

Chapter 5

Innovation Capability of Thailand's Automotive Industrial Network

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CHAPTER 5

Innovation Capability of Thailand's Automotive Industrial Network

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Due to its long history of development, the Thai automotive industry is now one of the most important industrial sectors of the country. This can be seen from statistical data, showing that Thailand has become more important in the automotive world market due to the high volume of exported automotive products and vehicles, especially during 2001-2010 (after the economic crisis). This success did not come by chance but from many factors of interest. One of the major factors is the role of the local suppliers. In this study, it is important to understand the relationship between the automotive manufactures and the local suppliers, especially in the technology transferred and innovation capability in the automotive industrial network. Therefore, seven case studies were selected for the interviews, and the focus of the interviews was on their innovation capability. Based on the interview results, the firms in the automotive industry can be classified into four types in terms of their technological capability. Therefore, to be able to support the automotive industry effectively, the government should provide different policies for the different groups of firms based on their particular needs.

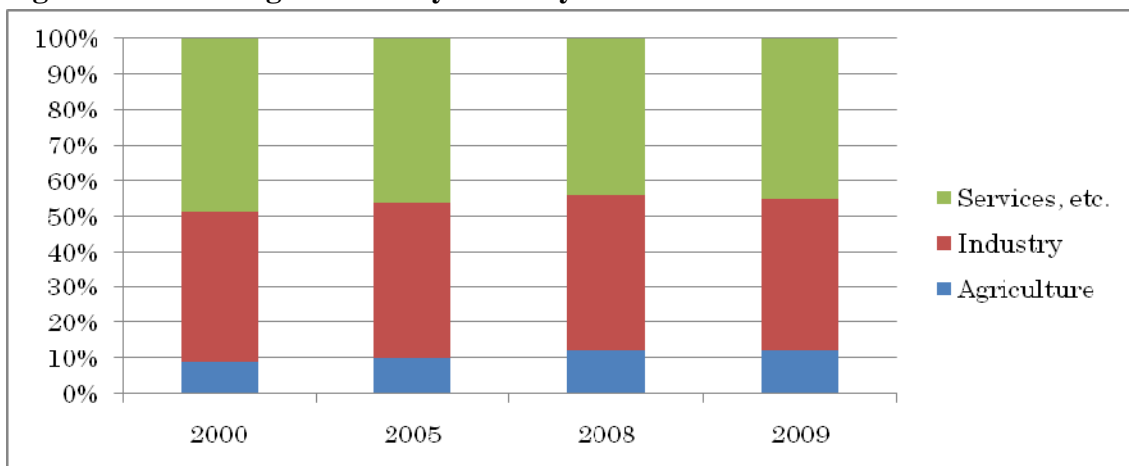
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1. Introduction: Thai Industry Overview

Thailand used to be a traditional economy with the major export being agricultural products, especially rice. In 1960, agriculture accounted for 32% of the total GDP of the country, while the share of manufacturing was only 14%. The proportion of agricultural products in the total GDP has been decreasing continuously in the past 40 years. In 2009, agricultural products provided only 12% of total products, while manufactures took up a 43% share, as shown in Figure 1. Thailand now has a GDP worth US\$584 billion (on a purchasing power parity or PPP basis) to rank 24th in the world, and its GDP growth of 8.0% in 2010 was among the highest in Asia. This classifies Thailand as the second largest economy in Southeast Asia after Indonesia.

Moreover, the structure of exported goods has substantially changed. In the early 1980s, 45% of total exported goods were food products. However, the share of food products in exports has now given way to machinery products. In 2010, exports of manufacturing products accounted for a 76.5% share of total exports, while food products made up only 11.02%, as shown in Table 1.

Figure 1: Percentage of GDP by Industry from 2000 to 2009



Source: World Bank (<http://www.worldbank.or.th/>).

Table 1: Export Structure of Thailand

| Industrial sector | Value (US\$ million) | | | | Share (%) | | | |
|-------------------------------------|----------------------|-----------|-----------|-----------|-----------|--------|--------|--------|
| | 2007 | 2008 | 2009 | 2010 | 2007 | 2008 | 2009 | 2010 |
| 1. Agricultural products | 15,167.7 | 20,139.4 | 16,429.9 | 21,526.1 | 9.86 | 11.33 | 10.78 | 11.02 |
| 2. Agro-industrial products | 9,489.5 | 11,714.0 | 11,264.5 | 13,222.8 | 6.17 | 6.59 | 7.39 | 6.77 |
| 3. Principle manufacturing products | 120,559.6 | 133,826.4 | 116,405.8 | 150,090.2 | 78.35 | 75.28 | 76.37 | 76.85 |
| 4. Mining and fuel products | 7,510.9 | 12,095.1 | 8,326.0 | 10,472.2 | 4.88 | 6.80 | 5.46 | 5.36 |
| 5. Others | 1,137.4 | 0.3 | 0.0 | 0.2 | 0.74 | - | - | - |
| Total | 153,865.0 | 177,775.2 | 152,426.3 | 195,311.6 | 100.00 | 100.00 | 100.00 | 100.00 |

Source: Thailand Trading Report (<http://www2.ops3.moc.go.th/>), Information and Communication Technology Center with cooperation from the Customs Department.

Table 2 shows Thailand's top six export products by value, as classified by the Harmonized System (HS) groupings. In 2010, the automotive products share was about 9.52% of all export value from Thailand. Based on HS, the top three export products were Group 84 (Machinery), Group 85 (Electronics) and Group 87 (Vehicles). Figures 2 and 3 show the yearly export and import value of these groups. It is noticeable that the import and export value dropped in 2009 due to the economic crisis but grew back in 2010.

Table 3 shows the trade balance for Thailand, where the positive value indicates that there are more exports than imports. From this table, the indication is that the automotive industry (Group 87) gradually increased in trade, becoming the largest gainer in 2010, more than the two other large groups (84 and 85).

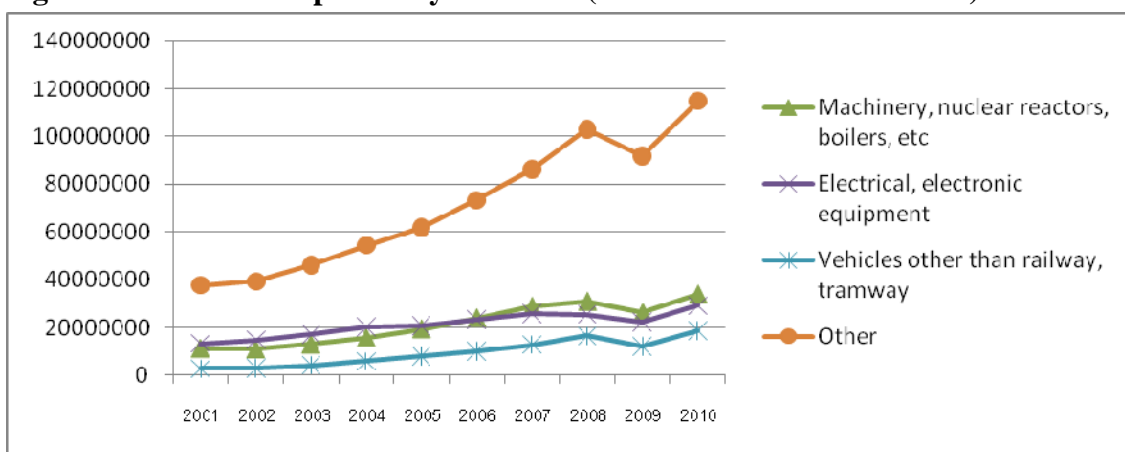
Based on the mentioned data, it can be seen that the automotive industry has become one of the most important industries of the country. This industry not only has a large share of the total exports each year but also shows a significant increase of its imports year by year.

Table 2: Top Six Exported Products by Thailand (Unit: Thousand US Dollars)

| Rank | Product label | 2010 | % |
|------|--|-------------|--------|
| 1 | Machinery, nuclear reactors, boilers, etc (Group 84) | 33,770,400 | 17.19 |
| 2 | Electrical, electronic equipment (Group 85) | 29,111,072 | 14.82 |
| 3 | Vehicles other than railway, tramway (Group 87) | 18,692,864 | 9.52 |
| 4 | Rubber and articles thereof | 14,735,608 | 7.50 |
| 5 | Pearls, precious stones, metals, coins, etc | 11,714,161 | 5.96 |
| 6 | Mineral fuels, oils, distillation products, etc | 9,714,099 | 4.95 |
| | All products | 196,422,624 | 100.00 |

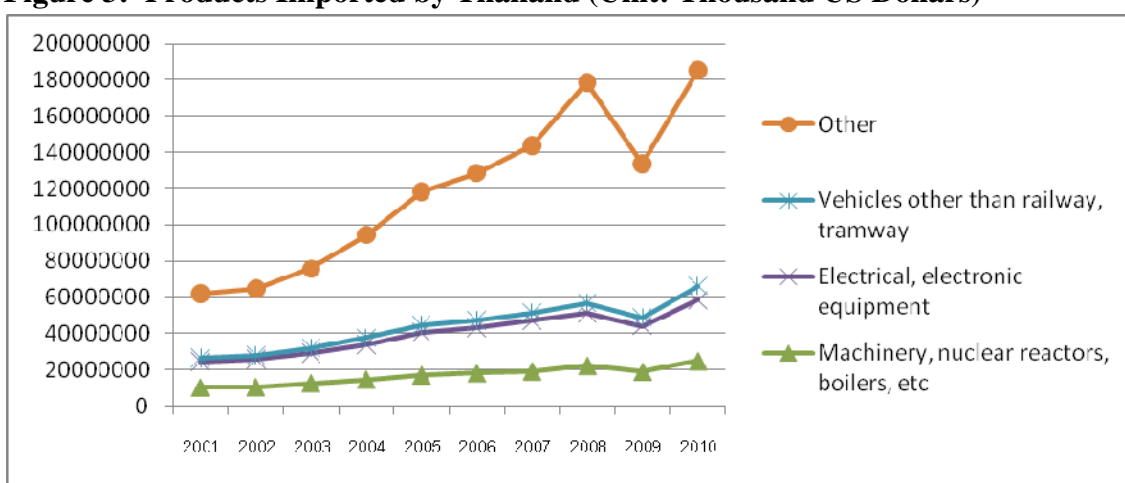
Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Figure 2: Products Exported by Thailand (Unit: Thousand US Dollars)



Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Figure 3: Products Imported by Thailand (Unit: Thousand US Dollars)



Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Table 3: Thailand Trade Balance by Product Group (Unit: Thousand US Dollars)

| Group | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-------|---------|-----------|------------|------------|------------|------------|------------|------------|
| 84 | 424,642 | 1,296,364 | 2,325,380 | 5,851,280 | 9,514,606 | 8,537,664 | 7,300,638 | 8,965,112 |
| 85 | 643,545 | 846,100 | -2,729,448 | -1,992,868 | -1,952,296 | -3,423,772 | -2,776,340 | -4,400,424 |
| 87 | 975,625 | 2,101,020 | 4,116,546 | 6,176,169 | 8,349,866 | 10,754,395 | 7,303,924 | 10,738,843 |

Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

2. Statistics of Automotive Industry

The automobile and auto parts industry is one of the most important industries that impacts the economic development of Thailand. The auto sector accounted for 10.5% of GDP in 2008. At present, Thailand is a production center of large manufacturers from all over the world. Thailand emerged as the world's 12th largest automobile producer in 2008 (up from 15th in 2007). As for the future, the automotive industry will be supported by the Thai government to become a large production base of eco cars in Asia, and the target has been set for the "Detroit of Asia" to become the world's 10th largest automotive manufacturer in 2011 (Hart-rawung, 2008). Thailand is already the biggest producer in Southeast Asia.

Thailand is becoming the center of large automotive manufacturers from all over the world, examples being Toyota, Honda, Nissan, Isuzu, and Ford. The country is a production base and exporter in the Asian region. It is also a production base of exporting motorcycles for large manufacturers in the Japan group. Moreover, the Thai government is planning to support the automobile industry in order to develop it as a production base. The automotive industry is considered a target industry that the

government is supporting due to its important role as one of the large production bases of the world.

A report by the International Trade Centre in 2010 found that the automobile and auto parts industry had total exports of US\$17,150 million, a dramatic increase from 2001, as shown in Table 4. Note that while the car exports value from 2001 to 2008 was less than that of trucks, the car exports value for 2009 and 2010 was more than that of trucks. The export value of parts and accessories of motor vehicles follows the trend of the export value of cars closely.

Compared with other ASEAN countries, Japan and India, Thailand's car exports rank No. 2 after Japan's and are followed by India's, as shown in Table 5. It is noted that the Thai car exports value gradually increased from 2001 to 2008, dropping in 2009. Then it increased again in 2010.

Compared with other ASEAN countries, Japan and India, Thailand's truck exports also rank second after Japan's and are followed by India's, as shown in Table 6. It is noted that the Thai truck exports value gradually increased from 2001 to 2008 and dropped in 2009. Then it increased again in 2010.

