Chapter 7

I4R for Circular Economy: Transition Trends and Readiness of Thailand Automobile Sector

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November 2020

This chapter should be cited as

Chollacoop, N. (2020), 'I4R for Circular Economy: Transition Trends and Readiness of Thailand Automobile Sector', in Anbumozhi, V., K. Ramanathan and H. Wyes (eds.), Assessing *the Readiness for Industry 4.0 and the Circular Economy*, Jakarta: ERIA, pp.234-250.

CHAPTER 7

Industry 4.0 Readiness for the Circular Economy: Transition Trends and the Readiness of Thailand's Automobile Sector

Nuwong Chollacoop

The Thai government has consistently promoted and supported Thailand's automotive industry over the past four decades. Initially, the industry was focused on establishing domestic production for import substitution through various government incentive programmes like tax privileges on investment, lower import taxes on completely knocked-down (CKD) parts, and higher import taxes on completely built-up (CBU) parts to shift from whole car imports to car assembly in the country. The next phase was government support for the domestic production of automotive parts to strengthen the domestic auto industry. The import taxes on CKD parts and whole cars were raised with enforced local content requirements from 1 January 1975, with an increasing percentage of local content over time to sustain the whole production value chain. Furthermore, foreign investment in the auto industry has been strongly pursued with technology transfers through joint ventures. Nowadays, domestic automotive production uses locally produced parts amounting to over 80% in value.

Foreign investment in the automotive sector spiked in 1987 when the Japanese currency was so strong that the production base shifted from Japan to Thailand to maintain competitiveness. Later in 1997 during the economic crisis, the Thai government allowed a higher proportion of share-holding by foreigners in Thai companies, as well as involved foreign car companies in the automotive industry roadmap with an aim for Thailand to become a production hub in Asia, the 'Detroit of Asia'. Hence, domestic automotive production skyrocketed from 0.36 million units in 1997 to 1.99 million units in 2017, or an 8.9% compound annual growth rate.

Since 2008, domestic automotive production has changed from production for domestic consumption to production for exporting.

The key government policies in the automotive sector have focused on the following product champions. First, during 1997–2007, the first product champion was the 'one-ton pickup truck', with various incentives to attract big foreign car makers to invest in production lines in Thailand, such as by keeping the diesel fuel price lower than the price for than gasoline, specifying a very low excise tax of 3% for pickup trucks (compared to 30%–50% for passenger cars). Unsurprisingly, 70% of vehicle production in Thailand is for one-ton pickup trucks. Next, from 2009 until now, the automotive industry focus has shifted from one-ton pickup trucks to passenger cars, resulting in an increased share of passenger car production from 28% in 2007 to 50% in 2017. The second product champion was launched in 2009 and was the 'eco-car', which is defined as a small car with higher fuel efficiency. Additional incentives have been laid out to attract foreign investment in eco-cars with export conditions through 'Eco-car Phase I' in 2009 with fuel efficiency better than 5 litres/100 kilometres, and 'Eco-car Phase II' in 2015 with fuel efficiency better than 4.3 litres/100 kilometres. A major incentive was a great reduction in the excise tax from the typical 30%–35% for passenger cars to 17% and 12%–15% for Eco-car Phases I and II, respectively. In addition, government support for biofuel, especially ethanol-blended gasoline or 'Gasohol' of various percentages (10%, 20%, and 85%), has lowered the gasoline fuel price. Recently, since 2016, the vehicle excise tax scheme has been changed from being engine displacement-based to being carbon dioxide-emission based to further the support small car segment.

