocates substantial budgets for education and training in the annual national budgets. Despite a large amount of education and training, the industry is of the view that there is a lack of affordable STI-driven (especially Industry 4.0) training programmes (Figure 38). There is also a lack of tax incentives for early career development in STI-based areas. Governments lack clear STEM career paths, corresponding remuneration (97.2% of Malaysian businesses are SMEs), and tax incentives for early career development in STI-related fields. Incentives are not provided for young people to pursue careers in the STEM fields. Many have chosen to pursue careers in non-STEM areas (such as business, accounting, and commerce-related areas). These career paths are seen as easier than the STEM areas; they provide faster career progression and higher income potential, which can result in a shortage of skilled workers in these areas. The lack of tax incentives for STEM education and training and the shortage of a STEM workforce can also have a broader impact on the economy, as it can limit the ability of organisations to develop and commercialise new technologies and adopt knowledge-based systems to improve their processes and products. The shortage of STEM-related talent will hinder their competitiveness in a rapidly changing global marketplace.

2.5.9 JOBS MARKET

The demand side of the job market equation is a further challenge within the talent ecosystem. It has been observed that the creation rate of high-skilled jobs continues to lag that of low-skilled jobs. In 2018 and 2019, 159,000 semi-skilled jobs were added annually, compared to 93,000 high-skilled jobs (Figure 67). Although the rate of new job creation declined after the outbreak of COVID-19 in 2020, the trend of semi-skilled job creation outperforming high-skilled job growth remains unchanged (54% more semi-skilled jobs added than high-skilled ones).

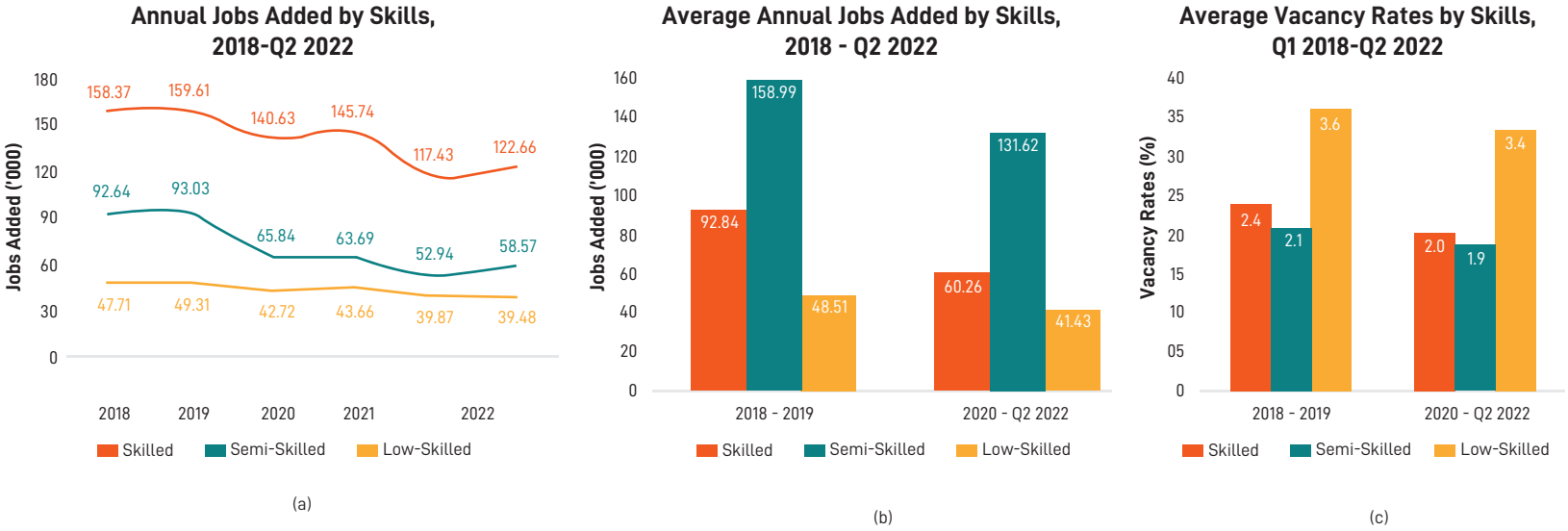


Figure 67: Annual Jobs Added and Vacancies by Skill

Source: Analysed by ASM from DOSM's 2nd Quarter Employment Statistics 2022

As indicated by the lowest average vacancy rates before the COVID-19 outbreak, most newly generated employment is filled by semi-skilled workers in Figure 67. Despite having fewer high-skilled occupations added annually, its average vacancy rates remain marginally higher than those of semi-skilled jobs. Nevertheless, considering the difference in the number of semi-skilled and high-skilled jobs produced, more individuals filling semi-skilled positions may have contributed to the supposedly high rate of skill-related underemployment, especially among the youth.

In addition to increasing the number of highly skilled positions on the job market, it would be crucial to ensure that adequately skilled and qualified individuals fill these positions. This would thus enable a simplified integration of talent supply and job market demand, a long-standing issue in talent development.

2.5.10 RESOURCE CONSTRAINTS

Higher Learning Institutions (HLIs) are integral to the talent ecosystem in the country. While many of the private HLIs must remain profitable to provide quality education and training, increasingly, public HLIs are required to be more self-sufficient. The latter is because government fiscal conditions have deteriorated over the last decade. The situation worsened during the COVID-19 health pandemic when most institutions transitioned to online courses. While digital education dampened the impact of the health pandemic on teaching and learning, it widened the digital divide and learning opportunities among more affluent and poor communities (Devisakti et al., 2023). Lack of resources has a major impact on marginalised communities and micro- and SMEs' access to important digital platforms to enhance their capabilities. In this context, HLI's mission of providing affordable, quality education and training programmes that meet the needs of industry and the broader community will be curtailed.

Further, the resource constraint results in HLIs being unable to create value for their stakeholders in the ecosystem (Jayabalan et al., 2021; Zhao and Cheah, 2023). These include providing students with adequate hands-on training, experiential learning opportunities, and new capabilities that will move Malaysian industries up the global innovation value chain. The absence of sustainable funding has the potential to adversely impact the quality and standard of education and training to meet the needs of the industry. This is evidenced by the high unemployment and underemployment among youth shown in the figures earlier. As the industry adopts new digital technology, such as generative AI, and many HLIs lag in ensuring students gain access to appropriate training in emerging technologies, the labour market will experience structural unemployment.

At the secondary school level, there is inadequate facilitation for students on all possible opportunities to further their education in areas that enable them to take employment or create employment in more technology-based and knowledge-intensive sectors. This includes matching students' aspirations, qualifications, competencies, career planning, scholarships, and applications to respective courses in the HLIs. If appropriate resources are not allocated to address the above issues, many will choose courses and training that are not aligned to their competency and industry needs—the potential of them taking courses that prepare them for "Sunset Industries" and not "Sunrise Industries." These will continue to widen the talent supply-demand gap and hinder the aspiration of producing a future workforce with 21st century skills.

2.5.11 SHORTAGE OF STI-BASED ENTERPRISE

Lack of deep tech and future skills start-ups to absorb STEM talent in the country are also major constraints that perpetuate the talent supply and demand gap. Due to weaknesses in the deep tech ecosystem, a lack of STEM-related career pathways, and an uncompetitive remuneration system, graduates have shown little interest in pursuing careers in STI-related companies (97.2% of the industry in Malaysia is SMEs). The number of STI-based enterprises in Malaysia that can employ STEM talent is limited. These factors are also major contributors to high unemployment and underemployment among youth with deep-tech skills outside of academia. The primary gaps in Malaysia's talent value chain are also attributed to diverse expectations from HLIs and the industry. Table 2 provides the supply and demand of the talent value chain in Malaysia.

Table 2: Supply and Demand of Malaysia's Talent Value Chain

Source: ASM Analytics, 2023

Supply Side	Demand Side
Institutions a. The youth enrolment rate in local TVET institutions in 2020 is relatively low at 6.1% compared to innovative countries, which recorded a 20% rate (ISIS, 2020). b. Talent mismatch is still a challenge and is due to a lack of in dustry interaction with higher learning institutions (HLIs). This causes students' abilities, perspectives, and interests to diverge from those of the industry (MDEC, 2021).	**Industries** a. Malaysian education places a strong focus on academic and professional credentials, but companies prefer candidates with sound technical skills, soft skills, and work experience (KRI, 2018). b. Aside from work-based training, employers rarely engage with youth or educational institutions (KRI, 2018). c. Employers believe that youth seek high salaries, but youth place a higher priority on job security and work-life balance (KRI, 2018
Graduates a. By 2025, Malaysia may have a shortage of 3,700 highly qualified people, which might worsen to 93,000 by 2030 (equivalent to 2.5% of Malaysia's highly skilled workforce in 2030) (Ferry, 2018). b. In 2020, the majority of TVET graduates' monthly salaries at all levels ranged from RM1,001 to RM2,000 (ISIS, 2020). c. In 2020, a minimum of 10% of recent graduates with degrees had been earning between RM1,001 and RM1,500 for at least the past ten years due to a skill mismatch (ISIS, 2022).	**Gig-Economy** a. Although there are more opportunities for freelance work in the gig economy, this job is unstable and insecure and offers limited labour and social protection (KRI, 2018).
TVET a. TVET education is perceived by Malaysians as being more geared toward low-income students, school dropouts, and students with low academic standing (Omar et al., 2020). For their own status and benefit, even parents with modest educational backgrounds choose university education for their kids over TVET (Dyrin et al., 2021).	**Labour Needs** a. Instead of investing and nurturing local Malaysian talent, CIPD proposes that Malaysia focus on meeting current labour needs and filling the present skills gap with foreign labour (CIPD, 2021 b. The rate of skilled job development is still rather slow; on average, each year, more semi-skilled positions are created than skilled jobs (ISIS, 2021).

Skilled: *manager, professionals, technician and associate professionals*
Semi-skilled: *Clerical support workers, Service and sales workers, Skilled agricultural, forestry, livestock and fishery workers, craft and related trades workers, plant, and machine operators and assemblers*
Low-skilled: *elementary workers*
***Skill levels were classified based on the Malaysia Standard Classification of Occupation (MASCO)**

2.6 DEMAND SIDE ANALYSIS OF MALAYSIAN INDUSTRIAL SECTORS

The Twelfth Malaysia Plan, 2021-2025 (Twelfth Plan) aims to achieve a prosperous, inclusive, and sustainable Malaysia. The policy focuses on four enablers: developing future talent, accelerating technology adoption and innovation, enhancing connectivity and transport infrastructure, and strengthening public service. Talent-related objectives of the Twelfth Plan necessitate cultivating highly competent talent to transform Malaysia into a high-technology, knowledge-intensive, prosperous, harmonious country and ensure the natural resources and treasures of the nation are used in a sustainable way to benefit current and future generations. Figure 68 illustrates the Twelfth Plan's talent-related targets and targets related to achieving the UNSDGs.