Table 4: Thailand Automotive Product Exports (Unit: Thousand US Dollars)

| Product Group | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| Cars | 674,184 | 527,959 | 780,803 | 1,128,565 | 2,160,709 | 2,921,663 | 3,853,716 | 5,228,187 | 4,090,824 | 7,070,154 |
| Trucks | 1,234,841 | 1,425,334 | 1,851,339 | 2,516,162 | 2,997,432 | 3,682,673 | 4,297,864 | 5,451,594 | 3,538,739 | 5,879,787 |
| Chassi | 4,074 | 135 | 152 | 40 | 18 | 21 | 216 | 95 | 109 | 150 |
| Bodies | 6,258 | 5,691 | 11,006 | 10,658 | 10,390 | 11,632 | 14,795 | 16,255 | 11,531 | 21,441 |
| Parts | 490,158 | 628,366 | 957,106 | 1,412,020 | 2,120,010 | 2,500,165 | 3,397,759 | 4,094,798 | 3,003,376 | 4,178,709 |
| Total | 2,409,515 | 2,587,485 | 3,600,406 | 5,067,445 | 7,288,559 | 9,116,154 | 11,564,350 | 14,790,929 | 10,644,579 | 17,150,241 |

Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Table 5: Car Exporters (Unit: Thousand US Dollars)

| Exporters | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-------------|------------|------------|------------|------------|------------|------------|-------------|-------------|------------|-----------|
| Japan | 52,991,700 | 62,699,896 | 68,390,664 | 74,822,896 | 79,769,272 | 94,485,248 | 108,147,200 | 115,440,408 | 62,268,308 | N/A |
| Thailand | 674,184 | 527,959 | 780,803 | 1,128,565 | 2,160,709 | 2,921,663 | 3,853,716 | 5,228,187 | 4,090,824 | 7,070,154 |
| Indonesia | 6,165 | 19,756 | 30,140 | 140,625 | 245,790 | 365,971 | 839,201 | 1,234,371 | 628,864 | N/A |
| Malaysia | 49,146 | 87,910 | 51,270 | 99,759 | 103,684 | 151,389 | 174,083 | 197,536 | 145,422 | N/A |
| Philippines | 1,709 | 25,026 | 155,728 | 154,443 | 169,894 | 89,678 | 63,183 | 95,395 | 94,354 | N/A |
| Viet Nam | 174 | 2,604 | 12,570 | 31,883 | 44,563 | 994 | 349 | 1,018 | 5,367 | N/A |
| India | 88,665 | 184,501 | 554,088 | 736,341 | 954,334 | 1,048,332 | 1,283,439 | 2,219,825 | 2,940,806 | N/A |

Source: International Trade Centre statistics since January 2010.

Table 6: Truck Exporters (Unit: Thousand US Dollars)

| Exporters | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|
| Japan | 5,113,765 | 5,927,081 | 6,679,833 | 8,071,499 | 7,578,306 | 8,293,843 | 9,985,414 | 12,053,741 | 6,558,696 | N/A |
| Thailand | 1,234,841 | 1,425,334 | 1,851,339 | 2,516,162 | 2,997,432 | 3,682,673 | 4,297,864 | 5,451,594 | 3,538,739 | 5,879,787 |
| Indonesia | 10,569 | 4,835 | 6,007 | 5,062 | 9,045 | 45,138 | 30,036 | 81,847 | 49,274 | N/A |
| Malaysia | 5,283 | 3,070 | 17,858 | 13,090 | 24,480 | 29,025 | 29,580 | 24,194 | 16,987 | N/A |
| Philippines | 121 | 4,206 | 6,478 | 6,400 | 2,804 | 2,138 | 708 | 553 | 1,080 | N/A |
| Viet Nam | 26 | 79 | 195 | 465 | 672 | 2,944 | 1,368 | 2,198 | 357 | N/A |
| India | 51,045 | 26,221 | 57,297 | 120,041 | 204,596 | 200,687 | 218,909 | 361,736 | 250,926 | N/A |

Source: International Trade Centre statistics since January 2010.

Although Thailand has car and truck manufacturers, there are some other car and truck models that are not yet produced or assembled in the country. Tables 7 and 8 list the countries and import values for cars and trucks from ASEAN, Japan and India. The car import values from Japan, Indonesia, and the Philippines have increased steadily. However, it is worth noting that in 2010 the car import value from Indonesia was almost the same as that from Japan. There is a similar observation for the Philippines where the car import value was close to that of Japan's.

Table 7: Supply Markets for Cars Imported by Thailand
(Unit: Thousand US Dollars)

| Exporters | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| World | 192,133 | 183,826 | 392,181 | 377,065 | 341,022 | 254,906 | 258,633 | 478,691 | 465,735 | 818,482 |
| Japan | 87,294 | 56,125 | 73,695 | 111,442 | 55,099 | 70,121 | 88,440 | 151,777 | 173,876 | 195,019 |
| Indonesia | 4,117 | 10,527 | 33,172 | 82,923 | 90,318 | 29,143 | 31,914 | 51,861 | 28,057 | 191,936 |
| Malaysia | 243 | 0 | 96 | 0 | 8 | 25 | 624 | 24,081 | 15,003 | 52,181 |
| Philippines | 4,459 | 25,910 | 175,269 | 116,707 | 115,873 | 82,935 | 40,076 | 79,074 | 77,179 | 119,900 |
| Viet Nam | 0 | 0 | 0 | 0 | 0 | 71 | 9 | 29 | 81 | 0 |
| India | 0 | 0 | 8 | 0 | 1 | 0 | 97 | 79 | 78 | 750 |

Source: International Trade Centre statistics since January 2010.

Table 8: Supply Markets for Trucks Imported by Thailand
(Unit: Thousand US Dollars)

| Exporters | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-------------|--------|--------|--------|--------|--------|--------|--------|---------|--------|---------|
| World | 57,083 | 60,726 | 41,525 | 47,216 | 42,957 | 41,367 | 73,453 | 190,891 | 86,090 | 183,088 |
| Japan | 33,313 | 38,949 | 28,135 | 28,036 | 12,017 | 23,563 | 20,691 | 39,171 | 41,617 | 116,001 |
| Indonesia | 0 | 0 | 0 | 0 | 0 | 892 | 9,559 | 57,411 | 10,201 | 18,019 |
| Malaysia | 57 | 0 | 0 | 23 | 0 | 12 | 208 | 287 | 143 | 0 |
| Philippines | 0 | 25 | 265 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Viet Nam | 127 | 0 | 0 | 0 | 0 | 0 | 69 | 2 | 30 | 0 |
| India | 0 | 0 | 7 | 0 | 0 | 0 | 10,288 | 26,713 | 922 | 5,518 |

Source: International Trade Centre statistics since January 2010.

However, this observation does not go to the truck imports value, as shown in Table 8. Japan exports trucks to Thailand but not as much as cars. Indonesia started to export trucks to Thailand in 2006 and India began in 2007. However, the truck imports value from these countries is still very low compared to the car imports value.

Tables 9 and 10 provide Thailand's trade balance for cars and trucks with other countries. It is observed that although Japan is the biggest car exporter and it gained

market share in Thailand during 2004-2009, Thailand gained in the 2010 trade balance.

However, Thailand lost in the car trade balance with India for the first year in 2010.

On the other hand, even though Thailand aims to be the biggest base for truck manufacturers, the country still lost in the truck trade with Japan from 2002 to 2010, and it began losing in the truck trade balance with India as of 2010.

Table 9: Thai Trade Balance for Cars with Other Countries

(Unit: Thousand US Dollars)

| Partners | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-------------|---------|---------|---------|-----------|-----------|-----------|-----------|-----------|-----------|
| World | 344,133 | 388,622 | 751,500 | 1,819,687 | 2,666,757 | 3,595,083 | 4,749,496 | 3,625,089 | 6,251,672 |
| Japan | 19,236 | 82,518 | -41,798 | -2,723 | -12,552 | -37,587 | -131,193 | -167,319 | 201,233 |
| Indonesia | 9,064 | 145,728 | 289,601 | 325,308 | 281,196 | 380,354 | 551,455 | 364,967 | 749,807 |
| Malaysia | 2,210 | 18,663 | 64,674 | 56,552 | 83,277 | 205,441 | 305,040 | 223,813 | 373,530 |
| Philippines | -24,981 | -77,161 | 30,012 | 129,511 | 217,066 | 309,393 | 337,585 | 352,691 | 585,278 |
| Viet Nam | 19 | 49 | 0 | 89 | 127 | 26 | 1,296 | 18,244 | 21,764 |
| India | 146 | 98 | 44 | 158 | 273 | 824 | 822 | 329 | -578 |

Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

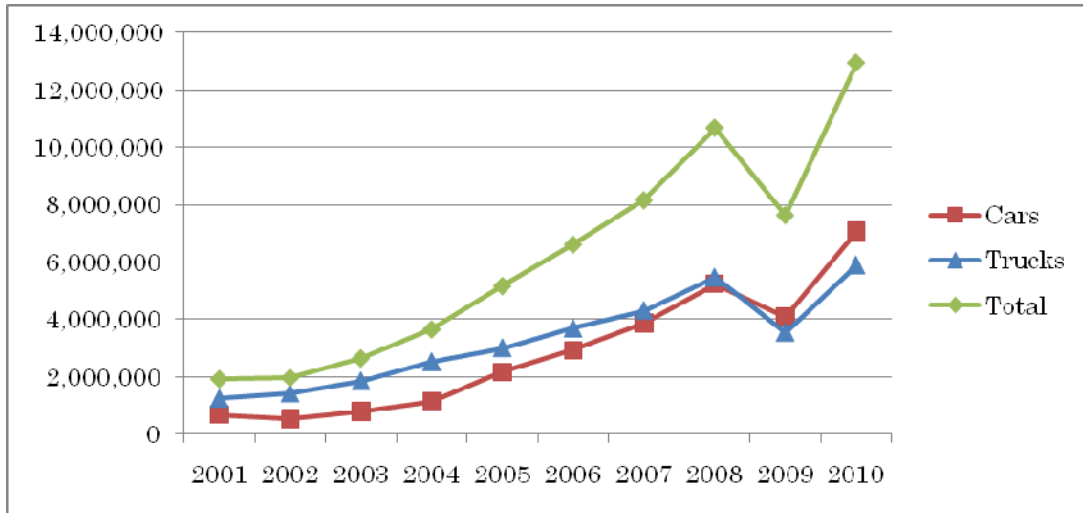
Table 10: Thai Trade Balance for Trucks with Other Countries

(Unit: Thousand US Dollars)

| Partners | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| World | 1,364,608 | 1,809,814 | 2,468,946 | 2,954,475 | 3,641,306 | 4,224,411 | 5,260,703 | 3,452,649 | 5,696,699 |
| Japan | -36,086 | -26,906 | -23,863 | -6,964 | -11,718 | -13,371 | -32,400 | -36,956 | -110,211 |
| Indonesia | 30,935 | 40,949 | 68,004 | 98,728 | 81,700 | 109,605 | 227,757 | 116,160 | 234,584 |
| Malaysia | 26,350 | 330 | 171 | 22,011 | 13,600 | 37,730 | 92,320 | 128,043 | 232,363 |
| Philippines | 6,343 | 23,898 | 32,736 | 15,376 | 30,239 | 48,722 | 85,070 | 92,448 | 132,725 |
| Viet Nam | 4,227 | 0 | 141 | 130 | 46 | 171 | 2,608 | 33,722 | 22,983 |
| India | 99 | 254 | 30 | 1 | 98 | -9,989 | -26,422 | 6,528 | -1,491 |

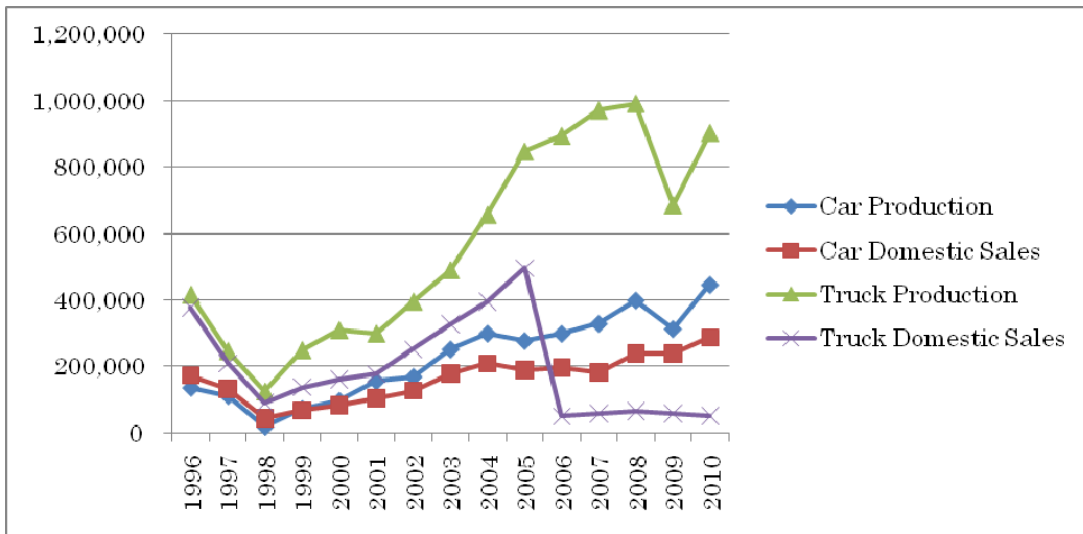
Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Figure 4: Thailand Export Value of Cars and Trucks (Unit: Thousand US Dollars)



Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Figure 5: Number of Cars and Trucks Produced and Sold in Thailand (Unit: Number)

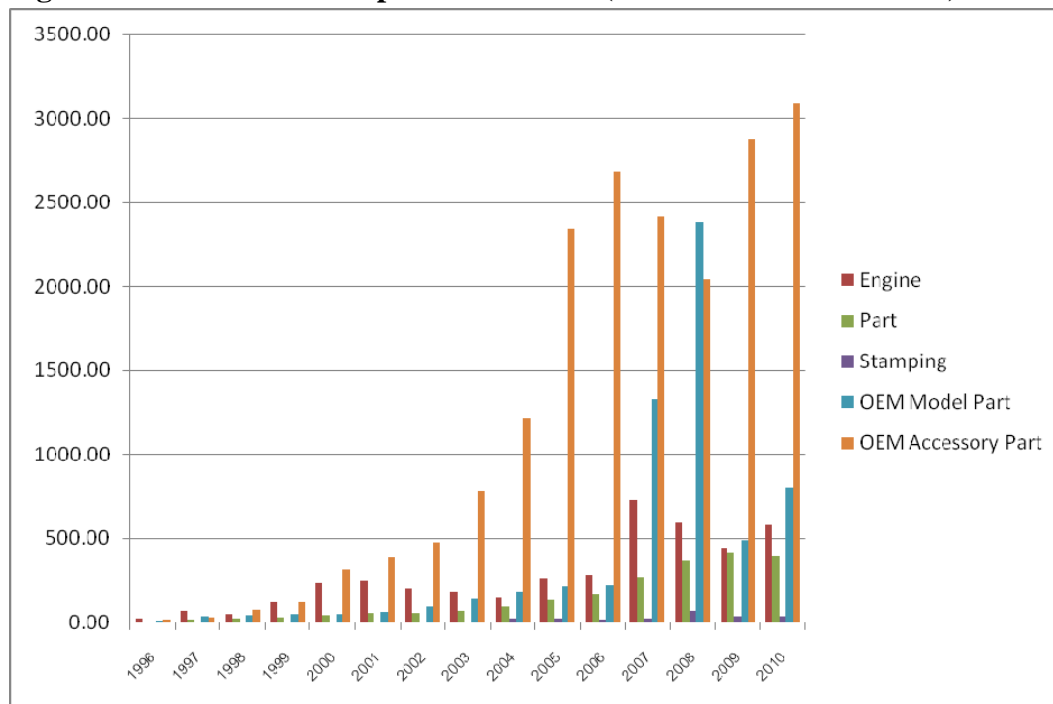


Source: Thailand Automotive Institute (<http://www.thaiauto.or.th>).