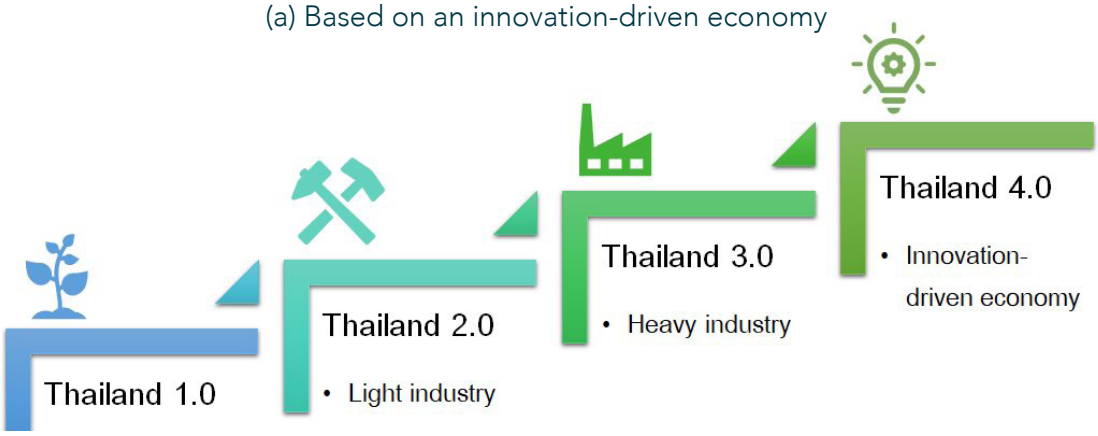
With the recent electric vehicle (EV) movement worldwide, it is not surprising that EV has become the third product champion, with many policy support programmes being drafted and launched for the EV value chain covering vehicles, motors, batteries, and charging stations. However, the Thai government has not followed the worldwide trend to boost EV demand through a direct subsidy in EV prices, but is rather using investment privileges like for the previous two product champions. Hence, the volume of EV, especially plug-in hybrid electric vehicles and BEV battery hybrid vehicles, has not grown so much.

1. Industry 4.0 Readiness for the Circular Economy Profiles of Firms and the Sector

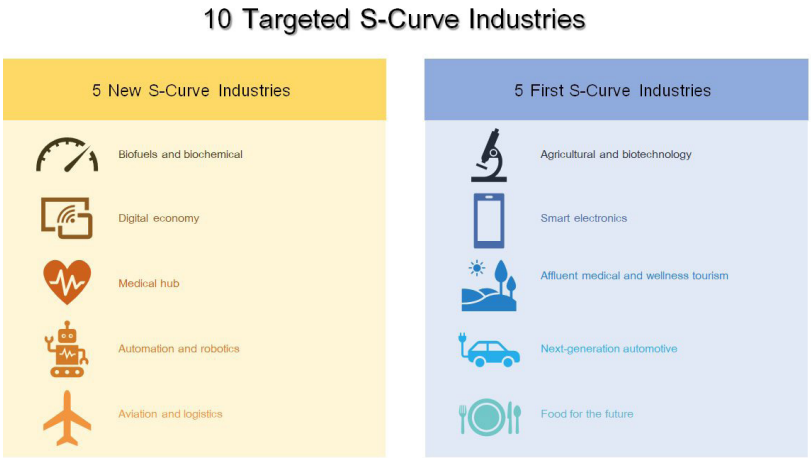
With the Fourth Industrial Revolution happening worldwide, Thailand has responded by establishing a new economic model under Thailand 4.0 based on an innovation-driven economy where five new S-curve industries and five first S-curve industries have been identified, as shown in Figure 7.1. In the case of Thailand, Industry 4.0 readiness (I4R) for the circular economy was assessed for the automotive sector, which is identified as one of the five first S-curve industries due to its well-established infrastructure and skilled personnel as a production hub for many foreign brand car makers.

Figure 7.1: Thailand 4.0 Scheme

(a) Based on an innovation-driven economy



(b) With five new S-curve industries and five first S-curve industries identified



Source: Author based on BOI (2018a).

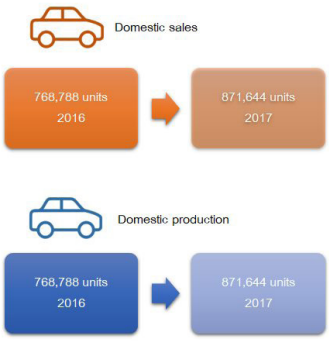
The automotive industry in Thailand has been one of the major contributions to economic prosperity. With production of almost 2 million motor vehicles, Thailand ranked 12th in the world in 2017 and currently has 18 international brands, as shown in Figure 7.2(a)–(b) (BOI, 2018b) scattered around the central and eastern parts of Thailand (see Figure 7.2(c)) (TAI, 2016).

