EU-Malaysia Chamber of Commerce and Industry

INDUSTRY 4.0 IN MALAYSIA

Opportunities behind the Challenges

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List of Abbreviations

11MP	11th Malaysia Plan
ASEAN	Association of Southeast Asian Nations
APAW	Action Plan for the Advancement for Women
BNM	Bank Negara Malaysia
EU	European Union
GDP	Gross Domestic Product
HDI	Human Development Index
M&E	Machinery and Equipment
MP	Member of Parliament
NGO	Non-Governmental Organisation
RM	Ringgit Malaysia
SME	Small-Medium Enterprises
USD	United States Dollar

Executive Summary

Around the world, traditional manufacturing is in the midst of a digital transformation that is accelerated exponentially by growing technologies such as intelligent robots, autonomous drones, sensors, 3D printing, etc. In 2011, the German government coined the term “Industry 4.0” to emulate the fourth industrial revolution in digitising automated processes. Since then the topic of Industry 4.0 has become a preferred focus of research and implementation amongst public and private entities, as it bears the notion for industries to remain at the spearhead of the technological frontier.

The aim of this paper shall be to analyse the position of Malaysia in its current transformation process towards Industry 4.0 in the manufacturing sector. By reviewing the advantages of digitisation and automation, this study highlights the importance for the manufacturing sector to initiate its transformation. Finally, the barriers and challenges to participate in Industry 4.0 in the manufacturing sector are outlined, leading to an evaluation of business opportunities for European companies.

The following are the key findings of our report:

The first finding is that the manufacturing sector plays a crucial role in its contribution towards Malaysia’s economy. The country produces a multitude of products from different industries within the manufacturing sector, such as electrical components, aerospace technologies and medical devices. Therefore, staying at the forefront of technological innovation is crucial for Malaysia to remain on its current growth path.

The second finding is that the Malaysian manufacturing industry is internationally oriented by its export and import structure, but also in terms of the presence of international companies that have opted to base their global production facilities in Malaysia. A considerable share of investment into the Malaysian manufacturing sector is contributed by FDI, especially into the Electric & Electronics industry, aerospace technologies and medical devices. Although major multinational corporations (MNCs) settle in Malaysia, the country is less advanced in the usage of latest production technologies, hence great advantages could be realized with a stronger implementation of Industry 4.0.

The third finding is that the Malaysian manufacturing industry finds itself under pressure to adapt. Important drivers of change are environmental concerns, outside pressure from supply chain partners and altered consumer preferences. Investments into Industry 4.0 solutions can help increase the competitiveness of the industry and mitigate the added external pressure.

The fourth finding is in regard to the challenges that withhold the manufacturing industry from adapting new technologies. Business owners state that they are unable to finance a complete transformation as well as manage the Industry 4.0 solutions, primarily due to lack of necessary knowhow and skills. Furthermore, the study highlights missing infrastructure as a key determinant for a slow uptake of new technologies.

The fifth finding is that despite key challenges facing the Malaysian manufacturing sector, new technologies possess multiple upside potentials that offset initial investments in financial and human capital. For instance, Industry 4.0 can offer cost-effective solutions to streamline operations and make them more efficient. Moreover, digital innovation can also help to expand the skillset of current employees, as re-skilling options are available to business owners - instead of the costly alternative of hiring new personnel.

Introduction

Businesses find themselves in a significant transformation regarding the way that products are conceptualised, created and marketed along the value chain. This is largely based upon the possibilities that modern technologies offer in terms of digitisation. This transition is so compelling that it is being labelled "Industry 4.0" to represent the fourth revolution in the manufacturing industry. From the first industrial revolution, mechanisation through water and steam power, to the electrified assembly lines in the second, the fourth industrial revolution takes key elements of the third revolution in the form of automation and enhances it with smart, digitised systems fuelled by data and machine learning.

The potential for Malaysian businesses to utilise these technologies is immense. While Malaysia possesses an abundance of natural resources, it is the manufacturing sector that has played a key role in turning Malaysia into a major player in the global value chain, especially within the sector of IT-related components[1]. Therefore, in order to defend this position in the value chain, the sector needs to keep up with global trends like Industry 4.0.

From mass production through the use of intensive labour force in production lines, to the use of robotics that increase efficiency, the manufacturing industry has constantly evolved with a gradual increase in the infusion of automation. The following study will explain and analyse the final step on this development continuum, Industry 4.0. Thereby, this paper will initially outline the social, political and economic situation within Malaysia, followed up by an in-depth analysis of Industry 4.0. The key areas will include a technical description of the Fourth Industrial Revolution, the current stage of adoption as well as the challenges, opportunities and future developments within the Malaysian manufacturing sector.

Scope

Although Industry 4.0 is applicable to multiple business areas, this study shall largely focus on the manufacturing sector. This sector is important for Malaysia's economy and remains the driver of growth and employment. We define manufacturing as the industrial sector that provides value through the transformation of materials into products. In order to develop the sector towards Industry 4.0, a major shift in the areas of People, Process and Technology has to be undertaken by private and public institutions. In this regard, a successful integration of Industry 4.0 into businesses requires policies that place emphasis on fostering an increased participation in Industry 4.0 by manufacturing companies. In the mid-term review of the 11th Malaysia Plan (11MP), a five-year development plan covering the years 2016-2020, the government placed an emphasis on embracing a broader ecosystem approach, as well as developing and taking advantage of integrated manufacturing and technology clusters.

[1] (OEC, 2020)

1. Introduction to Malaysia

Malaysia is centrally located within the Association of South-East Asian Nations (ASEAN), and consists of the Malaysian Peninsular and the states of Sabah and Sarawak on the island of Borneo (Malaysian Borneo). The Federation of Malaysia comprises of three federal territories (Kuala Lumpur, Putrajaya and Labuan) and 13 states (Sabah, Sarawak and the 11 states of Peninsular Malaysia). The capital city is Kuala Lumpur, whereas Putrajaya is the federal administrative centre of Malaysia.

Figure 1: Map of Malaysia
(Source: http://www.nationsonline.org/oneworld/map/malaysia_map.htm)

Malaysia is well-known to be a multi-ethnic, multicultural and multi-lingual society with an estimated population of 32.6 million inhabitants. Its citizens comprise of a melting pot of ethnicities, namely Malay, Chinese, Indian and indigenous people. Malays make up the majority of the population at 69.1%, followed by Chinese at 23%, Indians at 6.9% and other groups at 1%, including indigenous people[2]. The Malaysian constitution guarantees freedom of religion, although Islam is regarded as the state religion[3]. Approximately 60.4% of the population practice Islam, 19.2% practice Buddhism, 9.1% practice Christianity, 6.3% practice Hinduism and 2.6% practice Confucianism and other traditional Chinese religions. The official language of Malaysia is Bahasa Malaysia. However, English, as well as Chinese dialects and Indian languages, are widely spoken due to the multicultural makeup.

Malaysia has a tropical climate and possesses a total land mass of approximately 330,803 square kilometres, of which a large proportion is covered by rainforests; contributing to the substantial natural diversity within its ecosystem. Malaysia's strategic geographical location, with land on both mainland Asia and the Malay Archipelago, and a total coastline of 4,675 kilometres, offers attractions in the form of well-preserved nature, scenic beaches, diverse sea life and beautiful corals.

[2] (Department of Statistics Malaysia, Official Portal, 2018)
[3] (Constitution of Malaysia, 2009)

1.1 Political Situation

In 1957, Malaysia achieved its independence from Great Britain, as a state with a parliamentary democracy, constitutional monarchy and 13 federal states. Based on the rotation principle, one of the Sultans is appointed every five years as the representative Head of State. In addition, every five years the Malaysian people elect their government. This institution has the political decision-making power in the country and is represented by the Prime Minister.

Until the general election in May 2018, Malaysia's political landscape was marked by exceptional levels of political stability and continuity. The election in 2018 marked a historical shift in power, in which the previous ruling coalition led by then-Prime Minister Najib Razak was replaced by 92-year-old opposition leader, Dr. Mahathir Bin Mohamad. Handover procedures were peaceful and smooth, and it had been widely regarded as the cornerstone for a "New Malaysia" with a focus on modernisation and transparency.