Car and truck production increased during 1998-2008. In 2009, production dropped due to the economic crisis. Afterwards, production was continuously increasing (see Figures 4 and 5). Highlighting 10 years of rapid growth, production more than doubled between 2001 and 2005.

Thai automotive growth can be divided into three sections, as shown in Figure 5. In the first section, during the Tom Yam Kung crisis of 1997-1998, the economy decelerated all over the world and the value of the Thai baht fluctuated, which had the effect of reducing automotive production by 30% (Amano 2009). From 1999 to 2005, which is the second section, the economy started to recover. In addition, the large automotive manufacturer Toyota selected Thailand to be its biggest production base in Asia (Amano 2009). In 2006, which is in the third section, there was the so-called Hamburger crisis, as high prices for gasoline, high inflation rates, and the fluctuation of the economy caused total automotive sales to decline (Automotive Industry Analysis Division, 2009). In 2008, the Thai government announced the policy to promote automobiles that use substitute energy by tax reductions, but this increased growth to only 6.96% (Asawachintachit, 2009).

Figure 6: Vehicle Parts Exports 1996-2010 (Unit: Million US Dollars)



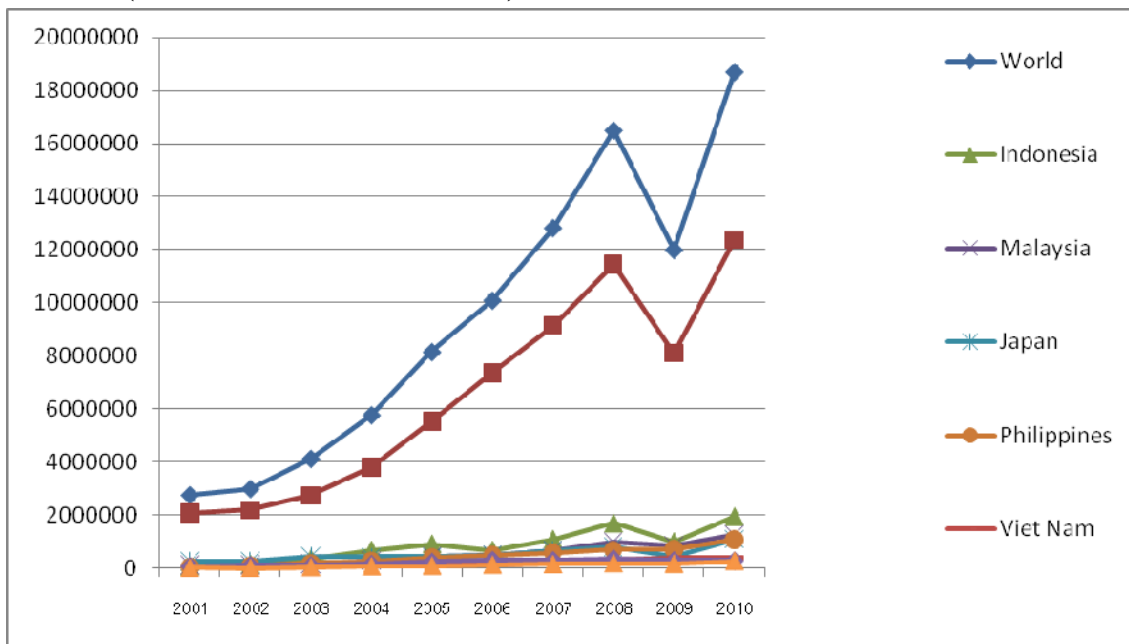
Note: The currency is based on the yearly average rate.

Source: Thailand Automotive Institute (<http://www.thaiauto.or.th>).

Figure 6 shows the parts exports from 1996 to 2010, and it indicates that the total volume increased every year. Especially from 2004 to 2005, it grew tremendously by 74.04%. OEM (original equipment manufacturer) parts are the major export, and they increased continuously from 2002 to 2008. Spare parts, engines, and others had lower proportions of exports. Figure 7 and Table 11 show that most parts and accessories of motor vehicles are exported to Japan, Indonesia, Malaysia, and the United States because the main automobile manufacturers are located in these countries.

Table 12 shows Thailand’s trade balance for automotive products. Although the trade balances for cars and trucks are positive, other automotive parts are still negative. This implies there are still many expensive imported automotive parts being used to assemble both cars and trucks.

Figure 7: Markets for Automotive Products Exported by Thailand
(Unit: Thousand US Dollars)



Note: Product: 87 Vehicles other than railway, tramway.

Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Table 11: Markets for Automotive Products Exported by Thailand
(Unit: Thousand US Dollars)

| Importers | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|--------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Japan | 270,005 | 267,813 | 445,113 | 423,161 | 418,718 | 505,014 | 665,313 | 814,047 | 459,076 | 1,097,787 |
| Malaysia | 109,290 | 124,583 | 177,465 | 274,743 | 436,161 | 480,258 | 671,811 | 982,962 | 861,485 | 1,253,205 |
| Indonesia | 71,912 | 151,698 | 359,318 | 684,207 | 914,826 | 685,210 | 1,090,105 | 1,692,899 | 1,003,148 | 1,938,073 |
| Philippines | 53,967 | 70,209 | 195,944 | 271,128 | 400,104 | 495,865 | 590,569 | 692,004 | 715,872 | 1,086,577 |
| Viet Nam | 87,054 | 78,181 | 66,683 | 91,211 | 125,565 | 122,813 | 199,020 | 309,404 | 385,971 | 381,309 |
| USA | 87,028 | 112,761 | 114,687 | 162,905 | 242,287 | 310,473 | 305,082 | 361,038 | 295,561 | 290,844 |
| India | 8,271 | 6,539 | 33,300 | 64,495 | 85,323 | 126,800 | 146,614 | 181,045 | 167,845 | 265,957 |
| Other | 2,079,195 | 2,191,409 | 2,742,826 | 3,803,846 | 5,529,304 | 7,366,562 | 9,152,715 | 11,461,311 | 8,105,699 | 12,379,115 |
| Total | 2,766,723 | 3,003,189 | 4,135,335 | 5,775,704 | 8,152,289 | 10,093,004 | 12,821,227 | 16,494,710 | 11,994,653 | 18,692,864 |

Note: Product: 87 Vehicles other than railway, tramway.

Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

Table 12: Thailand Trade Balance for Automotive Products
(Unit: Thousand US Dollars)

| Product Group | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---------------|-----------|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Cars | 482,051 | 344,133 | 388,622 | 751,500 | 1,819,687 | 2,666,757 | 3,595,083 | 4,749,496 | 3,625,089 | 6,251,672 |
| Trucks | 1,177,758 | 1,364,608 | 1,809,814 | 2,468,946 | 2,954,475 | 3,641,306 | 4,224,411 | 5,260,703 | 3,452,649 | 5,696,699 |
| Chassi | -86,029 | -165,831 | -268,630 | -323,646 | -267,309 | -244,296 | -266,817 | -287,741 | -241,022 | -389,167 |
| Bodies | 2,969 | -437 | -4,160 | -9,470 | -5,487 | -4,966 | -2,130 | -744 | -5,150 | -11,025 |
| Parts | -953,850 | -995,914 | -1,170,331 | -1,082,259 | -617,399 | -88,414 | 588,390 | 682,732 | 146,050 | -976,994 |

Source: International Trade Centre calculation based on Thai Customs Department statistics since January 2010.

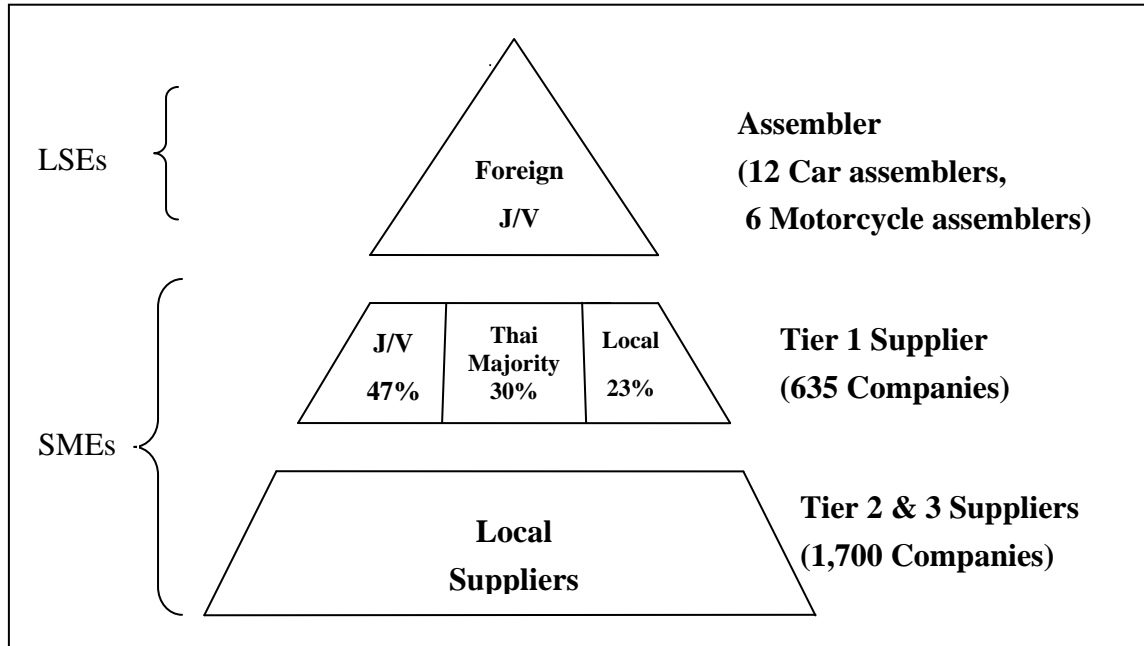
3. Thai Automotive Value Chain

In 1961, Thailand had only one automotive assembly plant. Currently, however, Ford, General Motors, BMW, DaimlerChrysler, Mitsubishi, Mazda, Toyota, Isuzu, Honda and Nissan all have an established presence in the country, together accounting for about 1.4 million vehicles produced annually. Thailand has an advantage over other countries in terms of its complete chain in the automotive industry, consisting of upstream raw materials providers and downstream automotive assemblers. All supply chain processes can be done domestically, and most suppliers are located near the assemblers, which can reduce production costs.

In the Thai automotive industry's supply chain, the 3rd tier and 2nd tier suppliers are indirect suppliers who provide or produce raw materials and small auto parts for 1st tier suppliers, who are direct suppliers or OEM suppliers who produce large auto parts for assemblers. Then, the 1st tier sends auto parts to assembling areas. After the assembly process, all cars are sent to either dealers or exported to other countries.

The structure of the automotive clusters in Thailand consists of three levels, which are assemblers, 1st tier suppliers, and 2nd and 3rd tier suppliers. In the structure of the Thai automotive industry, the number of auto parts suppliers is about 2,312, which can be classified as shown in Figure 8.

Figure 8: Structure of Thai Automotive Industry



Source: Tiasiri (2010).

The Automobile Assembler is an auto maker which receives the automobile parts from Tier 1 in order to assemble a vehicle as a manufactured finished product. Currently, there are approximately 16 auto assemblers and seven motorcycle assemblers, which are foreign and joint-venture enterprises.

The Automobile Parts Manufacturer Tier 1 is an OEM supplier and the producer of automobile parts directly provided to the factory. This group of auto parts is considered to be high-quality auto parts. The standard for auto parts is determined by the automobile manufacturers. At this moment, there are about 648 manufacturers in Tier 1, of which 287 are foreign entrepreneurs, with about 41% of that number being Japanese enterprises. Joint ventures total 38 manufacturers, while Thai enterprises account for 354 manufacturers. Of the 648 manufacturers, there are 386 automobile parts manufacturers and 201 motorcycle parts manufacturers, with the rest being producers of both automobile and motorcycle parts.