Figure 7.2: Thailand as a Production Hub for Cars

(a) In 2017 (12th world ranking)

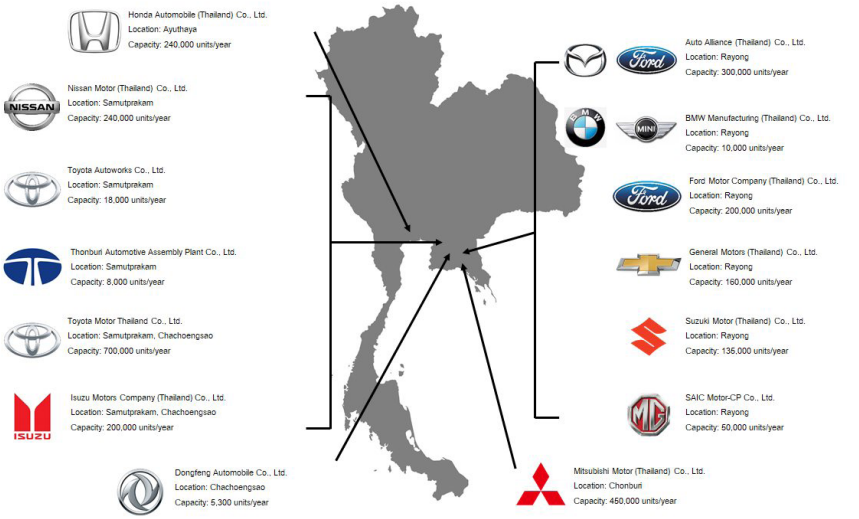
Global and Local Production

#	Country	Production (2017)
1	China	29.02
2	United States	11.19
3	Japan	9.69
4	Germany	5.65
5	India	4.78
6	Republic of Korea	4.11
7	Mexico	4.07
8	Spain	2.85
9	Brazil	2.70
10	France	2.23
11	Canada	2.20
12	Thailand	1.99

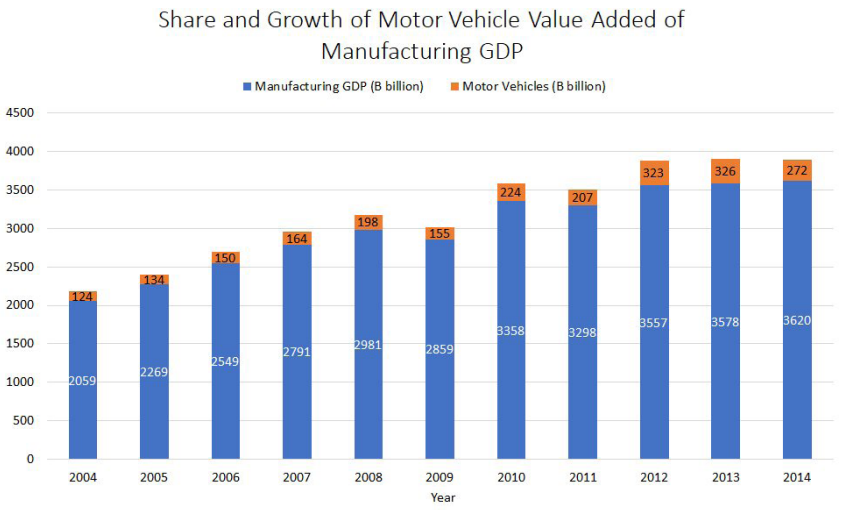


(b) With 18 international brands

(c) With production hubs in the central and eastern regions



(d) GDP

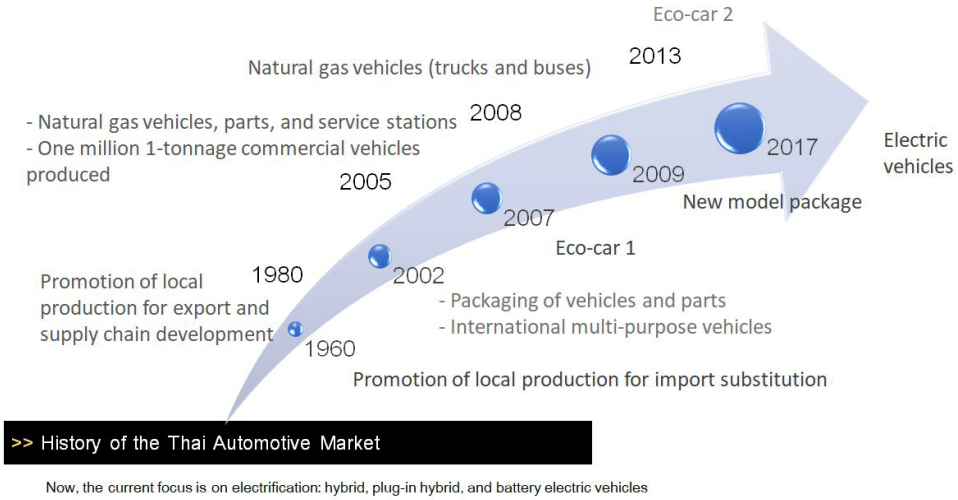


Source: Author based on BOI (2018b) and TAI (2016: 7).