Prior to this election, Malaysia was ruled under a single regime for six decades by the *Barisan Nasional* (BN) coalition. The victory of the *Pakatan Harapan* (PH) coalition was not only significant because it was the first ever change of power in Malaysian history, but it was also the result of the country's growing resentment towards the 1MDB corruption scandal engulfing former Prime Minister Najib Razak. The period following the historic election has since been dubbed "*Malaysia Baru*" (*Baru* for 'new' in Malay) or "New Malaysia," as it highlighted a new change in Malaysia.

Due to the unexpected resignation of Malaysia's Prime Minister Dr. Mahathir Mohamad at the end of February 2020, Muhyiddin Yassin was sworn into office on February 29, 2020 by Malaysia's King as the eighth prime minister, amid questions over his legitimacy and protests by the Pakatan Harapan (PH) coalition and his predecessor Mahathir. Under Muhyiddin, a new coalition named Perikatan Nasional (PN) was formed, consisting of members from Bersatu and the former opposition parties UMNO and PAS.

1.2 Economic Overview & Outlook

Malaysia is a dynamically developing country. Since the 1970s Malaysia has been able to transform from a middle-income country, depending on exports of natural resources and agricultural products, into an emerging, diversified multi-sector economy spurred on by high technology, knowledge-based, capital-intensive and export-driven industries. Since achieving independence, Malaysia has garnered nearly half a century of rapid and inclusive economic growth with real GDP expanding by 6.4% per annum on average since 1970. The Malaysian market is open and competitive, with strong links to global value chains, particularly in manufacturing electronic and medical goods.

Malaysia further demonstrated the resilience of its economy by a domestic demand-driven recovery after the global financial crisis in 2007 – 2008. Following a larger-than-expected growth of 5.9% in 2017, the Malaysian economy saw moderate growth in 2018, closing at 4.7%[4]. The central bank of Malaysia, Bank Negara Malaysia (BNM), attributes this to several external and domestic challenges including major policy and political shifts arising from the change of government and global trade tensions, as well as supply disruptions in the mining and agriculture sectors. Despite a slower pace, the economy remained resilient. Anchored by the domestic demand whereby private consumption remained strong, it recorded the fastest rate since 2012. In 2018, Malaysia's GDP ranked at 35 out of 193 countries[5]. Malaysia is estimated to grow at a 4.7% average from 2019 until 2023.

[4] (The Star Online, 2019)
[5] (International Monetary Fund, 2019)

1.3 Economic Key Facts

Currency	1 Malaysian Ringgit (MYR) = 100 sen
Exchange Rate[6]	1 EUR = MYR 4.50; 1 USD = MYR 4.07
Population[7]	32.6 million
GDP (2021 forecasted)[8]	USD 405 billion
GDP Growth (2020 expected)[9]	4.5%
Inflation Rate (CPI, 2018)[10]	0.89%
Labour Force (2018)[11]	15.3 million
Unemployment Rate (2018)[12]	3.3%
Total Export (f.o.b, 2019)[13]	MYR 986.36 billion
Total Import (c.i.f, 2019)[14]	MYR 849.07 billion

Malaysia's major export products in the first quarter of 2019 were electrical & electronic products, petroleum products, chemicals & chemical-based products, liquified natural gas (LNG), and palm oil & palm oil-based agriculture. The country's major export markets are Singapore, China, USA, Japan, Hong Kong and Thailand.

1.4 EU-Malaysia Trade Relations

Negotiations for a free-trade agreement (FTA) with Malaysia were launched in October 2010; however, talks reached an impasse in April 2012. Several reasons were attributed to insufficient progress - Malaysia was focused on securing an arrangement for trade in goods and was not prepared to liberalise in other respects expected by the EU such as procurement, competition policy and intellectual property rights (IPR).

The European Parliament has further adopted a "Resolution on Palm Oil and Deforestation of Rainforests" on 4 April 2017, with the aim to reduce the negative impacts of deforestation due to unsustainable or illegal palm oil production. The Resolution has incited a great deal of controversy and opposition, especially from Malaysia and Indonesia. The EU's position on palm oil has been strongly criticised in Malaysia and has led to major implications for the EU's relationship with Malaysia and the pending restart of the FTA negotiations.

[6] (XE, 2020)
[7] (DOSM, 2019)
[8] (Trading Economics, 2020)
[9] (Saieed, 2020)
[10] (World Bank, n.d.)
[11] (DOSM, 2019)
[12] (DOSM, 2019)
[13] (MATRADE, 2019)
[14] (MATRADE, 2019)

Malaysia was also excluded from the EU's Generalised Scheme of Preferences (GSP), an arrangement which offers developing countries preferential trading terms with the EU. Since Malaysia's economic development means that it does not qualify for the scheme[15], the country is placed at a disadvantage compared to other ASEAN member states who have FTAs or other special preference deals with the EU.

Despite the circumstances, trade between Malaysia and the EU has remained steady. The EU is Malaysia's third largest trading partner with exports to the EU reaching EUR 25.6B in 2018, continuing the gradual increase observable since 2006. EU export to Malaysia has also increased in 2018 reaching EUR 14.2B, in turn increasing the share of trade, which Malaysia conducts with the EU, to 11.6%[16].

1.5 EU-ASEAN Economic Relations

The EU and the Association of Southeast Asian Nations (ASEAN) have a strong trade relationship and have been interacting with each other on economic, trade and political terms for more than four decades. Their partnership began as early as 1972. ASEAN as a whole represents the EU's third largest trading partner outside Europe with more than EUR 237.3B of trade in goods in 2018.

The EU is ASEAN's second largest trading partner, while ASEAN is the EU's 5th largest trading partner. The EU remains the largest provider of Foreign Direct Investment (FDI) to ASEAN, with as much as 24% total FDI inflow in 2017. The EU's main exports to ASEAN are chemical products, machinery and transport equipment, whereas the main exports from ASEAN to EU are machinery, transport equipment, agricultural products, as well as, textiles and clothing[17].

[15] (European Commission, 2019)
[16] (European Commission, 2019)
[17] (European Commission, 2019)

2. Industry 4.0

What is Industry 4.0? The term refers to the digital development of the entire organisation and management value chain process and was originally coined in Germany. The concept has gained global traction since its inception in 2011.

2.1 From Industry 1.0 to Industry 4.0

The first industrial revolution took place in the second half of the 18th century. It witnessed the mechanisation of the manufacturing and processing industry, utilising water and steam power. The railway and the emergence of steam shipping allowed for fast transport of people and goods.

The second industrial revolution began in the late 19th century. It is characterised by mass production with the help of assembly lines, electrical energy and electric motors. Several technological advancements can be traced back to this period, including the emergence of new sources of energy: gas and oil. Innovations such as telegrams and telephones simplified communication, whilst automobiles simplified transport.

The third industrial revolution, also known as the digital revolution, allowed the use of electronics and IT. For the industry, this revolution gave rise to the era of high-level automation in production due to two major inventions: automatons—programmable logic controllers (PLCs)—and robots. The third industrial revolution reached Malaysia only in the 1970s[18].

The fourth industrial revolution, also referred to as Industry 4.0, is the move towards digitisation. In Industry 4.0, machines become self-aware so that they can communicate with other devices, as well as record and optimise their own performance and energy requirements. An example includes Internet of Things (IoT), which uses sensors to collect large sets of data that can be used to analyse and improve productivity. Advancements in Big Data means that they can produce insights for immediate action. The epitome of Industry 4.0 is the concept of Smart Factory in which Artificial Intelligence (AI) controls the machines and generates fault diagnoses[19]. Simply put, Industry 4.0 is the revolution that makes it possible to gather and analyse data across machines, which in turn enables faster, more flexible, and more efficient processes to produce higher-quality goods at reduced costs and enhanced energy efficiency. Industry 4.0 is about transforming production processes instead of merely utilising advanced digital technologies.