The Automobile Parts Manufacturer Tier 2 and Tier 3 is in the raw materials section or in parts for REM (replacement equipment manufacturers) who are responsible for providing raw materials to Tier 1 manufacturers or manufacturers of automobile parts, in order to sell in the spare parts markets or be a manufacturer who supports the production processes (or equipment supplier). Thus, the manufacturers in this group might be considered as Tier 1 in some products. The number of enterprises of this type is about 1,641, and most of them are Thai enterprises.

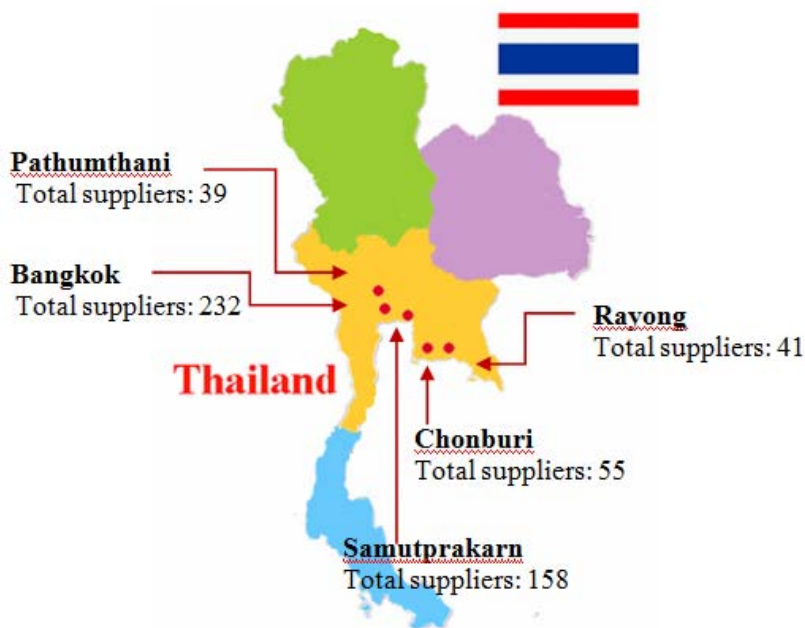
Table A1 in the Appendix shows the classification of the Thai automotive parts manufacturers by product groups. In total, there are 528 Thai automotive parts manufacturers listed as members of the Thai Auto Parts Manufacturers Association as of February 2011.

The automotive industry is located around industrial estates in Bangkok and the surrounding provinces, especially Samutprakarn, Chachaoengsao, Chonburi, Rayong, and Pathumthani. Most of the automotive assemblers are located in Samutprakarn Province, including Toyota, Isuzu, Nissan, and Hino. Many auto firms are located on Thailand's Eastern Seaboard, while most suppliers are in Bangkok, the next being Samutprakarn, Chonburi, and Rayong. The suppliers located in Bangkok, Chonburi, and Rayong are there mostly by design in order to serve the automotive industry through considerations of the infrastructure for accessing the industry. This includes shipping the finished goods through the ports located in those three regions, as shown in Figure 9 (Praisuwan, 2006).

Automobile Associations and Organizations in Thailand

One of the factors that helps in the development of the automotive industry is the private associations and organizations. The role of such organizations is to coordinate among members and support the members by providing updated information on government policies, laws, and technologies. There are four main associations and organizations in Thailand that support and cooperate with the automotive industry, as follows.

Figure 9: Principal Auto Parts Production Sites in Thailand



Source: Praisuwan (2006).

Thai Automotive Industry Association (TAIA)

Established in 1981, TAIA is a center for automobile assemblers, motorcycle assemblers, and auto parts and automobile engine companies. The association's objective is to gather news and information among members. It is central to the exchange of information in the industry, and it cooperates with other associations both

within and outside of the country. Moreover, TAI coordinates with the government to help in providing advice related to the automobile industry.

Thai Auto Parts Manufacturers Association (TAPMA)

TAPMA was created in 1987 as a union of auto parts manufacturing companies from the private sector. It serves as a center for automobile parts industrialists in the country in order to protect, support, and develop Thai industries. The association has 528 member companies. TAPMA's role is to cooperate with the government in drafting and implementing policies for the automobile parts industry. It represents the private sector and presents problems and obstacles facing the industry to the government. As such, it also represents Thailand's private auto parts sector in negotiations on the international stage. Moreover, TAPMA defends the legal rights of members and serves as a venue for members to exchange views. Furthermore, it serves as an auto industry information and news clearinghouse for both domestic and international members.

Thailand Automotive Institute (TAI)

TAI was established in 1998 to coordinate between the government and private organizations. The institute is responsible for researching and proposing suitable policies to the government. It acts as a center for coordinating among Thai automotive industries. It also determines and controls the standards of auto parts. Moreover, the institute provides testing services for auto parts certification. TAI gathers information in business areas and disseminates automotive news to its members. For international capacity building, it facilitates the development of human resources in the automobile industry. The institute strives to maintain the research and development (R&D) of

technology in the Thai automotive industry at the international standard. The institute has 652 member companies.

Automotive Industry Club (AIC)

Established in 1976 under the Federation of Thai Industries (FTI), AIC is a center for member companies in the automotive industry, consisting of manufacturers, distributors, importers, and exporters of cars and motorcycles. Acting as a focal point between members and agencies, including the government and other private agencies, the club's activities are aimed at promoting information sharing as well as facilitating joint solutions to various problems and concerns to strengthen the competitiveness of members and promote sustainable growth of the Thai automotive industry.

4. Innovation Capability

This part is a summary of the interviews of seven companies in the automotive industry, presented as case studies. These case studies involve three automotive assemblers, two of which are MNCs, three Thai-owned Tier 1 suppliers and one Thai-owned Tier 2 supplier.

In the case studies, the instrument for measuring technological capability developed by Rush *et al.* (2007) was also used. The measurement covers nine areas, including Awareness, Search, Building Core Competence, Technology Strategy, Assessing and Selecting, Acquiring Technology, Implementing, Learning, and Linking to External Sources. The results of the measurement of each firm will be presented in each case

along with the discussion. With the use of this simple survey tool, firms are classified into four different types depending on their technological capability level. Type A (Unaware/Passive) firms have low degrees of awareness of technology and of the effective practice of technology development. Type B (Reactive) firms recognize the need to keep up with technology but lack the skills and capabilities, and are slow in responding to the technology. Type C (Strategic) firms are highly capable, have a clear view of technology priorities, and have forward thinking. Type D (Creative) firms are knowledge-intensive, with fully developed capabilities and are able to redefine the technology frontier, challenge existing business models and create new markets.

4.1. Cases Studies

CASE 1: Toyota Motor Corporation

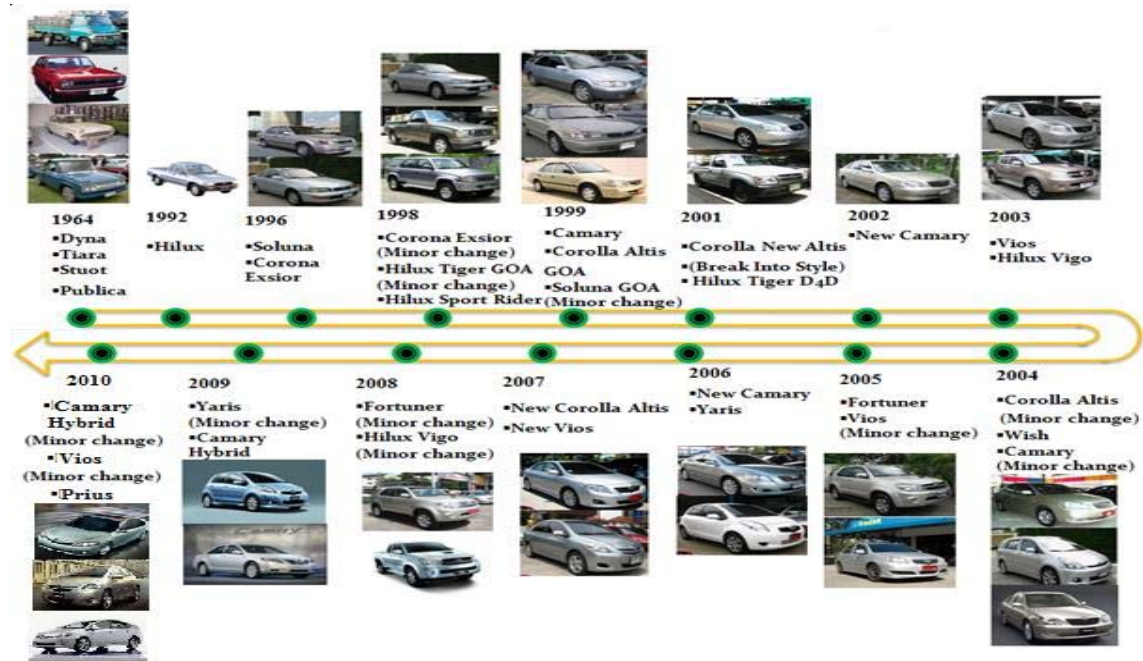
Toyota Motor Corporation was established in 1937 by Mr. Kiichiro Toyoda. Toyota first came to Thailand in 1956 as an agent for selling automobiles in the name of Toyota Motor Sales. Afterwards, Toyota established its first automobile assembly factory in Thailand at North Samrong in 1964, at a capital of 7,250 million baht, and changed the name from Toyota Motor Sales to Toyota Motor Thailand. Toyota now has four plants in Thailand, which are the Samrong plant, Thai Auto Works, the Gateway plant, and the Ban Pho plant (the plants are located in Chacherngsao and the head office is in Samutprakarn).

There are currently 135,000 associates, 119 dealers, and 312 showrooms in Thailand. There are a total of 151 suppliers (Tier 1) in auto parts manufacture. Approximately 70% of Toyota suppliers are joint ventures with Japanese firms and the

rest are Thai companies. As for total production, 40% is sold domestically and the rest is exported. The current share of the Thai market is 44%.

Figure 10 shows the time phase in the development of Toyota automobiles assembled in Thailand from 1964 until the present. In the earlier stage, Toyota assembled automobiles in the CKD (complete knocked-down) method where each auto part is imported and assembled in Thailand. Afterwards, Toyota set up an assembly plant in Thailand which now is the most modern and most efficient automobile assembly plant in ASEAN.

Figure 10: Development of Each Automobile Generation of Toyota (Thailand)



Source: TMAP-EM.

Toyota Technical Center Asia Pacific (Thailand) Company Limited (TTCAP-TH)

TTCAP-TH is a research and development base for Toyota in the Asia-Pacific region. It was established in 2005 at a cost of 2.7 billion baht. The center was set up to

meet the increasingly complicated needs of the region's automotive market. This R&D center plays an important role in supporting the Toyota Motor Corporation in the designing and modifying of vehicles and component parts that have been developed in Japan to meet the demands of the Asian market. The center, built on an area of 320,000 square meters, is located on Bang-na Trad Road Km. 29.5, in Samutprakan Province. Currently, it has a total of 290 employees. The responsibility of TTCAP-TH is to provide design, research and development works as well as producing prototype vehicles and component parts for the region.

Toyota Motor Asia Pacific Engineering and Manufacturing (TMAP-EM)

TMAP-EM was established in Thailand in 2007. Its core function is to generate world-class research and development to support manufacturing and engineering expertise in all Toyota production plants in the Asia-Pacific region, enhancing production and service capacity in order to meet customer demand.

Development in Toyota

Development in Toyota can be classified in three categories, as development in products, manufacturing process, and supply chain management. These can be further divided into three phases: before 2004, 2004-2009, and 2010. It can be said that the development of the products is a result of the changes in customer preference. Since products have been developed continuously, this affects the way of production and the supply chain as well. Toyota also develops the production process with higher technologies that help to reduce the cost of production, enable flexibility, and improve supply chain management, as summarized in Tables 13, 14, and 15.

Table13: Overview of Product Development

| Phase1: Original Model (Before 2004) | Phase2: Innovation Multipurpose Vehicle (In 2004) | Phase3: Small Speedy Project (In 2010) |
|---|---|---|
| Classify market as global market therefore the product is almost same all over the world just the small minor change occur. | Increase changes or innovation for product but focus in region base of market therefore the product design is differences between region for example; Asia, Europe and USA. (Adapt product according to the region preference) | The customer market is divided into each country depending on the demand from local customer. And the production time is decreasing. (Adapt product according to the local country preference) |

Source: Authors, based on interview with TMAP-EM.

Table14: Overview of Production Process Development

| Phase1: Original Model (Before 2004) | Phase2: Innovation Multipurpose Vehicle (In 2004) | Phase3: Small Speedy Project (In 2010) |
|--|---|--|
| Using individual line of production which means different product model is produced in different production line. <u>The disadvantage:</u> - High cost - No flexibility | Using mix models or mix lines method which means one line can produce several models. The number of car to produce for each model depends on the ratio that set in the system. <u>The advantage:</u> - Increase line efficiency - Decrease number of line - Increase flexibilities when the demand change | Using the same mix models or mix lines in phase2 but the technologies capacity is much higher than phase2 so, the production time required is shorter. <u>The advantage:</u> - High speed for production |

Source: Authors, based on interview with TMAP-EM.

Table15: Overview of Supply Chain Development

| Phase1: Original Model (Before 2004) | Phase2: Innovation Multipurpose Vehicle (In 2004) | Phase3: Small Speedy Project (In 2010) |
|--|---|--|
| Local Supplier has low skill, know-how and efficiency therefore, Almost all of material parts need to import from Japan. The ratio for supplier; 90% import and 10% local. | Local Supplier has higher skill, know-how and efficiency therefore, The ratio for supplier; 20% import and 80% local. Start to apply the following strategies to manage good level of inventory - milk-run strategy - Just-In-Time | The purchasing system already in electronic format so, the transaction is always up to date. <u>The advantage:</u> - Reduce lead time - Appropriate level of Inventory - Reduce production cost - Reduce shortage |

Source: Authors, based on interview with TMAP-EM.