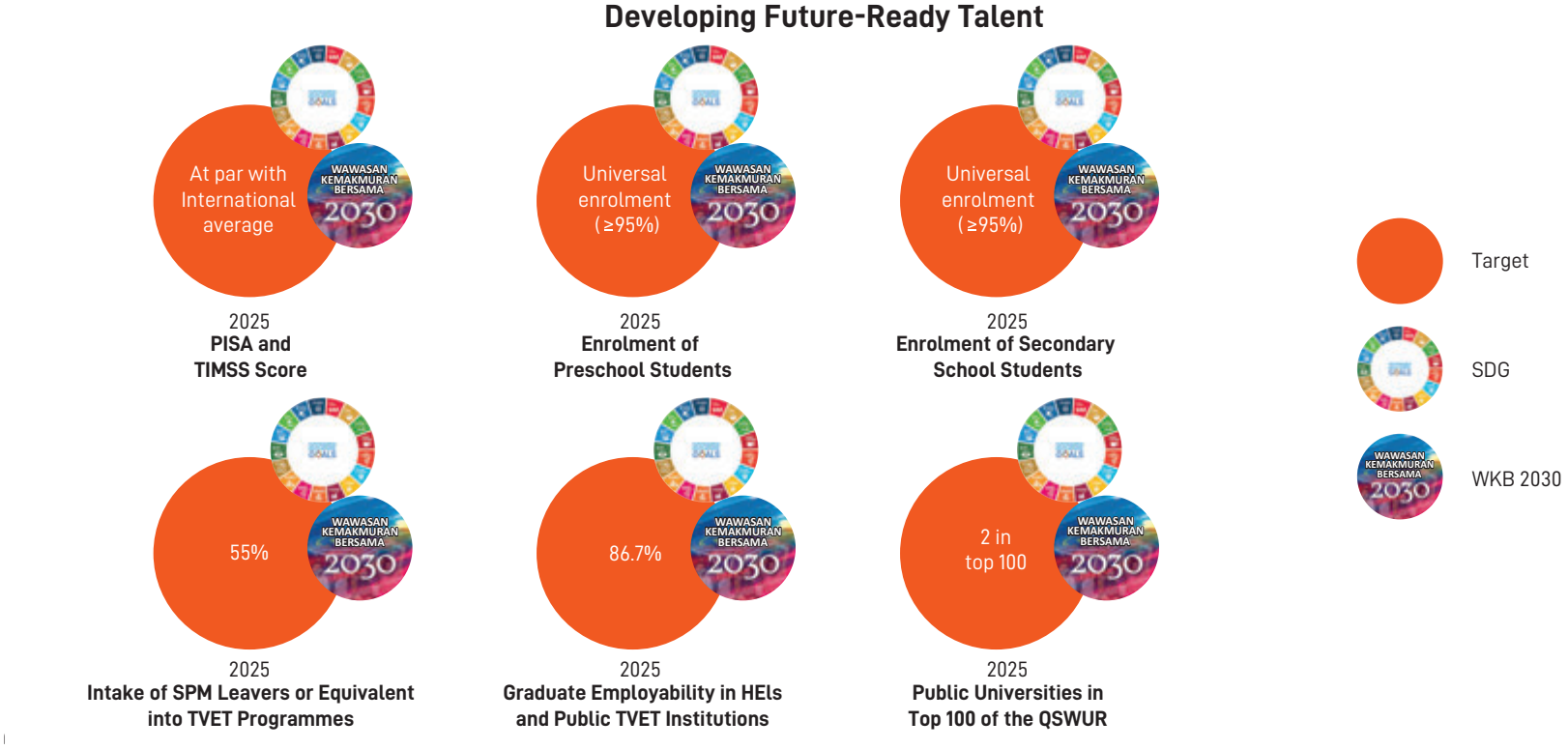


Figure 68: Twelfth Malaysia Plan's Talent-Related Targets

Source: 12th Malaysia Plan. EPU, 2021

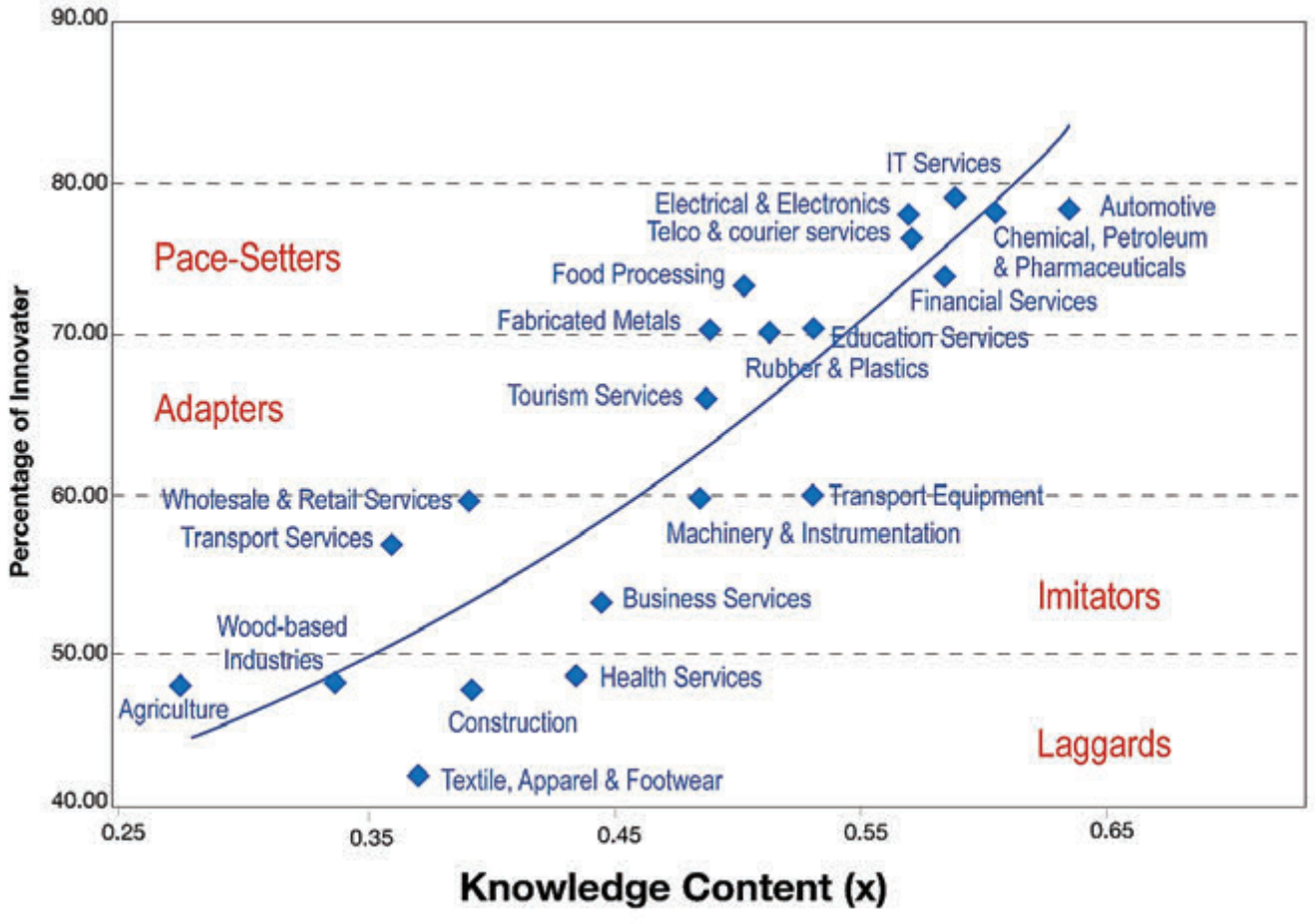
A detailed analysis of the knowledge ecosystem of 21 industrial sectors in Malaysia revealed strength in the industrial ecosystem in developing STI talent for the country (EPU 2016a and EPU 2016b). Among the key strengths is strong support from the Malaysian government to become technology-knowledge-intensive; significant fiscal and non-fiscal incentives are channelled to build STEM talent in the country. There are close to 600 colleges, universities, and training institutes that contribute to the capability and development of the workforce. Over the last four decades, several public and private institutions of higher learning and public research institutions (PRIs) have been established to lead the talent and R&D development of the country. These have attracted foreign direct investment (FDI) in many STEM-related technology-driven sectors in the country. The other attractive

feature of Malaysia is the cost of labour, which is relatively cheaper than in other STEM-driven developed countries. Access to cheaper labour from neighbouring countries also helps industries operating in Malaysia keep the cost of production low and be cost-competitive globally. Malaysia also has one of the largest diasporas from the Asia-Pacific region who are proficient in English, Mandarin, and Tamil. The social fabric of the country, coupled with the attractive incentives given by the Malaysian government, has resulted in a steady flow of FDI into the country. These have had a spillover in the form of technology and knowledge transfer to the local workforce. The other factors that contributed to industrial transformation and talent capability development are the rich natural resources and tropical climate in the country. Since the independence of the country, investments have been channelled to cultivate cash crops that have become important contributors to the wealth of the country. The natural environment also resulted in key service sectors such as tourism, hotels, food and beverage, and other industries related to travel and leisure becoming important sources of employment and economic development.

While there has been significant effort to develop talent and the local industrial ecosystems, the EPU (2016a and 206b) studies show that the local industrial ecosystems lag behind industrial ecosystems in more developed economies. Further, the 21 industrial sectors are in different stages of development with respect to knowledge intensity and innovative capability (refer to Figure 69). The key findings of the study show that the 21 industries can be clustered into four groupings (Pace-Setter, Adapter, Imitator, and Laggard) based on the level of knowledge content and innovative capacity. The cluster groupings are as follows:

- **Pace-Setter industries:** Food Processing; Chemicals, Petroleum, and Pharmaceuticals; Electrical and Electronics; Financial Services; Telecommunications and Courier Services; IT Services; and Automotive.
- **Adapter industries:** Rubber and plastic products; fabricated metals; education services; and tourism services.
- **Imitator industries:** Transport Equipment; Machinery & Instruments; TransportationServices; Business Services; and Wholesale & Retail
- **Laggard industries:** Agriculture; wood-based products; textiles, apparel, and footwear; health services; and construction sectors.

The study also found the following industries to be important knowledge enablers for the Malaysian economy: IT Services; Business Services; Education Services; Financial Services; Transportation Services; Electrical and Electronics; Machinery and Instrumentation; and Chemical, Petroleum, and Pharmaceutical.



Notes: Innovators are firms that report significant improvements not only in products and processes but also in internal management, organisational methods, marketing concepts, or business strategies. The knowledge content index consists of a composite index of several indicators that capture the enablers of the ecosystem: human capabilities, knowledge systems and leadership, technology and information structure, knowledge environment, knowledge generation, knowledge sharing, and knowledge utilisation. The R-squared (coefficient of determination) was 79.45%, which suggests that close to 79.45% of the variation in the knowledge ecosystem explains the variation in the innovative capabilities of firms.

Figure 69: Knowledge Content and Innovative Capabilities of the 21 Industrial Sectors

Source: A Study on Knowledge Content in Key Economic Sectors in Malaysia Phase III (MYKE III). EPU, 2016

The study found that public institutions (government agencies, trade associations, universities, and learning institutions) play an important role in influencing the knowledge enablers of the ecosystems for all 21 industrial sectors. However, these institutions do not directly influence the dynamic capability components (absorptive, adaptive, and innovative capabilities) of the workforce. In many advanced countries, these institutions were found to have a direct impact on the knowledge enablers of the industrial ecosystems and the dynamic capabilities of the workforce in these industrial sectors. The key challenges faced by the different industrial sectors in talent development vary, and they are outlined below.

Laggard Industries

The institutions to develop knowledge are not well coordinated; there is a low level of basic STI skills development due to the following factors: a large pool of transient labour force (cheap foreign workers); a shortage of talented staff to undertake capability development programmes; and a major brain drain problem in other industrial sectors that have better working conditions and remuneration. The sectors in this grouping are also overly dependent on foreign technology; there is a 'lock-in' culture that hinders the development of the local players. There are major weaknesses in the linkages between key stakeholders in the ecosystem; the linkages are fragmented and fraught with red tape and bureaucracy. These hinder knowledge sharing, low technology transfer, and adoption of technologies among key players in the sectors, especially SMEs. This curtails the dynamic capabilities of the local workforce. Local SMEs in these industrial groupings are also not savvy in the use of technology or how to effectively nurture the knowledge networks to gather market intelligence. The knowledge enablers primarily influence absorptive capability and a lower level of adaptive capability. TVET education and training have not been used effectively to transform the sectors to be technology- and knowledge-intensive. The primary focus of the enablers of the ecosystems is to enhance process improvement and compete on cheaper costs of production. The knowledge ecosystem is not sufficiently strong to create or enhance innovative capability and higher-value product development outcomes. Lack of local talent and expertise in these sectors hinders the sectors in the grouping from moving up the innovation value chain.

Imitator Industries

The ecosystems for the industrial sectors classified under this grouping also experience challenges with respect to weak coordination among key institutions to nurture talent and build the dynamic capability of the workforce. TVET education in the area lacks funding and is not well linked to meeting the needs of industry players. Lack of local expertise and talent in the sector has resulted in many firms becoming dependent on foreign technology and expertise. The skills training and capability development in these industrial clusters are catered to the use of foreign technology. This is primarily undertaken to enhance process improvement and gain a cost advantage and price competitiveness. There are very few firms and institutions in this industry grouping that nurture technology transfer with foreign technology players to build a strong, viable local technology supply chain. Local firms generally pursue product market outcomes through incremental innovation strategies. However, these products are placed at the lower end of the innovation value chain. Most of the products are not high-value-added products and struggle to achieve long-term sustainable competitive advantage with players from regional and advanced markets. Firms and the workforce in this industrial grouping have one of the highest risks of being disrupted by rapid technological developments (such as Industry 4.0 technologies and generative AI) and the increasing need to comply with international standards related to ESG and planetary health.

Adapter Industries

Local firms operating in this industrial grouping have higher knowledge intensity and innovative capability compared to firms in the laggard and imitator industrial groupings. However, firms operating in this group also face challenges in nurturing next-generation talent to help transition firms to become globally competitive. Among them is a lack of coordination among key institutions in the ecosystem concerning the strategic development plans, especially developing a more cohesive talent development strategy. Many of the capability development strategic plans are 'piecemeal' and fragmented. The lack of a more cohesive talent development strategy has led to mismatches in the supply and demand of skills in many industries. High costs of training, talent poaching, low investments in R&D, and the absence of a knowledge-sharing culture

have also hindered local players from creating a sustainable talent pool to enhance their innovative capabilities. The advanced skills acquired by workers in this industrial grouping are primarily to build absorptive and adaptive capabilities, leading to incremental process improvements. Hence, higher value-added product market development and design are limited among industry players.