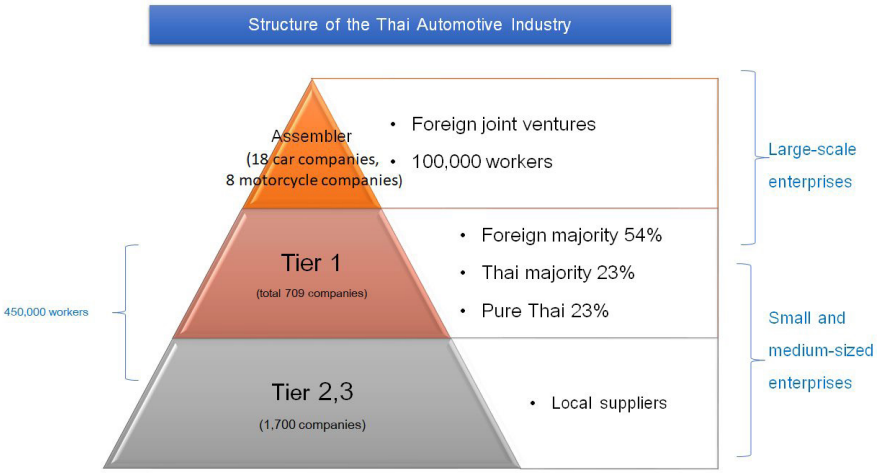
The contribution of the automotive industry to Thailand's gross domestic product (GDP) is in the range of 5%–9% (TAI, 2017). In 2017, more than half of vehicle production in Thailand was for exports, at 56%. With the history of the Thai automotive industry shown in Figure 7.3(a), the Thai government launched the National Automotive Master Plan in 2002, for which the 1st Automotive Master Plan (2002–2006) focused on the production of one-ton pick-up trucks as the first product champion with increased research and development investment and more value added content. The 2nd Automotive Master Plan (2007–2011) focused on eco-car production as the second product champion with a benchmark to international standards (UNECE) under Vision 2011 (TAI, 2017): 'Thailand is production base in Asia, which creates more value added to the country with strong automotive parts industry'. Under the current 3rd Automotive Master Plan (2012–2016), the Vision 2021, 'Thailand is a global GREEN automotive production base with strong domestic supply chains, which create high value added for the country' has been set forth with a strategic plan for three Centers of Excellence (COEs), namely the Research and Technology Development, Human Resource Development, and Entrepreneur Strength Enhancement, as well as two Good Business Environments, namely infrastructure and government policy.

Figure 7.3: Thailand's Automotive Industry

(a) History



(b) Structure

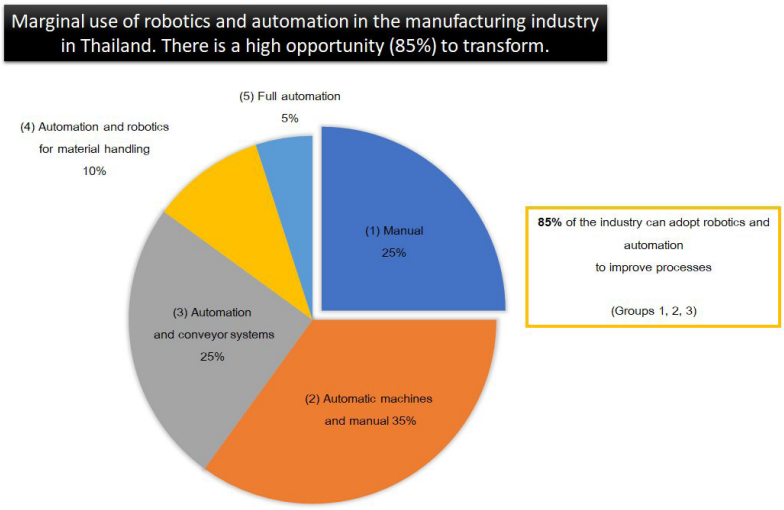


Source: Author based on BOI (2018b, 2018c).