2.2 Technologies and Scope

Industry 4.0 is a frequently used buzzword but there is currently still broad confusion amongst many Malaysian companies about what it exactly entails. Below are ten of the most prominent technologies shaping Industry 4.0 as outlined by the American consultancy firm BCG[20]:

[18] (Zahariah, 2012)
[19] (Bundesministerium für Wirtschaft und Energie, 2019)
[20] (Boston Consulting Group, 2019)

Big Data Analytics

Big Data Analytics is the collection and evaluation of large amounts of data from many different sources, such as production equipment and systems. Real-time decisions are able to be taken based on the data gathered. In the long run, this improves product quality and production efficiency.

Autonomous Robots

Robots will become independent and will learn to interact and work with other robots as well as humans. They are able to think, act and react autonomously as well as conduct remote decision making. This in turn contributes to a company's competitiveness, productivity and profitability. Robots are already widely used in the Malaysian manufacturing sector, but often simply automated, i.e. at Industry 3.0 level.

Simulations

In plant operation, more and more simulations are being used to exploit real-time data and to map the physical world in a virtual model that can include machines, products and people. This allows the operator to test and optimise the machine settings for the next product in the virtual world prior to the physical change, thereby shortening the machine's setup times and increasing efficiency[21].

Horizontal and Vertical System Integration

With Industry 4.0, companies, departments, functions, and capabilities become much more inter-related, as it creates company-wide, universal data integration networks and enables automated value chains. This shifts corporate boundaries. Digitisation enables the efficient exchange of data between machines, companies, partners and workpieces, as well as, the outsourcing of business processes[22]. Horizontal and vertical system integration has started to be introduced in Malaysia, usually amongst local branches of international companies, as well as, suppliers in various industries.

The Industrial Internet of Things (IIoT)

The Industrial Internet of Things means that devices - sometimes unfinished products - are enriched with embedded computing. In this way, field devices can communicate and interact with each other. The IIoT also enables the decentralisation of analysis and decision-making and gives real-time answers. The driving philosophy behind IIoT is that intelligent machines not only capture and analyse data in real time better than people, but also better communicate important information that can make business decisions faster and more accurate[23]. This technology is sometimes used in Malaysia in the form of RFID chips in the consumer sector or for payments at toll booths, shops or restaurants[24].

Cyber Security

Increased connectivity as part of Industry 4.0 makes it critical for businesses to protect industrial systems and manufacturing lines from cyber security threats. Therefore, it is essential to have reliable communications, as well as sophisticated identity and access management of machines and users. "Cyber security Malaysia" is an agency subordinated under the Ministry of Multimedia and Communications, which is continuously working to expand cyber security. Malaysia currently ranks eighth (2018) in the Global Cyber security Index, after having ranked third last year. Nevertheless,

[21] (MARii, 2019)
[22] (Hottinger Baldwin Messtechnik GmbH , 2019)
[23] (TechTarget, 2019)
[24] (Touch 'n Go, 2019)

Malaysia is still ranked higher than many countries in the EU, such as Italy (25th), Germany (22nd), Finland (19th) and Netherlands (12th). Regionally, cyber security is only higher in Singapore (6th)[25] [26].

Cloud Computing

Past industrial revolutions required a great amount of capital. Cloud computing in contrast makes many Industry 4.0 technologies accessible to smaller companies with minimal upfront capital investment capabilities. Companies can leverage cloud-based product design, simulation, AI and big data solutions to improve their production processes and build products better suited to their customers. Cloud storage is already being offered in Malaysia by local and international vendors[27].

Additive Manufacturing

Businesses have just begun to introduce additive manufacturing such as 3D printing, which they mainly use to create prototypes and produce individual components. With Industry 4.0, these additive manufacturing methods are widely used to make small batches of custom products that offer design benefits such as complex lightweight designs. Currently, there are no companies in Malaysia that manufacture 3D printers, despite one firm producing the granules necessary for 3D printing[28].

Augmented Reality

Augmented Reality-based systems support a variety of services. For example, selecting parts in a warehouse and sending repair instructions through mobile devices. These systems are still in their infant stages, but in the future, companies will use Augmented Reality more extensively to provide employees with real-time information to improve operations and workflow. In Malaysia, Augmented Reality can only be found in the consumer sector.

Advanced Materials

New materials and nanostructures are currently being developed with advantageous material properties such as high dimensional stability and thermal efficiency. In conjunction with additive manufacturing, this allows for further customer-oriented production.

2.3 Manufacturing Sector in Malaysia

2.3.1 Economic Significance

The Malaysian manufacturing industry is a substantial economic sector contributing about 22% to the GDP in the last 5 years. With its vast multiplier effect, the sector's growth has stimulated job creation, attracted investments and created business opportunities in downstream activities. The manufacturing sector is expected to remain resilient and is on track to achieve the targeted annual GDP growth rate of 5.1% under the 11th Malaysian Plan[29]. Fundamentally, the sector is made up of a large number of SMEs which account for 97% of the manufacturing firms. Although most of these SMEs do not have a strong global presence, many have the potential to be global exporters. Together with other ongoing initiatives like the eCommerce Strategic Roadmap or the Digital Free Trade Zone (DFTZ), the government is trying to provide the right platform for SMEs to reinvent themselves and

[25] Global Cybersecurity Index (GCI) (2019), International Telecommunications Index
[26] Global Cybersecurity Index (GCI) (2017), International Telecommunications Index
[27] MITI (2018)
[28] (MIDA, 2019)
[29] (Ministry of International Trade and Industry (MITI), 2018)

adopt the latest technologies to be globally competitive[30]. Besides the SME's dominance of manufacturing firms, there are a few highly relevant larger Malaysian firms, especially in the E&E industry as well as in medical devices - such as gloves - which are global leaders in their respective industries. Furthermore, a considerable share of FDI investors have selected Malaysia as their global production base, incidentally, paying taxes and employing locals, therefore contributing positively to the Malaysian economy.

2.3.2 Sector Overview

This section gives a brief overview of the most important sectors in the manufacturing sector. These are the industries that drive the success of the Malaysian industrial sector, whereby current growth rates are seemingly promising. Most of the industries listed below are represented by associations; a list of the relevant associations and stakeholders may be found in the Appendix.

Electrical and Electronics

The electrical and electronics industry (E&E) is a major driver in the Malaysian manufacturing sector, substantially contributing to GDP growth, export revenues, investment and employment. The main export destinations are China, USA, Singapore, Hong Kong and Japan. In 2018, investments amounted to USD 2.7B (approx. MYR 11.17B), representing 84.5% of total manufacturing investment[31]. 95.6% of all investments were Foreign Direct Investments[32]. In the same year, goods worth MYR 343B were exported from the electrical and electronics sector[33]. As far as Industry 4.0 is concerned, the sector also has an important role as it acts as a developer of forward-looking technology.

Machinery and Equipment

The machinery and equipment industry (M&E) is one of the key areas for growth and development, focusing on high value-adding innovations. The sector is currently experiencing steady growth of 3.7% (2018). By end-2020, investments are expected to amount to MYR 30.8B and exports will increase by an average rate of 6.7% to MYR 48.3B. Digitisation plays a role in this sector as it supports production, but also the communication and compatibility of modern machinery[34].

Chemical and Petrochemical

The chemical and petrochemical industry also has a strong position in Malaysia. With 98.5% of the total investment of MYR 26B in 2017 coming from within the country, the sector shows strong national participation[35]. About 73.8B m^3 of natural gas are extracted daily in Malaysia, as well as 705,000 barrels of oil. In the processing industry for rubber and plastic products, automation and energy efficiency are increasingly being optimised to produce internationally competitive Malaysian products[36].