Pace-setter Industries

Industries in this grouping have stronger cooperation among key institutions as well as a significant number of strategic plans to develop their ecosystems. These include strategies to nurture the next generation of talent, technological infrastructure, and incentive systems to attract FDI and domestic investments. However, many strategic plans have not tracked the quantum and quality of talent required to meet the needs of the industry amidst the rapid technological shifts and increasing demand to comply with ESG standards. Without proper foresight on the shifts taking place in the global and domestic markets, many of the institutions of learning and training centres are playing catch-up in meeting the manpower needs of the industry. One of the major challenges encountered by industry players in this grouping is that technological developments are taking place at a faster pace than institutions of learning and training centres equipping the workforce with the skillset needed. The lack of a creative and skilled workforce also hinders many local industry players from moving up the dynamic capability value chain (absorptive, adaptive, and innovative capabilities) and building a strong competitive advantage against intensive competition from regional and global industry players. The knowledge-sharing culture among firms was found to be weak. Hence, this results in lower knowledge spillover within the industry and across multiple industrial sectors. This gap was found to be more magnified between SMEs and larger firms. These gaps impact the quality of the talent in the ecosystem and the local industrial supply chains. These have resulted in the local supply chains being dominated by foreign players. Lack of talent and expertise has resulted in local firms becoming dependent on foreign technology and knowledge workers. The "lock-in" culture of foreign technology and expertise, coupled with weaknesses in the local talent ecosystem, has hindered knowledge transfer from the foreign to the local workforce. This has curtailed the supply of skilled local workers to power the high-tech sectors in Malaysia. While many of the industrial sectors have been classified as pacesetters in the domestic economy, many are at best imitator industries in the global value chain.

Inter-Industry and Intra-Industry Knowledge Flows

In an increasingly knowledge-intensive economy, inter-industry and intra-industry knowledge flows are envisaged to be high. These knowledge flows enhance greater harmonisation of skillsets in the various industrial sectors amidst converging technology platforms. Access to knowledge from multiple industrial sectors will enable firms to pursue greater economies of scale and scope. Table 3 shows the intensity of inter- and intra-knowledge flows among the 21 industrial sectors in Malaysia. It can be observed that high knowledge flows come from their industrial sectors. Sectors that have high knowledge flows to other sectors are IT Services, Business Services, Education Services, Financial Services, Transportation Services, Electrical and Electronics, Machinery and Instrumentation, and Chemical, Petroleum, and Pharmaceutical. These sectors are seen as enabling industrial sectors that contribute to increasing knowledge content in other industrial sectors. To enable inter- and intra-knowledge flows, these sectors must have a workforce that has the skillset to transcend multiple sectors of the economy.

Table 3: Source-Acquirer of Knowledge for the 21 Industries in MYKE III

Source: A Study on Knowledge Content in Key Economic Sectors in Malaysia Phase III (MYKE III). EPU, 2016

Acquirer \ Source	Agriculture	Food Processing	Chemicals, Petroleum, Pharma-ceuticals	Rubber and Plastic Products	Wood-Based Products	Fabricated Metals	Automotive	Transport Equipment	Textile, Apparel and Footwear	Electrical and Electronic	Machinery and Instruments	Education Services	Transportation Services	Finance Services	Tourism Services	Telecommunications Courier Services	Health Services	IT Services	Business Services	Wholesale or Retail Trade	Construction
Agriculture	28.4	8.0	2.3	1.1	0.0	0.0	0.0	1.1	0.0	0.0	2.3	0.0	5.7	0.0	0.0	1.1	1.1	0.0	8.0	9.1	0.0
Food Processing	16.6	26.8	0.6	1.3	0.0	1.9	0.0	1.9	0.0	1.3	11.5	1.9	0.0	1.9	0.0	0.0	2.5	3.8	8.3	7.0	0.0
Chemicals, Petroleum, Pharmaceuticals	5.0	4.0	35.0	9.0	3.0	0.0	0.0	0.0	0.0	1.0	11.0	4.0	3.0	4.0	0.0	0.0	2.0	4.0	7.0	2.0	2.0
Rubber and Plastic Products	2.7	0.0	4.7	34.5	0.7	3.4	6.8	2.0	1.4	6.1	12.2	0.7	3.4	3.4	0.7	1.4	0.7	0.7	9.5	2.7	2.0
Wood-Based Products	1.0	0.0	1.0	2.0	22.5	2.0	0.0	2.9	0.0	1.0	7.8	1.0	4.9	1.0	0.0	0.0	0.0	1.0	5.9	1.0	5.9
Fabricated Metals	0.7	2.2	4.3	0.7	1.4	25.2	2.9	1.4	0.0	4.3	10.1	0.7	0.7	0.7	0.7	0.0	0.0	3.6	6.5	0.7	11.5
Automotive	0.0	0.0	0.0	4.3	0.0	8.7	42.0	8.7	1.4	4.3	26.1	2.9	2.9	5.8	0.0	1.4	0.0	2.9	7.2	0.0	1.4
Transport Equipment	2.5	0.0	2.5	0.0	0.0	10.0	5.0	25.0	0.0	5.0	17.5	5.0	2.5	2.5	0.0	0.0	2.5	0.0	10.0	0.0	5.0
Textile, Apparel and Footwear	1.3	1.3	1.3	0.0	1.3	0.0	0.0	1.3	18.4	1.3	3.9	0.0	3.9	2.6	1.3	0.0	1.3	2.6	5.3	0.0	0.0
Electrical and Electronic	0.0	0.8	4.0	3.2	0.0	4.0	6.4	0.0	0.0	35.2	18.4	2.4	3.2	2.4	0.0	2.4	0.0	7.2	11.2	0.8	3.2
Machinery and Instruments	1.9	0.0	1.9	0.0	0.0	1.9	1.9	3.8	0.0	7.7	23.1	5.8	3.8	1.9	1.9	0.0	0.0	0.0	7.7	0.0	3.8
Education Services	1.7	0.0	1.7	0.0	0.0	1.7	5.2	1.7	0.0	1.7	3.4	41.4	3.4	8.6	3.4	3.4	3.4	20.7	13.8	3.4	0.0
Transportation Services	0.0	0.0	2.6	0.5	0.5	0.5	2.1	8.9	0.5	1.6	3.1	1.6	19.8	3.1	2.6	3.1	0.5	3.6	4.2	1.0	0.5
Finance Services	8.7	13.0	4.3	8.7	4.3	0.0	4.3	0.0	0.0	4.3	4.3	0.0	0.0	17.4	4.3	0.0	0.0	4.3	4.3	4.3	0.0
Tourism Services	0.6	5.5	1.2	0.0	0.0	0.0	0.0	1.2	0.6	1.8	0.6	3.6	5.5	5.5	39.4	3.6	4.2	13.3	11.5	3.0	0.0
Telecommunications and Courier Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	3.3	0.0	3.3	13.3	6.7	0.0	30.0	0.0	6.7	16.7	10.0	0.0
Health Services	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.5	6.6	0.8	3.3	6.6	0.0	34.4	13.1	9.8	0.0	0.8
IT Services	1.5	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	6.1	1.5	3.0	3.0	9.1	0.0	13.6	0.0	45.5	18.2	3.0	0.0
Business Services	0.0	0.0	1.6	0.8	0.4	0.4	0.4	0.8	0.0	2.4	2.4	2.0	1.6	7.1	1.2	1.6	0.8	7.5	19.0	0.8	10.7
Wholesale or Retail Trade	2.4	2.4	3.2	1.6	0.0	0.8	9.7	1.6	4.0	1.6	5.6	2.4	1.6	2.4	0.8	0.8	1.6	3.2	4.8	14.5	4.0
Construction	0.5	0.0	1.4	0.0	2.3	1.8	0.5	1.4	0.5	3.2	9.7	2.8	0.0	1.8	0.0	0.0	0.0	1.8	7.4	0.5	28.6

Notes: Green is high knowledge flow; Light Green is moderate-high; Yellow is moderate; Amber is moderate-low; Orange is low; and Red is very low. The numbers in the table are percentage of firms that have record thatthey have acquired knowledge from their own industrial sector and other industrial sectors.

CHAPTER 3:
WAY FORWARD

CHAPTER 3: WAY FORWARD

3.1 OVERVIEW

The previous chapters highlight that the global economic landscape is undergoing major structural changes powered by four major shifts: rapid technological development (increasing adoption of Industry 4.0 technologies, smart technologies, and generative AI systems); opening up of the global markets for trade (increase in new opportunities and threats for local firms); intensive competition for talent and skilled workers; and climate change (increasing demand for firms to meet the UNSDGs, ESG standards, and planetary health issues). Climate change and sustainable economic development are going to be central themes on the global development agenda. Nurturing the next-generation talent to help existing economic sectors have a more planet-friendly and skilled workforce to spawn new environmentally friendly industries will be at the forefront of many countries' development plans.

Against the above-mentioned global economic backdrop, to enhance the competitiveness and sustainability of the Malaysian economy, nurturing, attracting, managing, and sustaining next-generation talent will be critical. Future-proofing the talent of the country will be essential for local industries to navigate through a DVUCA world, balancing economic development with societal development and effective management of the natural resources of the country. This position paper proposes six key recommendations to strengthen the talent ecosystem of the country to ensure that it becomes an important supporting pillar for the nation to become a high-tech, knowledge-intensive, and globally competitive nation. Six recommendations have been formulated to enhance talent development in Malaysia. These six recommendations focus on future competitiveness, the national competency framework, collaborative networks, training consortiums, incentive packages, a diaspora for local development, and the procurement of local innovations. Each recommendation outlines the specific challenges it targets, emphasises the initiatives being implemented, and presents several use cases for Malaysia to leverage them further. Table 4 presents a comprehensive overview of the challenges and corresponding recommendations that have been proposed to address them.

Table 4: Overview of Challenges and Recommendations

No.	Key Issues	Challenges	Recommendation
1	Labour Market and Industry Competitiveness	How competitive are Malaysian workers and industries compared to the global landscape?	Foresighting and Futureproofing the Competitiveness of the Malaysian Labour Market and Industries.
2	Talent Skills Framework	Does Malaysia have an integrated framework for the supply of talent in various industries?	Formulation of the National Critical Competencies/Skills Framework.
3	Collaborative Talent Network	Which network underscores the collaboration between academic institutions and industries for financing initiatives and the future of work?	Future-ready Talent Collaborative Network (FuTCoN). Strengthen existing collaborative networks across all 21 industrial sectors and increase the inter- and intra-industrial knowledge flows across the 21 industrial sectors. Build strong industry, institutions of learning, public research institutions, and community partnerships to close the supply-demand talent gap.
4	Next-Generation STI Skill Development	Which training initiatives aim at developing highly skilled STI talent to support high-tech industries in Malaysia?	Establish deep and trans-tech forward schools to provide next-generation skills training.
5	Incentive Scheme for STI Talent	How does Malaysia retain STI talent for early career development and long-term retention?	Offer a competitive incentive package to attract highly skilled STI talent.
6	Local Talent Capability Development	What strategies does Malaysia employ to attract global talent and mitigate the outflow of skilled individuals?	Attracting world-class top STIE talent and a skilled diaspora to enhance local talent development.

3.2 LABOUR MARKET AND INDUSTRY COMPETITIVENESS

3.2.1 CHALLENGE 1: HOW COMPETITIVE ARE MALAYSIAN WORKERS AND INDUSTRIES COMPARED TO THE GLOBAL LANDSCAPE?

The Malaysian economy is experiencing significant structural changes due to rapid technological innovations, digital transformation, climate change, and pressures to meet ESG standards. The COVID-19 pandemic also exposed the inherent weaknesses in the national talent ecosystem. Gaps in the talent ecosystem significantly impact various aspects of the economy, including industry strategies, employment trends, consumer demand, industrial competitiveness, economic integration, and other economic dynamics. Education, training, and the labour market often struggle to keep pace with the rapid structural changes occurring in the global economy. This is a common challenge faced by many countries, including Malaysia. The following is the recommendation to build a more seamless, integrated, agile, responsive, and transformative talent ecosystem that will help the nation become a globally competitive nation:

3.2.2 RECOMMENDATION 1: LABOUR MARKET AND INDUSTRY COMPETITIVENESS

Foresighting and Futureproofing the Competitiveness of the Malaysian Labour Market and Industries

1. Conduct values-based assessment and regular foresight into global STIE trends and their impact on Malaysian economic sectors, industry, labour markets, and societal development.
    - i Foresighting must be undertaken jointly with industry and other stakeholders to map the ecosystems needed to future-proof their competitiveness and sustainability.
    - ii Frequency of foresight exercise: every two years and aligned with preparing five-year economic plans and mid-term reviews.
    - iii Key accomplishments, objectives, and outcomes should be assessed in midterm reviews. Effective refinements and adjustments should ensure that the STIE plans to construct robust dynamic capabilities (absorptive, adaptive, and innovative capabilities) and workforce and industry competitiveness in Malaysia.

2. The exercise should be jointly led by ASM, MiGHT, and the Economic Planning Unit (EPU).

Engaging in foresight activities of the Malaysian labour market and industries' competitiveness is imperative to obtain valuable insights into forthcoming trends, challenges, and opportunities. Policymakers, educational institutions, and businesses must proactively comprehend future trends, skill prerequisites, and industry dynamics to anticipate forthcoming changes effectively.