External Factors

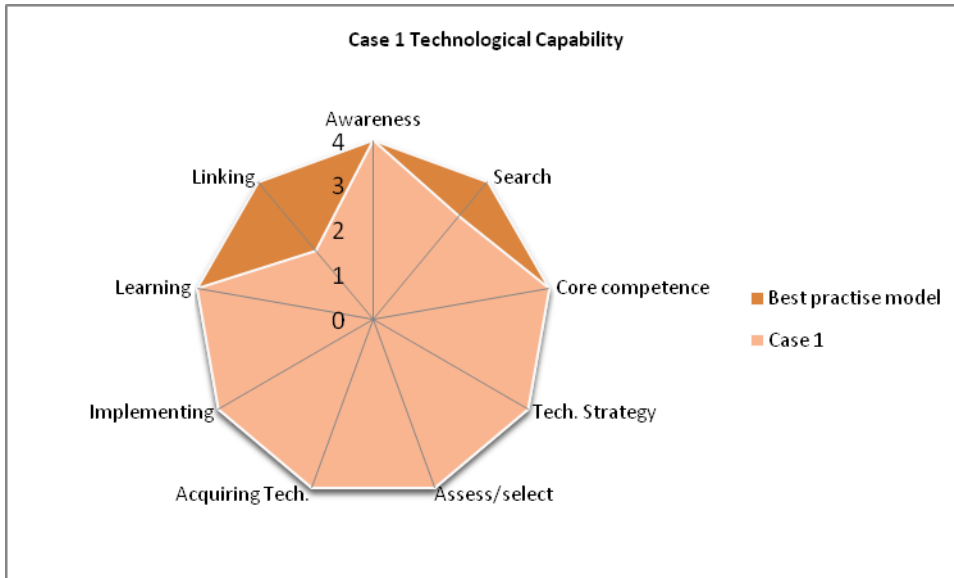
Toyota believes that customer preference is different from country to country, and as such the customers' needs are one of the important factors in creating new and innovative products that can satisfy customers in different areas. For example, the Asia region has a greater interest in hybrid cars than does Europe, while European customers prefer a car's luxury design over the engine inside.

Toyota believes that if it can gain a high level of corroboration from its suppliers, then it can achieve a win-win situation. Toyota always sets up a team to train and share knowledge with suppliers, suggesting that the suppliers use Toyota Production System which focuses not on producing in big lots and keeping high levels of inventory but on producing only what is needed, so as to reduce the cost of production for both Toyota and the suppliers. The criteria for recruiting suppliers are to always look at their innovation and improvement, key factors in comparing between choices of suppliers.

Internal Factors

Toyota has internal research and development called TMAP-EM as the key factor to create innovation. With good research planning, Toyota can develop new products and processes to satisfy customers with better production technology. It has a good policy called the "Toyota way" to encourage employees to continually improve and respect people such as through the following activities: mornings to talk and discuss about work, brainstorming, solutions solving and idea generation. Those activities lead employees to keep developing themselves to enhance skills and know-how in order to think outside the box and create innovations.

Figure 11: Toyota Technological Capability



CASE 2: Nissan Motor (Thailand) Co., Ltd.

In 1960, the first assembly plant was established under the name of Siam Motors & Nissan Co., Ltd. On April 21, 2009, Siam Nissan Automobile Co., Ltd. changed its name to Nissan Motor (Thailand) Co., Ltd. The ratio of major shareholders is Nissan Motor (Thailand) Co., Ltd. with a 75% share and Nissan (Japan) with 25%. Nissan invested 1,900 million baht of capital. It has 92 dealers and 164 service centers in Thailand. In 2009, Nissan Motor Thailand had a 5.6% market share. It has a total of 4,200 employees.

The parts ratio is 20% imported and 80% purchased domestically. Nissan has 248 suppliers which are 1st tier that provide automobile parts to the company. The domestic suppliers can be divided into three groups, which are Japanese companies who have settled in Thailand comprising 90%, Thai suppliers at 3%, and European suppliers at 2%. Nissan has good relationships with its domestic suppliers of more than 30 years.

After Nissan Motor became the main shareholder, the company could do more in collaborating with its suppliers. As a result, Nissan has a new model and innovation from collaborating with suppliers. The suppliers can develop the products and offer them to Nissan in the early phase of development sourcing. Nissan allows the suppliers to present and offer their products to the company, which helps to motivate suppliers to introduce new products and technology to Nissan. The suppliers have to develop their products in order to compete with other suppliers. Moreover, Nissan also sends an engineer in order to develop products together with suppliers.

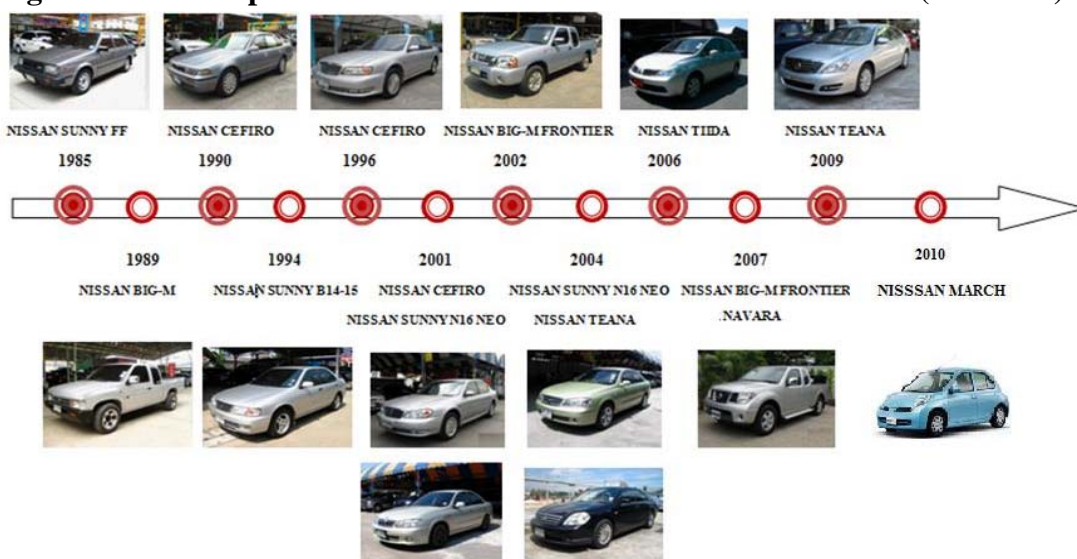
Nissan has also established a research and development base for the company in ASEAN, which is called Nissan Technical Center South East Asia Co., Ltd (NTCSEA). It was established in 2003 at a cost of 224.5 million baht. The center is located on Bangna-Trad Highway Km. 22 in Samuthprakarn Province. The total employees at NTCSEA is 114 persons. Nissan Motor (Thailand) Co., Ltd. holds 100% of the shares in NTCSEA. The center's responsibility is to develop vehicles for ASEAN and other countries to ensure that all specifications meet the local market requirements of each country and the standards of Nissan. The main activity of NTCSEA is to create performance innovations.

Of the external factors, the innovations at Nissan are motivated by the global trends that always change, for example, the green environment movement which is the main impetus behind creating the eco car. The rapid technological changes force the company to develop new technologies to compete against other auto makers. The economic downturn also pushed the company to introduce the eco car and the EV or electric vehicle.

Of the internal factors, Nissan has its NTCSEA, a research and development base for the company in ASEAN and other countries. The job scope of NTCSEA is to collaborate and develop products with suppliers by sharing information and know-how. NTCSEA has to respond by developing vehicles for ASEAN and other countries in order to meet the local market requirements and Nissan's standards. Moreover, the R&D team has the task of evaluating the market competition, customers, and customer feedback.

Human resources are one of the internal factors that the company also focuses on. Nissan always motivates employees in the organization to come up with new ideas and solve problems in order to develop processes and products continuously. The company has the "Nissan way" policy for employees to follow as cross-functional teams in order to learn and undergo experiences from work in different departments. Nissan always pushes employees in the organization to learn and develop to their potential to have innovations.

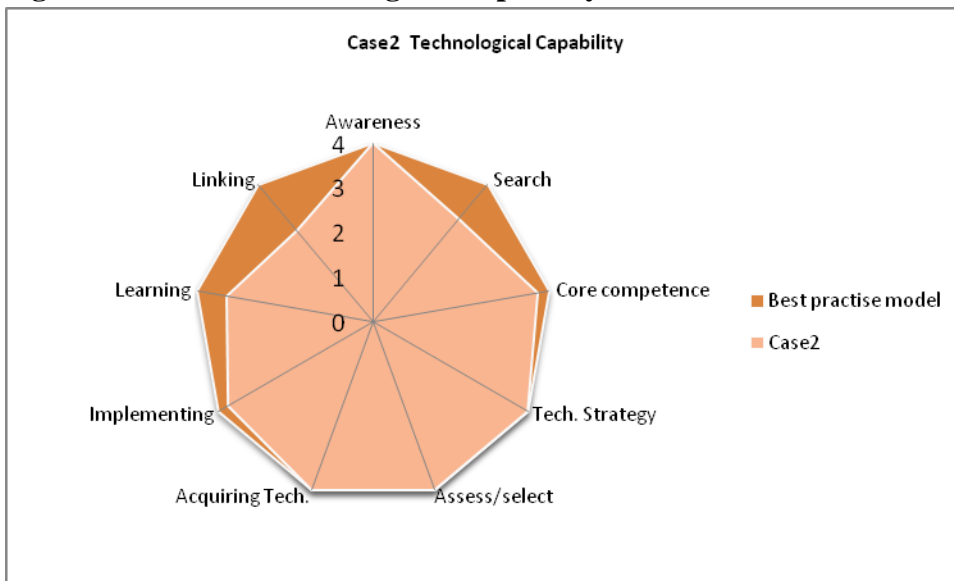
Figure 12: Development of Each Automobile Generation of Nissan (Thailand)



Source: NTCSEA.

Figure 12 show the time phase of the development of Nissan automobiles which are assembled in Thailand from 1985 to the present. All models of Nissan cars have been created by Nissan in Japan. Nissan launches a new model every four years and has minor changes to products every two years in order to support market needs.

Figure 13: Nissan Technological Capability



CASE 3:

The company in this case study and its corporate group constitute one of the major parts manufacturers in Thailand for cars and motorcycles. With leadership from top management growing up continuously since its establishment on March 16, 1977, the group today comprises 30 companies, which are 60% local and 40% joint venture. Companies are located in Samutprakarn, Laem Chabang, Rayong, Ayutthaya, Nakornnayok, Malaysia, and India. The products of the firm are well-accepted among the industries. Customers include all famous OEM manufacturers in Thailand, both

local and foreign companies, from Japan, Europe, the United States and other countries. These include Toyota, Nissan, Mitsubishi, Ford, Isuzu and Honda.

Innovation

The firm has raised its production capability continuously in producing better quality and new parts with higher technology. This continuous improvement ambition is an on-going process aimed at offering the customer highest satisfaction. The company's policies focus on how to create innovation. Most of the innovation in this company involves process innovation. Since top management realizes the importance of developing the organization, the management team performs the following activities in order to upgrade the organization to be a leader in automotive manufacture.

External Factors

The major motivation for innovation is the change in demands on products or production styles from customers, forcing the company to generate new ideas and production methods that match with design changes and also reduce the cost of production. For example, if a customer changes software, that encourages the firm to learn how to implement the new software to run the business. The company believes that it needs to develop in order to grow with customers. Sometimes the manufacturer does not wait for the customer's order but instead tries to develop an innovation and proposes it to the customer first, showing that the company has ability to co-design with customers. Even if the proposal is not accepted, at least employees can develop themselves to create something new and gain better capabilities.

Trends in technology lead the firm to pursue opportunities in visits to overseas companies, observing their operations and developments in order to learn from those successful companies, with the objective of enabling employees to see the benefits of the developments. In one example, Japan Technology Assistant (Japan TA) helps the firm by sending an advisor to explain how to develop and implement new technologies.

Automotive industry competition is intensifying and most companies are concerned about having competitive advantages. Firms should continuously provide unique products and services, that is, they must constantly be innovative in order to keep a step ahead of competitors. Growth of an organization needs to be supported in two perspectives: the organization itself and its human resources.

The criterion to select suppliers is focused on the potential to develop performance to support production in terms of quality and cost. Since the company needs to develop with customers, the firm will choose only the suppliers that have the capability to grow with them, thus influencing suppliers to be innovative as well.

Sometimes the human resources department works with universities, such as Thammasat University and the National Institute of Development Administration, to develop a curriculum for all levels of employees in the study of management. The R&D department cooperates with the Thailand Automotive Institute and the government for assistance on technology projects such as training programs, process development, software, and testing.

Internal Factors

Table 16 summarizes the milestones in the internal innovation development. This company continually improves itself by developing internal R&D and implementing the

SAP program. It promoted a “TSCIC” campaign as the organization’s culture. “T” stands for teamwork, “S” is for social responsibility, “C” means continuous improvement, “I” is for initiative/leadership, and “C” means commitment. The company also developed the new Thai Summit Production System and the so-called lean supply chain.

Table 16: Innovation Development

| Year | Innovation Development |
|-----------|--|
| 1977-2003 | Visit Over-sea Company to develop organization |
| 2004 | Develop internal R&D and Implement SAP program |
| 2006 | Develop TSCIC strategy |
| 2007 | Develop new Thai Summit Production System (TSPS) |
| 2008 | Develop Lean supply chain |
| 2009 | Develop Knowledge Management System (KM) |
| 2010 | Encourage Competition such as “Engineering Day” |

Source: Authors, based on interview with Case 3.