Medical Devices

The medical device industry indirectly spans across an extremely wide range of industries, including various plastic products, textiles, machinery, engineering and equipment, as well as, electronics. Under the 11th Malaysia Plan, the sector was identified as one of the main growth sectors that play an

[30] (Ministry of International Trade and Industry (MITI), 2018)
[31] (MITI, 2019)
[32] (GTAI, 2019)
[33] (MIDA, 2019b)
[34] (The Star Online, 2018a)
[35] (MIDA, 2019c)
[36] (GTAI, 2017)

important role in Malaysia's future development. Even though the sector is largely made up of SMEs that handle medical gloves, there are also numerous large companies that produce more complex and sophisticated products and therefore, are required to embrace the opportunities that Industry 4.0 technologies offer[37].

Aerospace

The aerospace industry has been designated as a strategic sector with high growth potential in the country's industrialisation and technological development programs. The sector incorporates subsectors such as engineering and design, aero-manufacturing, system integration and maintenance, repair and operations (MRO). With an expected passenger growth rate of 5-6% in 2020 through commercial flights and an increase to almost 2% of GDP in defence budget, the industry seems to be able to continue its positive growth trend.

Automotive

The automotive industry plays an important role for Malaysia. It is estimated that roughly 600,000 to 700,000 people are directly and indirectly employed within the industry. According to experts, the sector accounts for around 4% of Malaysia's GDP with a significant share in the manufacturing sector. The automotive industry and its suppliers, especially in the luxury segment and unlike most manufacturing sectors, are dominated by large international companies. The cars are mainly manufactured for the Malaysian market[38].

Malaysia's automotive market consists of two national car brands, Proton and Perodua, as well as international carmakers who locally assemble their cars to avoid high import duties of up to 105%[39]. In total, there are 27 manufacturing and assembly plants producing passenger and commercial vehicles, composite body sports cars, as well as, motorcycles and scooters. Malaysia also has more than 600 automotive components manufacturers, producing components such as body panels, trim parts, powertrain parts, rubber parts, etc[40]. Although the Malaysian automotive industry is partly protected from international competitors by these tariffs, it is subject to growing pressure to produce more cheaply in order to survive in the long term.

Moreover, the luxury segment mainly includes European manufacturers that use Malaysia both as a target market and as a production location.

Other Sectors

Other sectors include transport such as seaborne and maritime industry, textiles, pharmaceutical, metal, food processing, and services.

2.3.3 The Impact of Industry 4.0

In a document issued by the former government under Dr. Mahathir, the Ministry of International Trade and Industry (MITI) formulated a brief summary of the goals that it wishes to accomplish in accordance with Industry4*WRD*[41]:

[37] (MIDA, 2019d)
[38] (MARii, 2019)
[39] (Malaysian Automotive Association, 2018)
[40] (MITI, 2017)
[41] (MITI, 2019)

- Productivity*:* During the next 5 to 10 years, Industry 4.0 shall be embraced by more companies, boosting productivity across all Malaysian manufacturing sectors with an expected increase of 30% till 2025.
- Revenue growth*:* The Malaysian government aims to elevate the contribution of the manufacturing sector to the national economy from MYR254B to MYR392B in the time frame of 2016 to 2025.
- Employment*:* The digital transformation will change the employment landscape, as more high-skilled workers in the manufacturing sector will be needed. Malaysia aims to strengthen its innovative capacity and capability.
- Investment: The adoption of Industry 4.0 technologies requires investment in dynamic and innovative financial products.

2.4 Transformation Drivers

As increasingly technologically complex products are demanded by consumers, the manufacturing landscape has to evolve along the recent developments in Industry 4.0. The following section will highlight the main drivers of this transformation and will materialise the reasons why firms need to reassess their position in the manufacturing value chain.

2.4.1 Change of Global World Order

Though Malaysia has been able to maintain its 22nd rank among 63 countries in the World Bank Competitiveness Yearbook (WCY) 2019 published by IMD World Competitiveness Centre, Malaysia is increasingly challenged by the external environment, including the rise of China, the ongoing US-China trade tension and the rise of fast-growing emerging economies. Malaysia needs to move from an input-driven growth structure to a productivity-driven one, in order to achieve sustainable economic expansion, in line with the initiatives outlined in Malaysia's Productivity Blueprint (Chapter 2.5.2)[42].

2.4.2 Technology and Supply Chain Dynamics

As technology advances, more complex supply chain dynamics and networks of globally operating manufacturers will continue to evolve. Manufacturers need to shift from their traditional idea of a linear supply chain where different companies are responsible for different parts of the production and distribution chain. Instead, value chains are becoming increasingly interconnected through digitisation, in which datasets are located in clouds and universally accessible.

2.4.3 Environmental Management

Sustainable business approaches and environmental-conscious behaviour are becoming increasingly important for consumers and manufacturers in Malaysia. Therefore, environmental regulations including environmental concerns and standard based regulations, like the International Organisation for Standardisation (ISO), gain in value.

Malaysia's former Minister for Energy, Science, Technology, Environment and Climate Change (MESTECC) Yeo Bee Yin aimed to replace the Environmental Quality Act 1974 with a new act which would see greater enforcement and stiffer punishments meted out to those who pollute the environment[43]. For example, MESTECC launched the 'Roadmap Towards Zero Single-Use Plastic" policy in October 2018. The policy will ultimately put plastic manufacturers under pressure to comply with the new regulations. It was part of the government's strategy to overcome the country's environmental issue of waste management whilst also identifying sound recycling technologies. It

[42] (NewStraitsTimes, 2019)
[43] (Landau, 2019)

must be noted that updated plans by the government under Prime Minister Muhyiddin have not been announced by end-March 2020.

The future development of the energy sector will be determined by ambitious climate goals, population growth and increasing standards of living[44]. To promote an environmentally comprehensive energy sector, the Malaysian government has established the legal and institutional framework for environmental protection. Investors are encouraged to consider the environmental factors during the early stages of their project planning. Aspects of pollution control include possible modifications in the process line to minimise waste generation, seeing pollution prevention as part of the production process[45].

2.4.4 Shift in Customer Behaviour

Traditionally, a large share of the personal income of Malaysians is spent on consumer products. However, as the rate of urbanisation increases and middle-class society continues to evolve, a larger portion of the Malaysian population is now able to afford luxuries such as cars, electronic gadgets and leisure activities. The data on purchasing power amongst the Malaysian population, especially when it is placed relative to GDP, highlights that there is a gradual increase in the ability of people to purchase more valuable and luxurious goods[46]. As consumers in Malaysia become more sophisticated and cosmopolitan, studies have shown that Malaysians are displaying a growing preference for global brands, rather than locally manufactured products[47].

Furthermore, a change in the buying behaviour of Malaysians is noticeable as they are progressively abandoning the traditional brick-and-mortar stores for e-commerce stores. This also entails a higher price and quality sensitivity. For example, the manufacturing industry is facing increased pressure to adapt to changing conditions, as more customers demand greater personalisation and customisation options. This shift in customer behaviour demands manufacturers to facilitate flexible manufacturing processes, in order to react effectively to ever-changing preferences[48]. Experts project that the following industries will retail well during this process transformation: electronics, clothing, footwear, beauty and personal care.

2.5 Current Stage of Adoption

Malaysia is facing an increasing need to integrate Industry 4.0 in the manufacturing sector. The country's position as a destination for low-cost labour is gradually shifting away towards other emerging economies that offer similar services to even lower prices; therefore, challenging Malaysia's competitiveness in this field. Fortunately, the changing global landscape offers opportunities. In order to capture these and remain competitive within the ASEAN region, Malaysia has to transform its manufacturing sector.

A new source of competitive advantage may be established through an increase in the quality of labour, including higher productivity. With respect to this, Malaysia's labour productivity has grown at 3-4% over the last few years, whereas its relative global position and use of high-skilled labour has stagnated throughout the same period of time[49]. Investments into Industry 4.0 technologies and

[44] (Bartodziej, 2016)
[45] (MIDA, 2019)
[46] (World Bank, 2020)
[47] (Santander TradePortal, 2019)
[48] (Bartodziej, 2016)
[49] (CEIC, 2020)

services possess immense opportunities for efficiency, productivity and quality gains that are essential for Malaysia's manufacturing industry to evolve.