To address the Industry 4.0 worldwide trend, Thailand's Ministry of Industry has established a 20-year roadmap for Industry 4.0 for 2017–2036 (MOI, 2016), where the next-generation automotive industrial sector is a focus for the 10 targeted S-curve industries, as shown in Figure 7.1(b). Given the structure of Thailand's automotive industry, as shown in Figure 7.3(b), large-scale enterprises (LSEs), including foreign brand car makers and large tier-1 companies, will be the first group to adopt Industry 4.0. From a recent survey of the manufacturing industry (Institute of Field Robotics, 2017), Figure 7.4 shows that 85% of the industry has the opportunity to adopt robotics and automation to improve processes (classified as Groups 1–3 according to their levels of robotics and automation), whereas 50% of industry is ready to adapt manufacturing processes to use robotics and automation within 1–3 years. On the other hand, demand for skilled labour will increase by 2–5 times in the next 5 years.

Figure 7.4: Status of the Manufacturing Industry in Thailand

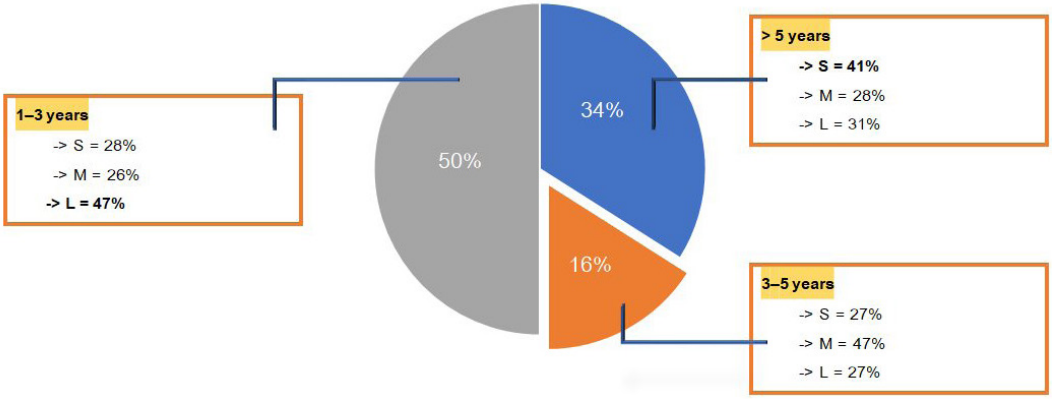
(a) Robotics and automation level



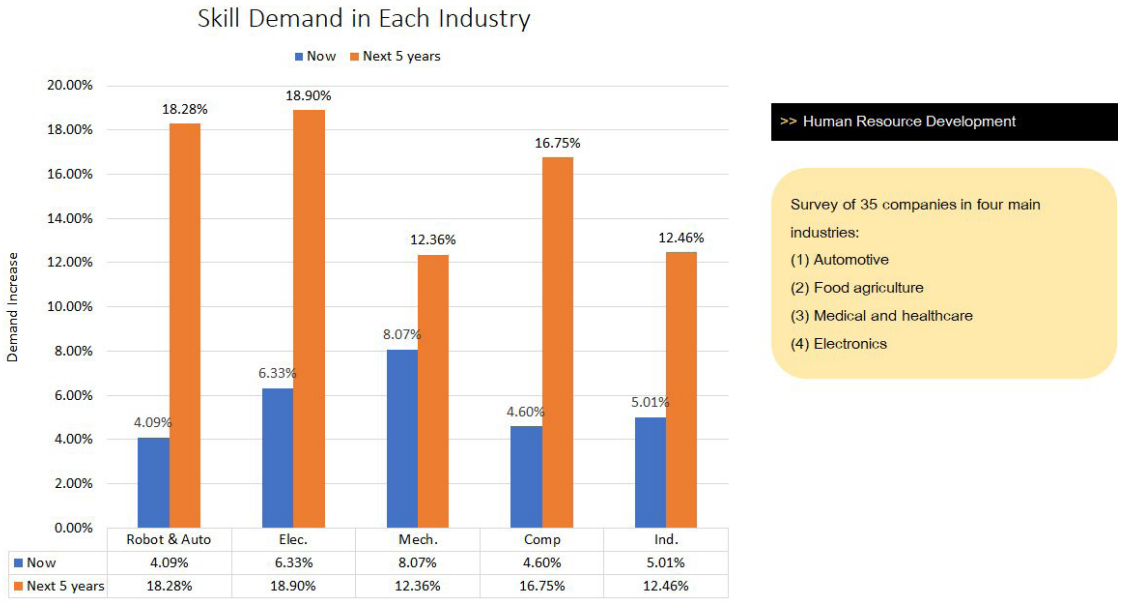
(b) Robotics and automation adoption

Fifty percent of the industry in Thailand is ready to adapt their manufacturing processes to use robotics/automation within 1–3 years

- Majority of **large** companies are ready to change in 1–3 years.
- Majority of **medium** companies are ready to change in 1–3 years.
- Majority of **small** companies are ready to change in 1–3 years.