Examples of new industries that will emerge from converging STI platforms (based on the 10–10 *My*STIE Framework) are discussed below. Developing talent to harness the 10 global STIs will lead to recombinant innovations, which will not only enhance the competitiveness of existing economic sectors but also spawn new industries and create new value-added jobs. An EPU study showed that several subsectors of the manufacturing sector are at the lower end of the innovation value chain (refer to Figure 69). For example, textile & apparel and wood-based industries are considered laggard industries; machinery & instrumentation and transport equipment are imitator industries; and rubber & plastics and fabricated metals are adapter industries. Incorporation of the 10 global STI drivers in these industrial sectors will enable them to enhance their knowledge content and innovative capabilities. Figure 70 shows the types of emerging technologies (based on recombinant innovation from the 10–10 *My*STIE framework) that can transform the manufacturing sector to be more technology- and knowledge-intensive. Building strong innovative capabilities within the manufacturing sector will generate a significant spillover impact on the medical and healthcare, business and financial, environment and biodiversity, and agriculture and food sectors.

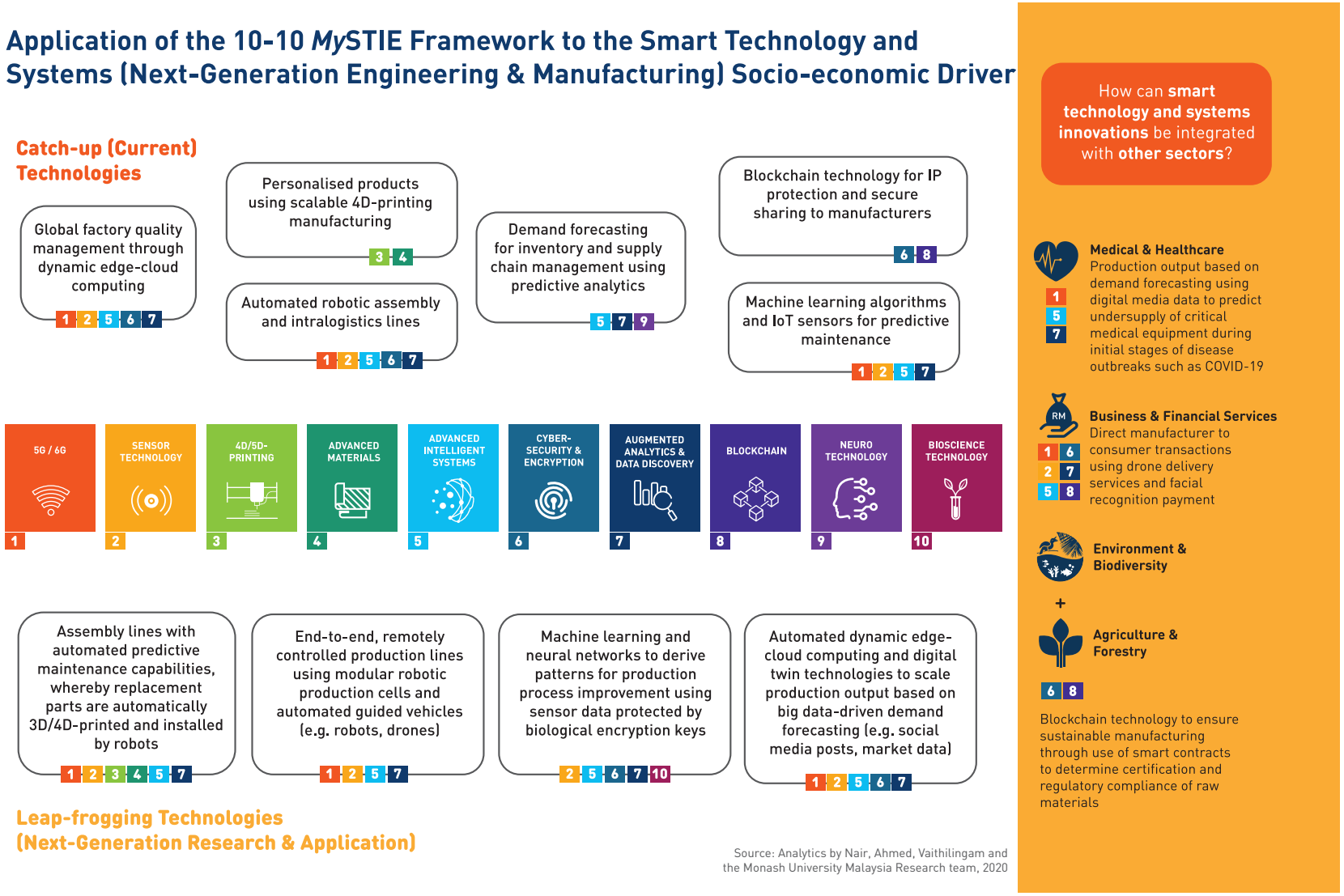


Figure 70: Key STIs to Transform the Manufacturing Sector to be Knowledge Intensive

Source: 10-10 MySTIE Framework. ASM, 2021

Another example is the agriculture and forestry sector, which has remained low-tech and uses cheap foreign labour. The agriculture sector is also one of the largest economic sectors and has one of the largest workforces in the country. This sector is critical for ensuring the food security of the country. Due to the low utilisation of technology, the sector is plagued by low productivity and is unable to provide adequate food for the country. As such, the country is highly dependent on foreign food products. This has a major capital drain on the country. Figure 71 shows examples of recombinant innovations (based

on the 10–10 *My*STIE framework) that can emerge in the agriculture sector. These new STI developments will have the potential to enhance the dynamic capability (absorptive, adaptive, and innovative capabilities) of the workforce in the agriculture sector. A highly tech-savvy workforce is critical for enhancing the competitiveness of the agriculture sector and enabling it to move up the global innovation value chain. The development of the new STIs in this sector will have a significant spillover impact on other sectors, such as the manufacturing sector, as more agri-technology will be developed and manufactured to cater to the increased demand in Malaysia and the region. It will also have a "knock-on" impact on the environment and biodiversity of the country as more eco-friendly agriculture technology is used in Malaysia. This includes a wider utilisation of biodegradable (renewable) energy sources, water sustainability models and technologies in the agriculture sector, and urban farming methods. Wider deployment of smart agriculture technology will also develop more resilient and sustainable agriculture communities. All of which will increase high-value-adding and stable employment jobs and increase the contribution of the agriculture sector to national wealth.

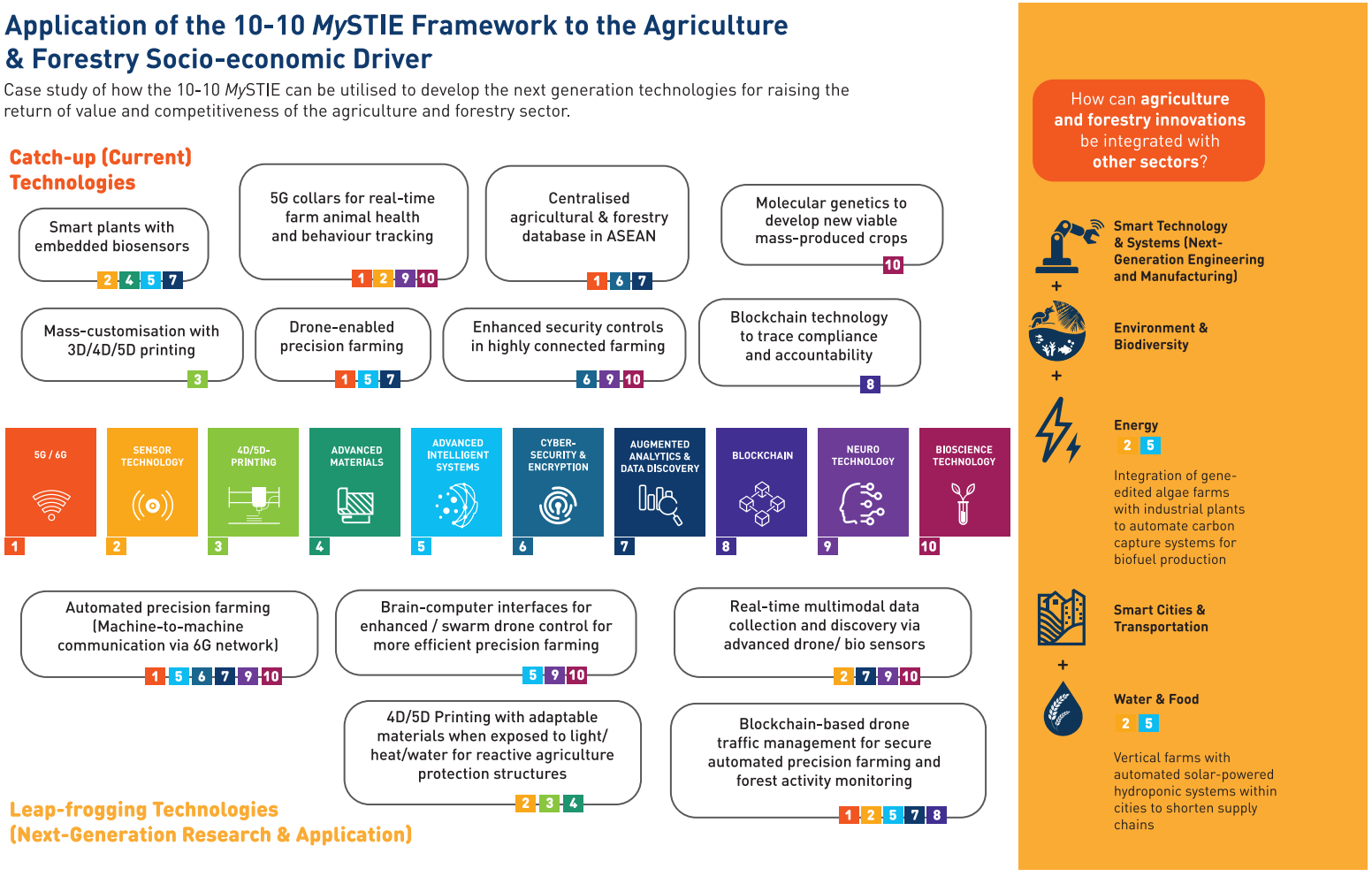


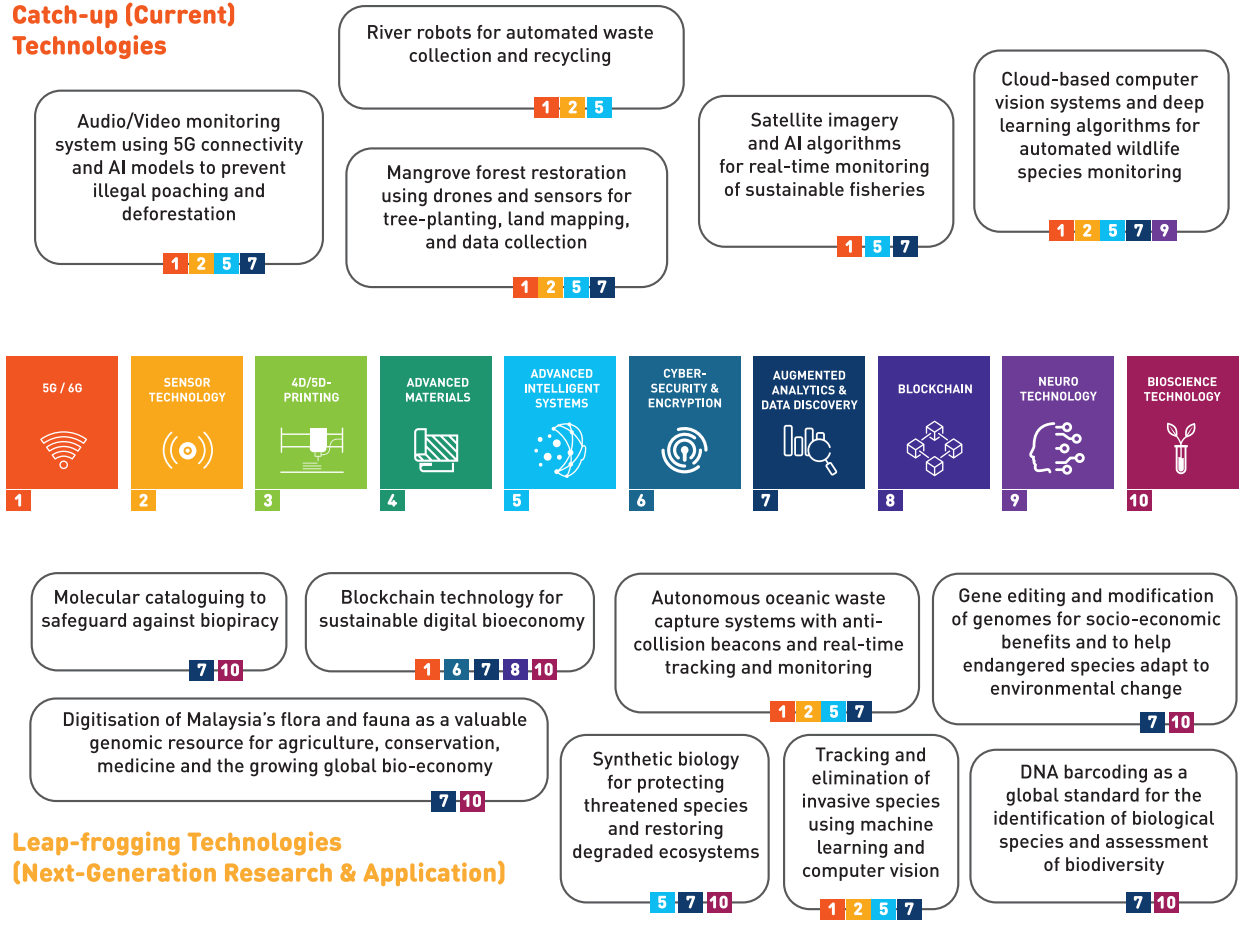
Figure 71: Key STIs to Transform the Agriculture & Forestry Sectors to be Knowledge-Intensive

Source: 10-10 MySTIE Framework. ASM, 2021

As highlighted in previous discussions, adherence to ESG and planetary health standards is going to be important for the Malaysian workforce and industries to be globally competitive. Foresighting on breakthroughs and discoveries in planet-friendly STIs will help industries adhere to planetary health boundaries and, at the same time, ensure the creation of high-value-added employment and broader socioeconomic development. Figure 72 shows the types of recombinant innovations that can emerge from the 10–10 *My*STIE that are related to the environment and biodiversity of the country. These have a significant spillover impact on key sectors such as water and food, tourism, smart cities, and transportation. Applications of STI foresighting in other economic sectors can be found in ASM (2021).