According to MIDA, the manufacturing sector, which poses as the backbone of the Malaysian industry, is still in its infancy in regard to its development of Industry 4.0 capabilities. Around 10% of the businesses operating in this sector are working at Industry 3.0 level, with the share of firms working at Industry 4.0 level falling to under 1%. The remaining 89% of the manufacturers work with manual labour or at Industry 2.0 standards. The discrepancy in the sophistication of operations is clearly visible between large, international companies and Malaysian SMEs; in that larger firms operate at either Industry 3.0 or have entered 4.0 levels, whereas SMEs tend to produce with simpler, less capital-intensive methods. Smaller firms are seemingly hindered by the perceived high upfront costs of the technology, running the risk of becoming redundant and uncompetitive within the market[50].

In this context, to fully allow SMEs to participate in the Industry 4.0 evolution and capture their own potential, it is important to bridge the chasm of adopting digitised processes. Initially, SMEs can, for instance, collaborate and participate in broader production networks with other SMEs, larger firms or multinational corporations to exploit economies of scope when streamlining their businesses. This should also help the companies to handle the conditions set forth by changing customer preferences, meaning that SMEs can exploit their comparative advantage in being more agile to new opportunities and technologies.

To further develop its economy, Malaysia has set the following goals[51]:

- Increase the productivity rate in the manufacturing sector
- The manufacturing sector should play a more important role in the overall economy of Malaysia
- Capacity and innovation capacity should be reflected in global innovation rankings
- In the manufacturing sector, the number of well-trained workers should be increased

The country is currently working on the implementation of this plan. However, there are still numerous hurdles that Malaysia needs to overcome, which will be highlighted in Section 2.7.

2.6 Government Incentives and Programmes

In order to spur the take-up of Industry 4.0, the Malaysian government runs a multitude of incentive programmes, chief among which is the Readiness Assessment as part of Industry*4WRD* that will be elaborated from section 2.6.2 onwards. Other, more general, incentives that have been published by the Malaysian Investment and Development Authority (MIDA) and are linked to either Industry 4.0 or the manufacturing sector are briefly discussed below[52]. It is important to note that programmes explained in section 2.6 have been sanctioned by the former government, but have not yet been confirmed by the current government.

- General incentive
    - Pioneer Status – five-year partial tax exemption
    - Investment Tax Allowance – allowance on capital expenditures (e.g. PP&E)
- Incentives for High Technology
    - A given company's product has to be listed on the "Promoted Activities" list, a collection of machine equipment that Malaysia wishes to push forward. This includes technology that is of particular relevance to Industry 4.0.

[50] (MGCC, 2019)
[51] (MITI, 2019)
[52] (MIDA, No date)

- Incentives for SME
    - The government incentives the growth of businesses by providing different exemptions to small enterprises, based on size, turnover, funds and produce. Again, some funds might be related to the "Promoted Activities" list.

2.6.1 Industry*4WRD* - National Policy on Industry 4.0

Malaysia's national policy on Industry 4.0 (stylised as Industry*4WRD*) was launched by former Prime Minister Dr. Mahathir in October 2018. It highlights Malaysia's case for action and outlines the implementation approach by the government in order to maintain Malaysia's international competitiveness. Since the original deadline of Vision 2020, by which Malaysia should have attained the status of an industrialised nation could not be upheld, the completion date has been pushed back to 2025 and is now part of the National Transformation 2050 Plan. The National Goals and Targets as listed in the National Policy for 2025 are the following[53]:

- Level of productivity per person per year to increase from MYR106,647 by 30%
- Improve contribution of the manufacturing to society from MYR254B to MYR392B
- Improvement in Global Innovation Index ranking from 35 to top 30
- Increase the number of high-skilled workers in the manufacturing sector from 18% to 35% to handle the Industry 4.0 transformation

The adoption of technologies related to Industry 4.0 can aid Malaysia in achieving its National Targets, hence why the aforementioned goals are grouped under this section. Productivity, innovation and re-skilling of workers are essential under Industry*4WRD* as the following parts below will show.

2.6.2 Readiness Assessment Programme

The Readiness Assessment (RA) Programme is an initiative of the government to assess the capability of firms adopting Industry 4.0. As part of Industry*4WRD*, the RA is linked to a fund that companies potentially receive to transform their business practices. It is important to note that the government retrospectively launched this initiative in order to promote and support companies that are trying to transform as part of Industry*4WRD*. It is likely that this service will enhance the attractiveness of Industry 4.0, as it unveils possible opportunities that entrepreneurs might have not considered. According to MITI, this program aims to prepare Small- and Medium-sized Enterprises (SMEs) for the long-term future and make the manufacturing sector less dependent on labour-intensive production.

The RA will support businesses in the following manner:

- Determine degree of readiness to adapt Industry 4.0
- Understand the magnitude of efficiency and performance gains
- Create a strategy to implement changes and eventually assess the performance of new systems

The former government has allocated MYR 210M from 2019 to 2021 to support the transition and migration to Industry 4.0. The Malaysian Productivity Corporation (MPC) has carried out Readiness Assessments in 2019 to assist up to 500 SMEs by migrating them to Industry 4.0 technologies[54]. Targeted industries include the electrical, chemical, engineering, aerospace, medical, automotive, and labour-intensive sectors such as F&B or furniture manufacturing.

[53] (GrowYourBusiness, 2018)
[54] (Ministry of International Trade and Industry (MITI), 2018)

2.6.3 Readiness Assessment – Step-by-Step Guide

This section considers the criteria and procedures that business owners and managers have to fulfil in order to receive funding by the government. The funding is mainly part of the Industry*4WRD* Readiness Assessment, which aims to support the transformation of SMEs to Industry 4.0. Hence, the government has set certain regulations that firms need to pass in order to become eligible for further funding. These regulations are part of the registration form that needs to be filled-out by the respective company, so that officials can assess the eligibility for funding or tax exemption. Below is a detailed description of the process that firms should expect when applying for the RA programme. Also, it is supported by a flow-diagram that the MPC has published.

1) Initially, the programme differentiates between "Manufacturers" and "Manufacturing Related Services (MRS)." The latter refers to companies that are indirectly in the manufacturing industry by for example, aiding in design, consultancy or installation. Manufacturing itself refers to the process, in which products are physically made and constructed.

2) Then, the company needs to fill-in the registration form, which is divided into four parts, including general information, reasons for adopting Industry 4.0, existing and planned uptake of relevant technologies and willingness to register for the government's Industry*4WRD* programme.

3) Thereafter, once the application has been filed, the officials will base their decision to permit assessment and funding on the following three criteria:

    - Firm operates in the manufacturing industry
    - Valid business license
    - In operation for more than 3 years

4) If the committee accepts the registration, then it will conduct the review and create a report to document the readiness of adopting Industry 4.0. The Malaysia Productivity Corporation (MPC) will be tasked to assess firms based on 21 separate dimensions and three main factors that entail: Process, People and Technology. Eventually, the respective firm receives a score by which to assess its readiness profile.

5) The services that the government provides for different types of companies deviate at this stage. Although Industry*4WRD* aims to support SMEs, companies in the manufacturing sector have different criteria for funding than MRS firms (see below). The government allocates <MYR 0.5M to each company, adjusting the funding depending on the requirements set forth by the report.

    - Manufacturing
        i. Sales turnover: MYR 0.3M – MYR 50M
        ii. Employees: 5 – 200
    - MRS
        i. Sales turnover: MYR 0.3M – MYR 20M
        ii. Employees: 5 – 75

6) In case a company does not meet the criteria above, i.e. fails to receive funding through the Industry*4WRD* programme, it can obtain a tax deduction worth MYR 27,000 to cover the costs of the Readiness Assessment.