The firm developed the Knowledge Management system to store the organization’s existing knowledge and to improve the organization’s performance by attempting to encourage and facilitate knowledge sharing among employees. For example, employees who have retired or are leaving the organization are interviewed to keep their skill and knowledge within the organization, and then all knowledge is centralized at a single place.

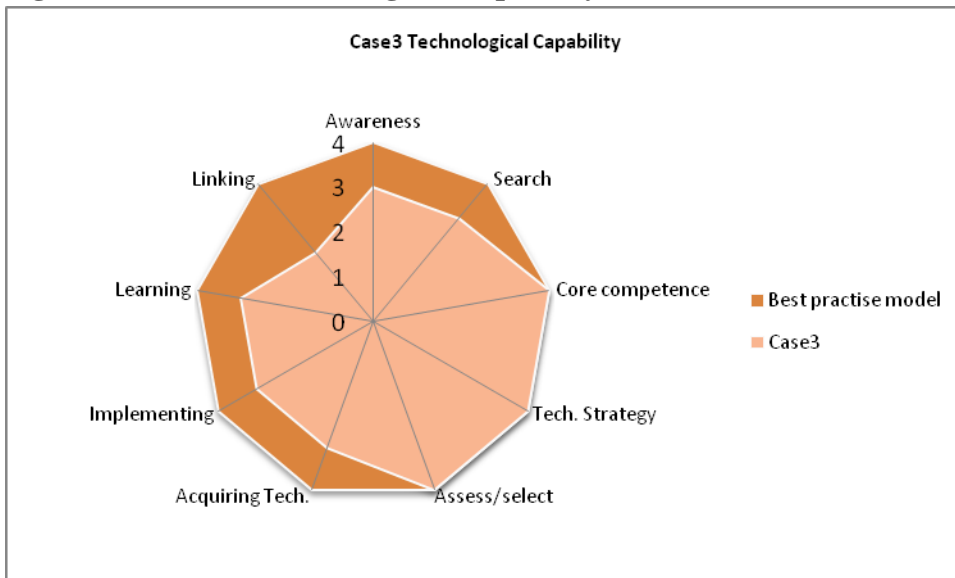
It promoted many activities to encourage employees to be innovative, such as the internal competition called “Engineering Day” that allows all employees to present their own project. The most innovative group wins and receives some reward. This activity can develop employees’ knowledge and skills, as well as increasing knowledge sharing

among them. Therefore, the direction of the innovation process has changed from top-down to bottom-up.

From all activities mentioned above, we can conclude that the major external factors for innovation are customer demand, technology, competition, and some outsiders. On the other hand, the internal factors are management’s support of change and the human resources management, which follows the slogan “Before we build parts we build people.”

Finally, the overall assessment of the firm’s capability level in technology and innovation can conclude that this company has fully developed a set of capabilities. It takes a creative and pro-active approach to exploiting technology and innovation for competitive advantage. The following figure shows the relative strengths and weakness in technological capability of the firm.

Figure 14: Case 3 Technological Capability



CASE 4:

The company in the fourth case study was established in 1975, with a vision to be a leader in automotive parts manufacturing in ASEAN by providing end-to-end services, and to grow together with customers. Sales volume in 2007 was almost 6 billion baht, and sales volume has been growing by more than 10% every year since 2003. The company group consists of four firms. Among the main customers are Auto Alliance, Dana, GM, Hino, Honda, Isuzu, Kubota, Mitsubishi Motors, Nissan, Toyota, and Yongkee. As of 2007, the firm had more than 2000 employees. There are many products that this company produces, including rear axle shafts, brake drums, brake discs, flywheels, leaf springs and coil springs.

For more than 60 years, the company has been the market leader in the manufacturing and sale of automobile parts. From decades of experience and expertise, it is the leading company in automobile parts, with the efficient manufacturing process contributing to product quality that is of an internationally accepted standard. It is QS 9000 and ISO 140001 certified (both are quality assurance certificates for the automobile parts industry).

Innovation in this company is focused on how it manages cost effectively, with an emphasis on research and development to reduce production costs and create new products to meet customer's needs. Most of the company's customers are OEMs, Mitsubishi and Toyota in Thailand.

External Factors

Since the level of technological capacity for this company was still low, how to develop products or processes needed highly technical expertise and skill. Therefore, it

came up with the solution of acquiring a Technology Assistant (TA) from abroad. Its customer, Mitsubishi, helped the company by recommending and sending a TA from Japan to support technology and equipment. The TA was very important in helping the company to grow continually because the established internal R&D was not successful. One more reason why it needed a TA was that the customer demanded a reliable TA to guarantee the company's efficiency. The customer also helped in terms of employee training by sending engineers to transfer knowledge. Sometimes it works with universities, such as King Mongkut's Institute of Technology Ladkrabang, to consult on product testing and development. The company has to run the business to achieve development without help from the government or associations.

The growth in technological development supports the customer in the changing or development of cars with a new style, and it reduces cost. For example, nowadays the eco car is more popular than other types. This affects the company's production process in order to change to match with that new model.

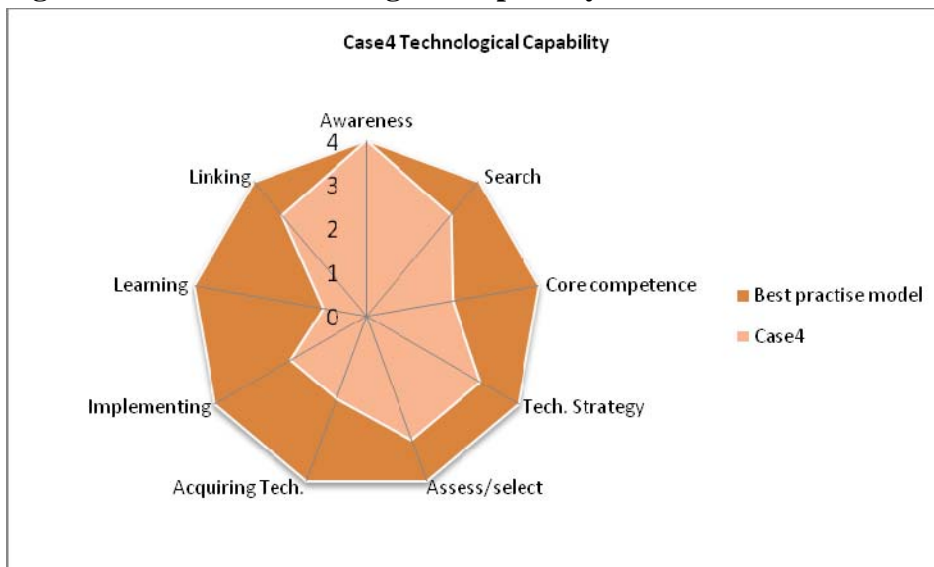
Internal Factors

The management team established an internal Technical Learning Center (Training Center) to train employees to achieve higher skill and expertise. Then it tries to set KPI values and intensively encourage employees to be innovative. Besides employee development, the company tries to implement technology programs such as SAP to help in running the business.

Finally, the overall assessment of the capability level for technology and innovation can conclude that the company has strong in-house capabilities and takes a strategic approach to technology. In some areas, the firm is in the technology frontier, but it still

has many important strengths. The following figure shows the relative strengths and weakness in technological capability of the firm.

Figure 15: Case 4 Technological Capability



CASE 5:

In the fifth case study, the firm is a 2nd tier company in Samutprakan who provides stamping of automotive parts and metal parts for making car seats for the major 1st tier companies. As the mother company obtained new customers in the Rayong area, it decided to establish this firm in 1999 at Chachoengsao to serve new customers. In the beginning, it was a small company with main production process involving only welding for making metal parts for car seats. Starting with fewer than 20 workers and 20 welding machines, it was considered a 3rd tier company who received the orders from its mother company. Three years later, the company was able to spin off from its mother company and have its own customers. By gaining more and more customers, the company has expanded its own production process and gained more experience and manufacturing skill. During the economic crisis in 2009, the company faced the same

problem as other firms in the same industry. It had to slow or even stop production temporarily due to the low number of cars being produced by the car manufacturers. However, after the crisis, the company recovered and expanded. Today, it has about 700 workers, with assets of US\$6 million to serve 12 customers in the 1st tier. Even with great success today, it can be said that this firm has almost no innovation at all in product design. Being at the 2nd tier, it makes the metal car-seat structure based on the design given by the 1st tier. Although there is no innovation in product design, the company owns innovative manufacturing processes. With 10 years of production experience, its engineers and workers are keen on the design process or even to modify a machine to be able to produce the part with low cost and high quality. Some of the design parts cannot be produced by a standard machine. Its engineers have to modify the machine or design a new machine. The company has a long relationship with its major customers and its major supplier. However, there is less cooperation between the company and its major supplier since the company usually buys standard products from the supplier. The standard products come with a certificate guaranteeing quality. Therefore, there is no need to assess the major supplier, which is a world-class company for quality control. Even so, quality assessment is needed for the small suppliers (about 20 companies) who provide a variety of raw materials. The relationship between this firm and its major customer is more important in terms of quality improvement, understanding the design, and machine selection. This relationship makes the firm more able to develop its own experience and skill. More than that, two Japanese engineers who retired from the customer company were recruited to be managers in this firm.

External Factors

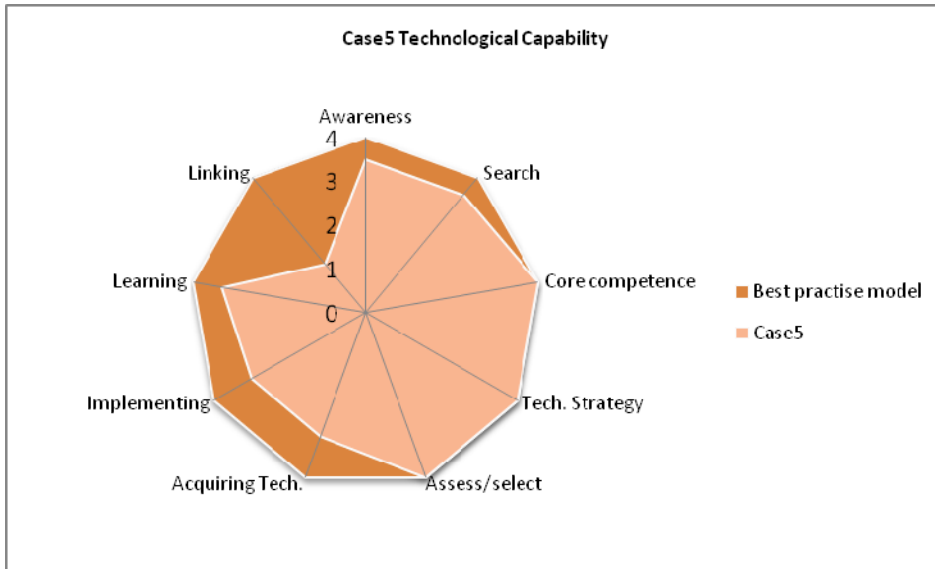
For external factors, customers may be the main factor driving the success of process innovation. Another factor is a private organization. This company is a member of the TAIA. As a member, it can obtain updated information from the association in terms of industry trends, technology, sources of raw materials, and government policies. With this information, the firm can plan and forecast for a better management plan.

Finally, the overall assessment of this company's capability level for technology and innovation can conclude that it is now in a state of gaining its own production experience. However, it is hard for the firm to step up to development of its own innovations due to the limit of its human resources. The following figure shows the relative strengths and weakness in technological capability of this company.

Internal Factors

It can be said that the major internal factors for supporting the innovation of the manufacturing process is the skill and experience of the manufacturing team, especially engineers and foremen. However, it seems to be very hard for this enterprise to upgrade itself to do products innovation since there are only seven engineers (including managers) out of the total of about 700 workers.

Figure 16: Case 5 Technological Capability



CASE 6:

The company in this case study is a Thai automotive parts manufacturer which is 1st and 2nd tier. The company was established in 1988 with an investment cost of US\$0.4 million. It supplies auto parts and motorcycle parts to many companies, including Toyota, Nissan, Isuzu, and Honda. The company is certified to the manufacturing standards of TS16949 and ISO 9001. The firm had a manufacturing base at Bangbon in its first year and in 1989 moved to Bangpakong.

Innovation

As the automotive industry rose continuously in Thailand, the company had to expand the plant and located near the seaboard and its customers. The firm receives innovation from its customers through know-how and information sharing. It always improves the products to satisfy customer demand and order requirements. The evaluation of customer enhancements motivates the firm to have new developments in both products and processes.

External Factors

This firm is a Thai supplier that is growing with its customers, such as Nissan (Thailand). These two companies have a good business relationship. The firm has received know-how from Nissan, which has sent a training team to the supplier to teach about work processes and suggest new technologies. Moreover, both companies have collaborated in product development.

