

**TECHNOLOGY TRANSFER DERIVED FROM FOREIGN  
DIRECT INVESTMENT (FDI) IN THE THAI  
AUTOMOTIVE INDUSTRY**

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**A Dissertation Submitted in Partial  
Fulfillment of the Requirements for the Degree of  
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School of Public Administration  
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## **ABSTRACT**

|                              |  |
|------------------------------|--|
| <b>Title of Dissertation</b> | Technology Transfer Derived from Foreign Direct Investment (FDI) in the Thai Automotive Industry |
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This thesis is a study of technology transfer from Car Maker Companies, through Foreign Direct Investment companies in Thailand. Much literature indicates that Foreign Direct Investment (FDI) contributes benefits of technology transfer to the host country, and this study is conducted to investigate whether technology transfer is happening in Thailand or not. What technologies at Car Makers are made available to Auto-Parts manufacturers in Thailand? And how is the technology transferred? Comparing companies with different characteristics of shareholding from Joint-Venture companies in which the Thai shareholding is 50 percent and above, to companies in which the shareholding is 100 percent Thai - is there a difference in the transfer of the technology from the Car Maker?

The platforms of data collection used for this study are interviews and questionnaires, and analysis of the data by both qualitative and quantitative methods. The sampling groups are Tier 1 suppliers of Auto-Parts manufactured in Thailand and are the same group as mentioned above.

The result of this study shows the role Foreign Direct Investment (FDI) plays in the host country as Thailand that FDI does not play an important role for Technology Transfer to Thailand. And in term of policy recommendation, the government should improve on education system and policy, adjust the investment policy, and develop the policy for local auto part manufacturers in term of research and development (R&D).

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## ABBREVIATIONS

### Abbreviations

### Equivalence

|      |   |
|------|---|
| ADB  | Asian Development Bank  |
| BOI  | Board of Investment   |
| EDB  | Economic Development Board  |
| EV   | Electric Vehicle  |
| FDI  | Foreign Direct Investment   |
| GDP  | Gross Domestic Product  |
| IATF | International Automotive Task Force                                   |
| ICT  | Information Communication Technology                                  |
| IoT  | Internet of Things  |
| IPA  | Investment Promotion Agencies   |
| ISO  | International Organization for Standardization                        |
| J/V  | Joint Venture   |
| JIT  | Just In Time  |
| MIS  | Management Information System   |
| MPI  | Manufacturing Production Index  |
| OEMs | Original Equipment Manufacturers                                      |
| OLI  | Ownership advantage, Location advantage,<br>Internalization advantage |
| R&D  | Research and Development  |
| ROA  | Return on assets  |
| TA   | Technical Assistance  |
| TNCs | Transnational corporations  |
| TPS  | Toyota Production System  |
| TQM  | Total Quality Management  |

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

At present governments of most developing countries are trying to attract foreign investors by granting privileges to investors. The objective is to gain capital that may incur from foreign investment in the form of corporate income tax which is taxed both at the company level and the private level (Jorgenson & Yun, 2012) for the development of their countries (Academic Focus, 2014). Besides, as developing countries have low incomes, there is a shortage of capital in the country. So there are not enough funds to invest in business (Charoenporn, 2015). Therefore, the promotion of foreign direct investment (FDI) has been used to solve financial problems for developing countries. Capital is important to the development of a country, which is used to increase economic capacity and to develop inadequate infrastructure (Velde, 2006). Thus, FDI is a favored form of investment for many countries. Effort has been put forth to encourage foreign investors to invest directly into their countries.

FDI has been increasingly popular since the 19th century, as investors wanted to participate in management to reduce their investment risk (Hymer, 1976) as well as the need for ownership (Dunning, 2001). This has made FDI become more popular than Portfolio investments.

Developing countries are beginning to see more and more that FDI is an alternative that can be used in economic development and transition to the new era (OECD, 2002). Both home countries and host countries believe that FDI have positive impacts on development because FDI may contribute to the increase in productivity and technology transfer, which enhances improvement of management skills and knowledge on international production networks as well as reducing unemployment rate and increasing the opportunity of entering international markets (Caves, 1996). In addition, FDI also stimulate the increment of domestic investment, generating revenue

for the population in the country, as well as supporting industrial expansion in developing countries and promoting exports. (Charoenporn, 2015). These benefits are the reasons developing countries reduce the regulations for FDI by promoting to more liberalization, and implementing with other policies to attract investment (OECD, 2002). Moreover, developing countries should ensure that their development policies are comprehensive and that overseas investment organizations contribute to investment in both public and private sectors (OECD, 2002).

Apart from what has been mentioned, FDI is also an important element that helps open the international economy and in the development of the country. However, the benefits of FDI do not happen automatically and not equally distributed in all countries, communities and in all sectors (Velde, 2006). FDI does not only have positive impacts on development but also has negative effects as well. Therefore Policies that would be implemented with FDI are very important.

## **1.2 Significance of the Study**

Thailand is one of the developing countries that promote FDI by granting special privileges to foreign direct investors in order to promote more foreign investment (Velde, 2006). FDI in Thailand is promoted through the Board of Investment (BOI), which offers privileges to foreign investors (Board of Investment, 2017).

However, foreign companies decide to make FDI for different reasons. Some companies invest because they want to expand the domestic market while others use FDI as a production base for export, cost reduction and to increase competitiveness. Some companies may invest abroad to follow their customers into foreign countries to deter their own customers from turning to other business partners. As FDI has many objectives, it is difficult for host countries to control the real objectives in many cases. Therefore, what Thailand should consider are the factors leading to positive impacts which Thailand could obtain from FDI. One of the interesting positive impacts that many researchers have identified is the benefits of technology transfer that may come with FDI. The people or companies that may a benefit from in this impact are the employees of FDI companies and companies in the supply chain that subcontracted in

the productions if technology is transferred. Technology consists of many types which have different characteristics and advantages. What methods have been used in the transfer of technology, and is it effective? Does the nature of the company affect the technology transfer?

Technology supports not only results in human resources, it also contributes to national economy development. Therefore, this study plays an important contribution to social and economic development.

### **1.3 Objectives of the Study**

The purposes of this research are:

- 1) To study whether local automotive parts manufacturing companies in Thailand have received technology transfer from Car Maker companies
- 2) If the local automotive parts manufacturing companies have received technology transfer, what types of technology local companies have received from the Car Makers, what methods have been used in the transfer of technology, and whether the technology that has been transferred is effective and beneficial to the organization?
- 3) Whether the nature of the companies affect the technology transfer.
- 4) To study the supportive approaches expected from the government for sustainable development in Thai industry.

When the results are known, relevant parties can use this information for improvement, and future development, or extend their economic strategies to enable domestic entrepreneurs to survive, as well as reduce the risks that may affect domestic economy and the economic system in the long run.

### **1.4 Research Question**

- 1) Whether Car Maker Company has actually made technology transfer to local automotive parts manufacturing companies, what types of technology has been transferred, and what methods have been used in the transfer?

2) Whether the technology that has been transferred to local automotive parts manufacturing companies in Thailand is effective, helps to increase the competitiveness, and is beneficial to the development of an organization in the future?

3) Whether there are differences in technology transfer to local automotive parts manufacturing companies between companies with 100% Thai shareholders and Thai joint venture with at least 50% Thai shareholders?

4) To succeed in sustainable development, how Thai Government agencies should provide support and assistance?

### **1.5 Importance of the Study**

This study examines the potential technology transfer from FDI in Thailand. This shows whether FDI leads to the transfer of technology, and if the technology is beneficial to local suppliers in Thailand. In what aspect the knowledge from technology transfers is effective and beneficial. How local automotive parts manufacturing companies in Thailand can use the technology transferred to enhance their competitiveness. This study also aims to achieve targeted support from government agencies for sustainable economy of Thailand in the future.

### **1.6 Scope and Limitations of the Study**

This study is a study of FDI in the automotive industry only. This study does not involve FDI in the service sector. The business segment in this study is in the automotive sector and is purely manufacturers of auto parts. This study does not involve industry in other businesses such as Motorcycle industry, Public transport or any other Merchandise industries. The samples used in this study were Business Group in Tier 1. The sample group in Tier 1 is Thai companies with 100% Thai shareholders and Joint Ventures with at least 50% Thai shareholders. The companies with more than 50% foreign shareholders are not included in this study. This study is emphasizing the benefits of Thai companies with Thai people as the main shareholders. Therefore, the companies with foreigners as the main shareholder are not included in the study. The criteria for segmentation are based on percentage of

nationality of shareholders within the company. In addition, the study of Tier 1 is the study of the relationship between Car Makers and Tier 1 automotive parts manufacturers, to see whether there is technology transfer from Car Makers to local auto parts manufacturers. If there is, what are the types and formats of these technologies in the real situation?

### **1.7 Definitions of Terms**

This research uses both qualitative and quantitative research models on data collection and analysis of information received in search of relevant information. The researcher collected data from specific groups which were Thai auto parts manufacturers and joint venture auto parts manufacturers with at least 50% Thai shareholders, using interviews and questionnaires to collect data for the group of companies mentioned above.

The interviewees were either the owner of the companies or managers at management level. Interview questions were open-ended questions to give the opportunity for respondents to express their opinions as well as freely comment on the issues. Phone interviews were conducted in order to support face-to-face interviews for more accuracy. In the part of questionnaire, the researcher sent the questionnaire to the Human Resources Department of each company. The Human Resources Department then collected the data and responded back to the researcher. Due to the disclosure of enterprise information, respondents were required to obtain permission from the organization to provide information. The researchers sent questionnaires to the Human Resources Department of each company. Then the HR department sent the questionnaire to the company owners or senior management for approval of the questionnaire. In addition, the Human Resources Department which was the information collector would be able to acknowledge how the department should improve human capital and in which direction to achieve sustainable development in the future.

## **1.8 Organization of the Study**

This study consists of 6 chapters. Chapter 1 discusses the importance and the purposes of the study, including the methods used and the limitations of this study. Chapter 2 discusses how FDI has been developed, the development process leading to FDI, types of FDI, characteristics of automotive business in Thailand and the criteria for approval of FDI in Thailand. Chapter 3 discusses the literature and theories related to this study, such as the positive and negative impacts of FDI, factors that affect the competitiveness of the organization, technology, and technology transfer, the Global Supply Chain and the International Automotive Task Force (IATF), which are related to the automotive industry, including the models of analysis and the conceptual frameworks. Chapter 4 focuses on the research component, which is non-experimental research, by studying of phenomena occurring as they appear, including details of the sample groups used in the study and the methods used in the analysis. Chapter 5 presents the results from the data collection. Whether there is the transfer of technology from Car Makers to the local automotive parts manufacturers and in what fields. Whether the technology transferred is effective in the development of the organization. Whether the differences in nationality of the shareholders of the companies affect the technology transfer, as well as the direction that government agencies should take in order to achieve sustainable development of the Thai industrial economy, including criticism of automotive industrial development policy and strategic plan for Ministry of Industry. Chapter 6 discusses the conclusions, viewpoint from researcher, policy recommendation and limitations of this research.

## **CHAPTER 2**

### **BACKGROUNDS OF FDI AND SITUATIONS OF THAI AUTOMOTIVE**

#### **2.1 Introduction**

FDI expanded significantly during the 1990s, and declined in 2001. Since 2000, data has shown growth of \$1.3 trillion, or 4 times the value of previous investment sectors, which was worth more than 80% of the investees and more than 90% of the outbound investment. In the 1990s, both investees and outbound investments were mostly in developed countries. The remaining 10-20% investments were distributed to developing countries but not evenly. Most of these investments went to Asia and Latin America, though the investments only flowed into some countries, such as in Asia, Singapore and China were the main recipients. Even though this amount of investment might be a small proportion in developed countries, but it was a huge sum comparing to domestic value. Moreover, the amount of support a money was far greater than the money from other sources that came into use in economic development (OECD, 2002).

Latin American and Caribbean countries such as Mexico, the Dominican Republic, Central America and Africa attracted FDI by using large natural resources. These countries used natural resources as a major factor in attracting FDI by investing in the form of state enterprises, and seeking FDI that was both effective and resource efficient in production. Although some countries attracted FDI by using factors related to production such as increasing the number of strategic partners, especially those countries in Asia with appropriate technology capabilities (Velde, 2006). However, governments in many countries have begun to realize that direct investment, both inbound and outbound, can be more than just the issue of balance of trade. For example, FDI contributes to a change in the entire production structure or

the actual economic structure. FDI and ownership of enterprises in foreign countries creates access to new skills and techniques which can improve productivity and growth as well as reducing poverty in a country (Velde, 2006). The increasing interest for FDI of many countries has been reflected by the establishment of Investment Promotion Agencies (IPA). The number of IPAs worldwide has increased dramatically since the 1980s, and especially in the 1990s, until in 2002, there were 164 IPAs (Velde, 2006). In 1999, the annual global IPA budget was valued at \$1.1 million, 8 percent of the majority of agencies in developed countries have an annual budget of less than \$100,000 while 21% have budgeted over \$5 million. Some IPAs are effective in targeting FDI and are able to develop continuously, including creating image, cluster provisioning for linkage support and other productive activities such as in Ireland, Singapore and Costa Rica. Promoting industrial segments and sectors is another specific policy for investment that has gained popularity over the last two decades. The Economic Development Board (EDB) of Singapore has followed a group approach over the past decade, by targeting companies in the electronics, semiconductor industry, petrochemical industry, and engineering, using clustering as a tool for shaping industrial policies that attract FDI, leading to increased linkages and growth (Velde, 2006).

## **2.2 Development Process Leading to FDI.**

Countries that want to open to FDI are required to prepare to attract interest of investors so that they would invest in their countries. Dunning (2001) has described the process of development to attract FDI while Dunning (2001) has explained the development of Host Countries as follow.

Pre-industrialization is the period without inflow and outflow of capital (inbound / outbound) because the investment environment is not attractive enough. There are not enough benefits to expand business overseas until the country has been developed in some aspects such as the development of infrastructures, for examples; roads for distribution, communication systems for trade. The development of government policies, such as special privileges on domestic raw materials and other privileges including tax privileges and access to cheap labor, is also essential in

attracting FDI. The level of stability of a country is also a very important factor. The more stable the country, the more attractive it is for foreign investors. These factors encourage more interest for decision making in the location of FDI.

In addition, the company that has exported some products to a country may find that the market is growing impressively, hence a decision to invest in FDI.

After the internal state of the host country begins to change and develop, for example; the development of education, the decline of interest in natural resources and the higher level of wages. These changes make a country to be less attractive to invest in, but on the other hand, more developed countries have better skilled workers and higher quality infrastructure technology. Meanwhile, domestic companies develop their own businesses and seek to grow in the international markets. As a result, the government may set policies to attract less FDI.

In Economic maturity stage, the situation has changed, with the host country wanting to invest in another country. Whether this would happen depends on two important factors: the company's own policies and state policies. This is an important part of the policy for both domestic enterprises and foreign investors. Forecasting the direction of each country is quite hard as the decision is also based on government policies. Countries that are in the same development stage may have different domestic business and foreign investment development paths. Some countries may adopt similar policies for different reasons, such as Japan and Sweden.

International development path will appear when there is a fluctuation in the investment between the inflow and outflow of capital (inbound / outbound) but this situation happens when there is a convergence between the level of development and the economic structure of a country. At this stage, local entrepreneurs will use their existing knowledge of ownership in the international markets. They may add to these advantages by acquiring additional assets or entering new markets. This stage of development has been going on since the 1990s. Creating wealth and productivity growth depends on the ability to control and utilize all knowledges or intellectual properties effectively. At this stage, the role of government is often crucial in determining the competitive environment for companies in their own countries and effectively exploiting the economic opportunities of the world.

## **2.3 Types of FDI**

FDI is a company come from a company located in foreign countries that wants to invest in Thailand or other host countries to generate returns to companies in their home countries. FDI can be divided into two broad categories, based on the impact of international trade, which are Horizontal FDI and Vertical FDI (Academic Focus, 2014).

Horizontal FDI is the type of investment that foreign investors invest in Thailand to sell their products to Thai people. This type of FDI helps reap the benefit from the reduction of transportation costs, increasing the chances of market penetration and avoiding trade barriers, and the privileges from the promotion of investment from Thailand Government. The disadvantage of this type of direct investment is that there are fixed costs incurred in setting up production bases. Therefore if the domestic market is too small, the benefits of investment may not be enough to cover the cost of setting up a production base. This type of investment does not stimulate exports, but imports may increase due to the requirement to import some machinery and raw materials from abroad to use in the production process (Academic, 2014).

Vertical FDI occurs when foreign investors invest in Thailand as a production base to export back to the investor's home countries or to other countries. Cost of production in Thailand, when combined with trade costs, such as transportation costs to the trading partners' countries, must be lower than domestic production costs to reduce production costs as much as possible. This type of investment stimulates both the import of machinery and raw materials from abroad for use in production, and also stimulates exports to foreign countries (Academic Focus, 2014).

Aspects that direct FDI choice to invest in the host country can be determined primarily by several factors such as general policy factors, specific FDI policy factors, macroeconomic factors and specific business factors (Velde, 2006).

### **2.3.1 General Policy Factors**

This theory suggests that long-term investment will benefit from stability. Investors may obtain information from the investor survey and have large amount of

evidence before investing to reduce the risks of investors. Politically unstable countries are likely to receive a small amount of FDI. The exception to this rule is if the country is rich in natural resources. The country will use this advantage to attract a large amount of investment, despite the often unstable political environment. General policy factors are important for developing countries that are trying to create a more market-friendly environment for the operation of the private sectors. Countries that have consistently done so can attract more foreign investment. For example, developing countries in some Latin American have converted to state-owned enterprises which can attract significant capital inflows in many sectors such as utilities, banking, and telecommunications. Countries with good investment climate can attract more investment (Velde, 2006). In addition, a warm investment climate depends on factors that need to be considered in investing such as the cost of starting a business, terms of contract enforcement or cost of closing (Djankov et al., 2000). These are factors that demonstrate the rigid rules of entry into the business, and can also be related to high amount fraud. Therefore weak management may cause suspension of investment.

### **2.3.2 Specific FDI Policy Factors**

Due to the incentives for investment, the demand for international trade, Investment Treaty and performance requirements, governments prioritize the FDI system as a mean to foreign investment linkages with a positive impact on the economic development of their respective countries. Over the past 3-4 decades, many countries have had restrictions such as barriers to foreign ownership, inadequate local skilled labors and unfavorable competitive environment. These are gradually changing from the liberalization of investment. But the difference in these factors is time. In the 1960s Southeast Asian economies, especially Hong Kong, Singapore and Malaysia were among the first countries to start free trade. While other Asian countries, such as South Korea, China and India, and Latin American countries started Liberalization in the 1980s. And in the 1990s, even Republic of Korea, which had limited direct investment and importing technology through licensing only, decided to change the policy model. After the crisis in Asia in 1997, to open to liberalization in direct investment, many countries have been trying to attract FDI. These countries

have set up a foreign investment promotion agency to help screen foreign investors into FDI as well as expansions of other factors. Examples of these factors are incentives, determining the area for exports, and Science Park. These factors have led to a reduction in FDI restrictions, hence the increasing competition in FDI (Velde, 2006).