As previously mentioned, a visualisation has been added below to aid the comprehension of the procedure. The file originates from the MPC and it clearly differs between process flows in which a firm receives funding, or not[55]:

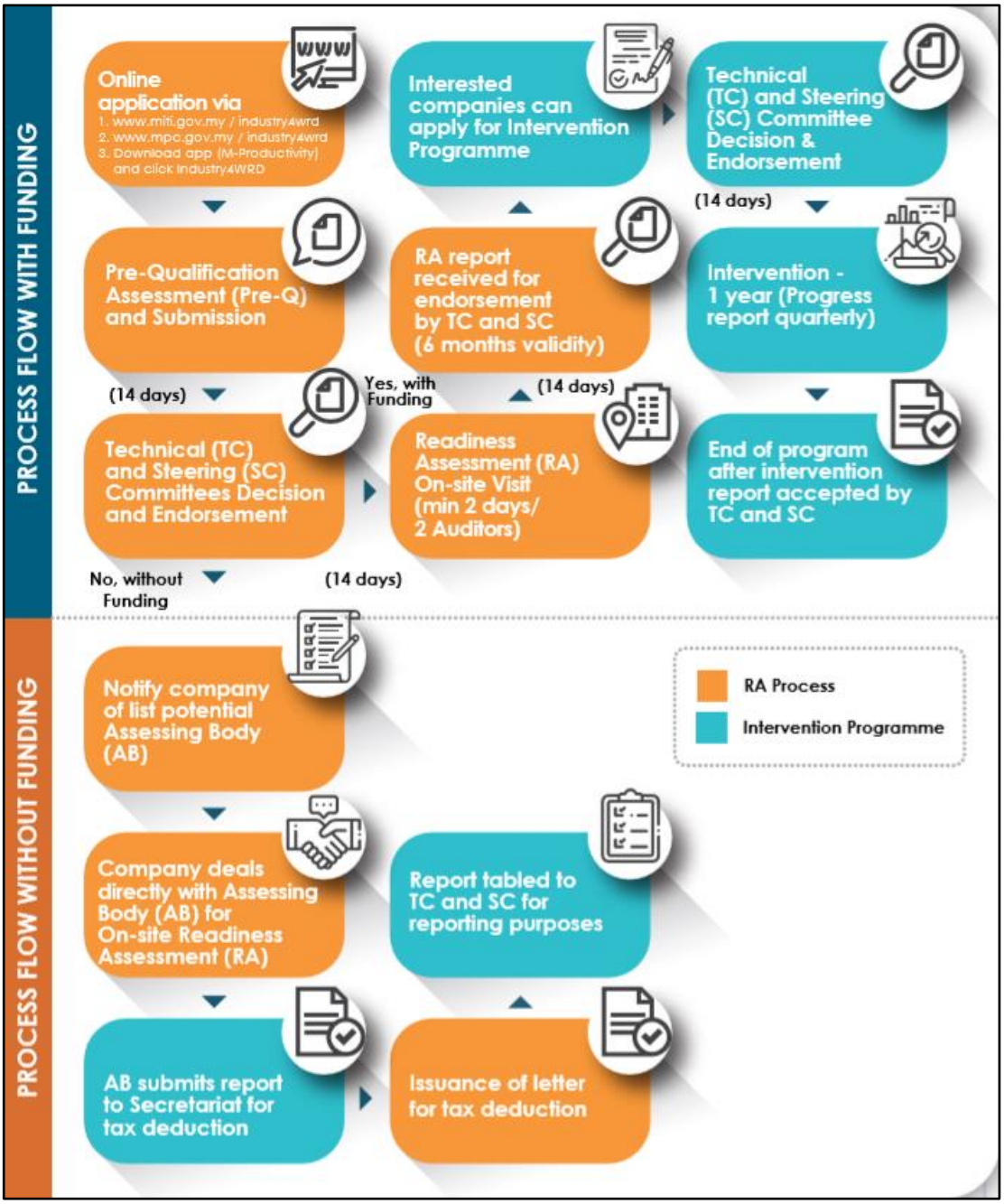

Figure 3: Readiness Assessment Visualisation
(Source: http://www.mpc.gov.my/wp-content/uploads/2019/02/Brochure-Industry-4wrd.pdf)

[55] (MPC, 2019)

2.7 Challenges

Malaysia has been identified as a leader in the "Readiness for the Future of Production Report 2018," jointly published by the World Economic Forum and A.T. Kearney, providing a global assessment of 100 countries. The paper outlines a strong current production base but highlights the significant gap to global leaders like China. But next to China, Malaysia was the only developing country defined in the 25 leader-quadrant, hence signalling the potential that Malaysia possesses. However, to continue its growth and access its potential the government of Malaysia needs to tackle the following challenges in order to bring the uptake of Industry 4.0 forward[56] [57]:

Lack of Awareness

The possibilities of digitising processes as part of Industry 4.0 are often not fully understood by local companies. These enterprises tend to follow the stigma: all or nothing. It would be sensible for Malaysian companies to partly modernise their most crucial processes, but companies tend to view this option as confusing as they do not know where nor how to start. Such businesses need to be informed about the added benefit of initiating a partial move to Industry 4.0, a task that public institutions and stakeholders could fulfil[58].

Digital Readiness

A significant share of Malaysian firms have automated less than 50% of their processes, with automation levels amongst SMEs coming in precariously low at under 20%. It seems like one of the reasons is that Malaysian companies are wary to digitise their manual processes because of cybersecurity concerns[59]. As previously mentioned, the government has understood the importance and launched a national agency in 2017 that handles cyber risks[60]. With more awareness and growing trust in the national system, more companies would potentially consider using technology like IIoT.

Human Resources

Although steps have been made in the right direction in the recent past, Malaysia's education system is not adequately equipping the workforce with required skills and knowledge for Industry 4.0, in particular for the areas of IoT, Robotics and AI. Hence, the education programs offered largely do not match the needs of the industry. According to a study conducted by Accenture, 34.4% of the Malaysians would want to see the education system reformed and regard it as the primary concern of the government. Moreover, close to 90% of the respondents reckon that Malaysia needs to act on the digital transformation, specifically within technologies seen at the workplace. Hence, there is seemingly a mismatch between supply and demand within the labour market[61].

Financing

The financial viability of Industry 4.0 is often seen as a major obstacle for manufacturers, as the management is unclear about the scale and point in time of implementing the changes. In a corporate statement, German conglomerate Siemens offers financing opportunities for manufacturers of any size and simultaneously reiterates that the scale of competitive advantage dwindles by time (detailed information can be found under this link)[62]. Moreover, the wide-spread adoption of Industry 4.0 is

[56] (MITI, 2019)
[57] (MGCC, 2019)
[58] (MGCC, 2019)
[59] (MGCC, 2019)
[60] (NACSA, 2020)
[61] (The Edge Markets, 2018)
[62] (Siemens, 2020)

dependent on the incentive structure and funding that the Malaysian government provides. As previously discussed, multiple proposals were drafted as part of Industry*4WRD* in order to meet the demand of subsidising the transition period and improving the sentiment of SMEs that struggle with funding.

Infrastructure

A quick internet connection is the backbone of an effective Industry 4.0, since the fourth industrial revolution requires machines to constantly communicate with one another. Despite the urgency for investment, Malaysia's digitisation uptake had initially been criticised by the World Bank in a report on the Digital Economy in 2018, stating that especially businesses do not readily adopt these vital changes[63]. Consequently, the former government decided to revise the 11th Malaysia Plan and implement changes through the *National Fiberisation and Connectivity Plan* to improve the attractiveness of Industry 4.0[64]. The plan entails to build a broadband Internet connection in 95% of inhabited areas by 2020 (2017: 92%). Malaysia has significant gaps in its high-speed broadband infrastructure, in particular in the more rural areas. Global comparison also shows that download speeds are slower and more expensive compared to similarly developed countries. In contrast, industrialised nations are driving their expansion of ultra-fast broadband Internet, in order to successfully integrate the technologies of Industry 4.0. In the EU, Singapore and Korea, capacities are expected to rise from 1 Gbps to 10 Gbps. In Malaysia, the plan envisages only a maximum expansion of 500 Mbps in the major cities and 30 Mbps in 95-98% of the inhabited regions[65]. Currently, Malaysia is 8th in terms of average internet connection speed at 13.3mb/s trailing behind the regional leader Singapore, which nearly has a four-fold quicker connection[66].