Another important game-changing industry is the halal industry, which produces goods and services that meet Shariah standards. In 2021, the Muslim markets will spend USD 2 trillion on various products such as food, pharmaceuticals, clothing, travel, media, and recreational products and services (Statista, 2023). This is envisaged to increase to USD2.8 trillion by 2025 (Statista, 2023a). Among the key sectors, food and beverages are the largest Muslim consumer market. The global Islamic financial market is also growing at a fast pace; in 2021, the value of the Islamic financial market was USD 3.95 trillion and is projected to increase to USD 5.9 trillion (Statista, 2023b). Over the years, Malaysia has built a strong halal industry. However, competition comes from regional markets and other countries with high Muslim markets. To move up the global halal market, Malaysia, with a small population and market, must become more productive, leveraging the strong STI infrastructure. These include building a strong halal supply chain using the 10-10 *My*STIE framework to value-add the ten socioeconomic drivers of the country. Figure 73 shows the role STI plays in developing new technologies that will raise the ROV of the halal industry and other related industries (as shown in Figure 74). A more knowledge-intensive halal industry has the potential to generate high-value-added industries and jobs for the Malaysian economy.

Application of the 10-10 *My*STIE Framework for Precision Biodiversity (Environment and Biodiversity Socio-economic Driver)



How can **precision biodiversity** be integrated with **other sectors**?

Water & Food
Blockchain to verify legal food sources and combat illegal fishing
8

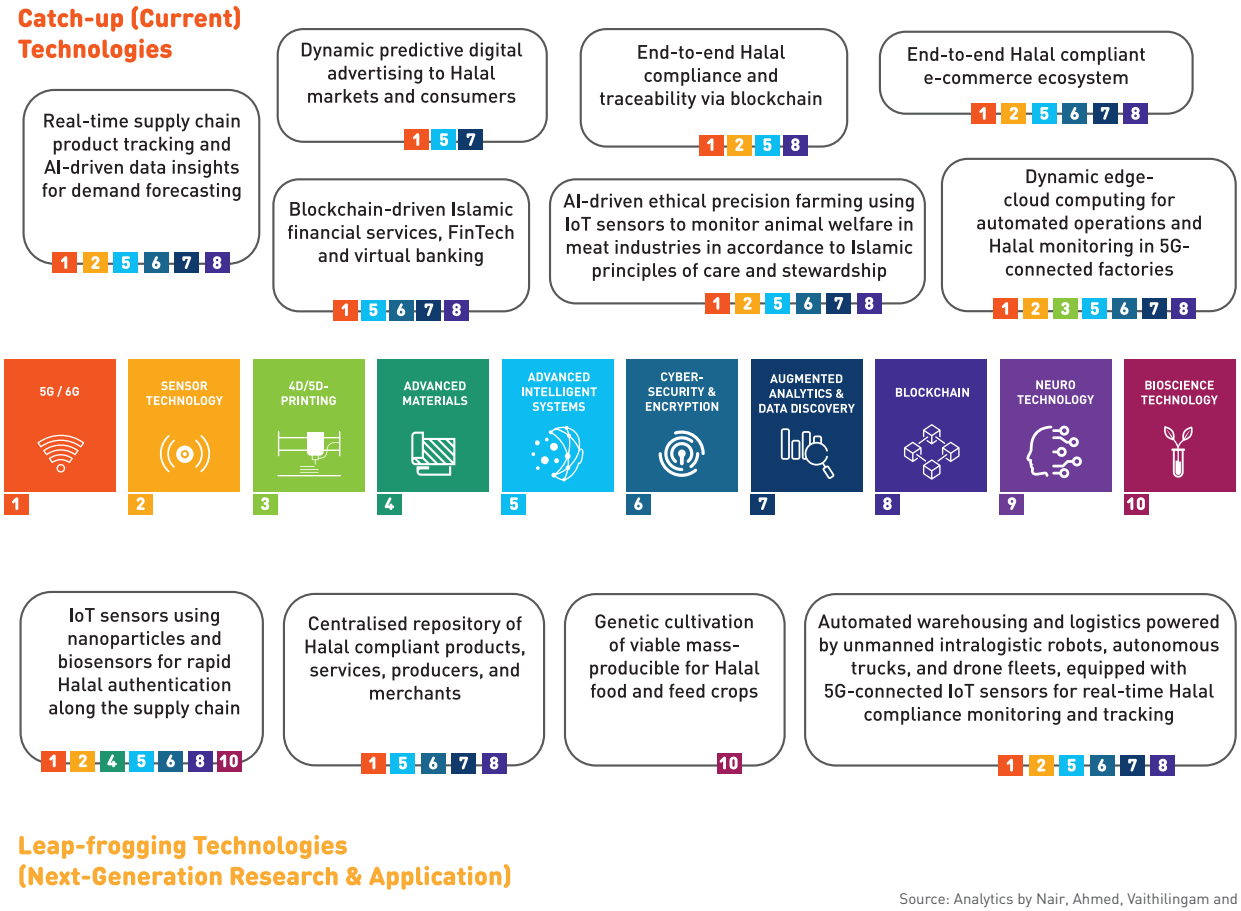
Culture, Arts & Tourism
Evaluating the environmental impact of ecotourism using machine learning algorithms
5 7 9

Smart Cities & Transportation
Active air pollution forecasting and solution provision using AI algorithms for pattern recognition using meteorological, satellite, traffic, and social network data
1 5 2 7

Figure 72: Key STIs in Precision Biodiversity to Power Planet-Friendly Industries

Source: 10-10 MySTIE Framework. ASM, 2021

Application of the 10-10 *My*STIE Framework: An Example for the Halal Supply Chain



Source: Analytics by Nair, Ahmed, Vaithilingam and the Monash University Malaysia Research team, 2020

How can other sectors leverage on **Halal supply chain innovations?**

Agriculture & Forestry
5G-connected biosensors for real-time monitoring of farms and fisheries for adulteration detection at source
1 4 2 5

Culture, Arts & Tourism
Personalised Halal-friendly holiday packages derived from pattern recognition of online search history and purchase behaviour
1 6 5 7

Medical & Healthcare
+
Business & Financial Services
6 8

Blockchain ledger tracing systems track certification of pharmaceuticals and medical devices manufacture for Halal assured healthcare services

Figure 73: Key STIs to Transform the Halal Industry to be Knowledge-Intensive

Source: 10-10 MySTIE Framework. ASM, 2021

Multiplier Effects of a Vibrant Halal Ecosystem on the 10 Socio-economic Drivers

GLOBAL HALAL SUPER CORRIDOR GAME CHANGER FOR MALAYSIA

A strong Halal ecosystem in Malaysia will serve to create several multiplier effects on the socio-economic drivers. The strength in the ecosystem will spawn new sectors, increase revenue streams and enhance Return on Value (ROV) for the rakyat

ENERGY
- Renewable Energy (ethical and clean energy)

BUSINESS & FINANCIAL SERVICES
- Halal Fintech for financial needs of Halal business
- Blockchain for green sukuk
- Traceability of financial transactions – ensure data privacy & protection, prevention of fraud and financial crimes

CULTURE, ARTS & TOURISM
- Islamic Culture & Arts
- Muslim friendly tourism – streaming of digital content of local culture and arts to the global community

MEDICAL & HEALTHCARE
- Halal vaccines, medical therapies and nutraceuticals clinical trials

SMART TECHNOLOGY & SYSTEMS (NEXT -GENERATION ENGINEERING & MANUFACTURING)
- Development of new smart-tech & devices to manage the Halal Industry
- Integrated system for Halal ingredient and product development

SMART CITIES & TRANSPORTATION
- Eco-friendly townships & transportation systems
- Halal supply chain (e.g. logistics, production, export and import) – seamless integration of multiple supply chains across multiple localities and jurisdictions

WATER & FOOD
- Food security and safe food systems
- Traceability of contamination in water and food sources

AGRICULTURE & FORESTRY
- Sustainable agriculture, fishery & forestry industries

EDUCATION
- Global Halal education industry covering STEM & non-STEM programmes / micro-credentials for the Halal economy

ENVIRONMENT & BIODIVERSITY
- Malaysia as a "Tropical Paradise" through the preservation and conservation of natural habitat in line with Islamic thought

Figure 74: Multiplier Impact of the Halal ecosystem to the other Socioeconomic Sectors

Source: 10-10 MySTIE Framework. ASM, 2021

In summary, talent ecosystems must keep abreast of STI developments globally to ensure that the industrial sector continuously builds dynamic capabilities. In this context, there must be key agencies in the country that undertake STI foresight to enable institutions in the country to develop catch-up and leap-frogging technologies. These include assisting firms, especially micro- and SMEs, to adopt these STIs to improve their processes, product design, and development. These will require appropriate institutional architecture and funding mechanisms to support the development of fundamental and translational R&D in core transformative STIs that will enhance the competitiveness of local talent and industrial supply chains.

Table 5: Use Case Scenarios on the Implementation of Strategic Foresight Exercise

Country	Initiative	Approach
South Korea	Frame Act on Science and Technology	The act mandates the Minister of Science, ICT, and Future Planning to work with relevant agencies, local governments, enterprises, research and education institutes, and S&T-related institutions to carry out foresight activities. The act also states that the government shall "periodically forecast development trends in S&T and accompanying changes in future society."
China	Foresight findings are incorporated into S&T planning and policy formulation.	Jointly led by the Chinese Academy of Science and Technology for Development (CASTED), the Chinese Academy of Engineering (CAE), the National Natural Science Foundation of China (NSFC), and the Chinese Academy of Sciences (CAS).
Japan	The National Institute of Science and Technology Polic (NISTEP) conducts foresight studies every five years to identify emergent technologies and trends that could significantly impact the economy and society. Contribute to the development and analysis of S&T indicators to assess the performance and impact of the country's R&D activities. These indicators help in monitoring progress and formulating evidence-based policies.	The foresight exercise employs networks of external experts and quantitative and qualitative data to assist the Japanese Government in formulating policies and strategies.

3.3 TALENT SKILLS FRAMEWORK

3.3.1 CHALLENGE 2: DOES MALAYSIA HAVE AN INTEGRATED FRAMEWORK FOR THE SUPPLY OF TALENT IN VARIOUS INDUSTRIES?

The persistent problem of the skills gap in the Deep Tech and Translational Tech domains is related to the mismatch between the skill sets currently held by the workforce and the required skills and competencies essential for efficiently functioning in these specialised domains. Advanced and ground-breaking technologies fall under the purview of the deep and translational tech domains, which call for a certain set of proficiencies, skills, and competencies.

According to the Science Outlook 2017 report, the industry will require more than 1.0 million professionals in STEM by 2020. This demand for STEM talent was expected to be driven by both national economic initiatives and regional economic corridors. This projection must consider the relevant competencies required for comprehensive talent planning and be aligned with the STI foresight exercise. A recent ASM foresight study based on the 10–10 *My*STIE has identified 30 niche sectors that will contribute to the economic development of the nation. The talent development plan should focus on the 30 STIE niche areas: 12 economic boosters, 7 societal well-being catalysts, and 11 dual enablers (refer to Figure 75).