### **2.3.3 Macroeconomic Factors**

These factors focus on human resources, infrastructures, sizes of business and growth of the market at the macro level. The decision on the location of FDI is based on economic factors and not on interim policy interventions. The study found that the relationship between FDI and technical and specialized engineering skills are very useful in attracting investment. Many studies have indicated the success of many East Asian countries that infrastructure has had an impact on attracting FDI. When studying from US FDI, we found that "The quality of infrastructure plays a very important role for developing countries", while the special support policy is better in developed countries where there are already adequate infrastructures. In developing countries, it is found that good infrastructure, such as transportation systems, telecommunications and information systems and energy are the positive factors. These factors have significant implications for direct investment. After that, FDI will improve the infrastructure. FDI also helps to develop skills in human capital. Some countries are trapped in "low skill low income" zone, while some countries can come out of this effectively with consistent education policies. Most economic literature attempts to focus on the overall factor of FDI but the importance of these factors is varies depending on the sector, type, and incentive of direct investment. For example, countries that want to attract knowledge from FDI, without sufficient domestic technology and capable human resources, will find it difficult to do so (Velde, 2006).

### **2.3.4 Specific Business Factors**

These factors based mainly on technology, for example, the development of information and communication technology (ICT) have had a tremendous impact on the way in which international activities are structured due to the need to facilitate more specific production. This can lead to competition in the best possible

environment. From what we have seen, it can be explained that these are the reasons direct foreign investment only goes to a few countries or regions and not others. This phenomenon also contributes to significant changes, which in turn promotes good quality local capacity. This shows that FDI affects economic development in a positive direction, and specific business factors are important factors in attracting FDI, as can be seen later. Business sectors focus on human resources and organizational management while in the macroeconomic perspective, FDI emphasizes the area of government transparency, such as bribery and corruption as well as the level of Domestic Crime and Terrorism, which is part of the social relational capital. However, the measures to deal with these factors depend on the policies of each country (OECD, 2002)

FDI affects the development of Thai industry significantly. In the early stage, FDI in the Thai industry focuses on substitution of imports. Later on, it has turned more in the direction of export industry as the Thai government has introduced policies to promote exports and grant privileges to exporters (Charoenporn, 2015). Therefore, FDI in Thailand started from the Horizontal FDI and then developed into vertical FDI. For Thailand, where there is a small scale economy and insufficient domestic savings for business expansion, FDI would reduce the gap between domestic savings and capital requirements. The entrance of Trans-National Corporations (TNCs) in the form of FDI is primarily aimed at acquiring a production base with cost advantage and low wages in Thailand. Another reason is that Thai government has facilitated investment by building infrastructure to support foreign investment, especially in advanced technology industries such as automotive industry and components as well as electronics industry. More importantly, FDI also comes with Technological Transfer and Knowledge Transfer which leads to cost optimization and labor efficiency in Thailand. This allows the industries that have been invested in by FDI to develop in a leap, and can enhance long-term competitiveness as well as creating employment (Charoenporn, 2015). Information from the Bank of Thailand identifies FDI during the period 2012-2017 that enters Thailand in the following businesses (see table 2.1)

Based on the table 2.1, the overall investment trend is likely to increase after the contraction in 2014. Many business sectors were expected to grow in 2017, including automotive production.

**Table 2.1** Foreign Direct Investment During the Period 2012-2017

| <b>Business Sector</b>   | <b>2017 p</b> | <b>2016 p</b> | <b>2015</b> | <b>2014</b> | <b>2013</b> | <b>2012</b> |
|--|---------------|---------------|-------------|-------------|-------------|-------------|
| Agriculture, Forestry and Fisheries                                | 4.19          | 6.69          | 5.32        | 5.95        | 2.09        | 5.85        |
| Mining and quarrying   | 198.10        | -29.11        | 490.38      | 183.93      | -81.11      | -94.96      |
| Manufacturing  | 2,348.76      | 1,446.50      | 3,180.47    | 4,739.50    | 5,260.21    | 1,599.03    |
| Food production  | 347.75        | 694.70        | 188.28      | 69.36       | 20.16       | -126.46     |
| Beverage production  | 52.27         | 10.02         | -89.39      | 74.29       | -13.21      | -39.58      |
| Paper production   | -7.87         | 107.80        | 47.37       | 173.62      | -28.00      | 48.69       |
| Coal and petroleum production                                      | -24.55        | 98.49         | -321.35     | 519.52      | 130.25      | 250.19      |
| Chemical production  | -216.89       | -295.28       | 1,108.20    | 455.80      | 371.04      | 995.23      |
| Pharmaceutical production  | 45.83         | -46.83        | 4.47        | 73.95       | 127.70      | 483.99      |
| Rubber and plastic production                                      | 289.83        | 290.02        | 815.40      | 271.29      | 557.87      | 517.63      |
| Computer production electronics And<br>optical equipment           | 755.12        | -322.46       | 1,333.96    | 135.07      | 667.19      | 42.09       |
| Electrical Equipment Manufacturing                                 | 23.47         | -625.52       | 323.07      | 2,404.76    | 47.48       | 146.37      |
| Manufacture of machinery and<br>equipment Not classified elsewhere | 179.26        | 462.93        | 752.69      | 35.65       | 518.20      | 511.34      |

**Table 2.1** (Continued)

| <b>Business Sector</b>   | <b>2017 p</b>   | <b>2016 p</b>   | <b>2015</b>     | <b>2014</b>     | <b>2013</b>      | <b>2012</b>      |
|--|-----------------|-----------------|-----------------|-----------------|------------------|------------------|
| Automotive, Trailers and semitrailers production                     | 518.70          | 581.08          | -780.59         | 160.22          | 1,666.46         | -454.42          |
| Furniture production   | 0.52            | 0.31            | -42.06          | -16.00          | 24.40            | -0.34            |
| Electricity, gases, steam and air conditioning systems               | -65.68          | -115.52         | 95.98           | -317.44         | 68.17            | -54.69           |
| Construction   | -2.25           | -320.01         | -336.23         | 117.82          | 71.17            | -171.49          |
| Wholesale and retail trade, Repair of motor vehicles and motorcycles | 1,235.21        | -1,063.68       | 1,524.75        | 494.22          | 1,353.34         | -189.70          |
| Transportation and storage facilities                                | -129.68         | -132.43         | 64.66           | -81.42          | 125.15           | -68.73           |
| Accommodation and food services                                      | -91.09          | 763.82          | 127.62          | 60.88           | -140.68          | -47.18           |
| Financial and Insurance Activities                                   | 3,252.55        | 946.43          | 2,986.50        | 1,778.37        | 3,038.43         | 1,855.90         |
| Real estate activities   | 1,814.62        | 1,427.67        | 1,289.83        | 1,286.14        | 1,595.39         | 1,039.12         |
| Others   | 536.18          | 132.87          | -501.69         | -3,292.49       | 4,643.80         | 9,025.89         |
| <b>Total</b>   | <b>9,100.91</b> | <b>3,063.24</b> | <b>8,927.58</b> | <b>4,975.46</b> | <b>15,935.96</b> | <b>12,899.04</b> |

**Source:** Bank of Thailand, 2018.

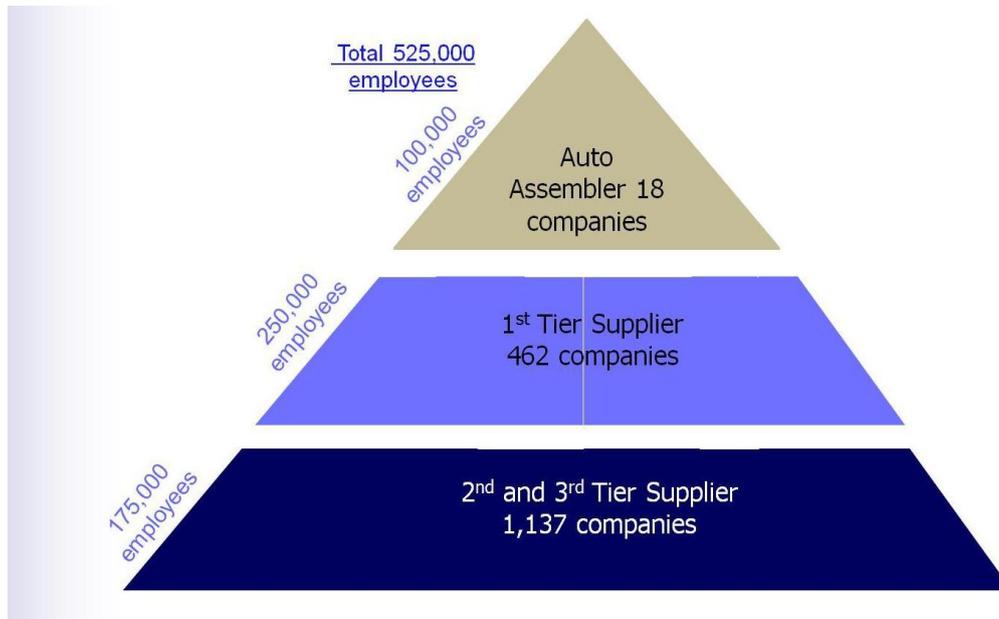
## **2.4 Characteristics of the Automotive Business in Thailand**

Thailand's economic structure has shifted from an agricultural-based economy to an industrial economy by developing from the agricultural processing industry to manufacturing as substitute for imported goods, and develops into a high-tech export-oriented manufacturing industry. Currently, the electronics and machinery industries, automotive and parts have become a more important industrial product. At present, the proportion of natural resources-based and labor intensive exports has decline while the mechanical product, computer and electronics parts, automotive and electrical appliances have become a major export product of Thailand (Charoenporn, 2015).

The trend of industry expansion in 2018, the growth rate of the Manufacturing Production Index (MPI) is projected to be in the range of 1.5 - 2.5 percent due to the recovery of the global economy. Automotive industry is one of the industries that are expected to grow in 2018. The automotive industry is estimated to produce about 2 million vehicles, or 2.56 percent, of which about 900,000 will be produced and sold in the domestic market, and 1,100,000 will be exported (Office of Industrial Economics, 2017). The automotive industry is one of the main target industries of Thailand. The proportion of FDI in automotive industry is highest in comparison with other industries. The review of NET Application of BOI has shown overall 790 investment projects valued at 6,268.55 million Baht. The majority of the investment is from the automobile industries of which there are 39 projects worth 1,266.04 million bath (Thailand Investment Review, 2017).

This research focuses on the automobile industry as it is the main target for promoting FDI. Thailand's automotive industry has been developing for more than 50 years, with the support of both the public and private sectors. Thailand is one of the largest auto manufacturers in Southeast Asia, which is one of the world's leading auto manufacturers, and currently is the center of automotive industry of ASEAN. Automotive industry is the main industry in Thailand accounting for about 12% of gross domestic product (GDP) in 2013. Data from the Automotive Institute (Rachanida Nitipathanapirak, 2017) indicated that more than 525,000 employees in the industry and approximately 462 suppliers in Tier 1 and 1,137 in Tier 2 & 3. These

numbers of companies include both the automotive and motorcycle manufacturers (Rachanida Nitipathanapirak, 2017).



**Figure 2.1** Data from the Automotive Institute in Tier 1 and Tier 2 & 3.

**Source:** Rachanida Nitipathanapirak, 2017.

Leaders in the automotive industry (Car Maker) with factories in Thailand are such as Auto Alliance Thailand (Ford & Mazda), Ford, BMW Manufacturing, General Motors, Hino Motor, Honda Automobile, Isuzu Motors, Toyota Motors, Mercedes-Benz Thailand, Mitsubishi Motors, Nissan Motors, Tata Motors, Suzuki Motor, Volvo Car Thailand and SAIC (Board of Investment, 2015)

In the supply chain of Car Maker and Car Assembler, there are segmentations based on the criteria of production. The supply chain of the automobile industry can be divided into 3 groups: Tier 1, Tier 2 & 3. Tier 1 is the supply chain or parts suppliers and the equipment delivered to the car manufacturers to assemble the car. For example, electronic systems for motor vehicles, engines and brakes, which require the technological ability to produce components in accordance with the standards, set by the assembly line. Tier 2 and 3 are the supply chain for component parts, materials

which in turn supply to Tier 1 such as metal products, machinery, plastic and glass (Chula Unisearch, 2005).

However, the format of the company in each Tier is different. When segmented according to the proportion of shareholders, there are companies with 100% foreign shareholders, companies where foreigners hold more than half of the shares, companies with at least half Thai shareholders and the companies with 100% Thais shareholders. Different company formats may result in differences in performance.

## **2.5 Situation of the Automotive Industry in Thailand**

Automotive industry in the first quarter of 2018 is still expanding. Production of cars increased by 11 percent compared to the same period last year. This is the result of 13% increase in domestic sales and 4% increase in exports. The total production volume is 539,690 units (Automotive Institute, 2018). The proportion of production in each category is shown in table 2.2.

## **2.6 Automotive Industrial Development Policy and Strategic Plan for Ministry of Industry**

### **2.6.1 Automotive Industrial Development Policy**

The guideline policy for the development of the automotive and auto parts industry consists of four main approaches: 1) Skill Development to Improve Productivity and Support for Future Technologies. 2) Product development and the development of production processes to improve competitiveness of the country and promote the use of domestic technology. 3) Linking Industries to Stabilize Upstream Raw Materials for the Expansion of the Automotive and Automotive parts Industries. 4) Upgrading Infrastructure to improve the competitiveness of Thai entrepreneurs. (Automotive Institute, 2013)

The development of skills to improve productivity and support for future technologies is set as the first approach because at present, the automotive industry of Thailand is experiencing labor shortages. This shortage is likely to be even more

severe in the future. Enhancing skills in all fields can help to maintain both short-term and long-term competitiveness. It also improves the production capacity and supports future automotive technologies which require higher levels of technology. Establishing a cooperative network between academic institutions and industrial sector provides opportunities for the industry to communicate the needs for skills to the institutions. This can be used as a guideline for curriculum development and skills development in the future. (Automotive Institute, 2013)

Product development and the development of production processes to improve competitiveness of the country and promote the use of domestic technology can be done by encouraging Thai entrepreneurs to turn more to research and development of new technology to support the production and export of hybrid and electric vehicles (EV). Attracting the attention of the world's leading automotive parts manufacturers help to create a high-tech manufacturing base, as well as the creation of safety and environmental standards equivalent to those of European countries. This promotes the transfer of technology to Thai entrepreneurs to prepare for the future development of Fuel Cell Automotive (Automotive Institute 2013).

Linking Industries to Stabilize Upstream Raw Materials for the Expansion of the Automotive and Automotive parts Industries helps support the Domestic Upstream Raw Materials Industry and helps establish linkages with Upstream Raw Materials producers in ASEAN, especially in steel and metal industries. (Automotive Institute, 2013)

Upgrading Infrastructure to improve the competitiveness of Thai entrepreneurs can be done by establishing a clear long-term policy and sending a good signal to the Entrepreneurs in the industry to encourage confidence from the investors. The government should review the projects or the measures that hinder business operations along with creating transparency and fairness for all levels of entrepreneurs. In addition, there must be clarity in the direction of technology support to ensure that future development will be in the right direction. (Automotive Institute, 2013)

### **2.6.2 Strategic Plan for Ministry of Industry**

The government has prepared a strategic plan for the Ministry of Industry (B.E. 2560 - 2564). In industrial development, it is necessary to promote the balance, stability and sustainability for the manufacturing sector in order to strengthen the potential of the industrial sector. This can be done by the development of supporting factors to facilitate investment and industrial development, by promoting and developing the industry to be socially and environmentally friendly and by increasing organizational capacity to provide quality services. The government has set the framework for the 12th National Economic and Social Development Plan for the development of the industrial sector in these following areas; 1) Overall economic development, 2) Sectoral economic development, 3) Agricultural development for food excellence, 4) Development of human potential and good quality of life, 5) Creating Equality, 6) Regional Development and Linkage, 7) Creating eco-friendly economic and social growth. (Ministry of Industry, 2016)

In addition to the framework of the National Economic and Social Development Plan, there are also additional policies, both short and long term, to support and promote the survival of SMEs. The government also sets the foundation for the economy and strengthens the business sector by promoting cluster in industry, implementing innovations and enhancing technology to increase productivity and efficiency (Ministry of Industry, 2016).

## **2.7 Forms of FDI and the Criteria for Recruiting FDI in Thailand**

In general, foreign companies can invest in Thailand through two types of investment, namely, using FDI channels and not using FDI channels. However, foreign investors investing in the auto industry are more likely to choose FDI as FDI may reduce concerns about proprietary technology. Therefore, the investment form of foreign companies in the Thai automotive industry is direct investment from abroad. The structure of the FDI Company has changed due to increasing global competition. Investors are looking for countries with good economic conditions and favorable policies to increase their competitiveness, including consideration of tariff barriers in various areas of the country (Kohpaiboon, 2008).

**Table 2.2** The Proportion of Production

| Type  | 2017      | 2017      | 2018      | Change<br>(%) |
|---|-----------|-----------|-----------|---------------|
|   |           | (Jan-Mar) | (Jan-Mar) |               |
| <b>Passenger Car</b>                                | 818,440   | 199,979   | 219,992   | 10.01         |
| <b>Commercial Car<br/>(exclude one-ton pick up)</b> | 40,325    | 9,186     | 9,350     | 1.79          |
| <b>One ton pick up</b>                              | 1,130,058 | 276,390   | 310,348   | 12.29         |
| <b>OPV</b>  | 0         | 0         | 0         | 0             |
| <b>Total</b>  | 1,988,823 | 485,555   | 539,690   | 11.15         |
| <b>Growth (%)</b>                                   | 2.28      |           |           |               |

**Source:** Automotive Institute, 2018.

FDI is an investment in equity capital which means investing in shares with the right to participate in business management from 10% or more, with the right to inter-company loans, return on investment, debt securities and trade credits in transactions between affiliates (Board of Investment, 2018). To promote foreign direct investment in Thailand, the government has set up The Board of Investment (BOI), as the main authority responsible for investment promotion with the duty to promote domestic investment. It promotes advertising on domestic investment climate and persuading investment in key industries, which are useful for economic, social and public security aspects of the country, as well as publicizing information related to investment and establishing investment service centers providing various investment services. These include facilitating and providing assistance to those interested in investing in preparation to invest in investment projects, recruiting investment partners and investment promotion planning. There are also other important functions which are analyzing, investigating and controlling on investment projects, as well as evaluating the results of the promoted projects. Any investment program that receives promotional privileges will be entitled to benefits both in terms of tax privileges and non- tax privileges. Examples of tax privileges include exemption or reduction of import duty on machinery, reduction of import duty on raw materials or essential

materials, exemption of corporate income tax and dividend, 50% reduction of corporate income tax, deducting shipping costs, electricity and water supply costs at twice the actual amount paid, deducting the cost of installing or constructing facilities increased by 25 percent more and exemption of import duty on raw materials or materials required for export production. Non-tax benefits are such as allowing foreigners to do analysis on investment, allowing foreign skilled labor and specialists to work in the promoted business enterprises, permission on ownership of land and allowing export of foreign currency, etc. However, a branch of a foreign entity cannot conduct any business that is reserved without having a business license in a foreign country. In order to apply for the permission, investors must apply for a business license from the Ministry of Commerce and the enterprise can only operate after the business license has been granted. If the desired business does not compete or overlap with Thai business, or is a business involving contact between affiliated members, or the investors can meet the conditions of investment and/or technology transfer to local personnel or organizations, the probability of approval is likely to be higher (Board of Investment, 2018).