(c) Skilled labour demand



Source: Author based on Institute of Field Robotics (2017).

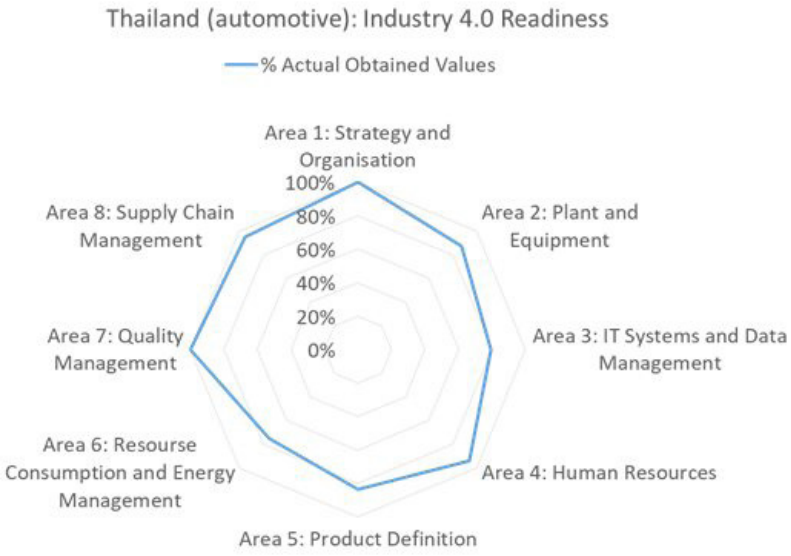
Focusing on automotive firms with well-established production lines as the first production champion, namely one-ton commercial vehicles or simply one-ton pickup trucks, as shown in Figure 7.3, two makers have a similar market share of 35% each in the over 6-million vehicle market (DLT, 2018). The Industry 4.0 readiness (I4R) and I4R for the circular economy (CE) assessment was conducted through a meeting lasting a few hours with a top executive in manufacturing from one of the makers. The results of the I4R and I4R for CE assessments are shown in Figures 7.5(a) and 7.5(b), respectively. The assessment focuses on eight areas, namely:

1. Strategy and organisation
2. Plant and equipment
3. IT systems and data management
4. Human resources
5. Product definition
6. Resource consumption and energy management
7. Quality management
8. Supply chain management

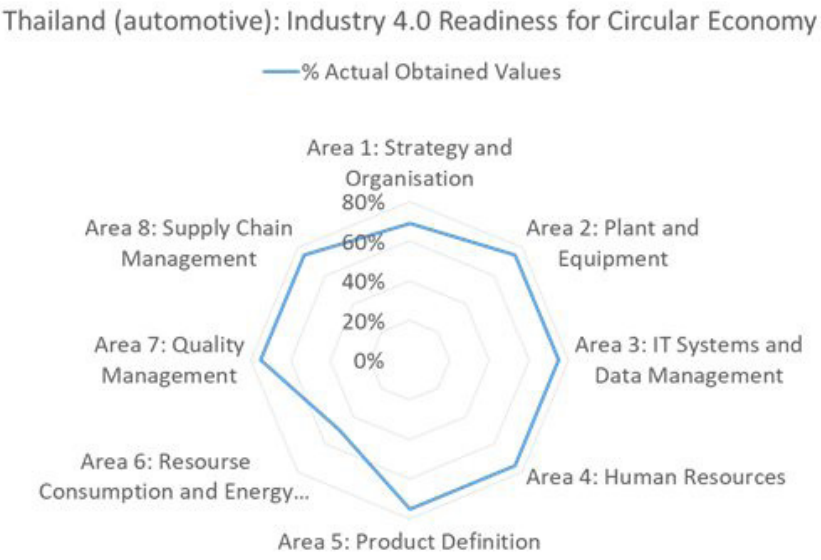
Figure 7.5(a) clearly shows that the firm has over 75% (average of 89%) readiness for Industry 4.0 since many of the company's policies comes from its headquarters in Japan, where Industry 4.0 has been a focus of industrial improvement. On the other hand, Figure 7.5(b) shows that I4R for CE has dropped to the level of 50%–75% (average of 71%) since the concept of I4 for CE is relatively new in Thailand, especially as implementation towards Industry 4.0 is usually associated with higher energy consumption from the utilisation of robotics and automation. Table 7.1 shows the classification of this large firm in terms of I4R and I4R for CE as an 'expert/frontrunner' and 'CE fast adopter'. It should be noted that the assessment results considered the company as a top runner since this large firm represents the sector of foreign joint investment, not the average automotive industry in Thailand.