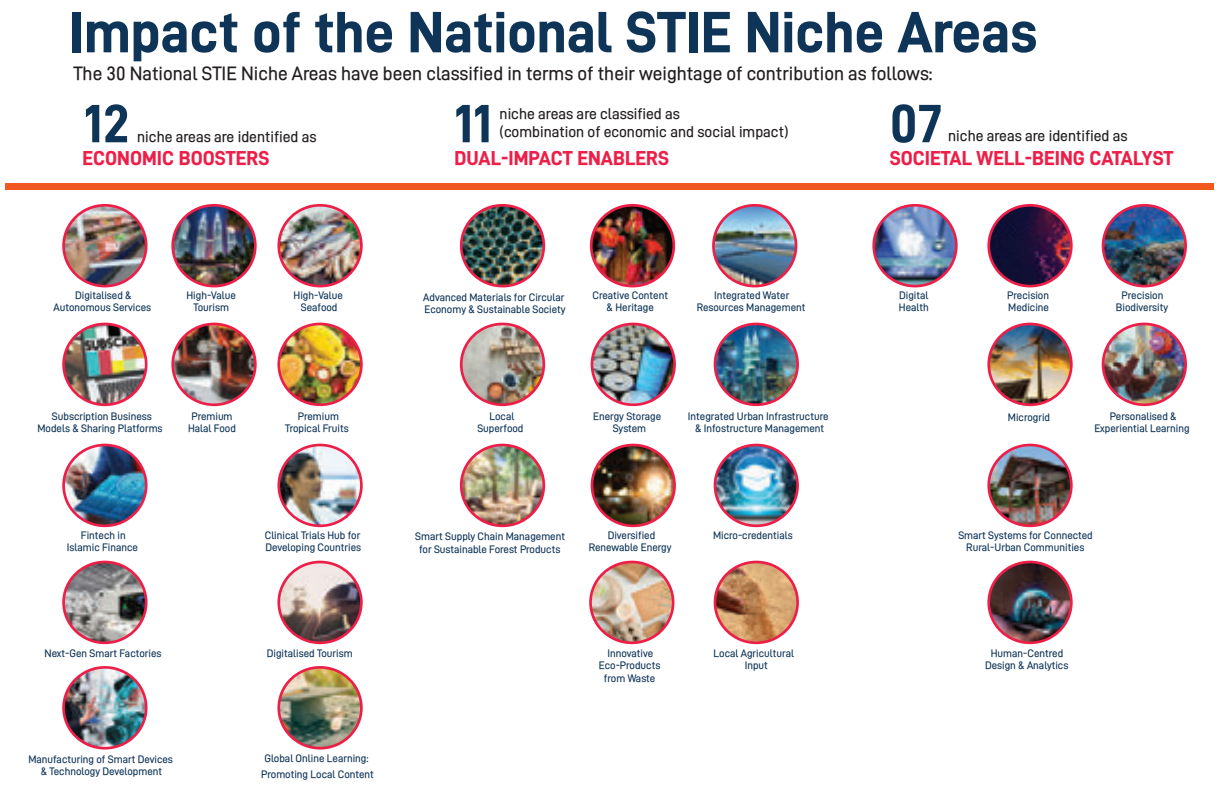


Figure 75: Talent Development in the 30 STIE Focus Niche Areas

Source: 10-10 Malaysian Science, Technology, Innovation and Economy (MySTIE) Framework. ASM, 2020

In this regard, Malaysia has established multiple skill frameworks to address the specific needs of diverse organisations and industries. These frameworks provide a structured approach to assessing, improving, and recognising proficiencies and abilities within specific industries. However, the growth of the skill frameworks may result in complexities, as these frameworks may not accurately forecast the future industry requirements of the country, which require talent with multidisciplinary skillsets (from the perspective of technical competence, sharp, and smart skillsets). To address this problem, there is a need to harmonise and align skill frameworks with the changing demand for talent in the domestic market. The following is the recommendation:

3.3.2 RECOMMENDATION 2: TALENT SKILLS FRAMEWORK
Formulation of National Critical Competencies/Skills Framework

1. To streamline and consolidate the National Critical Competencies/Skills Framework as a single point of reference that harmonises the different skills taxonomies across government ministries and industries towards addressing the skills gaps faced in Malaysia (e.g., HRD Corp. uses the Industrial Skills Framework, the Department of Skills Development uses the National Occupational Skills Standard, etc.).

2. The National Competencies or Skills Framework should also identify critical and emerging skills and jobs in Malaysia and adapt to every state in Malaysia:
    i. Critical Occupations List (COL) from Talent Corp.
    ii. Industry-relevant skills from the Industrial Skills Framework.
    iii. Wages data from the Department of Statistics Malaysia (DOSM): implementation of a progressive wage plan to attract and retain the best talent in the local industrial sectors.

3. The framework should shift away from focusing only on labour market shortages and instead undertake industrial transformation and shifts, including projections of future jobs and competencies needed by industries across Malaysia (in urban, semi-urban, and rural localities of the country).

By overcoming the challenges related to the application of multiple skill frameworks, Malaysia can cultivate a more cohesive and effective skills ecosystem that enhances the development of the workforce, reduces the occurrence of skill mismatches, reduces dependence on cheap labour, and facilitates the process of lifelong learning.

Table 6: Use Case Scenarios on the Formulation of National Critical Competencies/Skills Framework

Country/Organisation	Initiative	Approach
World Bank	Analysis of "Strengthening the Critical Occupations List (COL) and Leveraging the Malaysian Diaspora"	i. A survey on the relevance of COL reported that 95% of respondents acknowledged the importance of having a list of critical occupations. However, only 39% were aware of TalentCorp's COL, while only 24% had utilised it. ii. The COL only captures the industries' need for a given year (skills shortage) and does not project the critical occupations in the coming years or estimate future shortages (e.g., Australia's Skills Priority List).
Australia	Jobs and Skills Australia (JSA) Act 2022	JSA is an independent agency advising the Australian Government on current, emerging, and prospective labour market and workforce skills and training requirements. JSA generates annual Skills Priority List reports that include a list of job openings in Australia, a five-year skills outlook, and projections of the jobs that will be in demand.

3.4 COLLABORATIVE TALENT NETWORK

3.4.1 CHALLENGE 3: WHICH NETWORK UNDERSCORES THE COLLABORATION BETWEEN ACADEMIC INSTITUTIONS AND INDUSTRIES FOR FINANCING INITIATIVES AND THE FUTURE OF WORK?

In recent years, public universities have transformed their revenue models, necessitating self-sustainability and reshaping industry collaborations. In the past, public universities have relied on financial assistance from the government to maintain their institutional operations and academic activities. The demand for financial sustainability has a bearing on many facets, such as diversification of revenue streams, prioritising industry funding and sponsorships, and building collaborative research and development. Strategic collaboration with industries and other government-linked research organisations (GLROs) has compelled universities to diversify their revenue streams, strengthen their research capabilities, and offer education and training that aligns with industry requirements. The collaboration between universities, industries, and PRIs is evident in their efforts to close the skills gap and align education with the needs of the labour market. The following is the recommendation:

3.4.2 RECOMMENDATION 3: COLLABORATIVE TALENT NETWORK

Future-ready Talent Collaborative Network (FuTCoN)

1. Enhance existing industrial and knowledge networks and expand their reach and richness to other industrial and knowledge networks:
    i. Founding members would consist of all public and private scholarship providers and key ministries related to talent development.
    ii. FuTCoN acts as a neutral entity (like i-Connect) that provides advice and recommendations to the government (e.g., establishes a policy that highlights the focus on contributing back to society).
    iii. Encourage a culture of cross-pollination of ideas and knowledge among universities, TVET providers, and GLROs with access to state-of-the-art R&D, teaching, and training facilities.
    iv. Founding members should include national public and private scholarship providers to coordinate and plan the distribution of funds.
    v. The network would develop and govern a database and intelligent systems to match and facilitate talent opportunities in deep tech and future skills.

The collaborative talent network is a structured platform that aims to tackle the challenges associated with university-industry collaborations. It facilitates collaboration, resource sharing, and the alignment of efforts among universities, industries, and government agencies to develop skilled talent. This initiative is expected to address the skills gap, promote innovation, and enhance graduate employability.

Table 7: Use Case Scenarios on Future-ready Talent Collaborative Network

Country/Organisation	Initiative	Approach
France	The French National Network of Microelectronics and Nanotechnologies (CNFM) is a network of 12 interuniversity centres affiliated with an academic institution and two industrial organisations.	CNFM seeks to establish joint interuniversity centres to prepare students for the future, as well as an innovation strategy with new practices adapted to future technologies
Malaysia	Malaysia Technology Development Corporation (MTDC)	MTDC established a technology incubation centre to foster prototype research. Collaboration with public universities encourages the establishment of university-based technology centres.
	Penang Skills Development Centre (PSDC)	PSDC is a non-profit TVET training provider administered by a Penang-based council of industry representatives. PSDC's skills certification programmes are co-created with industry partners, leveraging the networks of over 246 companies.

3.5 NEXT-GENERATION STI SKILL DEVELOPMENT

3.5.1 CHALLENGE 4: WHICH TRAINING INITIATIVES AIM AT DEVELOPING HIGHLY SKILLED STI TALENT TO SUPPORT HIGH-TECH INDUSTRIES IN MALAYSIA?

Next-generation skill training refers to developing and acquiring skills essential for thriving in the future workforce that are needed by the 10 socioeconomic drivers of the country. As technology advances and industries evolve, there is a growing demand for new sets of skills that go beyond traditional knowledge and abilities. The inadequate practical training and laboratory experience provided to STI students is a significant problem that could affect multiple facets of their academic journey and career prospects. This phenomenon would result in a skill gap where STEM graduates do not understand industry practices. Such disconnected learning experiences will result in a lack of necessary practical skills in the workforce. The limited funding resources allocated to public research institutions have also impacted the quality of education provided, specifically in students' practical training and laboratory experience. Institutions must invest strategically and prioritise enhancing teaching and learning standards to overcome this financial limitation. Investing in infrastructure improvements and ensuring its alignment with industry needs is crucial for TVET institutions and institutions of higher learning to produce high-quality talent. The following is the recommendation:

3.5.2 RECOMMENDATION 4: NEXT-GENERATION STI SKILL DEVELOPMENT

Establish deep and trans-tech forward schools to provide next-generation skills training. This recommendation focuses on establishing Deep and Trans Tech Forward Schools based in all regions of Malaysia. The Deep & Trans Tech Forward School will be established through a consortium model between anchor industry partners, universities, GLROs, and TVET institutions to provide higher technical skills training in deep and translational technology areas. The government should dedicate funds to incentivise the setting up of these consortiums and to have an open bidding process to facilitate collaboration and partnerships in key areas and localities across the country. These Deep and Translational Tech Forward Schools are to:

1. Adapt a collaborative partnership model to deliver effective training in high-technology areas where members of the consortium have a cost-sharing mechanism for resources.

2. The consortium should consist of the following:
    i. Centres under the Federation Malaysian Skills Development Centre (FMSDC) provide TVET training resources.
    ii. Public/private universities and Government-linked Research Organisations (GLROs) institutes – access to high-end facilities and insights into deep technologies (an important source of training and research for students and researchers from institutions of learning in the country)
    iii. Industry players provide direct input into the TVET curriculum structure, providing experiential learning and employment opportunities.

3. To identify critical occupations, critical skills, tasks, vacancies, and wages.

Deep Tech Forward Schools should be established throughout Malaysia in the northern, central, eastern, southern, Sarawak, and Sabah regions based on their strengths and prospective areas of emphasis.