## **CHAPTER 3**

### **LITERATURE REVIEW**

#### **3.1 FDI Concept**

When referring to FDI, we can indicate that FDI is the result of changes or development of economic models in both developed and developing countries. FDI is defined in such contexts as an important form of effective international economic system and important to development (OECD, 2002), or FDI is the basis of domestic economic development, especially in developing countries (Denisia, 2010). In addition, it can also be said that FDI is a form of overseas investment, which is different from portfolio investment due to the need to control operations (Hymer, 1976), or FDI is considered to be a factor contributing to the economic growth of the host country as well as to solving the economic problems of developing countries (Moura & Forte, 2010). In which ever contexts, we cannot argue that FDI has taken an active role in the global economy. This is especially true in developing countries who are trying to attract developed countries to invest in their own country through the promotion of FDI to allow investors to control their operations and create a sense of diminishing risk in investing overseas.

In the past, portfolio investment was more popular than direct investment until investor behavior has begun to change. Due to the needs to increase security and stability after the investment, investors took over the control of the oversea enterprises themselves. Therefore, the direct investment rate has increased significantly (Hymer, 1976).

Velde (2006) has tried to explain the role of FDI in explaining the differences in economic growth and productivity development over the same period. Since the first decade of the United Nations' development in the 1960s, from the 1960s onwards, FDI has received both support and resistance. Some scholars say that direct investment causes economic growth and productivity in the economy as a whole,

while other emphasize the risks associated with FDI, which are seen as ineffective or negative, and cause the adoption of inappropriate technologies to developing countries.

Over the past four decades, FDI has been seen as beneficial. Almost every country is trying to provide the right atmosphere for investment. Many countries are becoming increasingly aware that they can attract FDI through the use of general economic and direct investment policies. At the same time, governments in different countries have become aware of the positive aspects of FDI, with a more appropriate perspective on FDI. Developments and community research has taken place, reflecting the impact of FDI on economic growth. However, there are not only positive effects that may arise from this type of investment promotion. Negative effects in various aspects can also occur. Impact on each issue may depend on the type of FDI, economic conditions, policies, types of general policies and investment policies, including trade, innovation and human resources as key factors in the link between direct investment and development (Velde, 2006).

### **3.2 FDI and the Development of Theory**

In the past, Hymer (1976) has attempted to distinguish between Port Folio investment and direct investment. The differences between these two types of investment can be distinguished as follows.

Portfolio theory: Portfolio theory is based primarily on interest rates. The simplest form of this theory stated that each Investor assumes maximum profits where there are highest returns on investment under the condition that there is no risk or uncertainties and no barriers to movement. Funds are moving from low-interest rate countries to high-interest rate countries. But in actual situations, risks, uncertainties and obstacles are certain to always arise. However, this simplest form of portfolio theory does not take into account the imperfections of capital market actuality (Hymer, 1976).

Direct investment theory: Direct investment theory began by Hymer (1960) attempting to distinguish clearly between portfolio and direct investment which are two types of long-term investments, with the transfer of international capital.

Basically, this is the question of who controls the company after the investment. When a capitalist has direct control over foreign companies, direct investment occurs. If the investor does not have control over the companies in which he invests, portfolio investment is then taking place. To describe direct investment, we must describe control. Two types of direct investment are explained as Type 1 and Type 2; Type 1 Direct Investment is using the same principle as portfolio investment, taking interest rate as the key factor. The purpose of this type of direct investment is to take absolute control over the use of assets of the companies invested. Type 2 Direct investment does not depend on interest rates and is known as 'International Operation'. The purpose of type 2 direct investment is to eliminate competition between companies in different countries or to gain proper returns associated with beneficial skills and abilities (Hymer, 1976).

There are two main reasons for investors to seek control over the companies in which they invest; 1) to conscientiously utilize the asset for investment security, and 2) to prevent bankruptcy, or protect the conflict of interest between investors including reduction in exchange rate risk. Therefore investors who seek management control normally choose the method of FDI to increase their business opportunities and reduce the potential risks of management from their partners. Direct investment theory has been developed from the following theories (Hymer, 1976).

#### International operations theory

Direct investment theory developed from the theory of International operations. Due to the diverse nature of companies, companies in some countries are controlled entirely by their nationals and some companies are controlled totally by foreigners. The corporate model may be in the form of a Joint Venture (J/V) or half owned by domestic nationals and half owned by foreigners, or maybe a partnership with different proportion of ownership or in the form of License by which the foreigners may not have the ownership. Relationship in various forms is the key issue of international operations. These forms of relationship have two dimensions. The first dimension is the control power of one company to another. The second dimension is to acquire shares in order to obtain legal ownership (Hymer, 1976).

However, these two dimensions are related as owning enough shares affects the control of the company. Therefore, FDI can lead to control in another company.

There are many reasons one company wants to control other companies in foreign countries. This may be because of the opportunity to monopolize the profits that may occur in many countries or the higher competitiveness of the trade or because some companies have many commercial interests that can be profitable in other countries. In addition, the expansion of operations to foreign countries is another strategy of risk diversification. However, even if the foreign-owned enterprises are managed and controlled by parent companies in home countries, they cannot avoid all the problems. Access to the information of that country, whether it be economic, language, legal system, and political, is at the expense of foreign investors. Moreover, there are other factors that cause the differences such as governments, customers and partners, which may not benefit the business. However, the biggest obstacle is the exchange rate risk because fluctuations in exchange rates may have a different effect on each investor (Hymer, 1976). The value may increase or decrease in each currency invested such as the use of the yen currency in Thailand. At the time, the yen may depreciate, so there is a necessity to use the yen at a higher rate to pay for plant construction or utility system in the manufactory. When companies in a foreign country pay a share of profits, the parent companies may earn more due to the process of exchange rate. On the other hand, if the yen strengthens, the investment money would have a higher value while the value of profit share may lessen.

Other motivations that attract international operations include: 1) the need to enter a market with high barrier of entry. So investors use international operations instead of international trade, whereby capitalists predict that they would be able to carry on their businesses and get profits in the long run. 2) Risk diversification; investors invest in varieties of businesses whether they are related or not, the profit of each business being inversely correlated. This type of investment is viewed as a risk reduction. Therefore, multinational investment does not relate to control if the investment is due to this reason. 3) Ownership of trade benefits. There are several of such benefits, for example procurement of factors of production that are less costly than competitors or effective production control and better distribution systems. 4) Higher business value may be obtained when establishing a business in another country, such as a product that is already in a developed country, as a generic product, but when entering the developing countries, the product may become a higher value product due to better quality than local products.

Another factor that has been mentioned is the exchange rate, which is seen as a motivation for direct investment but Hymer has argued that exchange rate is not a major motivation for international operations if other factors mentioned above are more important. Therefore, foreign companies are trying to eliminate the weaknesses that exist in international operations whether it is in terms of keeping profits from sales or reduction of competition. By making one affiliate produce and sell products in one model or another to prevent other company branches from selling the same product, thus prevents Intra Company Competition (Hymer, 1976).

In terms of capital for investment, Portfolio investment focuses on the interest rate required for investment without the flexibility of other forms. But in terms of international operations, investors can invest without having to consider mainly the interest rate. Due to the forms of international operations, international operations can be done in a number of ways without having to consider the capital, for example, operation in the form of licensing agreement or franchise, which is the sale of trademark rights instead of capital investment (Hymer, 1976).

The reason for the decline in portfolio investment is fluctuations in exchange rates. When comparing the interest rates between home countries and interest rates in host countries, if there is only slight differences in interest rates and exchange rates, investors decide to invest by borrowing from the Host country. In the end, investors have discovered that the costs of borrowing from the host country are cheaper than the costs of capital transfer from the home country. However, foreign investors will not borrow 100% of their capital from the host country due to concerns about bargaining power such as bargaining on the share of profits or requesting participation in decision making. Therefore the investor may have to choose between the power of control or investment at a lower cost. Other than the International Operation Theory previous discussed, there are other theories that have been referred to as being closely related to direct investment theory include: Production Cycle Theory, Internalization Theory, and The Eclectic Paradigm (Hymer, 1976).

Production cycle theory occurs because of the need for comparative advantage over competitors, which is the theory of Vennon that talks about creating production advantage. This concept is due to the fact that the United States wanted to maintain market share in the European market due to the recovery of the European economy

after the Second World War, and the US companies set up factories in Europe to maintain their share of the market (Hymer, 1976).

Internalization theory Hymer used this theory to argue the reason why entrepreneurs decide to use direct investment theory. This theory discusses the benefits of using existing assets most effectively (Hymer, 1976). For example, companies in the country of origin have unused machines due to the current machines not having enough features to support the latest more complicated workpieces. FDI allows enterprises in the home countries to relocate unused machines to host countries for less complex work. In addition, FDI can use existing assets to expand markets to cross-border markets (Dunning, 2001). Depending on the value of business operation, investors can choose the business model between inter-company and Intra-company model for utilization of asset.

The eclectic paradigm theory, Since 1977, John Dunning has developed a framework for recruiting source (The Eclectic Paradigm) which is a theory in economics and is also known as OLI-Model or OLI Framework. The development of OLI model or OLI Framework has led to the advancement of Internalization published in 1979. OLI consists of the following elements: Ownership advantage, Location advantage, Internalization advantage. 1) Ownership advantage refers to the ownership of intangible assets that give advantages to the company. These intangible assets can be in the form of intellectual property such as trademark and patents, or ownership of natural resources such as mining concession, or the ownership of technology and innovation such as Apple iPhone, or the opportunity to learn about the economy and economic development as well as the magnitude of the business size, which has resulted in easier access to funding sources (Denisia, 2010). Ownership advantage is also defined as the ability to link assets in different host countries to gain benefits or competitiveness (Dunning, 2001). 2) Location advantage refers to the decision making part on which country to invest in. There are 3 factors to decide: first, economic benefits such as qualitative factors and quantitative factors of production, transportation cost, long distance communication, market size and etc., second, policy benefits of the host country government that gives investors privileges, and third, social benefits, considering the distance between home country and host country together with social culture and the attitude of people in that country.

3) Internalization advantage is the ability of a business to increase its competitiveness by increasing the value of its existing assets. It can be concluded that in order to make the decision on where to invest, investors need to consider which factors are more important. This decision depends on the environment of each industry as well as on the strategy of each company. This theory cannot be used to explain FDI in a comprehensive way, due to the variety of decision factors and the expectations of individual companies. However, this theory provides an explanation for the growth of multinational corporations (TNCs) and points to in-depth reasons for choosing a direct investment model.

### **3.3 Impact from FDI**

The factors of FDI have changed over time. FDI in developing countries has attracted attention from various countries. Governments in different countries are well aware that it is not possible to assume that the effects of FDI will only be either positive or negative (Velde, 2006). For example, Selma (2013) stated that FDI is an important part of an open international economy and an important mechanism for development, and FDI has both positive impacts and negative impacts. In Velde (2006), it is stated that FDI affects development in many ways such as employment and income, capital formation, market access, market structure, technology and skills, fiscal revenue as well as cultural, political and social issues. So it is necessary to study in subsections that the influx of FDI leads to positive impacts and negative impacts on which factors and the actual effects of these impacts, to study the facts in that country.

#### **3.3.1 Positive Impact of FDI**

Many scholars have identified several positive effects of FDI. In terms of productivity growth, FDI may help to increase productivity (Caves, 1997) or have influenced the increase of overall output (OECD, 2002). Generally, increase in productivity can be determined by the ratio of the output to the volume of input. In addition, productivity enhancements can be determined by other principles, such as the measurement of technology resulting from changes in production techniques, measuring the efficiency of the production process which can produce at the highest

productivity that can be achieved with today's technology by improving efficiency. In term of economics, positive impacts of FDI mean maximizing profitability for the company including the development of real cost savings using the most cost-effective and fault-tolerant solutions to minimize errors. It can also be measured by comparing production processes by measuring the output of each process used. Apart from that it can be measured by living standards by measuring the performance of workers per working hour, which indicates the potential output (OECD, 2001).

FDI does not only contribute to productivity but also contributes to the transfer of technology by stimulating the flow of superior technology from developed countries (OECD, 2002) through FDI as the main channel for technology transfer (Makki & Somwaru 2004; Caves, 1997; Selma, 2013; Malhotra, 2014). Even the most important strategy of R & D has been expanded to some developing countries. FDI also helps in the transfer of clean and more environmentally friendly technology (Velde, 2006). This is a measure of the success of a technology transfer considering numbers of disclosures of patents and articles, citations of patents and articles, co-authoring, contribution to firm survival, new profitable products commercialized, and businesses thriving in employment and sales and causing productivity gains (Renault et al., 2008).

In another aspect FDI contributes to the development and human capital (Makki & Somwaru, 2004) or human resources (OECD, 2002) and improves management skills (Cave, 1996) through skill transfer training and transfer of new forms of management, and corporate practices as well as foreign management skills (Selma, 2013). To determine whether the skills, knowledge, capabilities of employees, and human resource efficiency in the organization have increased, one can assess from the results of the missions set by the organization to achieve the goals (Zakaria & Yusoff, 2011). These are due to the fact that FDI has provided knowledge of the international production network to the host country (Caves, 1996). Besides, in evaluation one can also use an accounting model to assess human resource development by considering the capital employed and return on assets (ROA) as human capital is the resource behind the organization.

In the aspect of poverty reduction, FDI has been identified as contributing to poverty reduction in host countries (Velde, 2006) because FDI creates opportunities

for employment both directly and indirectly. Direct employment is when a foreign company hires citizens in the host countries which mean that those people in that countries gain income directly from employment. Indirect employment is through the connection with a local company or industry, subcontracting to support foreign businesses, such as providing spare parts or parts to the production of the foreign companies (Selma, 2013). These supply chains extend to creating jobs for companies that have the potential to produce products for the foreign companies. It also opens up the international economic system, such as participation in the global supply chain. Manufactured parts from the host countries have the opportunity for export to other regions and countries through this supply chain. This system has helped developing countries access international markets and technology (OECD, 2002). Some countries do not have sufficient ability to open international trade on their own, either in technology or in competitiveness (Selma, 2013) so they rely on FDI channels to open up international trade.

In addition, FDI helps create a favorable environment for business competition as FDI contributes to the development of factors of competitive advantage such as helping to strengthen business competitiveness (Selma, 2013). Examples of factors that contribute to business competitiveness include: productivities and costs, because productivities and cost are the indicators of business efficiency. If domestic companies have high business competitiveness, they will develop and also be part of the growth of the income and economy of a country. As stated in the literature of endogenous growth, FDI induces a shift towards productivity which is important for long-term economic growth due to the fact that this economic growth spreads locally. For example, in Singapore and Ireland, where countries have high local capabilities, due to improvements from FDI. Local suppliers have become global exporters and also benefited most from direct investment in the long run. Without the increase in capacity or local links, which is a chain of value, these countries may benefit in the long term from FDI far less than it should be (Velde, 2006). However, it can still be said that FDI has a part in creating opportunities for domestic entrepreneurs (Albulescu & Tamasila, 2014). In his article, Makki and Somwaru (2004) concluded that FDI and trade led to economic growth in developing countries. FDI can increase economic growth by increasing the number of inputs, recapitalization or employment

directly and/or indirectly, resulting from being a local supplier (OECD, 2002). It also helps to create new domestic companies, which are part of economic growth (Malhotra, 2014) and expansion.

### **3.3.2 Negative impact of FDI**

Although FDI has a number of positive effects on development, it is likely that there would be negative impacts on local companies. This requires careful consideration of the host country's domestic policies. Selma (2013) has mentioned on the impact of FDI that FDI does not happen automatically, and that the importance of FDI will vary according to conditions of each country. If these deficiencies are not managed correctly, there can be a severe impact on the country. The deficiencies mentioned are such as the impact on domestic market competition (OECD, 2002) because TNCs subsidiaries may have more economic power than local competitors (Selma, 2013) or higher competency and stronger trade groups because of the former relationship.

Other factors related to the negative impact of FDI, which can be found in the literature review include: 1) trade deficit whether it is the transfer of money back to the home country or importing raw materials from abroad, which affects the balance sheet in the host country (Selma, 2013) as the existing FDI may avoid tariff restrictions that can be used to develop a host country (Velde, 2006). In the case of Serbia, which supports FDI in non-exchangeable sectors such as banking, insurance, telecommunication, real estate and retail, FDI has had a negative impact on the country in terms of development as the country does not gain the knowledge of increasing productivity and technology, and also resulted in a trade deficit because there is no export (Dimitrijevic et al., 2012). 2) Lack of political rights due to the dependence on foreign economies, which leads to the lack of political freedom (OECD, 2002), and receiving financial help may cause a loss of sovereignty and many other possible consequences (Selma, 2013). 3) Some host countries are not ready for technological development. Therefore some of the expected benefits may become non-existent (OECD, 2002). 4) Environmental impacts may occur if the law of pollution control in that country is not sufficiently tight (OECD, 2002). 5) From the

fact that profits of FDI have been transferred back to the home country, the host country cannot reap the full benefits of FDI (OECD, 2002).

### **3.4 Technology and Technology Transfer**

Technology can identify in many aspects. From the literature review, many researchers have identified that technology consists of objects that have been produced as devices with the purpose of increasing human capabilities or allowing humans to perform tasks that they cannot do (Grubler, 2003). Others defined technology as the integration of any tool or technique, any product or process, physical devices or methods of doing or doing by potential human beings to expand ideas. In this aspect, technology is viewed as a hardware or physical product. On the contrary, technology can be described as the knowledge or know-how that is used to address the ability of organizations to support products and services to achieve their goals (Gunsel, 2015). But no matter which definition is right, technology has been a part of human life for decades, and it has become necessary to development in the age of globalization. However, technology development requires a high budget for research and development. In developing countries, there is a need for technology development, but not enough capital, therefore developing countries need transfer technology from developed countries to make advancement in their countries.

#### **3.4.1 Definition of Technology Transfer**

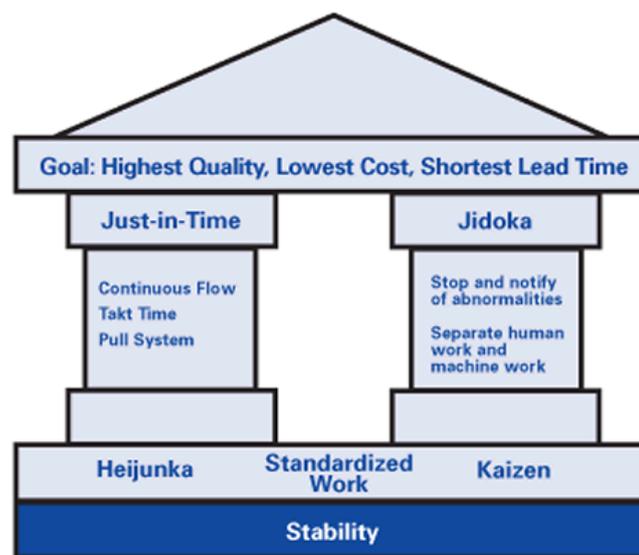
Jafarieh (2001) has mentioned about Technology Transfer that technology has many sections and angles. Mostly technology is related to more than one section and may interact with other sections as part of a shared system. So technology transfer is a dynamic process. There are many types of technology, including technology related to the product, the processes related to technology and technology related to management. Each type has different meanings. 1) Product technology refers to the knowledge that is used to produce any kind of product (Khan, 2011). In product design, designers define the style and the use of the product, and then transfer ideas to the drawing and planning to create products that respond to human needs. Creating innovative products must firstly be bases on goals and objectives, for example, to

create products that are used in new and innovative ways or systems (Cooper & Edgett, 2010) with the condition that the products should meet the market needs and business goals. Therefore, the transfer of knowledge in product-related technologies is the transfer of knowledge through product design methods, product specifications, information on the nature of the product, product-specific performance suggestions and the use of products from the company that developed the product to the company that receive the technology transferred (Khan, 2011).