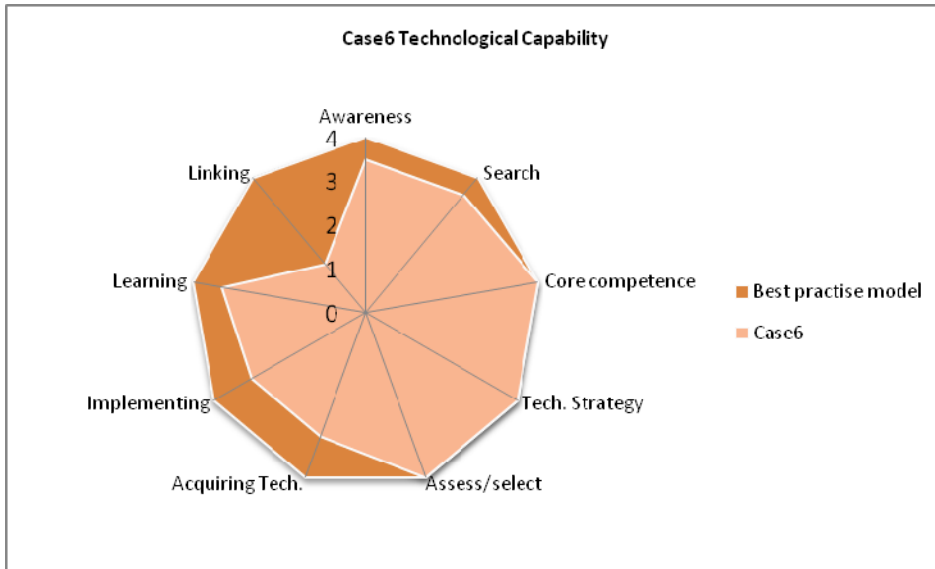
This firm learns new technologies and methods which can help it reduce lead time and respond to customer needs such as through Kaizen, Milk-run, and Just-in-time. The evaluations of the customers help the firm improve products and processes to meet customer requirements.

Internal Factors

The top management aims to support and develop the company to enhance business. This supplier always sends an engineering team to learn new technologies from other companies both in Thailand and overseas, and then incorporates the knowledge to develop the company in order to meet the local market requirements. It emphasizes learning from customer companies and solving problems together.

In this case study, we can see that the innovation which occurs in this company comes from know-how and information shared by its customers. Moreover, the support from the director is also a factor driving the company to further development.

Figure 17: Case 6 Technological Capability



The overall assessment, as shown in Figure 17, is that there are relative strengths and weaknesses in technological capability in this case. It can be concluded that the company intends for its core competencies, technology strategy, implementation and learning to drive innovation for a competitive advantage.

CASE 7:

This case study features a Thai-owned company which was established in 1967 with US\$15.9 million in registered capital. It is a 1st tier auto maker. The company was listed on the Stock Exchange of Thailand in 1994. The firm’s activities are the design and development of motor vehicles and automotive parts, the design and manufacture of dies and jigs, the manufacture of automotive parts, and vehicle assembly. There are three main areas in the group’s business, which are manufacturing, trading (vehicle dealerships) and property (real estate). Table 17 shows the recognized excellence award which can guarantee performance and product innovation.

Table 17: Recognized Excellence

| Year | Awards |
|-----------|---|
| 2005 | Car of the Year award, for TR Adventure Master, in the ‘Thai Automotive Innovation’ category, for the third consecutive year. Named by Forbes Asia as one of the 200 best ‘smaller’ (annual revenue less than US\$ 1 billion) public companies in the Asia-Pacific Region. |
| 2004 | Car of the Year award, for TR Adventure Master, in the ‘Thai Automotive Innovation’ category, for the second consecutive year. |
| 2003 | Car of the Year award, for TR Adventure Master, in the ‘Thai Automotive Innovation’ category. Prime Minister's Export Award in three categories: Best Exporter; Distinguished Brand; Distinguished Design |
| 2002 | Granted ISO 14001 International environmental standards certification, from BVQI |
| 2002-2001 | Car of the Year award, for TR Xciter, from Grand Prix Magazine, for two consecutive years. |
| 2000 | Authorized to use the ‘Thailand's Brand’ symbol for Thai products. |
| 1999 | Received ISO 9001 international standard certification for vehicle design and assembly, and QS 9000 certification for auto body parts, from BVQI. |
| 1998 | Received ISO 9002 international standard certification for auto body parts, from BVQI. |
| 1997 | World Economic Forum, Geneva: named one of the top performing companies from East Asia. |
| 1991 | Outstanding Entrepreneur and Designer of Industrial Products Award, from Ministry of Industry |
| 1990 | Leading Factory of the Year Award. |
| 1988-1986 | Environmentally and Hygienically Safe Industrial Factory Award, three consecutive years, from Bangkok Metropolitan Administration. |
| 1987 | Outstanding Product, Category Vehicles and Parts; International Asia Award. |
| 1986 | Outstanding Product, Category Modified Pick-up Truck |

Source: Authors, based on interview with Case 7.

The innovation that the company focuses on involves producing automobiles that are created by Thai engineers for Thai users and enhancing the product to meet international standards. The enterprise always develops and improves the product to build customer satisfaction through world-class service. It makes the product at a lower price than foreign companies.

External Factors

In accordance with the rapidly changing automotive market in Thailand, the company develops and improves the products in order to respond to customer needs and market trends. Engineers gain knowledge from other companies in Japan and China.

The company has made innovations on the bodies and interior designs of limousines, military utility cars, ambulance vans, and buses. Moreover, the firm collaborates with universities, such as MTEC (National Metal and Materials Technology Center, Thailand), for consultation on product testing and development.

Automotive parts production accounts for about 50% of the company's revenue from all products. Thus, the enterprise has changed its strategy to focus on producing these parts. Besides, as the automotive market in Thailand is seeing higher demand for eco cars, this encouraged the company to be the first supplier of parts to many makers, including Nissan. Furthermore, the plant is interested in forming a joint venture with the Toyota Motor Group to develop products and fit special accessories for special purpose vehicles, which could encourage the firm to enhance innovation.

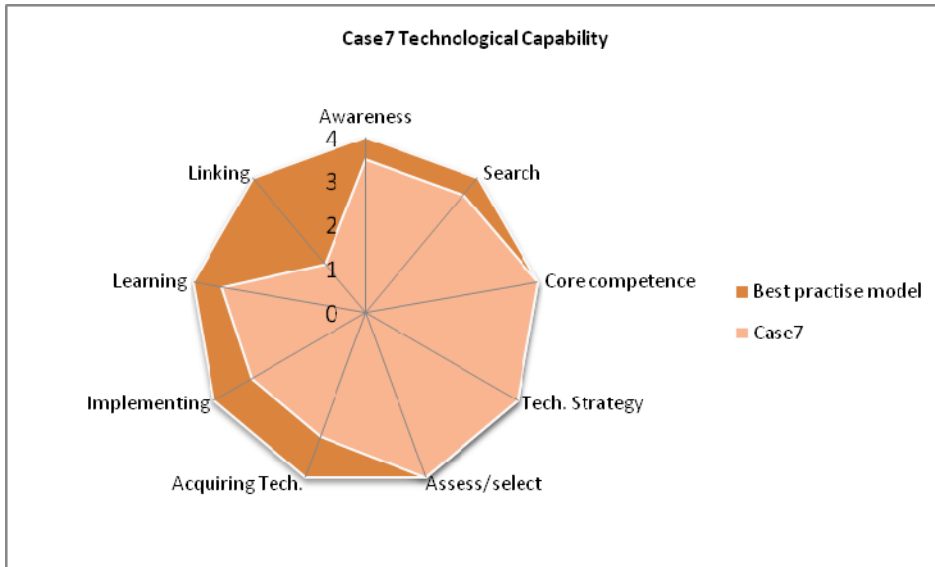
The company suggests that the Thai government and the automotive association should help Thai-owned companies compete with the multinational companies.

Internal Factors

The enterprise emphasizes human resources. The top management supports workers to have innovation and initiative in order to enhance employee skills and performance. It uses in-house R&D in order to develop the processes and products. Thus, all the products of the firm are produced and developed by Thai engineers. Moreover, the company transfers technological knowledge with its alliance.

The overall assessment, shown in Figure 18, is that the company has relative strengths and weakness in technological capability. It can be concluded that the company intends for its core competencies, technology strategy, and assessing and selecting to drive innovation for a competitive advantage.

Figure 18: Case 7 Technological Capability



4.2. Technological Capability Levels

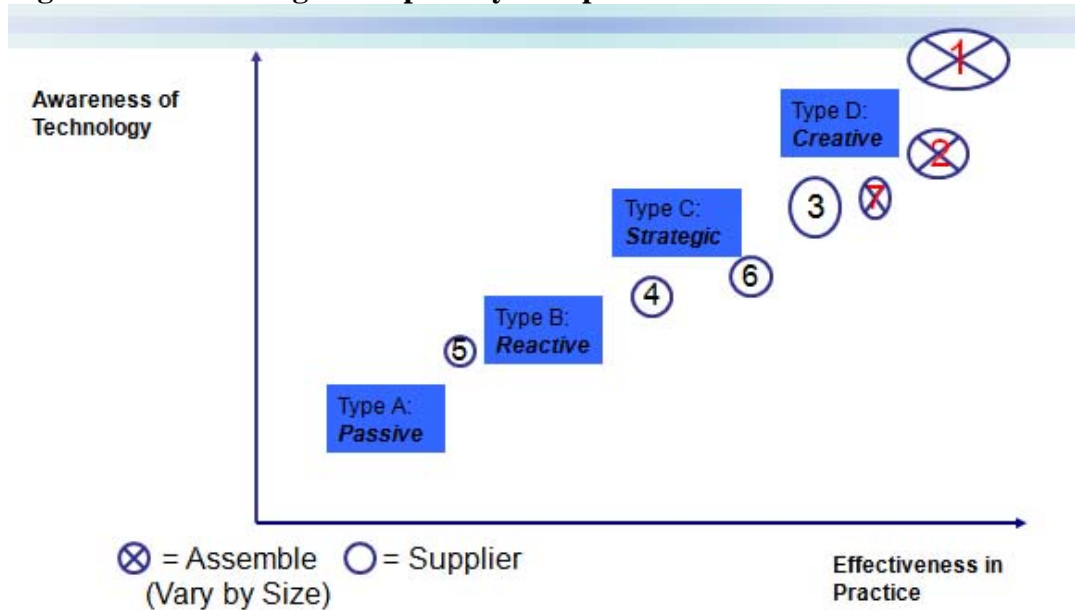
The following table summarizes the characteristics of all firms in the case studies that we conducted from the interviews.

Table 18: Summary of Case Studies

| | Case 1: Toyota | Case 2: Nissan | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 |
|---------------------------|---|---|--|---|--|--|---|
| Firm characteristics | Assembler | Assembler | 1 st /2 nd Tier Thai-owned company | 1 st Tier Thai-owned company | 2 nd Tier company | 1 st Tier Thai-owned company | Thai-owned Assemble and 1 st Tier company |
| Year of established | 1964 | 1960 | 1977 | 1975 | 1999 | 1988 | 1967 |
| Number of employee | 13,500 employees | 4,200 employees | | 2,000 employees | 700 employees | | |
| Number of company group | 10 companies | 5 companies | 30 companies | 4 companies | | - | 6 subsidiaries and 2 joint venture companies |
| Innovation Factors | | | | | | | |
| External factors | <ul style="list-style-type: none"> - Customer need - Relationship with supplier - Knowledge transfer to supplier | <ul style="list-style-type: none"> - Global trends - Technology trends | <ul style="list-style-type: none"> - Customer demand - Technology development - Technology assistant - Competition - Work with university | <ul style="list-style-type: none"> - Customer need - Technology assistant - Work with university - Technology development | <ul style="list-style-type: none"> - Customer need - Private organization (Thai Automotive Industry Association) | <ul style="list-style-type: none"> - Customer need - Relationship with customer and supplier | <ul style="list-style-type: none"> - Customer need and market trend - Collaborate with university - Learn from other companies |
| Internal factors | <ul style="list-style-type: none"> - Management support - R&D - Policy (Toyota way) - Employee Motivation | <ul style="list-style-type: none"> - Management support - R&D - Policy (Nissan way) - Human Resource management | <ul style="list-style-type: none"> - Management support - R&D - Policy (TSCIS, TSPS, KM strategies) - Employee motivation by internal competition - Human resource management | <ul style="list-style-type: none"> - Management support - Technical learning center - Employee motivation | <ul style="list-style-type: none"> - Management support - Skill and experience of technical team | <ul style="list-style-type: none"> - Management support - Learning capability | <ul style="list-style-type: none"> - Management support - R&D - Skill and experience of workers |

Source: Authors.

Figure 19: Technological Capability Comparison for 7 Cases



The above figure presents the technological capability levels for all of the interviewed firms. The circles represent the different types of assemblers and suppliers by firm size. As we can see from the previous tables, the interviewed firms have characteristics that differentiate them. These include whether they are large or small, foreign or local, and assembler or supplier. All cases are spread from Type B (Reactive) to Type D (Creative).

The foreign assemblers, which are Toyota (case 1) and Nissan (case 2), have the highest level of capability, and accordingly the highest investment on R&D and technological development. Next in line for technological capability is a purely Thai assembler (case 7) but the company is small compared to foreign firms and its market share is also smaller than that of foreign firms.

The 1st tier suppliers are rated as firm Type C (case 4 and case 6), which is lower than all of the assemblers and case 3. Although case 4 has started to establish R&D, it is for the improvement of the production process. Case 6 only receives technology transfers from its customers (assemblers), which forces it to only follow the design. It also gains technology transfers from its machine suppliers. However, case 3, which is also a 1st tier supplier, could be categorized as Type D. The reason why case 3 could be rated better than the other 1st tier suppliers is not only due to size and capital but also

because its management team encourages continuous development and technological and employee innovation. The 2nd tier supplier (case 5) gets the lowest level because it did not have enough human resources capability to motivate innovation. Moreover, as its production method for making small automotive parts is not complicated, the firm does not need to force any innovations.

4.3. Factors Affecting the Technological Capability Levels

It is observed that cases 1 and 2 are the MNCs and they have been well established in Thailand for decades. Thus, the technological capabilities of these companies are high as their mother firms had already set the policy for them to be able to absorb technology and be ready for innovation. They both have already set up product R&D centers in Thailand for local design to suit the local market.