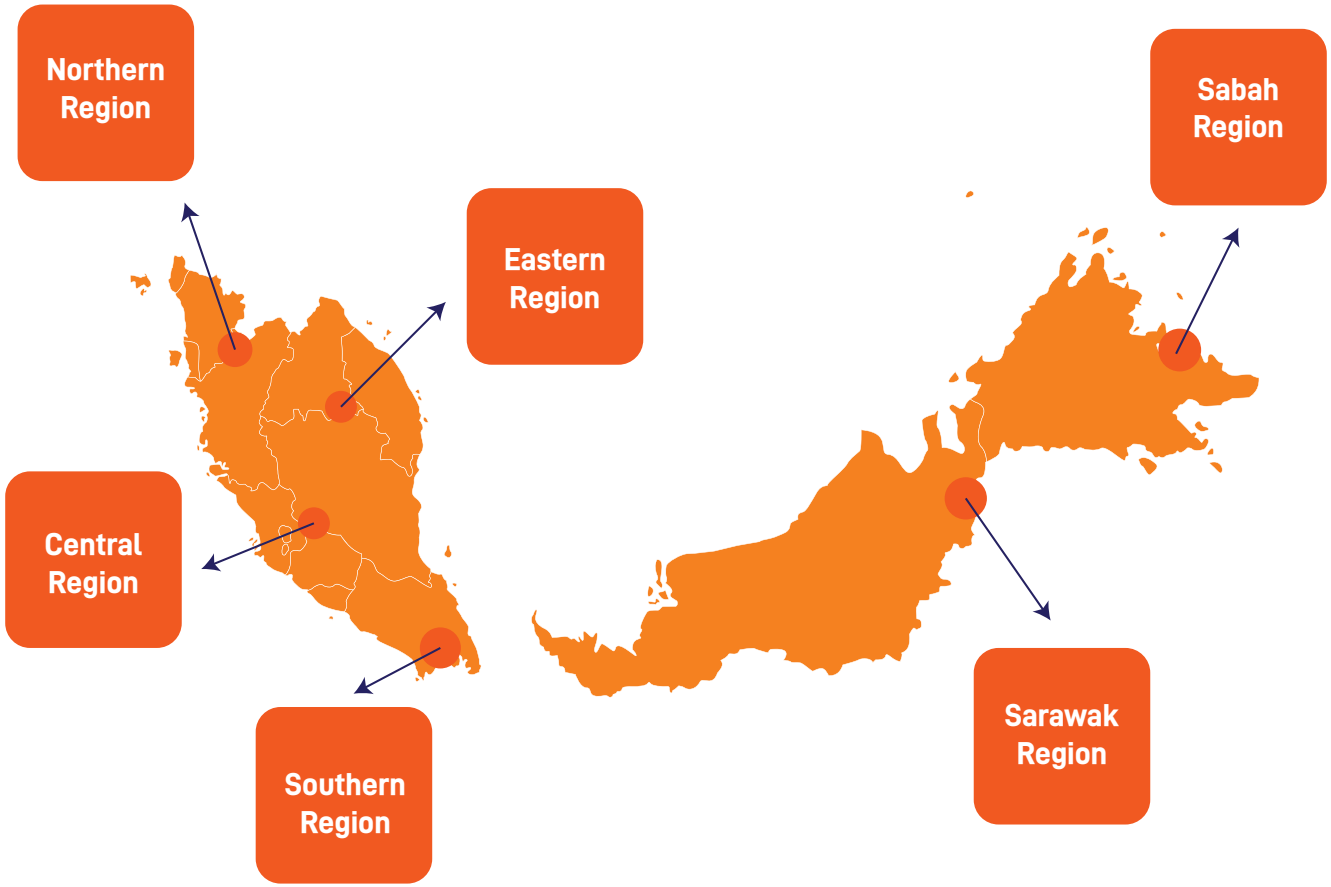


Figure 76: The Distribution of Deep Tech Forward Schools Across Six Regions

Source: ASM Analytics, 2023

Each Deep Tech Forward School must be established by bringing the following stakeholders together to collaborate and provide input on deep technologies for each cluster:

- Private and public universities
- TVET providers
- Lead employers
- Foundations and charitable organisations

As an ongoing initiative, the Prime Minister's Budget Speech for 2023 announced a pilot programme involving collaboration between federal TVET institutions and 50 companies, predominantly multinational corporations. A lead company will oversee, partially or entirely, the training programmes offered by TVET institutions, community colleges, Industrial Training Institutes (ILP), and Youth Skill Institutes (IKBN) that align with industry requirements. These leading firms are listed below:

Figure 77: Training Clusters by Companies

Source: Budget Speech 2023. MOF, 2022

Table 8: Use Case Scenarios on the Establishment of Training Consortium and Forward Schools

Country	Initiative	Approach
United Kingdom	Institutes of Technology (IoTs)	A physical education institution that offers a variety of higher technical courses (primarily at levels 4 and 5) across STEM-related sectors (e.g., advanced manufacturing, agriculture, and health sciences) via higher apprenticeships, higher technical qualifications, degrees, flexible courses for adults looking to reskill or upskill, and T-levels (technical-based qualifications through an industry placement of at least 315 hours). IoTs are developed in collaboration with employers, further education (FE), and higher education (HE) institutions. • The employer designs and administers the provided courses and training. • FE and HE primarily invest in facilities and provide equipment for students advancement. • IoT provides access to industry-standard facilities, offers the necessary skills for • the economy, and collaborates with experts in the industry to meet industry demand. • The IoT network is supported by the Gatsby Foundation. As of 2021, the UK government had invested £170 million in the development of twelve IoTs. To date, these IoTs comprise 40 FE providers, 60 leading employers and 18 universities. In 2021, an additional £6.4 million was invested to enable 10 IoTs to offer complimentary courses to those over the age of 19 as part of a pilot programme.
Malaysia	MIMOS STC	Undertakes numerous types of local talent training: i. Trains engineering graduates in failure analysis (FA) and wafer fabrication in collaboration with local universities. ii. Upskilling talent in companies by providing access to industrial-grade equipment and facilities.
	Forward Schools	A technology and future skills school offering a variety of online and on-campus instruction in coding, data science, design, digital marketing, etc., led by industry professionals.
	Academy in Factory (AIF)	A training programme that combines classroom learning with hands-on experience in a factory setting.

3.6 INCENTIVE SCHEME FOR STI TALENT

3.6.1 CHALLENGE 5: HOW DOES MALAYSIA RETAIN STI TALENT FOR EARLY CAREER DEVELOPMENT AND LONG-TERM RETENTION?

How does a country attract highly skilled STI talent? One method that can effectively promotethe early career development of STI talent is the provision of tax incentives. By providing taxincentives, governments encourage individuals, businesses, and institutions to invest in S&T activities and support the development of a skilled and innovative workforce. Currently, Malaysia does not offer such tax incentives. Current tax relief under education is restricted to individuals paying for post-secondary education at an institution of higher learning. In addition, many STI professionals are contemplating a career change due to the absence of flexibility in STI careers. Organisations and industries should resolve the lack of flexibility in STI careers to attract and retain top talent, as the gig economy offers a superior work environment and income. The following is the recommendation:

3.6.2 RECOMMENDATION 5: INCENTIVE SCHEME FOR STI TALENT
Offer a Competitive Incentive Package to Attract High-Skilled STI Talent

1. To provide a tax exemption for early-career Malaysians working in deep-tech and future skills jobs in Malaysia for up to 10 years.
    i. The tax break would define the nature of the activity performed by STI workers in a company and list the eligible STI areas for exemption. The tax exemption terms will be reviewed regularly to ensure they meet the demands of industries in strategic technology. This would encourage STI workers to remain in their field for many years to access these incentives and build strong experience and expertise in the STI areas.

2. To provide options for flexible working arrangements for employees under the Employment Act to promote work-life balance.
    i. Malaysia has introduced a flexible working arrangement provision in the Employment Act 2022. The flexible working arrangement is limited in hours, days, and place of work. However, the flexible working arrangement is not mandatory for employers to implement a flexible working policy.
    ii. The flexible work arrangement is granted based on STI-based jobs. Activities such as information gathering and processing, learning, coaching, and digital work may be conducted remotely. Activities that require manual labour, such as operating machines, using the lab, and fixing equipment, cannot be done remotely.

3. To develop an industry-led STI jobs guarantee programme.
    i. Industry would notify the government of the number of jobs needed, and the government would incentivise tax incentives for participating industries and support talent development programmes.
    ii. Industry works with the government to provide industry placement, guaranteed jobs within the industry, and government services to address the lack of jobs.

Governments must evaluate the local ecosystem, industrial needs, and policy goals to customise tax incentives that can efficiently encourage the initial professional growth of STI talent, thereby facilitating economic expansion and innovative advancements. To attract, engage, and retain skilled professionals in STI, organisations may establish policies and practices that promote work-life balance, career development, and cultivate a flexible culture. In the rapidly evolving realm of STIs, this phenomenon provides advantages to individual employees and reinforces organisations' overall success and innovation.

Table 9: Use Case Scenarios on the Tax Incentive Package and Flexible Working Arrangement

Country	Initiative	Approach
Romania	Introduction of a full personal income tax break	This incentive is for programmers employed by software companies (eligible programming-related occupations, bachelor's degree in an IT-related field).
Malaysia	The amendment on tax exemption was introduced in 2013	The 2013 amendment significantly broadened the policy's purview by expanding the list of eligible sector codes and bachelor's degree specialisations.
Singapore	The Civil Service of Singapore	Introduced flexible work options, including flexitime/staggered hours, formal teleworking, homeworking, job sharing, a compressed work week, and part-time work. In 2020, 78% of
Australia	The Fair Work Act	The Act allows employees to request flexible working arrangements, including hours of work, work patterns (split shift and task sharing), and location.

3.7 LOCAL TALENT CAPABILITY DEVELOPMENT

3.7.1 CHALLENGE 6: WHAT STRATEGIES DOES MALAYSIA EMPLOY TO ATTRACT GLOBAL TALENT AND MITIGATE THE OUTFLOW OF SKILLED INDIVIDUALS?

Numerous nations compete aggressively to attract skilled talent from around the world. The United States, Canada, Australia, and Singapore have established themselves as popular destinations for global talent due to their robust economies, strong educational institutions, and favourable immigration policies. This increased competition, lack of targeted initiatives, and constant policy changes make it difficult for Malaysia to attract the world's best talent. The phenomenon of brain drain, which refers to the emigration of highly skilled people from one country to another, is another concept involving the global mobility of skilled individuals. In the case of Malaysia, it is attributable to several push factors, including dissatisfaction with current policies, differences in earning potential, lack of career prospects, quality of education concerns, and enhanced quality of life abroad (World Bank, 2011). Attracting global talent aims to bring skilled professionals into a nation to fill skill gaps. This is a key strategy to stimulate innovation in strategic STI areas that will enhance the dynamic capabilities of the workforce and industry. As the workforce creates strong dynamic capabilities, it will have an endogenous impact on attracting more talent and investments into the industrial ecosystem and the country. All of which will strengthen the domestic supply chain and nurture next-generation industries and jobs. However, countries that do not create a conducive STI environment will experience the loss of talented workers to other, more attractive ecosystems. The loss of STEM talent to other countries will have a major impact on the economic growth trajectory. The following is the recommendation to build strong dynamic capabilities in the local workforce.

3.7.2 RECOMMENDATION 6: LOCAL TALENT CAPABILITY DEVELOPMENT
Attracting World-Class Top STIE Talent and a Skilled Diaspora to Enhance Local Talent Development

1. To leverage existing permanent residence (PR) and STI-related visa/employment pass (EP) platforms (e.g., Talent Corps' RPT programme and MDEC's DE Rantau programme), there is a need to expand the scope of these programmes to include a dedicated lane or programme for leaders in deep tech and future skills.

i. The PR and EP should be expanded to include criteria for world-class technology leaders who have led high-value corporations and/or developed technology applications experts in their field. These are to encourage them to use Malaysia as a 'test-bed' to develop new technologies and next-generation STEM talent in areas related to the 10-10 MySTIE and future STIEs that will shape Malaysia's socioeconomic development.

ii. PR and EP should be linked to KPIs, including talent-related targets where the individuals must train and mentor local talent for a specified number of years in critical areas aligned to the 10-10 MySTIE.

Minimum Eligibility Criteria

- Has worked in Malaysia for at least 3 years
- Holds a valid Employment Pass (EP) at the time of application, with at least 3 months' validity
- Possesses a minimum of 5 years of total work experience
- Holds a Diploma or above (Degree/ Masters/ PHD) or a Professional Certificate from a recognised Professional body
- Earns a basic monthly salary of RM15,000, excluding allowances (effective 1st Feb 2017). For lecturers & doctors, a basic monthly salary of RM8,000, excluding allowances
- Has filed income tax in Malaysia and paid taxes for a minimum of 2 years

Benefits

Figure 78: TalentCorp Residence Pass-Talent (RP-T)

Source: Residence Pass-Talent (RP-T). TalentCorp, 2017.

2. Encouraging local STI diaspora living abroad to return to Malaysia to build strong STEM talent and industries of the future-this is done by expanding and enhancing the Returning Experts Programme (REP)to include information on:
   i. Skills requirements based on in-demand jobs and the Critical Occupation List (COL)
   ii. Opportunities in deep tech and future skills relevant to their expertise based on the 10-10 MySTIE Framework
   iii. Inclusion of mentoring roles for local talent in their fields of expertise for a set number of years

3. Intensification of mapping and utilisation of Malaysian STI diaspora who are well-established overseas to connect with and mentor local talent through their institutions as well as to support development projects based on their fields of expertise.
   - Mapping high-skilled STI talent to become STI ambassadors to promote local STI products and innovation.

4. Introduce a "work visa" for foreign students, similar to the H-visa in the United States, who have completed their studies at a Malaysian institution of higher learning in key STI strategic areas with a major talent shortage. This will increase the talent pool in key STI areas at a rapid pace in a much more cost-effective way.

The attraction of world-class STIE talent and skilled diaspora, as well as the enrichment of the local talent pool, will necessitate an integrated strategy to nurture a vibrant STIE ecosystem in Malaysia. This multifaceted approach entails putting in place the following: pro-STEM talent immigration policies; competitive financial and tax incentives; continuous improvement of the STI infrastructure and infostructure; investing in capability development programmes (to build the dynamic capability of the workforce); incentives to foster strong collaboration among industry, government agencies, GLROs, community organisations, and the Rakyat; and the relentless effort to meet global standards and best practices related to ESG and planetary health issues.