2) Process-related technologies consist of the knowledge used in the production process, organization of production information and operation of the machine. This section may involve the transfer of technology in terms of the procurement of machinery or equipment or other technical support related to the manufacturing process, and quality control, inspection and testing techniques. Suppliers may improve their production processes to ensure that the products meet customer needs. In the context of the automobile industry, Car Maker may send engineers to supplier companies for better knowledge transfer (Khan, 2011). However, the current pace of technological development is deeply changing the way people live and work. Business leaders and policymakers must keep up with the technology and philosophy that affect today's production systems to create a competitive advantage and strategies for development of the country (Kearney et al., 2017).

3) Technology related to management is the knowledge of technology used in business operations. The acquisition of this type of technology allows the company to increase its competitiveness because of the efficient use of resources (Khan, 2011). Technology related to management may be divided into two forms: 1) Organization Management Overview; Technology related to the Organization Management Overview may be in the form of a Management Information System (MIS) a systematic information management system that involves the process of gathering, storing and transferring data to support the implementation of internal management. MIS operates by collecting the information into the centralized storage and the information is then distributed to the various departments in the organization to be used in all levels of the organization. The information collected must be up-to-date, accurate, prompt, and complete. Therefore, MIS is one of the mechanisms ensuring the required information is available to managers or operators at the time they need it as the basis for decision making, management planning, follow up and control

operations for better efficiency. 2) The second form is the management of the production. The most popular model used for production management is the Toyota Production System (TPS), an evolution that is essential to the efficient business process after the large manufacturing system invented by Henry Ford. Outside of Toyota, TPS is referred to as Lean Production as it is a popular term in the two best-selling books, *The Machine That Changed the World* (Womack et al., 1990) and *Lean Thinking* (Womack et al., 1996). However, the authors of both books have clearly stated that the foundation of their research on Lean is TPS (Liker, 2004) and the development of Toyota. The TPS system consists of two pillars; Just-In-Time (JIT) and Jidoka as shown in the figure below.



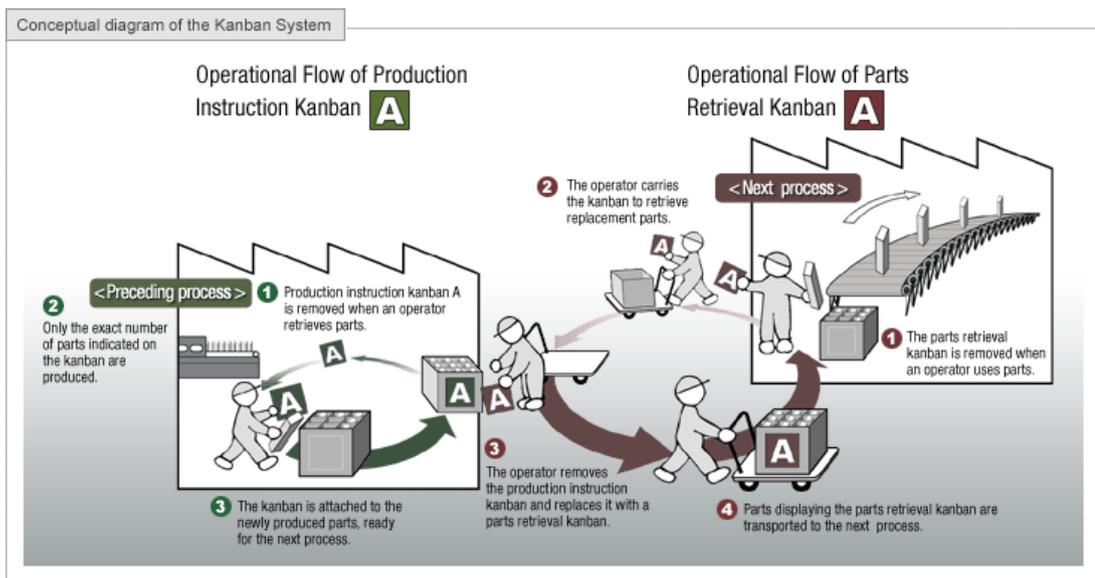
Toyota Production System "House."

**Figure 3.1** Just-In-Time (JIT) and Jidoka.

**Source:** Lean Enterprise Institute, 2018.

The first pillar is the "Just-In-Time" pillar which is the philosophy of complete elimination of waste. "Just-in-Time" refers to doing "only what is needed only when necessary and in the desired amount". For example, to be effective in producing a large amount of cars, there is a need to create a detailed production plan, including purchasing parts. Sourcing "what needed when it is needed in the amount needed"

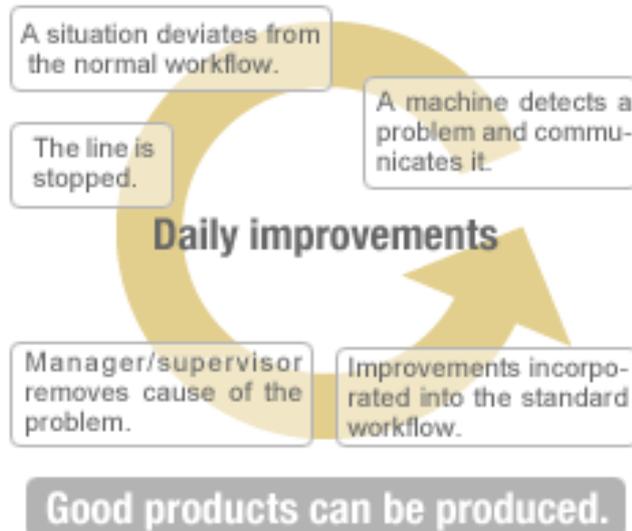
according to this production plan can reduce waste, inconsistencies and improper requirements, resulting in increased productivity. In the Just-In-Time pillar, Toyota has adopted a production control system called "Kanban system" and applies to the Just-In-Time system. The kanban symbol represents the products required in production. (Toyota-Global, 2018)



**Figure 3.2** Kanban System

**Source:** Toyota-Global, 2018.

The second pillar is Jidoka, which is the principle of manufacturing high-quality products that stop the device when a problem occurs and display the point of the problem. Toyota calls this displays of the point of the problem “Andon”. This section allows entrepreneurs to solve the problems quickly. The process of this system is shown below.



**Figure 3.3** Andon, display the point of the problem.

**Source:** Toyota-Global, 2018.

TPS is a worldwide system. Other than TPS, there may be other systems. Implementation of these systems depends on each Car Maker to determine which system is appropriate to support their control of the operation.

As we have mentioned that these three types of technologies are beneficial to the organization as they can be used to create competitive advantage for the organization. Therefore transferring these three types of technologies from the car manufacturer to their local supplier is the key to developing the technology base of local entrepreneurs (Khan, 2011).

In general, FDI is the best channel for technology transfer, not only for cross border transfer but also for the transfer of technologies between companies, especially between international and domestic companies (Torlak, n.d). The possibility of technology transfer can happen in 3 ways; to emulate, linkages between the manufacturing industry at various stages, and the movement of workforce from foreign companies to local companies (TRF, 2010). Technology transfer to suppliers should be encouraged because it focuses on enhancing the capabilities of trade partners, especially in the automotive industry where there are great amounts of knowledge of technology and management, such as Toyota production systems that suppliers can exploit and enhance their competitiveness. The suppliers can develop

these technologies and apply them with the existing knowledge whether in terms of knowledge of technology or knowledge of management, which gives rise to new capabilities. In general, Car Makers focus on developing suppliers and cooperating in transferring knowledge to suppliers. This allows suppliers to study the modern system which Car Makers view as sustainable development. The company's knowledge acquisition begins with the development of knowledge for the personnel in the company. In terms of Resources based view, the personnel in the company can be perceived as resources of the company. The larger number of talented personnel in a company, the higher is the company's competitiveness. In Khan's (2011) research, knowledge is defined as the most strategically important resource of a company, especially in very technology-intensive industries as the companies can take advantage of such knowledge to create a sustainable competitive advantage, including the development of core competencies. Therefore acquiring knowledge and skills gives the company a competitive advantage from these skills and knowledge. In addition, companies may be able to offer products, processes, services, or improvements to existing products efficiently. Therefore, the development of a knowledge based view in a company is crucial to the organization's strategy, especially in high tech industries. This includes the automobile industry as the most important issue is the ability to create new knowledge of the company along with the ownership of proprietary knowledge. This new knowledge or innovation then strengthens the supply chain of a business. Technology transfer is not just about technology or management, but also involves expressing the relationship between Car Makers and its partners. Car Makers must have confidence and trust in the suppliers in order to transfer technologies as there is a risk of leakage of these technologies to their competitors. Therefore technology transfer is an important issue for development. In the car industry, Car Makers transfer technology to their supplier companies and the personnel of the Car Makers' suppliers would then gain knowledge from the transfer of technology and management. This allows the suppliers' companies to apply the knowledge transferred to develop their existing knowledge thus enhance the core of the enterprises' development and competitiveness.

Knowledge has become a source of long-term advantage in the fierce competition in the globalized world where resources play an important role in

building and developing sustainable competitiveness. In the transfer of knowledge, it is accepted that trade partners are involved in human resource development, performance, sales growth and the development of new products in the companies. Therefore, the important factor leading to the effectiveness of knowledge transfer is important to consider. In the case of the automobile industry, we argue that different car components depend on the design. Some of them are complex engineering which require additional information to describe and transfer data. Comprehensive knowledge requires a more rigorous mechanism for data transfer (Khan, 2011), where the receivers of the technology transferred can apply and implement the technology to add more value to the organization.

The processes and mechanisms for transferring knowledge of each company may vary. The details of technology transfer may depend on the importance of the various aspects of the partners, such as the transfer of knowledge by employee training, transfer of specialists or key personnel to the supplier's organization, providing relevant business documents, knowledge transfer by meeting with suppliers, transfer of knowledge from performance review between organizations, providing the supplier companies with technology from the company's existing products and allowing the supplier companies to learn the production process and operation of machinery etc. (Khan, 2011).

Technology is the driving force of three major phenomena: 1) Increased efficiency may reduce pollution to the environment. 2) Reduce the use of raw materials by increasing the precision of production, such as reducing the opportunity of waste and increase the lifetime of a product 3) Reduce waste that needs to be eliminated by matching supply and demand more effectively. Although technology is a valuable asset for performance and growth, technology can worsen the situation of inequality. This is because not every company and every country would be able to receive and use the same level of technology, especially in medium and small business. Therefore, the transfer of knowledge and innovation must occur in other sectors as well not only just in the network of customers and suppliers. Information dissemination is possible through the use of institutional structures and organizations existing in the country. When these innovative management systems improve, every sector will be able to access to knowledge based technology resources and the size of the company is no longer a problem. (Kearney et al., 2017)

However, despite the development of technology, there are still opportunities for potential risks if the manufacturers choose to develop the technology on a path that does not respond to the trends of the market demand, develop too slowly or are unable to establish a consistent quality standard for product development. Below are the examples of such companies.

### **3.4.2 Nokia Corporation**

Nokia was a market leader in communications equipment technology but there is a change in the industry because Software has become a major component of the mobile industry. The launch of the first I-Phone in 2007 and the Android device from HTC in 2008 marked the beginning of Nokia's disruptions. After that, Nokia started to develop Software by choosing the MeeGo Operation System but the operating system is too similar to the general market with no outstanding features. This made the products of Nokia unappealing to the market and therefore lack competitiveness (Lubinaite, 2015) eventually led to the sale to Microsoft. Today, HDM Global, a Finnish company which is from the same nationality as Nokia, has acquired Nokia from Microsoft. HDM continues to use the Nokia brand to market, working with Foxconn for R&D due to the fact that Foxconn has a manufacturing experience with the I-Phone, therefore it is worthwhile to continue to watch for future scenarios.

### **3.4.3 Eastman Kodak Company**

Kodak was an American company established in 1889, which supplied photographic equipment which was a very successful product in the 19th century. It may not be widely known but Kodak was the first company to invent the digital camera. Kodak has suffered a setback in the 20th century due to mistakes made by delayed decisions of the executives. The change of evolution was a part of Kodak's failure. Kodak, the company that invented the first digital camera, failed to keep up with the growth of technology (Wiles, 2012).

### **3.4.4 Ford Motor Company**

Edsel is Ford's big mistake, due to over-advertising. Ford developed a new car model and named the model "Edsel". This vehicle model was developed with a Self-

adjusting breaks system, and electronic hood release as well as a powerful engine for mid-range vehicles. But when the model was first launched for sale, people felt that it was a too expensive compared to ordinary cars. Edsel sold only 64,000 cars and sales fell in the following year, until Ford finally canceled production of the model. Ford discovered three problems which were bad looks, stupid name and too expensive price (Drinnon, 2016). However, Ford has used this failure as an expensive lesson to develop and improve the successful Ford Mustang.

### **3.5 External and Internal Factors Analysis**

Internal factors and external factors are very important to the company. The company must understand the competitive environment in order to develop its strategy and to create a sustainable competitive advantage. The internal factors may refer to organization, marketing or finance of a company while external factors may refer to competitors and environment. A tool used to analyze internal and external factors is SWOT analysis

According to Bonnici and Galea (2015), SWOT analysis is identified as a tool to examine strengths and weaknesses within the organization as well as opportunities for growth and improvement, and threats from external environment which are essential to the survival of an organization. The information about organization is collected and sorted into 4 categories: strengths, weaknesses, opportunities and threats. Strengths and weaknesses often arise from internal factors while opportunities and threats are often caused by external factors. Internal analysis is used to identify resources, capabilities, core competencies, and competitive advantage in the organization. External analysis identifies market opportunities and threats based on the environment of competitors and the general environment (Bonnici & Galea, 2015).

The analysis of internal strengths and weaknesses allows the organization to recognize the resources that need to be developed and the resources required to maintain competitiveness (Ommani, 2011). The strategic management process begins with an in-depth assessment of the organization by looking at the internal resources and capabilities, which are the source of core competencies that will create

competitive advantages (Gurel & Tat, 2017). Resources are defined as tangible and intangible inputs which are necessary to produce products or services. Tangible resources include raw materials, facilities, machinery and equipment. Examples of intangible inputs are financial resources, technology, human capital, partner networks, sales force structures, distribution networks, patents, branding, customer base, brand value, and reputation of an organization. Components of internal strengths and weaknesses analysis are the company's internal resources within the financial systems, management, infrastructure partnerships, manufacturing, distribution, marketing, and innovation-related resources (Bonnici & Galea, 2015).

The purpose of external environment analysis is to help organizations to realize critical developments and factors relevant to the future (Ommani, 2011). The external environment consists of variables that are beyond the control of an organization, but need to be analyzed in order for the organization to adapt its strategies in accordance with the business environment (Gurel & Tat, 2017). External analysis helps identifying potential threats and opportunities for future expansion. Threats in the external environment impede the competitiveness of an organization. The analysis of opportunities and external threats is divided into three perspectives; 1) an analysis focused on the competitor's enterprise resources and conditions that may affect the company's market share, revenue and profitability of a company in the future, such as finance, management, organization, partnerships, production, distribution channels, marketing and innovation-related resources. 2) The analysis of the industrial environment by using the Porter's factors analysis model in namely the intensity of competition, threats from new market entrants, bargaining power of buyers and trade partners and threats of substitute products. 3) General environmental analysis, which are the political, economic, social and technological (PEST) analysis, including environmental law, demographic data, ethics and governance. Strategies that arise from all three parts of the analysis will help in defining the organization's vision, mission, and strategic planning. The analysis of the industry environment is a review of factors that have a direct impact on an organization's revenue stream and must be addressed strategically (Bonnici & Galea, 2015).

### **3.6 Global Supply Chain and Global Platform**

According to the Asian Development Bank (ADB) report (Veloso & Kumar, 2002), which has provided information on the global supply chain dynamics of the automobile industry since 2002, there were many factors that determine consumer consumption which contributed to the development of technology, for example, safety technology and environmental impact mitigation technologies. Many OEMs used new technologies and innovations as a marketing strategy. The change in technology affected the changes in the level of the supply chain because all auto parts manufacturers had to be able to respond to the competition. In the past, the competition among OEMs would remain largely within the regional brand. American car manufacturers dominated the US market. Japanese car manufacturers dominated the Japanese market. European car manufacturers dominated the European market. Since the 1990s, the situation has changed, and to respond to market trends and needs, Car manufacturers were undertaking a global operation plan by introducing new models at the same time with the same standard in different places. With the investment taking place in new locations, Car Makers have demanded their suppliers to come into new regions where they were located, and often near their plants. The second important factor was the organizational restructuring of the surrounding automotive investors. Due to the shorter sales cycles and shorter product life cycles, car manufacturers and suppliers could not save on design and manufacturing costs, which greatly impacted on the total costs. There were also regulatory requirements and increased consumer demand that made automobile manufacturers to focus on the common platforms with interchangeable modules, which allowed OEMs to perform faster with lower development costs. Besides, this also allowed guaranteed sufficient product differentiation in terms of efficiency which help support expansions, and at the same time, maintain the level of efficiency and brand management. Humphrey and Memedovic (2003) have pointed out the same issue. For global car manufacturers, the real benefits of globalization are based on raising standardization of cross-market models. In the modern automobile industry, economies of scale are no longer in the major assembly. Nevertheless, the search of economic scale is still important in automotive parts and design manufacturing (Humphrey & Memedovic, 2003). So, Car

Makers need to focus on the Global Platform that uses modules or shared systems. Some car manufacturers have small numbers of models and the production volume is not enough to be competitive thus resulting in loss and leading to merger eventually, for example, Nissan-Renault and GM-Mitsubishi (Humphrey & Memedovic, 2003).

To deal with the increasing cost, Car Makers are less likely to involve in production and assembly by delegating responsibility for the development, production and assembly of critical parts of the vehicle to their suppliers. The methods and forms of delegation will depend on each car manufacturer's policies. Therefore recruiting a partner that can work with the entrepreneurs in developing and manufacturing the system is important. Criteria for selecting suppliers as business partners include: 1) Competitive costs and quality. 2) Research and development capabilities. 3) Intimacy with the Car Maker's development center 4) Logistics costs, etc. The new direct suppliers are becoming big global companies which are specialists in the complex systems or collectors of general and simple tasks in subsystems. Suppliers are expected to be highly responsible for the design and engineering of these systems and to coordinate the required supply chain for the production and assembly of Car Makers (Humphrey & Memedovic, 2003).