Figure 7.5: I4R and I4R for CE Assessment of a Large Automotive Firm win Thailand

(a) I4R assessment



(b) I4R for CE assessment



Source: Author.

Table 7.1: I4R and I4R for CE Survey Results for a Large Firm in Thailand's Automobile Sector

Rating Classification	Actual Obtained Value	Maximum Value	Readiness Classification	Rating
Industry 4.0 readiness	118	132	Expert/Front runner	0.89
Industry 4.0 readiness for the circular economy	40	56	CE fast adopter	0.71
Circular economy-adjusted Industry 4.0 readiness rating				0.64

Source: Author.

2. Gaps in Industry 4.0 Readiness and Industry 4.0 Readiness for the Circular Economy

For the case of the large firm in Thailand's automobile sector, the gap in I4R was not large since the policies from its headquarters are geared towards Industry 4.0, as shown in Figure 7.5(a). However, some gaps exist in I4R for CE because many early-stage actions for Industry 4.0, especially robotics, automation, and IT, require higher energy consumption but with better efficiency and fewer errors. These gaps will decrease over time when the implementation steps have been optimised to become a routine procedure.

3. Trends to Shape Future Opportunities

With global awareness and the realisation of Industry 4.0, there are plenty of future opportunities in Thailand, especially because the government has incorporated Industry 4.0 into many sectors, including industry and energy. Figure 7.6 shows the 20-year trend of the strategic development of Industry 4.0 (MOI, 2016), starting from building startups or 'one tambon one product' (where tambon is the Thai word for sub-district), strengthening small enterprises, and upgrading medium-to-large enterprises and finally sustaining them. Figure 7.6 shows how Industry 4.0 can support Thailand 4.0, the new model of Thailand's economic propulsion that aims to adjust its economic structure towards being a 'value-based economy' in order to step over the middle-income trap by transforming from traditional agriculture into new era agriculture with the following emphasis on technology management:

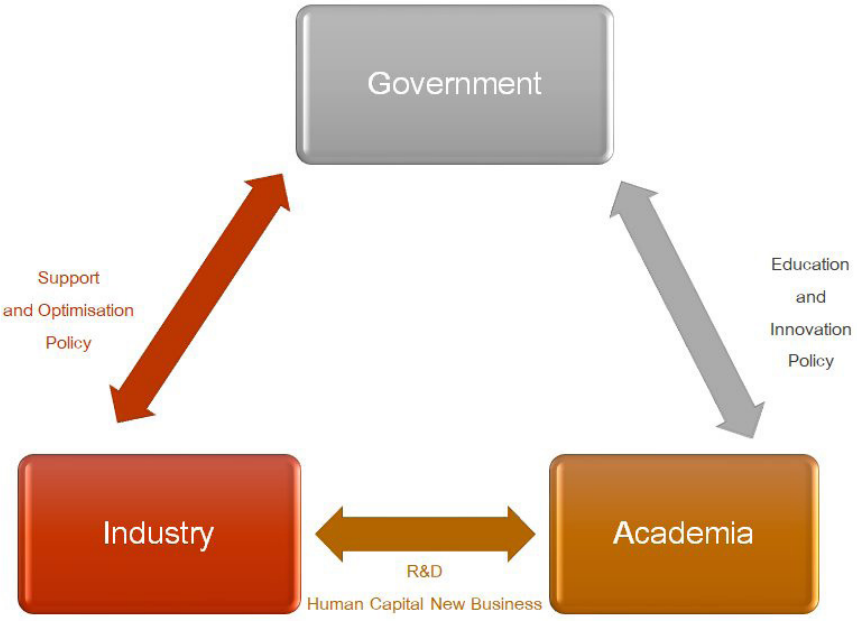
- Traditional small and medium-sized enterprises to smart enterprises with high capacity
- Low-value traditional services to achieve a high value
- Low-skilled labour to knowledgeable, specialised, and highly skilled labour

This is in order to transform the current 'industrialisation drive economy' into an 'innovation drive economy' as follows:

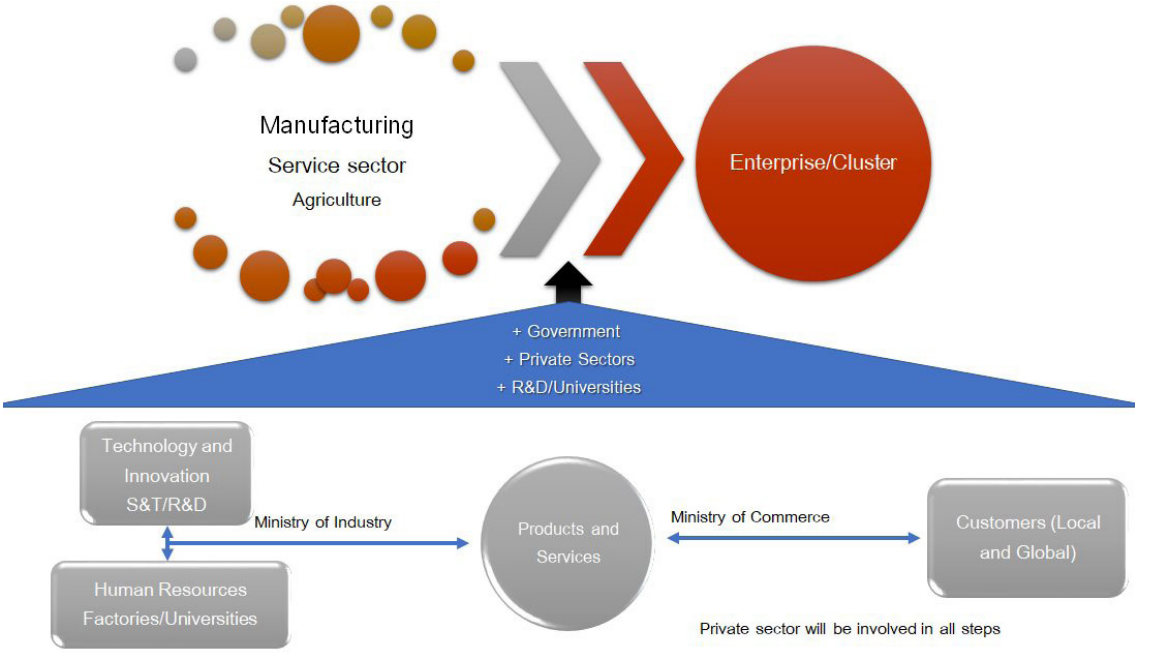
- Consumer commodities to innovative commodities
- Industry-based to technology-, creativity-, and innovation-based
- Industrial production to high value-added services

Figure 7.6: Twenty-year Industry 4.0 Roadmap

(a) To support Thailand 4.0



(b) With strategic framework



Source: Author.

The 20-year strategic plan for Industry 4.0 has the vision to move towards intellect-driven industry with linkages to the world economy and has the five following goals:

1. Average GDP growth from the industrial sector of at least 4.5% annually
2. Average investment growth of at least 10% annually
3. Average value growth from industrial exports of at least 8% annually
4. Average total factor productivity growth from the industrial sector of at least 2% annually
5. New private sector for emerging industry, 150,000 cases

4. Thailand to Prepare for the Transition

As shown in Figure 7.1(b), the transition towards Industry 4.0 will focus on first S-curve and new S-curve industries. The first S-curve industries are the following:

1. Agricultural and biotechnology
2. Smart electronics
3. Affluent medical and wellness tourism
4. Next-generation automotive
5. Food for the future

As industries are those in which Thailand has potential and expertise in production and they have created substantial economic and commercial value. However, if these industries do not invest in new technology for further improvement, they will reach saturation with low growth. Hence, new technology and innovation are keys for the continued growth of the first S-curve industries. On the other hand, new S-curve industries are:

1. Biofuels and biochemical
2. Digital economy
3. Medical hub
4. Automation and robotics

These are new industries that strongly utilise technology and innovation with a high potential for future growth. However, since these industries are new with a relatively

small group of entrepreneurs, they are not yet strong and have less economic value than the first S-curve industries. Hence, it is necessary to nurture the growth of these industries' entrepreneurs. In addition to these two groups of industries, there are groups of industries that have been using traditional technology for production with limited growth potential. Some may have less economic value than the first and new S-curves industries. Hence, an industrial revolution is necessary and could comprise the following:

- Clustering of textiles, clothing, leather, and jewellery to become a fashion industry
- Increasing creative design, cultural-based design, and innovation-driven technology, like nanotech clothes for sports and specialty-clothing for medical and health applications
- Clustering of materials for industry, like composite materials development for sustainability
- Transforming petrochemical and plastic industries with clean and environmentally friendly technologies

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