Table 10: Use Case Scenarios in Attracting World-Class Top STIE Talent and Skilled Diaspora for Local Talent

Country	Initiative	Approach
Singapore	Tech.Pass	Dedicated visa lane for high-value, highly-experienced technology leaders to conduct disruptive and cutting-edge innovations in Singapore.
Australia	Global Talent Visa	Australia's next generation of home-grown talent will be mentored and developed through the provision of immediate visas to those who excel in one of ten targeted sectors.
Israel	Integration in Science Programme	Pathway for New-Immigrant and Returning-Resident Scientists to Return to Israel, including Funding Assistance and Facilitation Throughout the Integration Process.
European Union	Global mapping of diaspora engagement under the EU Global Diaspora Facility (EUDiF)	• Consolidating knowledge through mapping and research on diaspora-development policies, practices, and priorities in partner countries, in addition to diaspora-led initiatives. • Capacity development activities for local, national, and regional authorities in partner countries, as well as diaspora organisations. • Ideas exchange and partnership building through dialogues. • Mobilising diaspora professionals to support development initiatives in their home countries.

The six key recommendations mentioned above are pivotal to ensuring Malaysia transitions to becoming a developed nation by 2030, aligned with the six core values of Malaysia MADANI. The smart and sharp skills geared towards the value-based (ROV) mindset of the 8R Centric Philosophy proposed in this study are the way forward in developing the next-generation talent that will develop humanising technology that addresses the 17 United Nations' Sustainable Development Goals and a planet-friendly development agenda of the nation. The global economy is changing at "warp speed." Malaysia needs to invest in STEM talent and the enabling ecosystem that will enable the country to be globally competitive and be at the forefront of the global development agenda. More importantly, the new talent ecosystem will place the nation in a better position to mitigate the risks associated with a more DVUCA world. The recommendations provided in the report will help Malaysia nurture the next-generation talent and industries that will power Malaysia's transition to becoming a developed country while preserving its beautiful natural habitat and biodiversity for future generations and the global community.

REFERENCES

REFERENCES

1. Academy of Sciences Malaysia. (2018). Science Outlook 2017: Converging Towards Progressive Malaysia 2050 [online]. Available from: https://www.akademisains.gov.my/asm-publication/science-outlook-report-2017/ [accessed 10 March 2022].
2. Academy of Sciences Malaysia. (2021). Science Outlook 2020: Unlocking the Future [online]. Available from: https://www.akademisains.gov.my/asm-publication/science-outlook-report-2020/ [accessed 19 May 2023].
3. Bell, J., Crowley, K., Storksdieck, M., Besley, J., Cannady, M. A., Nelson, A. G., Phillips, T., Riedinger, K., and Ballard, M. (2019). Defining and Measuring STEM Identity and Interest in STEM Learning. Volume 1, Issue 12. Richmond. Connected Science Learning.
4. Chartered Institute of Personnel and Development. (2019). The Future of Talent in Malaysia 2035 [online]. Available from: https://www.cipd.org/globalassets/media/knowledge/knowledge-hub/reports/future-of-talent-malaysia-report_tcm23-53251.pdf [accessed 19 May 2023].
5. Darussaman, M. S. (2020). Graduate mismatch in the labour market [online]. Available from: https://www.thestar.com.my/news/nation/2020/09/27/graduate-mismatch-in-the-labour-market [accessed 14 February 2022].
6. Devisakti, A., Muftahu, M., and Xiaoling, H. (2023). Digital divide among B40 students in Malaysian higher education institutions. Education and Information Technologies [online]. 29:1857–1883. Available from: https://doi.org/10.1007/s10639-023-11847-w [accessed 24 January 2024].
7. Department of Statistics Malaysia. (2020). Graduates Statistics 2019 [online]. Available from: https://newss.statistics.gov.my/newss-portalx/ep/epFreeDownloadContentSearch.seam?cid=8405 [accessed 24 January 2024]
8. Department of Statistics Malaysia. (2020). Labour Force Survey Report Fourth Quarter [online]. Available from: https://newss.statistics.gov.my/newss-portalx/ep/epFreeDownloadContentSearch.seam?cid=8422 [accessed 24 January 2024]
9. Dyrin, S., Kornilova, I., Sabirov, I., Asratyan, N., Vazieva, A., & Gayfutdinova, T. (2021). Life Plans of Graduates of Technical and Vocational Education Institution. SHS Web of Conferences, 97, Article ID: 01046. [accessed 24 January 2024]
10. Economic Planning Unit (2016). Malaysian Knowledge Content Study – III (MyKE-III Phase 1) [online]. Available at: https://www.ekonomi.gov.my/sites/default/files/2020-02/MYKE_PHASE_1_part1.pdf [accessed 24 January 2024]
11. Esquivel, K., Elam, E., Paris, J., & Tafoya, M. (2021). How children develop Identity. Retrieved from https://socialsci.libretexts.org/Bookshelves/Early_Childhood_Education/Book%3A_The_ Role_of_Equity_and_Diversity_in_Early_Childhood_Education_(Esquivel_Elam_Paris_an d_Tafoya)/03%3A_The_Development_of_Identity_in_Children/3.02%3A_How_Children_Develop_Identity
12. Fanning, A.L., O'Neill, D.W., Hickel, J., and Roux, N. (2022). The social shortfall and ecological overshoot of nations. Nature Sustainability, 5(1), 26-36. doi:10.1038/s41893-021-00799-z
13. The International Labour Organization (2013). Global Employment Trends 2013: Recovering from a second jobs dip. Geneva: The International Labour Organization.
14. MIT Sloan Management Review (2022). Toxic Culture Is Driving the Great Resignation. Retrieved from https://sloanreview.mit.edu/article/toxic-culture-is-driving-the-great-resignation/
15. NST Online (2022). Govt gives serious attention to STEM, says PM [NSTTV]: New Straits Times. Retrieved from https://www.nst.com.my/news/nation/2022/09/832827/govt-gives-serious-attention- stem-says-pm-nsttv
16. TWAS (2018). The unknown number. Retrieved from https://twas.org/article/unknown-number
17. The International Labour Organization (2024). What is skills mismatch and why should we care? Retrieved from https://www.ilo.org/skills/Whatsnew/WCMS_740388/lang--en/index.htm

18. World Bank (2021). The State of the Global Education Crisis: A Path to Recovery. Retrieved from https://www.worldbank.org/en/topic/education/publication/the-state-of-the-global-education-crisis-a-path-to-recovery
19. McKinsey & Company (2022). The Great Attrition is making hiring harder. Are you searching the right talent pools? Retrieved from https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/the-great-attrition-is-making-hiring-harder-are-you-searching-the-right-talent-pools
20. McKinsey & Company (2021). 'Great Attrition' or 'Great Attraction'? The choice is yours. Retrieved from https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/great-attrition-or-great-attraction-the-choice-is-yours
21. ISIS (2020). Youth Unemployment in Malaysia & the Region. Retrieved from https://www.isis.org.my/2020/01/10/youth-unemployment-in-malaysia-the-region/
22. ISIS (2021). Researcher calls for better TVET teachers to produce skilled workers. Retrieved from https://www.isis.org.my/2021/12/24/researcher-calls-for-better-tvet-teachers-to-produce-skilled-workers/
23. ISIS (2021). Experts: Fresh grads' pay as low as RM1,000 a systemic problem, can't just blame Covid-19 pandemic. Retrieved from https://www.isis.org.my/2021/04/15/experts-fresh-grads-pay-as-low-as-rm1000-a-systemic-problem-cant-just-blame-covid-19-pandemic/
24. Jayabalan, J., Dorasamy, M. and Raman, M. (2021), Reshaping Higher Educational Institution through Frugal Open Innovation, Journal of Open Innovation, 7(2), 145; https://doi.org/10.3390/joitmc7020145
25. Korn Ferry (2018). Future of Work - The Global Talent Crunch Country Perspective: Malaysia. Retrieved from: https://focus.kornferry.com/wp-content/uploads/2015/02/KF-Talent-Crunch-Country-Report-Malaysia-Digital.pdf
26. Khazanah Research Institute (2018). The School-to-Work Transition of Young Malaysians. Kuala Lumpur: Khazanah Research Institute.
27. Leeds University (2020). A Good life for all planetary boundaries,. Retrieved from https://goodlife leeds.ac.uk/
28. Roser, M., and Ortiz-Ospina, E. (2016). Global Education [online]. Available from: OurWorldInData.org. Available at: https://ourworldindata.org/global-education [accessed 24 January 2022]
29. MDEC (2021). Digital Talent Snapshot in Malaysia Q2, 2021. Retrieved from: https://mdec.my/wp-content/uploads/Digital-Talent-Snapshot-Q2-2021-PDF-compressed-1.pdf
30. Ming Lee S. (2022). Gender Differentials in Educational Profile and Field of Study among Residents. Retrieved from: https://www.singstat.gov.sg/-/media/files/publications/population/ssn222- pg16-19.ashx
31. MOE (2013). Malaysia Education Blueprint (2013-2025). Putrajaya: Ministry of Education.
32. MOHE (2019). Laporan Kajian Pengesanan Graduan. Putrajaya: Ministry of Higher Education.
33. MOSTI (2020). Dasar Sains, Teknologi dan Inovasi Negara (DSTIN) 2021-2030. Putrajaya: Ministry of Higher Education.
34. Nair, M., Ahmed, P., and Vaithilingam, S. (2022). Values-Based Development and Competitiveness: A Conceptual Analysis. Retrieved from: https://sunwayuniversity.edu.my/sites/default/files/d7/webuni/SU-2204-Sunway-Value- Based-Paper-Report-2022-FA-181222.pdf
35. Nair, M. Ahmed, P., Vaithilingam, S., Narayanan, P., Chain, A.W., Lee, D.L.W, Qing, Y.H., Lim, C.C., Juin, L.W., Tang S. (2020), Business Sentiment 2020/2021: A Perspective from Malaysian Executives, Monash Business Sentiment Survey. Retrieved from: https://www.monash.edu.my/__data/assets/pdf_file/0009/2432277/MSH-343-Monash-Business-Sentiment-Brochure-2020-FA-161220-For-Web.pdf
36. OECD (2019). Education at Glance Germany 2019. Retrieved from: https://www.oecd.org/education/education-at-a-glance/EAG2019_CN_DEU.pdf.
37. OECD (2019). Education at Glance United States 2019. Retrieved from: https://www.oecd.org/education/education-at-a-glance/EAG2019_CN_USA.pdf

38. Omar, M. K., Ismail, N., Rauf, M. A., & Puad, M. H. M. (2020). Factors on Deciding TVET for First Choice Educational Journey among Pre-Secondary School Student. European Journal of Molecular & Clinical Medicine, 7, 609-622.
39. O'Neill, D.W., Fanning, A.L., Lamb, W.F., and Steinberger, J.K. (2018). A good life for all within planetary boundaries. Nature Sustainability 1, 88-95. doi:10.1038/s41893-018-0021-4
40. Ras, E., Wild, F., Stahl, C., and Baudet, A. (2017). Bridging the Skills Gap of Workers in Industry 4.0 by Human Performance Augmentation Tools – Challenges and Roadmap [online]. Available from http://dx.doi.org/10.1145/3056540.3076192 [accessed on 10 July 2023].
41. Ray, P.P. (2023). ChatGPT: A comprehensive review and background, applications, key challenges, bias, ethics, limitations and future scope. Available from: https://doi.org/10.1016/j.iotcps.2023.04.003 [accessed on 10 July 2023].
42. Statista (2023). The Existing and potential value of Muslim market worldwide in 2021 and 2025. Retrieved from: https://www.statista.com/statistics/796103/global-muslim-market-size/
43. Statista (2023). Total value of Islamic finance assets worldwide from 2021 to 2021 with a projection for 2026. Retrieved from: https://www.statista.com/statistics/1090815/worldwide-value-of- islamic-finance-assets/
44. The World Bank, UNESCO and UNICEF (2021). The State of the Global Education Crisis: A Path to Recovery. Washington D.C., Paris, New York: The World Bank, UNESCO, and UNICEF.
45. Center For Global Development. Learning Loss and Student Dropouts during the COVID-19 Pandemic: A Review of the Evidence Two Years after Schools Shut Down. Retrieved from: https://www.cgdev.org/publication/learning-loss-and-student-dropouts-during-covid-19-pandemic-review-evidence-two-years
46. The International Labour Organization (2024). Global Wage Report 2022-2023. Retrieved from: https://www.ilo.org/digitalguides/en-gb/story/globalwagereport2022-23#home
47. World Economic Forum (2016). The Human Capital Report 2016. Retrieved from: https://www3.weforum.org/docs/HCR2016_Main_Report.pdf
48. World Economic Forum (2020). The Future of Jobs Report 2020. Geneva: World Economic Forum.
49. World Economic Forum (2023). The Future of Jobs Report 2023. Geneva: World Economic Forum.
50. Zhao, S. and Cheah, K.S.I. (2022). The challenges of Malaysian private universities in reaching sustainable education toward responsible consumption. Cleaner and Responsible Consumption. Retrieved from https://doi.org/10.1016/j.clrc.2023.100130
51. Zwetsloot R., Corrigan, J., Weinstein, E. S., Peterson, D., Gehlhaus, D., and Fedasiuk, R. (2021). China is Fast Outpacing U.S. STEM PhD Growth. Retrieved from: https://cset.georgetown.edu/publication/china-is-fast-outpacing-u-s-stem-phd-growth/

e ISBN 978-629-7712-06-2