As suppliers begin moving from component manufacturers to sub-assemblies, it is important to have the ability to process many of the components needed to produce the parts and the ability to operate their own supply chains. There has been improvement in the presence of regional factories where car manufacturers assemble cars, and where the sub-assemble company clustered. However, the enhancement of engineering capabilities, which are often the key and costliest issues, designing, testing, verification and prototyping must be part of the capabilities of these companies. So, in working on a sub-component level, the suppliers must not only be able to supply at a low price but also be able to demonstrate significant engineering capabilities as well as having sufficient funding to withstand the cost of product development for many years prior to earning (Velooso & Kumar, 2002). The changes that have occurred can be summarized into 3 issues as follows. First, there is a change in the design activity from the entrepreneurs to the suppliers, which may be a joint design between the two parties. Second, there is a transition to Complete System Integration (Sub assembly system or modules) rather than single assembly line. Tier1

suppliers will be responsible not only for the assembly of parts but also the management of Tier2 suppliers as well. Thirdly, the entrepreneurs are more involved in defining the production and quality systems of their suppliers (Humphrey & Memedovic, 2003).

A study of the automobile industry in Asia should focus on assessing the capabilities of local auto parts companies and identify future development paths for these companies. As OEMs are increasingly active by multinationals enterprises and rely more on the suppliers in term of engineering and production process, the development of the automotive industry in any country in this region depended on the strength of the local supply chain. It is therefore important to promote good understanding of the automotive industry in Asia and to develop appropriate policies for development (Veloso & Kumar, 2002).

### **3.7 International Automotive Task Force (IATF)**

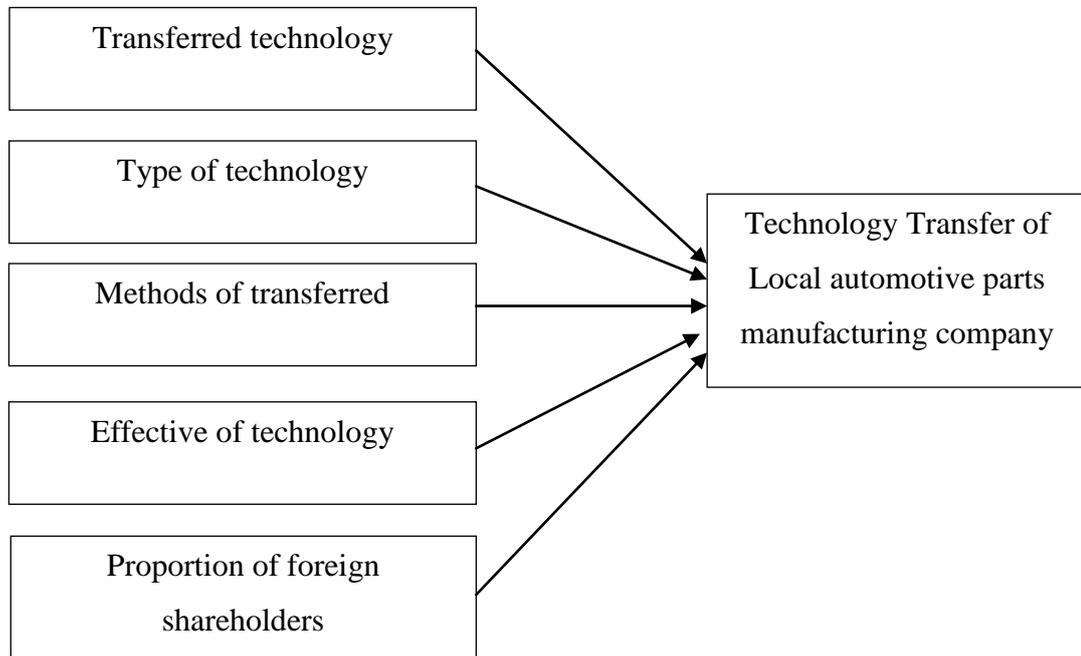
International automotive task force (IATF) is an ad hoc group of automobile manufacturers, established to support the improvement of product quality for automotive customers worldwide and to develop an agreement on requirements in international standard quality systems. Members of IATF are such as BMW Group, FCA US LLC, Daimler AG, FCA Italy Spa, Ford Motor Company, General Motors Company, PSA Group, Renault, Volkswagen AG and the vehicle manufacturers respective trade associations – AIAG (U.S.), ANFIA (Italy), FIEV (France), SMMT (U.K.) and VDA QMC (Germany) (International Automotive Task Force, 2018). IATF 16949: 2016 or formerly known as ISO / TS16949, is a universal quality management system standard widely used in the automotive industry worldwide. It is a good standard for evaluating the differences as well as a support system in the supply chain of automotive preconceptions around the global. IATF 16949 is the new standard replacing ISO / TS 16949: 2009 in defining the requirements of quality management systems for organizations in the automotive industry. IATF 16949 is a standard that is associated with ISO 9001: 2015. This means that organizations in the automotive industry that require approval from IATF 16949 certification must meet the requirements of ISO 9001: 2015. IATF 16949 1<sup>st</sup> Edition was announced in

October 2016 and became effective on January 1, 2017. (International Automotive Task Force, 2016).

### **3.8 Conceptual Framework**

From Literary Review, There are a number of factors that are resulted from FDI, which affect the host country both positively and negatively. However, this research focuses on the positive potential impact of technology transfer, since technology is an important factor in development of various sectors. The results obtained from interviews and questionnaires will be analyzed to find conclusions and answer research questions.

In Thailand, auto parts manufacturers are divided into three groups, namely Tier 1, Tier 2 and Tier 3. This research focuses mainly on the relationship between Car Makers which are FDI companies with Tier 1 local auto parts manufacturers, because Tier 1 deals directly with Car Makers. This study emphasizes on companies with 100% Thai shareholders and at least 50% Thai shareholders because this study only focuses on local companies. From the theory, FDI leads to the transfer of technology to countries that open to investment. Whether this is true and how likely it is for the automobile industry, one of the major industries of Thailand. If FDI truly leads to technology transfer, what type of technology has been transferred, what methods are used and how effective the technology received from Car Makers to enable local parts manufacturers to develop further? The concept of research is as follows.



**Figure 3.4** The Concept of Research

In the first section, the researcher explored the facts about technology transfer in the car manufacturing industry whether Car Makers have transferred technology to auto parts manufacturers and the real situation in term of technology transfer. If technology transfer does truly occur, what technologies that Car makers have transferred. Then in the next step the researcher analyzed the methods used for transferring technology and the effectiveness of the technologies received from Car Makers to local auto parts manufacturers. Finally, the researcher analyzed whether the differences in proportion of foreign shareholders between the companies with 100% Thai shareholders and the companies with at least 50% Thais shareholders affect the amount and the types of technology transferred, and the supportive approaches which received from interview.

This study analyzed the data obtained from the interviews and questionnaire. Information obtained from the interview, the researcher identified the content of the interview, and then analyzed the data from the interview by concluding the key factual information and analyzed as specified in the research framework to acknowledge all the answers from the interviews.

For the data obtained from the questionnaire, the research was conducted by using cross tabulation analysis techniques. Both independent and dependent variables were group samples where the independent variables are located on the column. In the table, the percentages of the rows, columns and all other percentages were specified. The statistic used to test the significance of the relationship between the dependent variables and the independent variables of technology transfer was chi-square.

## **CHAPTER 4**

### **RESEARCH METHODOLOGY**

Research Methodology is the tool used in research to obtain empirical data and to help researchers finding the answers that are valid and reliable. Research Methodology is a scientific approach, focusing on asking the questions to find the correct answer systematically, and it is reliable because it can be traced back and re-examined. The objective of this research is to obtain the answers with validity and reliability. In this research, the Researcher used qualitative and quantitative research models. The use of qualitative research was due to the fact that this research required investigation on the current form and situation of the automobile industry to understand the phenomena occurring. As literature review alone could not cover the current situation, the researcher has conducted quantitative data sequencing after qualitative data collection to investigate the current situation more clearly and use only quantitative method in some issue.

#### **4.1 Research Process**

In this research, the researcher used both qualitative and quantitative methods to conduct this study. In terms of qualitative, researcher uses the focus group model for studying the phenomena occurring as they appear on the automobile industry, explanation of the relationship between technology transfer and foreign direct investment. In this study, the use of qualitative research methodology helped to assist the researcher in case of incomplete variables when conducting quantitative research. This is a situation that can occur due to changes in the dynamic environment leading to the increase in the variables required in the analysis. Therefore, qualitative research contributes to the completeness of the research. In the part of quantitative research, the researcher used the non-experimental research model. The type used is cross-tabulation analysis. The researcher collects data for only one time at a certain period

of time. However, cross-tabulation analysis does have weaknesses in variables and sample groups. If the researcher cannot gather enough data on the variables or sampling groups is not the actual representative of the research, the conclusion of the research may distort the truth. Moreover, researcher use only quantitative methods on some issue due to the analysis will be easier to understand the result. Therefore, for the factual conclusion of this study, the researcher used both qualitative and quantitative research to conduct this research.

## **4.2 Population and Unit of Analysis**

Population refers to the target audience we want to study. In this research, the population is the private local auto parts manufacturers in Tier 1 who manufacture and assemble automotive parts by delivery directly to Car Makers. In Tier 1 's companies if divided by the proportion of shareholders can be categorized into 4 groups which are companies with 100% foreign shareholders, joint venture companies with more than 50% foreign shareholders, joint venture companies with at least 50% Thai shareholders and companies with 100% Thai shareholders. In this research, the researcher chose to study only Tier 1 joint venture companies with at least 50% Thai shareholders and companies with 100% Thai shareholders. Companies with 100% foreign shareholders, joint venture companies with more than 50% foreign shareholders are not included in the research because this research emphasized local business. The sample groups of Thai companies were divided into 2 sub-groups which were companies with 100% Thai shareholders and joint ventures with at least 50% Thai shareholders.

The interviews in this research, the researcher conducted face-to-face interviews with six executives of companies in Tier 1, three of which were wholly owned by Thai shareholders and three were joint ventures with at least 50% Thai shareholders. The interviewees were the owners of the company or senior executives who truly operate and manage in all departments of the company or the HR managers who take care of employees in all parts of the organization. The other eight companies surveyed were interviewed via telephone, four of which were the companies owned by 100% Thai shareholders and the other four were joint venture companies owned by

50% or more Thai shareholders. The data were gathered from Human Resources or Engineering departments, which could provide information on the real situations.

The researcher then collected the data using questionnaire by sending the questionnaire to the Human Resources department of 84 targeted companies. The human resources department would then collect the data and hand it to the researcher. The Human Resources Departments were involved because the information required for this research needed approval from the owners or executives of the companies. The Human Resources Department is in the position for obtaining permission to disclose company information to third parties.

After that, the answers were compared both quantitative and qualitative to see whether they were in the same direction. It is a review between the executive view and the employee perspective, in order to provide accurate and reliable answers to the study. It is also to compare whether there are differences in term of technology transfer between the two sample groups of companies.

### **4.3 Sampling Group**

The researcher used a purposive sampling technique for sampling for this research because the required data is specific. The researchers used this method to conduct the research and selected from all 4 groups. The latest data in 2017 indicated that there were 462 companies in the Tier 1 group. However, the researcher experienced difficulties in obtaining the up-to-date data because the database has not been updated. From the database of the Automotive institute, the total number of companies in Tier 1 is 690 companies, which still consists of Automobile Parts Manufacturers with 100% Foreign shareholders, Automobile Parts Manufacturers with more than 50% Foreign shareholders, Automobile Parts Manufacturers with more than 50% Thai shareholders and lastly Automobile Parts Manufacturers with 100% Thai shareholders. There were 2 sample groups selected by the researcher: Automobile Parts Manufacturers with at least 50% Thai shareholders and Automobile Parts Manufacturers with 100% Thai shareholders. There are 43 auto parts manufacturers with at least 50% Thai shareholders and 41 auto parts manufacturers with 100% Thai shareholders. The changes of number in the database may have been

the result of companies that cannot survive in the business, or have been merged with other companies, or may have changed from companies in Tier 1 to Tier 2 & 3. Therefore, the number of sample companies used in the analysis was 84 companies. The researcher was not able to use data from other sources due to the requirement of Tier-1 segmentation in the automotive industry. Therefore it is a necessity to refer to the sample groups from the list of companies from the Automotive Institute so as to be able to trace back and re-examine the analysis. The researchers did not use the sample groups from Tier 2 and 3 because neither of these groups operated directly with Car Makers.

The interviews were interviews with representatives of the companies mentioned above. There are two parts of the interviews which were face to face interviews and phone interviews. For face to face interviews, the researcher conducted interviews with six executives from Tier 1, three of which were owned by 100% Thai shareholders and three were joint ventures with at least 50% Thai shareholders. The interviewees were either the owners of the companies or senior executives who involved in management in all departments of the company or Human Resource managers who took responsibility of employees in all units of the organizations. Face to Face interviews included interviews on the direction the government should support or improve. For telephone interviews, the researcher conducted interviews with employees of 8 companies in Tier 1. The four companies of which were 100% owned by Thais shareholders and the other four were joint ventures with at least 50 % Thai shareholders. Interviewees were staff members in the Human Resource or Engineering department. The nature of the interviews was similar to the face to face interviews with the exclusion on the directions the government or government agencies should improve. The reason for the exclusion was because the interviewees were employees who operated in specific area and were not involve in the overall control of the companies. The telephone interviews were conducted to compare the answers and responses of the employees to those of the executives.

In terms of data collection using questionnaires, the value of the sampling error and the confidence level for the random samples for quantitative research were considered at 0.99. This means that there is only 1 chance in 100 for error. In this

case, the size of the target group is 84 while the standard error is 0.1, so the number of population required for the research is 84 companies.

In conducting quantitative research using questionnaire as a tool to collect data, the researcher have talked to Human Resources to explain the importance of this questionnaire. The researcher made a total of 84 phone calls. There were 20 companies unable to provide information. Therefore the questionnaires were sent to the other 69 companies although only 40 companies responded.

#### **4.4 Data Collection**

In this research, the researcher used interviews and questionnaires to collect information from relevant people in the automotive parts manufacturers in Tier 1. The number of automotive parts manufacturers in Tier 1 identified by the Automotive institutes was 462 companies (Automotive Institutes, 2017), which were only around 65% of the 709 companies recorded in 2015. Nevertheless, the researcher used the information contained within the database of the Automotive Institute as a basis for this research. There were a total of 690 companies in the database, 84 of which were joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders. This research only studied the specific group of companies with at least 50% Thai shareholders and 100% Thai shareholders as it focused mainly on Thai entrepreneurs. In the part of data collection, both the interview and the questionnaire were used to obtain factual and reliable answers.

In qualitative data collection as mentioned above, there were two methods of data collection which were Face to Face data collection and interviewing via telephone. In Face to Face data collection, the researcher made phone calls asking for permissions to interview with the person mentioned above. Then e-mails were sent to confirm the appointments. At this stage, the format of the interview was semi-structure, talking face to face and using open-ended questions. The open-ended questions allowed natural conversation on the current situation. The issues were on how the companies co-operated with Car Makers, what type of technology has been transferred and how the transfer occurred, and whether the technology was effective and enabling the companies to enhance their strategies as well as suggestions on

improvement and development of the government agencies to create sustainable development for Thai economy in the future. After the Face to Face interviews, the researchers conducted telephone interviews with 8 more companies. As for the telephone interviews, the researcher only hand recorded the data without sound recording.

For quantitative data collection, the researcher used questionnaires to collect data. The questionnaire was created by using Nominal level. The set of messages used was a specific question determined to test the sample groups, and then the overall score of the messages was calculated for conclusion.

#### **4.5 Data Analysis**

Before analyzing the data, the researcher transcribed the data from the voice recorder and summarized the data obtained from the interviews, both from face to face interviews and phone interviews, as well as sorting all the information obtained from the questionnaires into categories for easy analysis and conclusion. However, the researcher could not reveal the name of the companies providing the information in the interviews because the interviewees did not want to have any negative impacts upon disclosing the information. Therefore, the researcher was required to encode the company name instead.

In qualitative data analysis, the researcher interpreted the results of the interviews and analyzed the content to answer the research questions. The part of quantitative research is the study of the relationship between Foreign Direct Investment and technology transfer in various fields to local automotive parts manufacturers in Thailand whether the technology transfer actually occurred, the numbers of companies received the technology, the types of technology transferred and the effectiveness of the technology in terms of development. Then the researcher compared the differences of the technology transfer between local automotive parts manufacturers with 100% Thai shareholders and joint ventures of automotive parts manufacturers with at least 50% Thai shareholders to see whether there are similarities or differences. The model used to analyze this part was Cross-sectional technique.

The Cross-tabulation technique is used to study the relationship between dependent variables and independent variables. Both the dependent variables and the independent variables were group variables. Chi-square was used to test the significance of the relationship between the dependent variables and the independent variables.

## **CHAPTER 5**

### **EMPIRICAL EVIDENCE**

In this chapter, the researcher will summarize the messages received from the interviews in each company and the results from the questionnaire, and then compare the answers if they are in the same direction. This is to answer the questions as to whether Car Makers, which make foreign direct investment in Thailand, contribute to technology transfer among the domestic automotive parts manufacturers. If technology transfer has occurred, what types of technology have been transferred? If the technologies transferred are effective, how possible it is for the local auto parts manufacturers to enhance their development and create new corporate strategies to promote sustainable development from these technologies. Do the different types of the companies, namely, the companies with 100% Thai shareholders and joint ventures with at least 50% Thai shareholders lead to differences in technology transfer, including the results from interview in terms of supportive approached.

#### **5.1 Summaries of Face to Face Interviews**

##### **5.1.1 Joint Ventures with at Least 50% Thai Shareholders**

###### **1) F1 Company**

The F1 Company is a company that manufactures automotive parts for customers located in Thailand. Based on the interview with related executives, the executive oversees a group of companies that are joint ventures with the F1 Company. The company opened to foreign direct investment 20 years ago. In the past, when local companies imported technology, they had to pay for product development to the companies or technology owners from abroad, who designed and invented the technologies as all technologies were patented. This cost was known as "Technical Assistance" expense or "TA", and arose as a result of the recommendation by leading

Car Makers to overseas companies so that the local companies could produce specific product or products to meet their requirements. This type of production was only for car assembly in one country. Nowadays it is not possible to conduct business in the same way because the production model has changed to production to supply worldwide consumption. So the company began to look for partner or partners that could meet and exceed the market requirements. This led to the invitation to foreign companies who could provide technology and management to form joint ventures to help develop the existing companies to grow according to the changing market situations. The characteristics of the market are turning more and more into Global Platform. The Car Makers expect automotive parts manufacturers to be able to perform product design by themselves as well as produce and export to the world market without issues on the product quality. These companies must also guarantee quality of the product as well.