Improved digital infrastructure does not only benefit Malaysian companies in the manufacturing sector, but also companies in the services sector and individuals. A network expansion is also important for attracting foreign investment, but also to strengthen long-term new economic sectors and promote digital entrepreneurship. In principle, the prospects in this area should be seen as positive for the future, allowing for a digital transformation.

Governance

It is evident that the degree of centralisation within a country will affect the ease of implementing policies, as a clear chain of command improves readiness to enact[67]. Since Malaysia is not uniform in its degree of centralisation throughout the country, it is inherently more difficult to enforce policies, like setting investment priority on broadband connections. It would be important for all policymakers throughout Malaysia to understand the opportunity that investments in this sector have, both for entrepreneurs and the government.

[63] (The World Bank, 2018)
[64] (PWC, 2019)
[65] (MCMC, 2018)
[66] (Sakinah, 2020)
[67] (CFI, 2020)

3. Market Potential

With the various challenges outlined, the Malaysian market displays potential for European companies to enter the market and support companies to adopt new manufacturing technologies and processes. However, considering the priorities of European countries, it becomes evident that the goals tend to deviate significantly for their Malaysian counterpart. Adapting the strategy to the local necessities is an important consideration for European firms and will be elaborated upon further in this section[68] [69]. The following chapter offers insights into the areas of possible collaboration as well as the industries with a currently higher potential of the Industry 4.0 transformation.

Technology

The digital transformation is based primarily on matching the most effective technologies with the capabilities and limitations of local firms. Most Malaysian manufacturing companies are uncertain about the technology, as well as, how much investment is needed for the acquisition. Generally speaking, smart technologies and standards are cost-effective and interoperable. European companies can assist Malaysian manufacturers by taking up a quasi-consultative role based on experience and transfer of knowledge. This correlates well with the government's effort to work with global industry leaders and secure flagship projects that demonstrate the effectiveness of the new technology solutions. Developing new technology and processes that address specific needs in key sectors will be crucial to develop Malaysia's position as a preferred high technology destination.

The majority of manufacturing firms in Malaysia are SMEs and they typically have lower levels of collaboration in research, limited access to high performing graduates and lack of capital to invest in strategic planning. Hence, it is important to ensure that solutions are accessible and effective for SMEs, while also providing them with the necessary assistance. This is not a short-term process; a supportive environment and partnership is needed to achieve long-term strategies in the field of Industry 4.0.

Financing

Overall, it can be assumed that from a Malaysian perspective, the initial investment into Industry 4.0 technology appears to be too high, whilst the return on investment (ROI) takes too long to materialise. Concerns among companies are raised on the ROI as they are experiencing difficulties in maintaining their day-to-day operation in the current economic environment and cannot afford the burden of a locally unproven technology. Hence, it is important for European technology providers to offer incentives and funding options or recommendations to private entities, especially to SMEs (as seen with Siemens in section 2.7).

Infrastructure

European companies should understand the limitations that the business might face as a result of lacking, digital infrastructure. As previously elaborated, plans to comprehensively cover Malaysia's high-speed broadband and 4G technology stumble behind plans of industrialised countries. A well-managed digital infrastructure allows companies across the globe to settle their manufacturing businesses in Malaysia, whilst optimising production using Industry 4.0 technology. However,

[68] (MGCC, 2019)
[69] (MGCC, 2019)

government plans look promising and it is likely that Malaysia will develop to an Industry 4.0 destination once the policy Industry*4WRD* kicks off.

Human Resource

An important factor in promoting the uptake of Industry 4.0 is matching the requirements of the industry with the training of higher education institution. A collaboration is important to create a holistic and effective Industry 4.0 ecosystem and prepare the people and workforce for Industry 4.0. European companies can assist the Malaysian firms with valuable experience in re-skilling employees. In this regard, qualified and skilled workforce is the key to the introduction and adoption of Industry 4.0 technologies.

As outlined in the challenges there is a discrepancy between the real needs of industry and the professional training or degree programs offered by universities and colleges. Although Malaysia's Technical and Vocational Education & Training (TVET) program already exists, it is still slow in providing workers with the up-to-date technical and entrepreneurial skills for specific industry needs.

However, as digitisation progresses, the industry will need to make production, logistics and control processes faster, more efficient and more sustainable if it wants to withstand international competitive pressure in the future. Since 2015, the *Malaysian-German Chamber of Commerce and Industry* (MGCC) has successfully implemented such dual training programs in cooperation with businesses and selected vocational schools. The training occupations offered are certified according to German standards, as well as, local requirements. Accordingly, it is precisely in this area of training that there is great potential for European companies to offer Malaysians an attractive overall package of technology and training.

3.1 Maritime Industry

The maritime industry incorporates the shipbuilding and ship repair industry, as well as, the oil and gas offshore sector. With its vast multiplier effect on supportive manufacturing and service industries, the maritime sector significantly contributes to the national economy. In order to fully reach its potential in capturing the regional and international market, there is a need for Malaysia to look for new ways to transform the industry to be more competitive. The adoption of Industry 4.0 provides the opportunity to do so[70].

The Malaysian Government has already taken a proactive approach with the development of the Industry*4WRD* strategic paper and extended and specified the policy with a specific maritime report "Malaysian Shipbuilding/Ship Repair (SBSR) Industry: Positioning in the Industry 4.0"[71]. The report by MIGHT (Malaysia Industry-Government Group for High Technology) is an assessment on the level of awareness and readiness on the SBSR industry in facing the 4th industrial revolution. In addition to the report, interviews have been conducted, providing additional information about demands for the Industry 4.0 transformation.

In particular, the Malaysian maritime shipbuilding and repair industry still follows very traditional methods that will have to be moved and replaced by modern disruptive technologies. Big data and Artificial Intelligence are highly demanded to improve operations. Moreover, the ship design process in Malaysia is still using time consuming 2D methods that can be replaced by simulation technology

[70] (MGCC, 2019)
[71] (MIGHT, 2018)

using 3D-Design. Generally speaking, Industry 4.0 can help to improve resource efficiency and narrow down the interaction between ship owners and shipbuilders with real-time monitoring, in which design, shipbuilding, operation and maintenance are digitalised. Most dominantly technologies of system integration and energy efficiency are demanded. However, the biggest challenge given in the sector is the lack of sufficient infrastructure for digitisation. Finally, a survey by MIGHT revealed that despite the worry of financing, 65% of the respondents are willing to invest in Industry 4.0, spreading confidence among European technology providers to enter the Malaysian market[72].

3.2 Automotive Industry

As the automotive industry exhibits strong efficiency gains due to Industry 4.0, it also poses as a valuable topic to unveil within the scope of this study. When using the term "automotive sector," this paper refers to the manufacturing process of carmakers, specifically within the Malaysian context. With recent data showing a growth rate of 2.3% between H1:2018 and H1:2019[73], the industry snatched 4.2% of the country's Gross Domestic Product (GDP) in 2018[74] and employed over 700,000 workers by 2016[75].

Deloitte Insights published a research article on the integration of Industry 4.0 into the automotive industry and explicitly labelled it as a "technology to stay relevant." However, this technology is not only relevant for manufacturing purposes, but also within the product portfolio of automakers. Hence, the researchers conclude that 2.4M jobs could be missing between 2018 and 2028, specifically skilled labour in Industry 4.0, amounting to USD 2T of foregone economic output[76]. The economic importance of this industry to Malaysia should immediately become apparent and be a reason for the government to lead talks and initiate investments into this industry. This section will discuss the evidence on existing and planned policies of public and private institutions in the automotive sector.

Most notably, the Malaysian government re-organised its automotive institute, the Malaysian Automotive Institute (MAI) in 2018 to place a greater focus on the necessities of Industry 4.0 and the challenges the industry faces. Thus, it has been re-labelled as the Malaysia Automotive, Robotics and IoT Institute (MARii). The key headline the organisation pursues is to support the education of automotive staff by making them familiar with the new technologies. For instance, the institute organises workshops in the areas of augmented reality and advanced modelling[77]. Specifically, the institute aims to award diplomas and degrees as part of a specialised vocational training, allowing workers to match the necessities of the industry. The MITI, senior to the MARii, reflects this policy change in the newly launched National Automotive Policy which combines the amendments mentioned above[78].