It is quite common that the assembler companies are those who create the product design in the automotive industry. Thus, the customer or market trend is the major factor stimulating each of cases 1, 2 and 7 to be innovative. However, the major barriers for case 7 to be more innovative are the local technological availability, the local human capacity and advanced automotive R&D, especially in engines.

The TA is the key for local companies to achieve rapid technology transfers that would help them improve their quality and production processes, as clearly seen from cases 3 and 4. Case 6 does not have a TA but receives technology transfers from its customers or machine suppliers. The growth and innovation of case 6 are clearly slower and less than for cases 3 and 4.

The major internal factor is the human resources management that stimulates all employees to be creative and express their ideas. The style of management is called “bottom up.” This can be observed in case 3, which is the 1st tier supplier, but it can have Type D (Creative), different from cases 4 and 6. In addition, the top management attitude is also the key to making case 3 more innovative than cases 4 and 6. The top management of case 3 aggressively seeks out technology from the partners, while case 6 only relies on the customers and case 4 was forced to have the TA.

5. Government Impact and Policy

Based on Kaosa-ard, M.S. (1993), government policies on the automotive industry from the 1960s to 1993 can be divided into four phases: “Initial Protection” (1962-1969), “Industrial Rationalization” (1972-1977), “Localization” (1978-1986), and “Transition Toward Low Protected Industry” (1987-1993). The first policy phase was to stimulate the automotive industry via investment incentives from the Board of Investment. The policies in the second and third phases focused on building the local producers. During the last phase, government policy seemed to be in the role of supporting rather than protecting this industry. Along with the four phases of government policy, the development of the automotive industry seems to be quite successful, as can be seen in the automotive sector’s significant increase in economic value and its large number of local producers. Today, Thailand is not only able to produce cars for the domestic market but is also one of the world’s automotive exporters. Credit should be given more or less to past policy. In terms of quantity (the large number of local producers), it is impressive. However, in terms of quality (the performance of local producers), it is hard to say whether government policy has been successful. Based on the previous section, most of the local producers are in the 2nd and 3rd tier, with only a few in the 1st tier. It can be said that the past policy was able to accelerate only the number of local companies, with technology transferring still quite slow. Due to globalization and trade liberalization via several agreements within the international community, competition in the world market will grow even stronger. To survive, Thai producers must become sufficiently capable. Own innovation is what can make them capable. However, innovation needs a strong technology background. Therefore, the government has to ensure that new policies can strengthen local producers’ capability by increasing the technology transfers from major automotive assemblers to the local producers. At the last stage, after absorbing enough technology, the local producers will be able to start their own innovation and they can survive in the competitive world.

Policy Recommendations

In the past, government policy aimed to support the automotive industry as a whole. It seems to have been successful, and after many decades the automotive sector has grown stronger. Many local producers participate on different levels as part of the automotive supply chain. As mentioned earlier, the policy of the government should focus more on increasing firms' capabilities. However, based on the surveys and the interviews in the previous section, local producers have different technological capability. This can be classified into four levels: Type A (Unaware/Passive), Type B (Reactive), Type C (Strategic), and Type D (Creative). Looking at the structure of the Thai automotive industry, Type D are those who are the assemblers, and Types C, B and A are those who are in the 1st, 2nd and 3rd tiers, respectively. Therefore, government policy should not be designed generally for the automotive industry as a whole but for meeting the needs of the different levels of firms, as follows.

Policy for Type D firms:

The policy for this group should motivate them for transferring technology. Establishing R&D units for high-technology automotive components of the Type D firms is an excellent starting point for technology transfers. However, besides a large amount of investment, establishing a high-tech R&D unit involves many more factors, including sufficient and capable human resources, intellectual property protection, and large local demand. Therefore, the government should assist Type D firms in the establishment of R&D units.

Policy for Type C firms:

The firms in this group have a good chance at gaining the most benefit from technology transfers. They have management people who are aware of the importance of technology, sufficient and capable human resources for absorbing the technology, and even some innovations of their own. Many of them can do well in process innovation as they know how to make the product and can develop efficient ways to improve their production, even though they have less product innovation. They do not know how to design the product to suit customer needs since they lack a high level of technology and do not understand customers very well. Therefore, government policy

for this group should aim to enhance their ability to create product innovations. Government policy should support them in setting up R&D budgets and R&D units for product innovation. This can be done via the strong incentive of tax reduction. Also, a stronger link should be developed between the national research centers, universities and the firms of Type C for developing product innovation.

Policy for Type A and B firms:

The strength of the firms in these groups is their large number of skilled workers who can do the precise design jobs. However, the limited number of engineers inhibits them from absorbing technology transfers. It may be difficult for them to pay very high salaries for recruiting more engineers. Therefore, government policy for these groups should help them to develop and enhance the capability of their own people. The government may provide grants for universities or private organizations to set up technology incubator centers for developing the technological capability of workers in the automotive industry, especially for the firms in the 2nd and 3rd tiers (or Type A and B firms).

Finally, in short summary, the proposed policy is for the government to tailor-make policies that support the different types of firms in the automotive industry. This should create linkage between technology transfers and more self-innovation by the local firms.

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APPENDIX

Table A1: Automotive Parts Classified by Product Group Produced by Thai Manufacturers

| | Automotive Parts Classified by Product Group | Number of Thai Manufacturers |
|----|---|-------------------------------------|
| 1 | Agricultural & Farm Machines, Trucks, Tractor | 30 |
| 2 | Air Bags | 8 |
| 3 | Air Compressors, Air Conditioners | 22 |
| 4 | Air Filters | 14 |
| 5 | Air Fresheners, Polishing Waxes, Coolants, Break Fluids | 2 |
| 6 | Alternators | 6 |
| 7 | Aluminum Die-Castings | 10 |
| 8 | Axles | 13 |
| 9 | Balance Weight Leads | 2 |
| 10 | Batteries, Battery Chargers, Battery Terminals | 10 |
| 11 | Bearings | 17 |
| 12 | Bedliners | 3 |
| 13 | Blanking Parts | 10 |
| 14 | Body Modification, Busers, Trailers, Others | 3 |
| 15 | Body Parts | 35 |
| 16 | Bolts & Nuts, Fasteners, Stud & Screws | 15 |
| 17 | Break Cylinders | 8 |
| 18 | Brake Hoses | 8 |
| 19 | Brake Linings | 14 |
| 20 | Brake Pads | 18 |
| 21 | Brake Parts | 26 |
| 22 | Brake Pipes | 6 |
| 23 | Bumpers | 24 |
| 24 | Bushing | 28 |
| 25 | Cam Shafts & Crank Shafts, Crank Cases | 16 |
| 26 | Car Alarm, Car Clock, Anti-Theft Devices | 1 |
| 27 | Car Radios, Car Antennas, Speakers | 3 |
| 28 | Carbon Brushes | 3 |
| 29 | Carburetors | 4 |
| 30 | Carpets, Floor Mat | 8 |
| 31 | Catalytic Converters | 5 |
| 32 | Chasses | 10 |
| 33 | Chassis Frames | 14 |
| 34 | Chemicals | 11 |
| 35 | Clutch Covers | 2 |
| 36 | Clutch Cylinders | 7 |
| 37 | Clutch Disc, Clutch Plates | 13 |
| 38 | Clutch Facings | 2 |
| 39 | Coil Springs | 10 |
| 40 | Condensers | 4 |

Table A1 (Continued)

| | Automotive Parts Classified by Product Group | Number of Thai Manufacturers |
|----|--|-------------------------------------|
| 41 | Conduit Tubes, Wire Protection Products | 3 |
| 42 | Control Cables | 8 |
| 43 | Cooler / Air Conditioners, Heater / Air Conditioners | 9 |
| 44 | Cross Pins | 2 |
| 45 | CV Joints | 6 |
| 46 | Cylinder Heads, Block | 9 |
| 47 | Cylinder Liners | 10 |
| 48 | Dashboard & panels | 10 |
| 49 | Decals, Emblems | 2 |
| 50 | Differential Gear | 5 |
| 51 | Disc Break Assembly | 20 |
| 52 | Disc Pads | 12 |
| 53 | Distributors | 11 |
| 54 | Door Handles & Locks, Door Hinges & Checks | 18 |
| 55 | Drive Shafts | 8 |
| 56 | Drive Transmission & Steering Parts | 4 |
| 57 | Drum Brake Assembly | 13 |
| 58 | Electrical Parts, Components | 24 |
| 59 | Electro Plating | 8 |
| 60 | Engines | 10 |
| 61 | Engine Mountings | 19 |
| 62 | Engine Parts | 37 |
| 63 | Engine Valves | 6 |
| 64 | Excavators, Forklifts | 1 |
| 65 | Exhaust Pipes & Mufflers | 19 |
| 66 | Exhaust Systems | 11 |
| 67 | Fan Shrouds, Fan & Fan Clutches | 10 |
| 68 | Fiber Glass Parts | 6 |
| 69 | Flashers, Relays & Solenoids | 7 |
| 70 | Fly Wheels, Pulleys | 16 |
| 71 | Fog Lamps | 6 |
| 72 | Fuel Filters | 12 |
| 73 | Fuel Level Gauges | 4 |
| 74 | Fuel Pumps | 4 |
| 75 | Fuel Tanks | 11 |
| 76 | Fuses & Fuse Boxes | 5 |
| 77 | Gaskets | 11 |
| 78 | Gear Wheels | 6 |
| 79 | Glass Lenses | 3 |
| 80 | Glow Plugs | 1 |

Table A1 (Continued)

| | Automotive Parts Classified by Product Group | Number of Thai Manufacturers |
|-----|---|-------------------------------------|
| 81 | Grillers | 10 |
| 82 | Head Lamps | 8 |
| 83 | Heat Exchangers | 4 |
| 84 | Heat Treatment | 9 |
| 85 | Horns & Buzzers | 6 |
| 86 | Hoses | 15 |
| 87 | Hubs | 11 |
| 88 | Hydraulic System | 4 |
| 89 | Ignition Coils | 2 |
| 90 | Instruments and Gauges | 2 |
| 91 | Interior Parts | 23 |
| 92 | Iron & Steel Casting & Forging | 22 |
| 93 | Jack & Tool Kits | 5 |
| 94 | Jigs & Fixtures | 25 |
| 95 | Lamps & Lights | 16 |
| 96 | Lamps, Bulbs, Accessories | 10 |
| 97 | Leaf Springs | 9 |
| 98 | Leathers | 3 |
| 99 | Lubricants, Oils & Petroleum | 5 |
| 100 | Machines, Machine Tools | 25 |
| 101 | Machining Center Parts | 23 |
| 102 | Magnetos | 3 |
| 103 | Manifolds | 2 |
| 104 | Metal, Steel, Steel Pipes | 14 |
| 105 | Mirrors | 13 |
| 106 | Moulds & Dies | 62 |
| 107 | Moulded Forms | 8 |
| 108 | Mud Guard | 17 |
| 109 | Oil Coolers | 5 |
| 110 | Oil Filters | 19 |
| 111 | Oil Pumps | 7 |
| 112 | O-Rings, Oil Seals, Seals | 20 |
| 113 | Other Accessories and Parts | 47 |
| 114 | Paints | 16 |
| 115 | Panels-Body, Door | 18 |
| 116 | Pedals | 7 |
| 117 | Piston Rings, Piston Pins | 18 |
| 118 | Plastic Injection Moulds | 26 |
| 119 | Plastic Parts | 19 |
| 120 | Pressed Parts | 37 |

Table A1 (Continued)

| | Automotive Parts Classified by Product Group | Number of Thai Manufacturers |
|-----|---|-------------------------------------|
| 121 | Radiators, Radiator Caps | 13 |
| 122 | Rubber Hoses | 12 |
| 123 | Rubber Parts | 35 |
| 124 | Seat & Seat Spring, Seat Parts | 25 |
| 125 | Seat Belts | 11 |
| 126 | Shock Absorbers, Shock Absorbers Parts | 23 |
| 127 | Spring Plugs | 7 |
| 128 | Speedometers | 6 |
| 129 | Springs | 15 |
| 130 | Stabilizer Bars | 7 |
| 131 | Stamping Parts | 53 |
| 132 | Starters | 11 |
| 133 | Steering Locks | 2 |
| 134 | Steering Sheft Columns & Gear, Pump's Assy | 6 |
| 135 | Steering Wheels | 5 |
| 136 | Sun Visors | 6 |
| 137 | Suspension Parts | 16 |
| 138 | Switches | 7 |
| 139 | Thermosetting Parts (Insulator) | 2 |
| 140 | Torsion Bars & Stabilizers | 8 |
| 141 | Trading, Import, Export | 15 |
| 142 | Transmission Belts & V-Belts | 5 |
| 143 | Trucks, Trailers, Parts | 16 |
| 144 | Tuk Tuks | 1 |
| 145 | Turbo Chargers & Super Chargers, Components | 3 |
| 146 | Tires, Tubes, Valves | 6 |
| 147 | Universal Joint, Ball Joints, Yokes | 6 |
| 148 | Vehicle Assembly | 6 |
| 149 | Water Pump | 8 |
| 150 | Weather Stripping & Insulating Tubes | 4 |
| 151 | Wheel Caps | 4 |
| 152 | Wheels, Light Alloy | 7 |
| 153 | Wheel, Steel | 3 |
| 154 | Windshields & Glass | 7 |
| 155 | Window Glass | 8 |
| 156 | Window Regulators | 6 |
| 157 | Window Washers | 2 |
| 158 | Wiper Arm & Blade, Wiper Motors & Linkage Parts | 7 |
| 159 | Wiring Harnesses | 8 |
| 160 | Others | 24 |

Source: Thai Auto Parts Manufacturers Association (<http://www.thaiautoparts.or.th/>).