In reality, Car Makers do not provide technology, knowledge or expert personnel to their automotive parts manufacturers. What the Car Makers really want is that the automotive parts manufacturers would be able to operate to meet their requirements. Location is also another important factor in the selection of a Tier 1 automotive parts manufacturer. The example of this circumstance is when Car Makers have a demand for Electric Vehicle (EV) parts, they would only design the exterior parts of the vehicle. However, the design of the Car Makers is still dependent on their suppliers, thus the collaboration of the Research and Development (R & D) between the Car Makers and suppliers ranging from the development of materials to the production process. This leads to higher costs for the suppliers as a result of Research and Development (R & D) and procurement of raw materials but the benefit that the supplier would receive is the opportunity to get more contracts from the Car Makers. Therefore if a supplier in Tier 1 wants to do business with a Car Maker but does not have its own technology to offer, it might be hard for the supplier to get a contract. In some cases, some automotive parts manufacturers may be able to produce automotive parts locally with their own technology but they do not have any factory or partner in the countries where Car Makers assemble cars. These manufacturers may have a very low chance to get a deal from Car Makers due to the condition of the global platform even with a strong R & D team. This is due to the fact that the Car Maker wants to

control the quality of products in the same direction worldwide, using the word Global Platform to determine the quality. So if there is an agreement in production partnership between a Car Maker and a company in Tier1, this can lead to the production of products worldwide. This is why local companies need to form joint ventures in the countries where Car Makers are located to extend production and sales opportunities as well as technology. Another benefit for automotive parts manufacturers to participate in the global platform is the opportunities for employees of the organization to develop, for example, the opportunity to receive training from foreign partners, which leads to the access of new technologies as well as international cooperation in term of technology. However, at present, the development mainly comes from the development of the suppliers while Car Makers only propose their requirements. Then the suppliers' companies respond to these requirements to meet their goals. This leads to the cooperation between local auto parts manufacturers and joint ventures to work together toward development whether in terms of the management, market and technology development and human resources.

Some Car Makers have not yet started on the Global Platform due to the fact that their strong marketing factors are only present in the Asian market but in the future, it is uncertain which direction these companies would take in term of their operations. Nevertheless, cooperation with joint ventures and/or setting up factories abroad helps create opportunities for development in marketing and competitive advantage. The companies may use existing technology to help reduce production costs and to compete in the global market. In addition, working with Car Makers is a great opportunity for companies to develop their own technology.

The development of vehicle technology has evolved into Electric Vehicle (EV), which has been developing since the last 10 years. If the EV cars become popular, resulting in higher demand in the market, the market share of motorized vehicles may be affected. Some car parts, such as engines and exhaust pipes, may have less demand but the demand for electronics and batteries may increase. Therefore the company has to watch for changes in the market and prepare to deal with the changing environment.

## 2) F2 Company

The F2 Company is a joint venture with Japanese companies. Based on the interview with the related executives, in the past, the F2 Company was a 100% Thai company. Most of the operation processes were to follow requirements of drawings from customers. The company has to pay for technical assistance or TA to the Japanese company who owned the technology. At present, the company has formed a joint venture with a Japanese company with its own technology. When Japanese Car Makers has a proposal for new model, the joint venture company based in Japan would cooperate in the designs with Japanese Car Makers. In fact, the Car Makers depend on technologies of the suppliers therefore Car Makers do not introduce new technology or knowledge to the company. After the products have been designed, the company must also design the production process and the equipment used in the production process. In this process, the Car Maker Companies will approve the drawings related to the manufacturing process that the F2 company has submitted, such as the Drawing of Jig Fixture or the Drawing of Mold and Dies.

In terms of management, the company follows the customer's plans which are defined in the requirements by focusing on the main tasks. The Car Makers also provide training to the suppliers' personnel to encourage the supplier company to work in compliance with the requirements of the Car makers. For example, in quality measurement, there is evaluation by an auditor, as well as training on methods and procedures to operate according to the standards of each Car maker. Regarding Global Platform, the Car maker will decide from the potential of the Supplier. After potential evaluation, the Car Makers then provides the knowledge required to participate in the Global Platform. The company may start by separating each component and then ship them to the destination country under the condition that Tier 1 Suppliers must have production plants in the destination country where Car Makers assembles cars. Then the production process is expanded into a full-line production system similar to that of the existing company.

At present, the current product development of the F2 Company uses technology from the joint venture to cooperate in product design and development with Car Makers. The company did not get technology transfer from Car Makers. The knowledge gained from Car Makers is in the field of management. This enables the

company to know that if the company wants to cooperate with a global enterprise, which direction it should develop. In employee development, the company has to develop its own personnel to match the current market situation.

### 3) F3 Company

From the interview with the executives of the F3 Company on technology transfer, the company uses the existing technology in designing and preparing prototypes for customers. Car Makers do not offer technology transfer, but they provide management concepts instead, such as improvements in various aspects. This is because the technology is not transferable. In the case of a Tier 1 company, it is necessary to learn by itself. The company has the opportunity to visit the Car Maker companies, but the Car Makers only allow observation with no further explanation. So it depends on the suppliers to analyze and apply what they have observed. Car Makers' activities are mostly in the field of corporate management. On production process and product design development, the company conducts employee development in the organization by sending employees to learn from overseas joint ventures company. At present, some products are developed by the company itself. The knowledge of product development begins by recruiting outside employees who are knowledgeable in product design to work with the Car Makers to achieve the product development.

In personnel development, Car Makers organize meetings, performance evaluation or quality assessment, including human resources development because some Car Maker companies focus on personnel. Sometimes these arrangements may not be as effective because personnel development is based on the people who attend the training. The attendees are either those who could create benefits to the organization or those who could not. These activities, however, do not contribute to the development of the organization. Technology transfer from Car Makers may occur if the Car Makers holds some stake in the auto parts manufacturers and on the condition that there are trade monopolistic relationships with the supplier companies. Then the Car Makers would follow up and examine the development.

Tier1 companies learn and train from their joint ventures, and from the experience and expertise of employees in the organization, as well as participation in the Government Cooperation Organization. The F3 Company cooperated with the

University in Engineering and Research and Development by sending employees to participate in the projects. The Company strongly suggests the government should actively and seriously undertake the related projects with utmost efficiency.

### **5.1.2 Companies with 100% Thai Shareholders**

#### 1) F4 Company

The F4 Company is a company with 100% Thai shareholders in the automotive industry. Based on the interview with the company's management, the company produces products according to customers' drawings and requirements by designing its own production processes. The company receives the technology in manufacturing from suppliers rather than receiving from Car Makers. The management of the company is the one who studies these technologies from outside of the company. In the past, Car Makers determined the types of materials used in production and which company to purchase from. Currently, the company can select the raw materials by itself. Knowledge transferred from Car Maker is mainly on management, such as 5S and production planning but for in-depth designing, the company does not receive knowledge from Car Makers. The Car Makers usually only audit the production and management that they are as agreed upon and to see whether the company does activities according to the requirements of the Car Makers. However, the company has to design the process of these activities by itself and must be able to solve the arising problems as well.

Car Makers transfer knowledge on management principles such as lean, TQM or other systems with the goal of defect reduction and cost reduction by training at the Car Maker companies. This training contributes to the development of productivity and efficiency but does not help with designs or new innovations on manufacturing component parts. It emphasizes more the aspect of management. The company has its own R & D team which focuses on designing production process. However, the ability of the team is still not enough for product design. Although the R & D personnel of the company coordinate with the Car Makers' personnel on a regular basis, the company has not transferred the essential technologies in product design. Moreover, Global Platform marketing has resulted in the company being exposed to price competition from other countries. The company may lose market

share due to this issue. So the company must begin to consider developing their own innovation as well as developing itself on other crucial aspects. As for development from the government agencies, the government should take good care its personnel working in related fields have reasonable income which would enable this group of personnel to establish new inventions with the private sector.

## 2) F5 Company

From the interview with the F5 Company's executives, technology transfer depends on the nature of the tasks involved. Some Car Maker companies have transferred technology and some do not. Upon assembling some component parts, some of the customers prefer to assemble by themselves. Some customers have better knowledge on which component parts should be used with which systems. Some Car Makers only require partial assembling. Some Car Makers disclose to the company on where the component parts are positioned in which part of the car while other do not. The reason for this may be because the designs come from a Tier 1 company and not from the Car Makers. Therefore the Car Makers do not have is knowhow. The F5 Company has basic knowhow technologies as the company used to employ foreign product designers to work in the company and to train its personnel. From then on the company has continually emphasized its own development. For the manufacturing process, some Car Makers can advise on the production processes because they have the knowledge within their companies due to the fact that they already manufacture the products. Other Car Maker companies cannot make any suggestion as they do not have the specific production processes within the company. Therefore in the production process, some Car Makers can transfer the knowledge while other cannot as they do not own the technology. For the part of corporate management, Car Maker companies require their suppliers to use the same system for easier and more convenient operation. In other cases, the company's system may be better than the systems of the Car Makers, but the company has to make adjustments to accommodate the needs of its customers.

The main problem in Thai companies is the English language skills of employees. This makes knowledge transfer inefficient due to not enough understanding and the inability to ask questions. In addition, the mathematical knowledge of Thai engineers is insufficient compared to Japanese engineers. Thai

engineers still need more development in many aspects to be able to receive technology transfer. Engineers in Thailand are rather good in imitation but inferior in creative thinking. They are not skillful enough to design the products. The suggestion on the improvement of the basic skills is to send more Thai personnel to train abroad as the instructions in Thailand are not efficient enough. Also Thai government should have a clear viewpoint on which direction Thai economy should take as well as the allocation of the government personnel to suit the economic policies.

### 3) F6 Company

According to the interview with the related executives of the F6 Company, a company with 100% Thai shareholders, the company conducts business with the Car Makers by sending R & D team to work with Car Makers. After the company receives the drawing from Car Makers, the company would proceed on designing the production process and equipment used in the production to meet the requirements of the Car Makers. The coordination between the company and Car Makers is mainly in the production process but not including product development. In term of Drawing, the company has some knowledge on specification of the design so it understands the reasons behind the design as well as being able to develop more from the knowledge. As for the manufacturing process, the company has to make offer of its own skills first to assure the Car Makers that the company has sufficient competencies in the production required. In term of management, the Car Makers have transferred knowledge in management which the company can apply to develop its own organization.

## **5.2 Summaries of Telephone Interview**

### **5.2.1 Thai Joint Ventures with at Least 50% Thai Shareholders**

#### 1) T1 Company

Based on the interview with related parties, the T1 Company receives the drawing from Car Makers, which identifies the standard specification of the products. After that, the company makes a quotation and presents a production process to the purchasing department of the Car Makers. Then the Car Makers will compare the prices of each supplier. If the company is selected, it would go into

details with the Car Makers on which aspects of the component parts require thorough control and which position are the key point of the components. The machinery used in the production is the machines that the company has to acquire and improve on its own for achieved quality and higher efficiency in production as well as for higher productivity, without any support from the Car Makers. The company has to design the production process in order to meet the standard requirements mentioned in drawing without any technology transfer from Car Makers. As for the production process, Car Makers only verify that the actual machinery is available as informed, and review that the production management documents meet the standards set by the Car Makers.

#### 2) T2 Company

From the interview with the T2 Company, the company has its own technology so there is no technology transfer from Car Makers. The company presents products to Car Makers and then quotes the price to Car Makers who are interested in the products. As the company uses its own technology, it is normal practice to design its own production process as well. After the deal is made, the company makes a prototype of the component parts for the Car Makers to trial assembling and test the quality of the product. In term of the process of production, the company sends the machine data and the layout of the production to the Car Makers. As for management, the Car Makers transfer knowledge on production optimization activities, such as quality control activities and productivity improvement activities.

#### 3) T3 Company

The T3 Company is a joint venture with a Japanese partner, conducting business with Car Makers using technology received from the joint venture. Since the company is a joint venture with its parent company in Japan, the company does not receive technology transfer from Car Makers in terms of product design or manufacturing process. The company uses the same organizational format as its Japanese parent company. Although the company's knowledge of machinery comes primarily from Japan, the company also receives additional technology transfer on product development and machinery used in production from its affiliates counterpart in other countries as well as in China. Then the company applies these technologies to

create more value. On the aspect of management, the company tries to conduct all activities requested by Car Makers. The Car Makers provide the formats of these activities and the company applies them to its organization.

#### 4) T4 Company

T4 Company is a global company with manufacturing plants located in many countries around the world. Each major plant in each continent has its own research and development engineers responsible for the new models. The R & D of each major plant performs product design according to requirements of the customers. After the Design is complete, the company quotes prices to the Car Makers. If the company gets the deal, it will apply the design to co-design with the Car Makers to ensure that the quality of the production meets the customers' requirements. The company in Thailand does not participate in product design. Its main task is to coordinate after the first prototype is done to ensure that the products meet the requirements of the Car Makers. For the production process, the company designs the entire production process. The knowledge in production process design is shared from affiliates in other countries. After the production process design is completed, the company would send the information to the Car Makers to approve for production. As for the part of management, the parent company abroad is the one which designs the management of the production system according to customer requirements, such as reduction of losses within the production line, etc. The car maker would either examine the management system of the company or audit for possible errors of the performance.

### **5.2.2 Companies with 100% Thai Shareholders**

#### 1) T5 Company

The company manufactures outer parts for the Car Makers. The coordination depends on the component parts manufactured. Some of the products use knowhow of the company. Car Makers design the appearance of the products, and then the company would design the working system of the parts. For some component parts that do not require any knowhow, the customers would send the drawings asking for quotations as of the rough specifications. If the Car Makers accept the terms and the prices, then the Car Makers would provide additional explanations on the key

points of the products in order to eliminate the chance of error. As for technology transfer on the production process, the company has to operate on its own and send the information to Car Makers for auditing before the production begins. There is no technology transfer from Car Makers. For the transfer of management related technology, Car Makers provide training on production managements. The training is on the principles of management that require serious actions to be useful.

### 2) T6 Company

The company produces component parts for the Car Makers with two types of operations. The first type of operation is manufacturing using the company's own technology on the condition that the specifications of the products must meet the customers' requirements, such as the accuracy of a position set by the customer. The design and production must also meet the customer specifications. The second type of operation is production from the Car Makers' drawing, the company must control all the various values in production such as accuracy and tolerance set in the drawings to meet the requirements. Car Makers do not provide any production process knowledge. On the other hand, if the company gets the deals, Car Makers would examine the production system to ensure that the company actually has production capability. In addition, each Car Maker has different conditions on the management of the production depending on each company's policies. The types and number of activities to improve efficiency in the operation depend on each Car Maker. Nevertheless, the company must meet the IATF 16949/2016 standard, updated from the T / S 16949 standard, which is the current standard for the car industry.

### 3) T7 Company

The company cooperates with Car Makers, in which the company designs and delivers the drawings to Car Makers. The company develops products based on its own experiences. The company presents the draft designs and dimensions to Car Makers. If the company gets the deal, it would then cooperate with the Car Makers manufacturing the products to meet all the requirements. In the production process, the company plans and designs its own production line. Before the production begins, the company would share all the information with the Car Makers, who would then inspect the production process to ensure the production efficiency and approve the production. In the part of management, the Car Makers suggest

improvements in some aspects of management but do not transfer knowledge directly. The company's organizational management occurs through internal development by sending employees to outside training to increase their knowledge and skills.

#### 4) T8 Company

The company produces according to the drawings of customers. The Car Makers provide the drawings to the company for bidding, and then compare prices of all the bidders. If the company gets the deal, the Car Makers would go into details on the key points of the drawing, but would not explain the important points of critical point design. The Car Makers would inspect the production line to check whether the company has sufficient capability. There is also agreement on the control of the operation to meet the standards set in the drawing. The company has to provide its own machinery used in the production as a part of the preparation. The Car Makers only make inspection to see whether there is machinery as informed. However, they do not make any suggestion on how the production process should be operated. In the part of management, the Car Makers transfer knowledge on various aspects of management through meetings and other production management related activities.

### **5.3 Quantitative Data Collection**

From quantitative data collection, the researcher has divided data collection into 3 parts: the first part is technology transfer, the second part is the methods of technology transfer, and the last part is the effectiveness received from technology transfer.

#### **5.3.1 Quantitative Data Collection on Technology Transfer**

There are 3 types of transfer of technology from Car Makers to local auto parts manufacturers which are product-related, process-related and management-related. With a total of 28 questions of technology transfer in the questionnaires, there were 40 companies in the sample group. The number of answers to all the questions are 1,120 responses. The total number of respondents who did not receive technology transfer was 764 responses, and the number of respondents who received technology transfer was 356 responses. The number of responses can be divided into several

groups as follows. For Product-related Technology Transfer, there were 277 responses which did not receive technology transfer, and the number of respondents receiving the technology transfer was 83 responses. For Process-related Technology Transfer, the number of responses for not receiving process-related technology transfer was 178 responses, and the number of respondents receiving technology transfer was 102 responses. For Management-related Technology Transfer, the number of responses for not receiving management-related technology transfer was 309 responses in total, and the number of respondents receiving technology transfer was 171 responses. The table presented below shows the results of the technology transfer responses mentioned above. The researcher processed the data obtained from the questionnaire by using the SPSS program and choosing the Cross Tabulation for data analysis (See Table 5.1).

**Table 5.1** Types of Technology Transfer from Car Maker Companies.

| <b>Categories</b>                 | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Technology transfer in percentage</b> | <b>Non-technology transfer in percentage</b> |
|-----------------------------------|--------------------------------|----------------------------|--------------|--|--|
| Technology Transfer of Management | 309                            | 171                        | 480          | 35.6%                                    | 64.4%  |
| Technology Transfer of Process    | 178                            | 102                        | 280          | 36.4%                                    | 63.6%  |
| Technology Transfer of Product    | 277                            | 83                         | 360          | 23.1%                                    | 76.9%  |
| <b>Total</b>                      | <b>764</b>                     | <b>356</b>                 | <b>1120</b>  | <b>31.8%</b>                             | <b>68.2%</b>                                 |

**Source:** Primary Data, 2018.

Considering the details in each group, beginning with the product-related technology transfer (consisting of 9 questions), out of the 40 local auto parts manufacturers, which were either joint ventures with at least 50% Thai shareholders or companies with 100% Thai shareholders, there were a total of 277 responses not receiving technology transfer and 83 responses which received technology transfer. The quantities received for each question are shown in the table below (See Table 5.2).

The results of the questionnaire on process-related technology transfer (consisting of 7 questions), from the sample group of 40 local auto parts manufacturers, which was either joint ventures with at least 50% Thai shareholders or companies with 100% Thai shareholders, there were a total of 178 responses not receiving process-related technology transfer and 102 responses receiving the technology (See Table 5.3).

The results of the questionnaire on management-related technology transfer (consisting of 12 questions), out of the sample group of 40 local auto parts manufacturers, which was either joint ventures with at least 50% Thai shareholders or companies with 100% Thai shareholders, there were a total of 171 responses not receiving process-related technology transfer and 309 responses receiving the technology (See Table 5.4).