After the government launched its Industry 4.0 programmes in 2016, the private automotive sector responded shortly after in 2017[79]. Proton, Malaysia's third largest carmaker with regard to sales[80], announced its move towards a high technology factory that fulfils Industry 4.0 standards. Proton and the Ministry of International Trade and Industry cooperated closely during this flagship project of the

[72] (MIGHT, 2018)
[73] (Lee, 2019)
[74] (ASEAN Post, 2019)
[75] (MITI, 2017)
[76] (Dutt, Natarajan, Wilson & Robinson, 2020)
[77] (MARii, 2019)
[78] (ASEAN Post, 2019)
[79] (The Mole, 2017)
[80] (The Malaysian Reserve, 2019)

Malaysian manufacturing industry[81]. The first car rolled off the production line in late 2019 after an investment of MYR 1.2B created over 1000 jobs[82]. The company wishes to construct 280,000 units per annum using more efficient processes that, at the same time, meet the standards of modern cars[83]. The example of Proton goes to show that the Malaysian government and the industry can work in tandem to apply the learning of Industry 4.0 in the manufacturing sector.

3.3 Machinery and Equipment industry

The Machinery and Equipment sector, also known as M&E, is an economic powerhouse in Malaysia as it boasts over 1,400 companies and around 140,000 employees[84] [85]. The industry is seemingly in a competitive place with specialised, international firms exploiting the opportunity of low-cost labour. Since the term M&E is fairly broad, it combines a significant number of sub-sectors in which machinery is required, including power generation and metalworking. The government has constructed an incentive programme, which will be discussed in further detail below, to support specific products like robots and packaging machinery[86]. The mix of government support and continuous qualitative work by businesses means that short-term forecasts look promising. The industry is forecasted to reach a respectable growth rate of 3.7% in 2020. This is partly related to robust investor sentiment with inflow funds reaching MYR 30.8B and exports set to grow by 6.7% per annum to MYR 48.3B.

In order to sustain this growth rate over a longer time, the government supports investments into this manufacturing-related industry. However, it becomes evident that the incentives are fairly outdated, as they do not explicitly target technology from the Industry 4.0 pool. The policies of Industry 4*WRD* stipulate that encouragements into high technologies by the government should have occurred in 2016, as part of the funding pillar of these policies[87]. Despite this, the incentive packages issued by the MITI in recent years, largely focusses on Pioneer Status and Investment tax exemption, with investments being focussed on personnel, rather than adoption of Industry 4.0 technology[88].

Further headwind originates from concerns by businesses towards Industry 4.0. ViTrox, a company in the Malaysian M&E industry, commented on the challenges that the industry faces by stating that the mindset of SMEs is slow to change, since firms face high costs and have a lack of labour and expertise. The industry fails to acknowledge that automation is not part of 4.0, but rather acts as the requirement for Industry 3.0. If the government can unlock the potential, technology manufacturer ABB calculated that Industry 4.0 standards would boost company productivity by 200%, increase product lifetime by 30% and reduce energy consumption by 30%[89].

[81] (The Mole, 2017)
[82] (Proton, 2019)
[83] (Daily Express, 2017)
[84] (MITI, 2020)
[85] (MIDA, 2020)
[86] (MITI, 2020)
[87] (MITI, 2018)
[88] (MITI, 2020)
[89] (ViTrox, 2017)

4. Conclusion

Industry 4.0 has become a buzzword for the modernisation and digitalisation of production processes. It includes new technologies such as Blockchain, cloud services and artificial intelligence that allows for the enhancement of existing business models. The advantages of transforming towards an integrated value chain at Industry 4.0 standard is mainly based on the pursuit of optimising processes and becoming more cost-efficient. With its enormous potential, Malaysian firms need to ensure that they are not excluded from this transformation and continue to operate at an internationally competitive level.

This study has offered a holistic analysis of the drivers, challenges and opportunities that the adoption of Industry 4.0 possesses, especially for the Malaysian manufacturing sector. The Malaysian government has recognised the potential of Industry 4.0, which has led to the implementation of the accelerator-programme Industry*4WRD* by the cabinet of Malaysia's former Prime Minister Dr. Tun Mahathir. Although current data on expected industry growth in the automobile and machinery industry is formidable, the underlying growth driver might dwindle as international competitors are more capable of addressing the issues of modernisation. For instance, current data shows that Industry 4.0 adoption amongst firms is dramatically low (<1%), hence, it is paramount for Malaysia's policymakers to stimulate the industry to adopt new technologies.

The transformation that Malaysian companies are arguably "forced" into is a result of the following external pressures: competitors, partners in the value chain (upstream and downstream), environmental considerations and a shift in consumer preferences. Ultimately, this reveals the shortcomings of Malaysian firms whom face headwind in grasping the immense added value of Industry 4.0 solutions. In turn, financing, constructing and overseeing the infrastructure poses as a deterrent to many firms, as they are not yet fully sensitised for the topic. The government should bundle its efforts to promote the new technologies, focussing on the competitive advantage that companies may achieve compared to international competitors.

Companies from abroad, especially European firms, can capitalise on the Industry 4.0 transformation in Malaysia by offering knowhow, technology and capital to local companies. Successful examples include Siemens that have initiated a platform to support SMEs in their endeavour towards full digitisation. As the willingness to change increases, Malaysian firms are an attractive investment for European companies to bring in their key competencies. Besides, multinational companies that already settled in Malaysia would also profit from government efforts as their production capabilities would improve with greater investment in new technologies, further inducing FDI inflow from the companies' side. Therefore, to sustain investment from abroad, the Malaysian government needs to continue its efforts in implementing Industry 4.0 technologies.

To conclude, the Malaysian manufacturing sector shows great potential in integrating Industry 4.0 technologies. The government has seemingly understood the importance of taking action and started encouraging the industry by offering consulting services, as well as, tax incentives. Changing market dynamics and external pressures require the manufacturing businesses to change their stance towards technology and the role it can play in helping the industry to tackle the challenges of the future.

Agencies and Related Associations

Malaysian Industry- Government Group for High Technology (MIGHT)

Prime Minister's Department
MIGHT PARTNERSHIP HUB, Jalan IMPACT,
63000 Cyberjaya, Selangor,
Malaysia

Tel: +60 3 8315 7888
E-mail: info@might.org.my
Website: https://www.might.org.my

Ministry of International Trade and Industry (MITI)

Menara MITI, No. 7, Jalan Sultan Haji Ahmad Shah,
50480 Kuala Lumpur, Malaysia

Tel: 603-8000 8000
Fax: 03-6206 4693
Email: webmiti@miti.gov.my
Website: https://www.miti.gov.my

Malaysian Investment Development Authority (MIDA)

MIDA Sentral, No.5, Jalan Stesen Sentral 5,
Kuala Lumpur Sentral,
50470 Kuala Lumpur, Malaysia

Tel: +603-2267 3633
Fax: +603-2274 7970
E-Mail: investmalaysia@mida.gov.my
Website: http://www.mida.gov.my/home/

Federation of Malaysian Manufacturers (FMM)

Wisma FMM, No. 3 Persiaran Dagang, PJU 9, Bandar Sri Damansara,
52200 Kuala Lumpur, Malaysia

Tel: +603-6286 7200
Fax: +603-6274 1266/7288
E-Mail: webmaster@fmm.org.my
Website: www.fmm.org.my

Malaysia Automotive Robotics and IoT Institute (MARii)

Block 2280, Jalan Usahawan 2, Cyber 6, Cyberjaya,
63000 Selangor Darul Ehsan, Malaysia

Tel: +603-8318 7742
Fax: +603-8318 7743
E-Mail: info@marii.my
Website: http://marii.my/

Ministry of Science, Technology and Innovation (MOSTI)

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Ministry of Energy and Natural Resources (KATS)

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