**Table 5.2** The Quantity of Product-related Technology Transfer

| <b>Questions</b>   | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--|--------------------------------|----------------------------|--------------|--|--|
| Transfer knowledge how to design the new product                       | 40                             | 0                          | 40           | 100.0%                                       | 0.0%                                     |
| Transfer knowledge how to design the system of new product             | 40                             | 0                          | 40           | 100.0%                                       | 0.0%                                     |
| Transfer knowledge how to make the plan of new product                 | 40                             | 0                          | 40           | 100.0%                                       | 0.0%                                     |
| Transfer knowledge of new machinery supporting production              | 24                             | 16                         | 40           | 60.0%  | 40.0%                                    |
| Transfer knowledge of new materials for future development             | 27                             | 13                         | 40           | 67.5%  | 32.5%                                    |
| Transfer knowledge of quality problem solving from materials           | 20                             | 20                         | 40           | 50.0%  | 50.0%                                    |
| Transfer knowledge of new devices that support operator to work faster | 23                             | 17                         | 40           | 57.5%  | 42.5%                                    |

**Table 5.2** (Continued)

| <b>Questions</b>   | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--|--------------------------------|----------------------------|--------------|--|--|
| Transfer knowledge on how to produce the new product               | 40                             |                            | 40           | 100.0%                                       | 0.0%                                     |
| Transfer knowledge of new materials increasing the product quality | 23                             | 17                         | 40           | 57.5%  | 42.5%                                    |
| <b>Total</b>   | <b>277</b>                     | <b>83</b>                  | <b>360</b>   | <b>76.9%</b>                                 | <b>23.1%</b>                             |

**Source:** Primary Data, 2018.

**Table 5.3** The Quantities of Process-related Technology Transfer

| Questions  | Non-technology transfer | Technology transfer | Total      | Non-technology transfer in percentage | Technology transfer in percentage |
|--|-------------------------|---------------------|------------|---------------------------------------|-----------------------------------|
| Transfer knowledge on how to reduce waste                  | 9                       | 31                  | 40         | 22.5%                                 | 77.5%                             |
| Transfer knowledge on how to improve productivity          | 11                      | 29                  | 40         | 27.5%                                 | 72.5%                             |
| Transfer knowledge of product testing                      | 40                      | 0                   | 40         | 100.0%                                | 0.0%                              |
| Transfer knowledge of production process                   | 40                      | 0                   | 40         | 100.0%                                | 0.0%                              |
| Transfer knowledge of quality control process              | 40                      | 0                   | 40         | 100.0%                                | 0.0%                              |
| Transfer knowledge of using the machine effectively        | 26                      | 14                  | 40         | 65.0%                                 | 35.0%                             |
| Transfer knowledge of what is proper process of production | 12                      | 28                  | 40         | 30.0%                                 | 70.0%                             |
| <b>Total</b>   | <b>178</b>              | <b>102</b>          | <b>280</b> | <b>63.6%</b>                          | <b>36.4%</b>                      |

**Source:** Primary Data, 2018.

**Table 5.4** The Quantities of Management-related Technology Transfer

| <b>Questions</b>   | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--|--------------------------------|----------------------------|--------------|--|--|
| Technology transfer for use in management  | 0                              | 40                         | 40           | 0.0%   | 100.0%                                   |
| Transfer knowledge for development of partner network                            | 17                             | 23                         | 40           | 42.5%  | 57.5%                                    |
| Transfer knowledge in financial management for future development                | 4                              | 36                         | 40           | 10.0%  | 90.0%                                    |
| Transfer knowledge of customer network development                               | 8                              | 32                         | 40           | 20.0%  | 80.0%                                    |
| Transfer knowledge of factory location strategies                                | 10                             | 30                         | 40           | 25.0%  | 75.0%                                    |
| Transfer knowledge of human resources development                                | 19                             | 21                         | 40           | 47.5%  | 52.5%                                    |
| Transfer knowledge of machine layout strategies                                  | 18                             | 22                         | 40           | 45.0%  | 55.0%                                    |
| Transfer knowledge of new technologies that can support more accurate management | 18                             | 22                         | 40           | 45.0%  | 55.0%                                    |

**Table 5.4** (Continued)

| <b>Questions</b>  | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|---|--------------------------------|----------------------------|--------------|--|--|
| Transfer knowledge of supplier's negotiation  | 5                              | 35                         | 40           | 12.5%  | 87.5%                                    |
| Transfer knowledge of value adding to brand awareness and the reputation of company               | 19                             | 21                         | 40           | 47.5%  | 52.5%                                    |
| Transfer knowledge of warehouse location strategies   | 17                             | 23                         | 40           | 42.5%  | 57.5%                                    |
| Transfer technology used to manage production, for example, Toyota Production System, Lean System | 36                             | 4                          | 40           | 90.0%  | 10.0%                                    |
| <b>Total</b>  | <b>171</b>                     | <b>309</b>                 | <b>480</b>   | <b>35.6%</b>                                 | <b>64.4%</b>                             |

**Source:** Primary Data, 2018.

### **5.3.2 Quantitative Data Collection on Methods of Technology Transfer**

From the questionnaire, there were 9 questions on the methods of technology transfer. Out of the sample group of 40 companies, there were 360 responses in total to all questions. The total sum of the responses of not receiving technology transfer was 143 responses, and the total of the responses of receiving technology transfer was 217 responses. The results show the quantity of the number of responses to the technology transfer method in the following table (See Table 5.5).

### **5.3.3 Quantitative Data Collection on the Effectiveness of Technology Transfer**

The results of the questionnaire on the effectiveness of the technology transfer were divided into 3 types similar to those of technology transfer. These 3 types are the effectiveness gained through the transfer of product technology, the effectiveness gained through the transfer of process technology and the effectiveness gained through the transfer of management technology.

Based on the comparison of the 18 questions of the questionnaire, from 40 local auto parts manufacturers which are joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders, out of the total of 720 responses, there were 365 responses from the respondents admitting that the technology transferred did not contribute to effectiveness and 355 responses accepting that the technology transfer was effective. The table below shows the results of the technology transfer (See Table 5.6).

**Table 5.5** The Number of Methods Used to Transfer Technology

| <b>Questions</b>   | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--|--------------------------------|----------------------------|--------------|--|--|
| Allows you or your company's employees to learn the manufacturing process and operation of the machinery | 22                             | 18                         | 40           | 55.0%  | 45.0%                                    |
| Allows you or your company's employees to learn the technology which is available in the company         | 16                             | 24                         | 40           | 40.0%  | 60.0%                                    |
| Allows you to engage activities directly that promote technology and management's knowledge              | 15                             | 25                         | 40           | 37.5%  | 62.5%                                    |
| By the other methods   | 37                             | 3                          | 40           | 92.5%  | 7.5%                                     |
| Performance review between organizations, for example, using the evaluation form                         | 4                              | 36                         | 40           | 10.0%  | 90.0%                                    |
| There are seminars to provide knowledge  | 7                              | 33                         | 40           | 17.5%  | 82.5%                                    |
| To provide relevant business documents such as supply chain system or auditing plan                      | 10                             | 30                         | 40           | 25.0%  | 75.0%                                    |

**Table 5.5** (Continued)

| <b>Questions</b>                               | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--|--------------------------------|----------------------------|--------------|--|--|
| To support the training of employees           | 12                             | 28                         | 40           | 30.0%  | 70.0%                                    |
| Transfer important person to your organization | 20                             | 20                         | 40           | 50.0%  | 50.0%                                    |
| <b>Total</b>                                   | <b>143</b>                     | <b>217</b>                 | <b>360</b>   | <b>39.7%</b>                                 | <b>60.3%</b>                             |

**Source:** Primary Data, 2018.

**Table 5.6** The Efficiency of the Technology Transfer

| <b>Categories</b>        | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--------------------------|--------------------------------|----------------------------|--------------|--|--|
| Efficiency of Management | 206                            | 194                        | 400          | 51.5%  | 48.5%                                    |
| Efficiency of Process    | 29                             | 51                         | 80           | 36.3%  | 63.8%                                    |
| Efficiency of products   | 130                            | 110                        | 240          | 54.2%  | 45.8%                                    |
| <b>Total</b>             | <b>365</b>                     | <b>355</b>                 | <b>720</b>   | <b>50.7%</b>                                 | <b>49.3%</b>                             |

**Source:** Primary Data, 2018.

Based on the 6 questions on effectiveness from product-related technology transfer in the questionnaire, out of the sample group of 40 companies, there were a total number of 240 responses. Out of all the questions, there were 130 responses to the questions suggesting that the product-related technology transfer did not contribute to effectiveness, and there were 110 responses to the questions confirming that the product-related technology transfer was effective. The number of responses of the sample group of 40 companies on the effectiveness of the product-related technology transfer is shown in the following table (See Table 5.7).

Based on the questionnaire, there were 2 questions on the effectiveness from process-related technology transfer. Out of the sample group of 40 companies, the total number of responses to the questions was 80 responses. There were 29 responses to the question suggesting that product-related technology transfer was not effective. The total number of respondents receiving the effectiveness of technology transfer was 51 responses. The quantity of responses to the effectiveness of process-related technology transfer of the sample group of 40 companies is shown in the following table (See Table 5.8).

**Table 5.7** The Efficiency of Product-related Technology Transfer

| <b>Questions</b>   | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--|--------------------------------|----------------------------|--------------|--|--|
| New innovations by which product quality can be improved           | 20                             | 20                         | 40           | 50.0%  | 50.0%                                    |
| There are innovations that can be used for increasing productivity | 19                             | 21                         | 40           | 47.5%  | 52.5%                                    |
| There are innovations that can be used for reducing costs          | 21                             | 19                         | 40           | 52.5%  | 47.5%                                    |
| There are new products every year or almost every year             | 22                             | 18                         | 40           | 55.0%  | 45.0%                                    |
| There are strategies for research and development                  | 25                             | 15                         | 40           | 62.5%  | 37.5%                                    |
| There are ways to develop new innovations                          | 23                             | 17                         | 40           | 57.5%  | 42.5%                                    |
| <b>Total</b>   | <b>130</b>                     | <b>110</b>                 | <b>240</b>   | <b>54.2%</b>                                 | <b>45.8%</b>                             |

**Source:** Primary Data, 2018.

**Table 5.8** The Efficiency of Process-related Technology Transfer

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| <b>Questions</b>                         | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|--|--------------------------------|----------------------------|--------------|--|--|
| Productivity increase for production     | 15                             | 25                         | 40           | 37.5%  | 62.5%                                    |
| Reduce waste from the production process | 14                             | 26                         | 40           | 35.0%  | 65.0%                                    |
| <b>Total</b>                             | <b>29</b>                      | <b>51</b>                  | <b>80</b>    | <b>36.3%</b>                                 | <b>63.8%</b>                             |

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**Source:** Primary Data, 2018.

There were 10 questions regarding the effectiveness of the transfer of management technology in the questionnaire. From all 40 companies in the sample group, there were a total of 400 responses to all the questions. Out of all the questions, there were 206 responses to the question suggesting that management-related technology transfer was not effective. There were a total of 206 responses to all questions of effectiveness gained from the transfer of technology, and there were a total of 194 responses from all questions admitting gaining effectiveness from the transfer of management technology. The number of responses of the sample group of 40 companies on the effectiveness of the transfer of management technology is shown in the following table (See Table 5.9).

**Table 5.9** The Efficiency of Management-related Technology Transfer

| <b>Questions</b>  | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|---|--------------------------------|----------------------------|--------------|--|--|
| Companies can create new markets and new customers by entering different markets            | 22                             | 18                         | 40           | 55.0%  | 45.0%                                    |
| Companies can create new markets and new customers Increase the number of customer base     | 22                             | 18                         | 40           | 55.0%  | 45.0%                                    |
| Employees in the organization are more capable and contribute to the innovation development | 16                             | 24                         | 40           | 40.0%  | 60.0%                                    |
| Employees in the organization are more capable and create new strategies for organization   | 18                             | 22                         | 40           | 45.0%  | 55.0%                                    |
| New strategies on the other side (if any)   | 39                             | 1                          | 40           | 97.5%  | 2.5%                                     |
| The company's revenue has increased due to better management knowledge                      | 20                             | 20                         | 40           | 50.0%  | 50.0%                                    |
| The company's revenue has increased due to the acquisition of new technologies              | 21                             | 19                         | 40           | 52.5%  | 47.5%                                    |

**Table 5.9** (Continued)

| <b>Questions</b>  | <b>Non-technology transfer</b> | <b>Technology transfer</b> | <b>Total</b> | <b>Non-technology transfer in percentage</b> | <b>Technology transfer in percentage</b> |
|---|--------------------------------|----------------------------|--------------|--|--|
| The organization has a new strategy for human resource management | 22                             | 18                         | 40           | 55.0%  | 45.0%                                    |
| The organization has a new strategy for logistics management      | 14                             | 26                         | 40           | 35.0%  | 65.0%                                    |
| There is management strategy for production                       | 12                             | 28                         | 40           | 30.0%  | 70.0%                                    |
| <b>Total</b>  | <b>206</b>                     | <b>194</b>                 | <b>400</b>   | <b>51.5%</b>                                 | <b>48.5%</b>                             |

**Source:** Primary Data, 2018.

## **5.4 Summary of Interview Results**

### **5.4.1 Summary of Face to Face Interviews Results**

Based on the results obtained from the interview, it can be concluded that Car Makers have transferred technology to local auto parts manufacturers in two areas which are product and management. The transfer of process technology did not appear in the 6 interviews of the sample group. Although there is the transfer of product technology from Car Makers not every company has received the technology due to the differences in business conditions on technology transfer. All of the companies that the researcher has interviewed have received management technology, but only some have received product technology while none of them have received process technology. The details of the interview results are divided into 2 parts which are joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders. The explanation starts with joint ventures with at least 50% Thai shareholders describing the events in the transfer of product, process and management technology as to whether Car Makers have transferred technology to local auto parts manufacturers. If there is transfer of technology, on what issues have the Car Makers transferred technology, by what methods, and can the effectiveness gained through the transfer be developed further? Then we move on to the companies with 100% Thai shareholders explaining the same topics, and comparing the similarities and differences between the two types of companies, including the supportive approach from interviewees.

Based on the summary of the interviews with joint ventures with at least 50% Thai shareholders, 3 supplier companies of the Car Makers have received transferred knowledge on management to achieve the goals set by the Car Makers. The Car Makers have conducted various kinds of activities with their suppliers through joint meetings, and evaluation to develop the system of operation and quality assurance systems. In product design, it is either cooperation between the Car Makers and the suppliers, or that the supplier companies are the sole designers. The companies responsible for product design may be a foreign company that has formed a joint venture with a Thai company or a joint venture situated in Thailand. This is due to the fact that there has been transfer of technology from the joint ventures. Some

companies even perform their own design development. In terms of process technology, the 3 supplier companies did not receive any technology from the Car Makers, but they have either learned from their joint ventures or on their own. Although the joint ventures with at least 50% Thai shareholders have received transferred management technology, this is not extended to the transfer of product and process technology from the Car Makers. On the contrary, the companies have received transferred knowledge from their foreign partners. The companies may send their employees to their foreign joint ventures to learn various aspects. In addition, a joint venture with 50% of Thais holds a marketing advantage as these joint ventures can expand to other countries.

When Car Makers require the companies to produce automotive parts for assembly in other countries or other continents, joint ventures have more opportunities as they have the technology that can support the operation. Cooperation with the Car Makers is a great opportunity for the companies to develop themselves, especially in the field of technology and in preparation to face the ever changing global marketplace in order to increase their capabilities to survive and grow.

This is the summary of the interviews with the companies with 100% Thai shareholder; the 3 companies are suppliers to Car Makers. The Car Maker companies have transferred knowledge on management to the 3 companies and knowledge on product to 2 of them. The management knowledges that have been transferred include some concept of production systems such as Total Quality Management or TQM, Loss reduction or Lean system and 5S system through various activities. The goals of these activities are to decrease losses or reduce costs or to ensure that the operations are in the same direction in order to achieve easier operation. Some companies have been able to apply these knowledges to further develop their organizations. Some companies, despite their better management systems, have to adjust to the formats required by the Car Makers. For product technology transfer, two out of three companies have had transferred technology from Car Makers. The two companies (knowledge on product) received the drawings from the Car Makers they subcontracted from. It is important for the auto parts manufacturers to know the critical points of the component parts they produced. In these cases, the Car Makers need to transfer this information to the auto parts manufacturers to specially consider

when manufacturing to minimize the chance of error in the production of the component parts. This provides the companies with good understanding of the reasons behind the designs. Although this is not an in-depth knowledge, some companies have been able to further develop this knowledge. Another company that has not been mentioned is the company that has not received technology transfer from Car Makers because the company is capable of developing its own product technology and presented it to the Car Makers. This enhances the competitiveness of the company. If the company has the ability to generate generous amounts of profit, the company can expand to the global market to support the upcoming Global Supply Chain.

The last part is transferring process technology. The three companies which are owned 100% by Thai shareholders did not receive this type of technology. This may be because the Car Makers do not possess any know-how of the production of component parts. Therefore, there is no knowledge to transfer.

For effectiveness gains from technology transfer, it can be said that the transfer of management technology contributes to efficiency in the organization as it is management of the efficiency of production, cost and delivery time which are related to customer satisfaction. If the companies do not make any adjustment, their competitiveness will decline as they could not operate in accordance with business standards. In terms of efficiency gained from product-related technology transfer, there were only two companies with 100% Thai shareholders that have received technology transfer. The knowledge gained from the technology transfer is not quite effective because it is only partial, and therefore unable to apply to the development of the product. Lastly, there was no transfer of production process technology from the Car Makers to the three companies interviewed; therefore there is no effectiveness to be mentioned.

When comparing joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders, both types of companies have had transfer of the technology of management. The reason may be because the Car Makers aim for quality component parts at lowest possible cost to be delivered on the specific schedule. This is usually known by the concept of Quality-Cost-Delivery (QCD), which can be determined from the activities done with the suppliers. These activities are such as Total Quality Management (TQM) or Lean, which is a waste minimizing

production process or Milk Run, the transportation method used to support a Just-in-Time (JIT) production system. The transfer of these knowledges to auto parts manufacturers is usually through meetings, evaluation of various operations or by another method within the activities. On the transfer of product technology, the joint ventures with at least 50% shareholders have not received technology transfer from Car Makers as they have their own technologies, which may have been transferred from their partner companies or they may have developed their own technologies. Having one's own technology is a competitive advantage. If the Car Makers have approved the technology, the severity of pressure on price competition will reduce. On the other hand, if the product subcontracted is similar to the product produced by joint ventures of the Car Makers, the joint ventures are more likely to win the contract due to the internal relationship between affiliates. This is one situation which the auto parts manufacturers have to endure. As for the companies with 100% Thai shareholders, two out of three companies have received technology transfer due to subcontracting on the production of the auto parts. Although the knowledge gained through the operation is not an in-depth knowledge, it can provide the basis of knowledge in product design, such as material selection or the key point in the design of each component part. The important issue here is the severity of price competition because Car Makers are capable of investigating the potential of each company as to whether it has sufficient capability to produce the specific products, by checking the machines in the manufacturing plant and price selection. This may lead to a very serious price competition. For the one company with its own know-how and product technology, the situation is rather better as it does not have to face the same level of severity on domestic price competition. Since the company has its own technology, there is no need for the Car Makers to transfer any. Therefore they only purchase the products. In addition, developing their own technology would help enable the companies with 100% Thai shareholders to generate high revenue leading to sufficient capital to invest abroad and open up more opportunities to step into the Global Supply Chain.

The final part was the transfer of process technology; both types of companies, joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders have not received any technology transfer from Car Makers. One reason

suggested from the interviews is that Car Makers may not have the technology of the production process due to the fact that the Car Makers may not be the developers of the technology. Therefore the Car Makers are not able to transfer technology to the auto parts manufacturers. This has resulted in the requirement on the part of the auto parts manufacturers to develop their own production processes. In some cases, the companies may already have the know-how of the specific production processes which they may have received from their joint venture counterparts. In other cases, the companies may already have the technology of the production process of the specific products. Therefore, there is no production process technology transfer from Car Makes to auto parts manufacturers.

The government policy that should be improved is the education of the population in the country. The first issue Thai education should address is the language ability, especially English which is a universal language. It is unarguable that Thai children have poor English skills. Although there is transfer of knowledge from foreigners, the knowledge transfer is not effective because of inadequate understanding and the inability to ask questions. Apart from the issue of language, it is also necessary to emphasize mathematical knowledge to encourage the development of Thai personnel to be able to reap more benefits from technology transfer. Another solution to the issue is that the government should encourage more students to study abroad to increase the level of competence of personnel in the country. Moreover, the government should pay attention and take good care of its key personnel as well as promoting cooperation between the government and the private sector for continuous and sustainable development in Thai society.

#### **5.4.2 Summary of Telephone Interview Results**

In this research, the telephone interviews provide additional information to support the information obtained from the face to face interviews. The summary results of the telephone interviews were obtained by the similar process to the face to face interviews. The conclusion of the interview is divided into two parts according to the nature of the companies which are joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders. The explanation began with joint ventures with at least 50% Thai shareholders similar to summary of the face

to face interviews by describing the events in the transfer of product, process and management technology, whether the Car Makers have transferred technology to local auto parts manufacturers. If there is, what types of technology the Car makers have transferred and by what methods, and whether the technology is effective enough to encourage organizational development. Next we move on to the companies with 100% Thai shareholders in the same topics and then compare the similarities and differences between the two types of companies. In the telephone interviews, the researcher did not interview on the topic of the improvement approach required from the government or government agencies.

From the results of the interviews, it can be concluded that the Car Makers have transferred technology to the local auto parts manufacturers in two areas which were product and management technology. The nature of the transfer for both types of technology is similar. Both types of knowledge were only partially transferred through discussions on the specific details on key positions of the component parts necessary for production control. In terms of management, all of the companies interviewed have received management technology because this type of knowledge would help ensure time delivery schedules. This is the principle that enables Car Makers to negotiate for price reduction or better discount in the future. This principle also enhances quality control of production which in turn helps ensure that the Car Makers would receive good quality products. In the area of manufacturing process technology, there was no transfer of this type of technology to any companies interviewed.

The four joint ventures with at least 50% Thai shareholders can be divided into 2 groups which are the companies with their own technology and the companies using the drawings of the component parts from Car Makers in the production. Three out of four companies have their own technology. This group of companies already has knowledge on product design. The knowledge was gained either from their joint ventures abroad or the companies have developed their own product design. As for the auto parts manufacturer that uses drawings from Car Makers, the knowledge on the key position for production of each component part would have been transferred through detailed description from the Car Makers. The company also has to design the production process to meet the accuracy control.

In terms of production process, every company has to design their own production process. In some cases, some companies may have imitated the production lines from their overseas joint ventures. In other cases, the executives of some companies have to search for and make adjustments of the production process while other companies may have product design personnel within the companies. However, all of the information on the production processes must be submitted to the Car Makers for approval prior to production. As for the management, the Car Makers provides the concepts of management and activities. Some Car Makers may provide training at their companies on various aspects of management for the employees of their supplier companies. All auto parts manufacturers have to apply these knowledges to achieve efficiency. Next, the Car Makers may investigate the documentation provided by the Suppliers to make sure they have done the activities required. For some companies their overseas Head Quarter may have designed their management processes. The Car Makers would then investigate any errors that needed improvement. The suppliers must meet the standards required by the Car Makers.

The four companies with 100% Thai shareholders have been separated into two groups as well. The first group is the companies with their own technology and the second is the group of companies using drawings of the component parts from Car Makers in production. Technology transfer from Car Makers to the companies with 100% Thai shareholders has the same nature as that of the joint ventures with at least 50% Thai shareholders. The companies with their own technology have not been transferred product technology from the Car Makers. If they have been subcontracted, they might receive necessary knowledge from the Car Makers to ensure smooth production, such as the knowledge gained from the drawings of the component parts or the knowledge gained from discussions on details of the key position of the parts. From the sample groups of companies, three out of four have their own technology, and two out of four companies operate in both methods by utilizing their own technology in production as well as producing according to drawings from the customers. In terms of the production process technology, the four companies in the sample group designed their own production processes and then submitted the production models to Car Makers for approval prior to production. The Car Makers

would inspect the machinery and production systems to ensure the capability of suppliers to manufacture according to agreed standards.

In the area of organization management, Car Makers provide models of activity to the auto parts manufacturers to improve management efficiency through conferences, training and various activities or through management improvement recommendations during the audit. However, each Car Maker has different management styles therefore the activities suppliers were required to optimize operational efficiency and to meet either the old T/S 16949 Standard or the new IATF16949 Standard depending on the policies of each company. In addition, some companies have developed their own internal organization development as well as sending personnel to training outside the organizations to increase their skills and knowledge.

In the effectiveness gained through technology transfer, as mentioned above, the local auto parts manufacturers have transferred some product technology through subcontracting. All of the companies have received management technology in the form of various activities such as meetings, conferences and training sessions. However, the effectiveness gained through technology transfer is mainly management effectiveness because the auto parts manufacturers need to improve and develop their management systems to deliver quality products on the right schedule.

When comparing joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders, the technology transfer from Car Makers is not associated with the proportion of Thai shareholders of the companies. Both the joint ventures and the wholly owned Thai companies are treated in the same way by the Car Makers. If the company has its own technology, Car Makers assume the role of co-designer. For the company that manufactures auto parts according to drawings from Car Makers, the Car Makers would provide suggestions after the company has been subcontracted to produce the component parts.

## 5.5 The Results of Quantitative Research

### 5.5.1 The Result of the Study of Technology Transfer

From the results of the study of technology transfer obtained from the questionnaire, it can be concluded that the automotive parts manufacturers in Tier 1 have received transferred knowledge from the Car Makers in all three aspects which are the product, process and management knowledge. However, the amount of technology transferred in all three types is less than the amount of no technology transfer. It can also be concluded that the local auto parts manufacturers have received all three categories of technology in different quantity. The overview of the transfer of the three types of technology can be summarized as the most common technology transferred is management technology and the least amount of transfer is process technology. The results obtained from the analysis using the SPSS program are shown as follows (See Table 5.10).

**Table 5.10** Analysis of Results of Technology Transfer

| <b>Case Processing Summary</b> |       |         |         |         |       |         |
|--------------------------------|-------|---------|---------|---------|-------|---------|
|                                | Cases |         |         |         |       |         |
|                                | Valid |         | Missing |         | Total |         |
|                                | N     | Percent | N       | Percent | N     | Percent |
| Answer on technology transfer  | 1120  | 100%    | 0       | 0.0%    | 1120  | 100.0%  |

| <b>Answer on technology transfer by Categories (Crosstabulation)</b> |            |                     |       |       |
|--|------------|---------------------|-------|-------|
| Categories   |            | Answer of           |       | Total |
|  |            | technology transfer |       |       |
|  |            | No                  | Yes   |       |
| Technology transfer of management                                    | Count      | 309                 | 171   | 480   |
|  | % of Total | 27.6%               | 15.3% | 42.9% |

**Table 5.10** (Continued)

| Categories                     |            | Answer of<br>technology transfer |       | Total  |
|--------------------------------|------------|----------------------------------|-------|--------|
|                                |            | No                               | Yes   |        |
| Technology transfer of process | Count      | 178                              | 102   | 280    |
|                                | % of Total | 15.9%                            | 9.1%  | 25.0%  |
| Technology transfer of product | Count      | 277                              | 83    | 360    |
|                                | % of Total | 24.7%                            | 7.4%  | 32.1%  |
| <b>Total</b>                   | Count      | 764                              | 356   | 1120   |
|                                | % of Total | 68.2%                            | 31.8% | 100.0% |

#### Chi-Square Tests

|                    | Value  | df | Asymp. Sig. (2-sided) |
|--------------------|--------|----|-----------------------|
| Pearson Chi-Square | 18.701 | 2  | .000                  |
| N of Valid Cases   | 1120   |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 89.00.

**Source:** Primary Data, 2018.

Result (refer from Table 5.10):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all Technology Transfer questions. In this case, N = 1,120, while N (Missing) is the number of responses to the questions with errors. In this case, N = 0, the sum of the responses to all questions (Total N) is 1,120.

B: In the Cross Tabulation table, based on the questions from the questionnaire, there were 28 questions from the sample group of 40 companies. The total number of questions was 1,120, so the number of responses must also be 1,120. The amount of responses to the questions, 'receiving technology transfer' was 356 responses, or 31.8%, and 'did not receive all technology transfer' was 764 responses, which amounts to 68.2%. Considering each group, the questionnaire can be

summarized as follows: the results obtained from the questionnaire on management technology transfer were 171 responses or 15.3% of all that received technology transfer, and not receiving all technology transferred was 309 responses, which accounted for 27.6% of the total. From the results of the questionnaire on the process technology transfer, there were 102 responses, or 9.1% of the total that received technology transfer, and 178 responses for not receiving all the technology transfer which accounted for 15.9% of the total. The results of the questionnaire on the product technology transfer were 83 responses or 7.4% of the total that received technology transfers, and not receiving all technology transfer was 277 responses, which accounted for 24.7% of the total.

C: Sig value is .000, so independent variables affect the dependent variables significantly.

D: Pearson Chi-square value is calculated at 18.701, with the Degree of Freedom (DF) at level 2 with the standard value of 0.020. The confidence level is 0.99 or 99%. The value is higher than the standard therefore it can be concluded that Car Makers did not participate in the transfer of technology to local auto parts manufacturers.

When considering the subgroup information of the technology transfer, it can be summarized as follows. The area of product technology transfer showed the topic that has not been transferred at all is the product design methodology, the product utility system design, the production process of a specific component parts and the product creation planning. Other areas of product technology that have been transferred, although not in high volumes, were such as the transfer of knowledge on new machinery that would help increase productivity, the transfer of knowledge of new materials to enhance product quality or for future development, the transfer of knowledge of new equipment that enhances the speed of the operation and the transfer of knowledge on solving product quality problems due to raw materials. The results of the analysis using the SPSS program are as below (See Table 5.11).

**Table 5.11** Analysis of Results of Product Technology Transfer.

|                                       | <b>Case Processing Summary</b> |         |         |         |       |         |
|---------------------------------------|--------------------------------|---------|---------|---------|-------|---------|
|                                       | Cases                          |         |         |         |       |         |
|                                       | Valid                          |         | Missing |         | Total |         |
|                                       | N                              | Percent | N       | Percent | N     | Percent |
| Answer on product technology transfer | 360                            | 100%    | 0       | 0.0%    | 360   | 100.0%  |

| <b>Answer of product technology transfer (Cross tabulation)</b>            |            |                               |      |       |  |
|--|------------|-------------------------------|------|-------|--|
| Categories   |            | Answer of technology transfer |      | Total |  |
|  |            | No                            | Yes  |       |  |
| Transfer knowledge of how to design the new product                        | Count      | 40                            | 0    | 40    |  |
|  | % of Total | 11.1%                         | 0.0% | 11.1% |  |
| Transfer knowledge of how to design the system of new product              | Count      | 40                            | 0    | 40    |  |
|  | % of Total | 11.1%                         | 0.0% | 11.1% |  |
| Transfer knowledge of how to make the plan of new product                  | Count      | 40                            | 0    | 40    |  |
|  | % of Total | 11.1%                         | 0.0% | 11.1% |  |
| Transfer knowledge of new machinery that can support production.           | Count      | 24                            | 16   | 40    |  |
|  | % of Total | 6.7%                          | 4.4% | 11.1% |  |
| Transfer knowledge of new materials for future development.                | Count      | 27                            | 13   | 40    |  |
|  | % of Total | 7.5%                          | 3.6% | 11.1% |  |
| Transfer knowledge of quality problem solving from materials               | Count      | 20                            | 20   | 40    |  |
|  | % of Total | 5.6%                          | 5.6% | 11.1% |  |
| Transfer knowledge on new devices that support operator in working faster. | Count      | 23                            | 17   | 40    |  |
|  | % of Total | 6.4%                          | 4.7% | 11.1% |  |

**Table 5.11** (Continued)

| Categories   |            | Answer of<br>technology transfer |       | Total  |
|--|------------|----------------------------------|-------|--------|
|  |            | No                               | Yes   |        |
| Transfer the knowledge of how to<br>produce the new product                  | Count      | 40                               | 0     | 40     |
|  | % of Total | 11.1%                            | 0.0%  | 11.1%  |
| Transfer the knowledge of new<br>materials increasing the product<br>quality | Count      | 23                               | 17    | 40     |
|  | % of Total | 6.4%                             | 4.7%  | 11.1%  |
| <b>Total</b>   | Count      | 277                              | 83    | 360    |
|  | % of Total | 76.9%                            | 23.1% | 100.0% |

**Chi-Square Tests**

|                    | Value               | df | Asymp. Sig. (2-sided) |
|--------------------|---------------------|----|-----------------------|
| Pearson Chi-Square | 89.847 <sup>a</sup> | 8  | .000                  |
| N of Valid Cases   | 360                 |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.22

**Source:** Primary Data, 2018.

Results (Table 5.11):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all Technology Transfer questions on product technology. In this case, N = 360, and N (Missing) is the number of faulty responses to the question which is 0. The sum of the responses to all questions (Total N) is 360.

B: In Cross Tabulation table, there were 277 responses to 'not receiving technology' which accounted for 76.9%, and there were 83 responses to 'receiving technology', or 23.1%

C: Sig. value is .000, so independent variables affect dependent variables significantly.

D: The Pearson chi-square value is 89.847, with the Degree of Freedom (DF) at level 8, with the standard value of 1.646. The confidence level is 0.99 or 99%. The value is higher than the standard value therefore it can be concluded that Car Makers did not participate in the transfer of product technology to local auto parts manufacturers.

The results from the questionnaire on process technology transfer indicated the aspect that has not been transferred at all were the process of quality control, the production process and the testing process. The other areas of the process technology that have been transferred in good proportion were such as the transfer of loss reduction methods to increase productivity which accounted for 78% of the total sample group of 40 companies as well as the transfer of knowledge in monitoring for productivity improvement with the proportion of 73% and the knowledge transfer of the appropriate production process with the proportion of 70%. However, the transfer of knowledge in utilizing the machines to full capacity is only about 35%. The result of the analysis using the SPSS program is shown as follows (See Table 5.12).

**Table 5.12** Analysis of Results of Process Technology Transfer

| <b>Case Processing Summary</b>           |       |         |         |         |       |         |
|--|-------|---------|---------|---------|-------|---------|
|  | Cases |         |         |         |       |         |
|  | Valid |         | Missing |         | Total |         |
|  | N     | Percent | N       | Percent | N     | Percent |
| Answer on process<br>technology transfer | 280   | 100%    | 0       | 0.0%    | 280   | 100.0%  |

| <b>Answer on process technology transfer (Cross tabulation)</b> |            |   |       |       |
|---|------------|---|-------|-------|
| Categories  | Count      | Answer of<br>technology transfer          |       | Total |
|   |            | No  | Yes   |       |
|   |            | Transfer knowledge of how<br>reduce waste | 9     |       |
|   | % of Total | 3.2%                                      | 11.1% | 14.3% |

**Table 5.12** (Continued)

| Categories   |            | Answer of           |       | Total |
|--|------------|---------------------|-------|-------|
|  |            | technology transfer |       |       |
|  |            | No                  | Yes   |       |
| Transfer knowledge of how to improve productivity          | Count      | 11                  | 29    | 40    |
|  | % of Total | 3.9%                | 10.4% | 14.3% |
| Transfer knowledge of product testing                      | Count      | 40                  | 0     | 40    |
|  | % of Total | 14.3%               | 0.0%  | 14.3% |
| Transfer knowledge of production process                   | Count      | 40                  | 0     | 40    |
|  | % of Total | 14.3%               | 0.0%  | 14.3% |
| Transfer knowledge of quality control process              | Count      | 40                  | 0     | 40    |
|  | % of Total | 14.3%               | 0.0%  | 14.3% |
| Transfer knowledge of using the machine effectively        | Count      | 26                  | 14    | 40    |
|  | % of Total | 9.3%                | 5.0%  | 14.3% |
| Transfer knowledge of what is proper process of production | Count      | 12                  | 28    | 40    |
|  | % of Total | 4.3%                | 10.0% | 14.3% |
| <b>Total</b>   | Count      | 178                 | 102   | 280   |
|  | % of Total | 63.6%               | 36.4% | 100%  |

**Chi-Square Tests**

|                    | Value   | df | Asymp. Sig. (2-sided) |
|--------------------|---------|----|-----------------------|
| Pearson Chi-Square | 139.877 | 6  | .000                  |
| N of Valid Cases   | 280     |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.57

**Source:** Primary Data, 2018.

Results (refer from Table 5.12):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all questions on Process Technology Transfer. In this case, N = 280, and

N (Missing) is the number of responses to the faulty question which is 0. The sum of the responses to all questions (Total N) is 280.

B: In the Cross Tabulation table, the process technology transfer consists of 7 questions. From 40 local auto parts manufacturers, which were joint venture with at least 50% Thai shareholders and companies with 100% Thai shareholders, there were 178 responses to 'not receiving process technology transfer', which is 63.6% of the total process technology, and 102 responses to receiving process technologies, which accounted for 36.4%

C: Sig. Value is .000, so independent variables affect dependent variables significantly.

D: The Pearson Chi-square value is calculated at 139.877, with the Degree of Freedom (DF) at level 6 with the standard value of 0.872, confidence level of 0.99 or 99%. The value calculated is higher than the standard therefore it can be concluded that Car Makers did not participate in the transfer of process technology to local auto parts manufacturers.

The results from the questionnaire on management technology transfer demonstrated the effects of technology transfer on management. The aspect that has not been transferred was the technology of organization management. However, in terms of technology transfer in production management, there was as high as 90% or 36 companies which have been transferred this type of technology. For the remaining areas of knowledge, there was less than 50% of technology transfer. These knowledges were such as the knowledge on how to increase value added to the brand and reputation of the companies, and the transfer of knowledge on human resources development, which accounted for 48%. The knowledge transfer of new technologies helps enable more accurate management. The transfer of knowledge on the appropriate machine location accounted for 45%. The transfer of knowledge on the establishment of an appropriate warehouse and the transfer of knowledge on partner network development accounted for 43%. The transfer of knowledge on appropriate manufacturing location accounted for 25%. The transfer of knowledge on customer network development accounted for 20%. The transfer of knowledge on supplier negotiation for production costs reduction accounted for 13%, and knowledge transfer on financial management for survival and future development accounted for 10%. The results from the analysis using the SPSS program are shown as follows (See Table 5.13).

**Table 5.13** Analysis of Results of Management Technology Transfer

|  | <b>Case Processing Summary</b> |         |         |         |       |         |
|--|--------------------------------|---------|---------|---------|-------|---------|
|  | Cases                          |         |         |         |       |         |
|  | Valid                          |         | Missing |         | Total |         |
|  | N                              | Percent | N       | Percent | N     | Percent |
| Answer on management technology transfer | 480                            | 100%    | 0       | 0.0%    | 480   | 100.0%  |

**Answer on management technology transfer by Categories (Cross tabulation)**

| Categories   |            | Answer of technology transfer |      | Total |
|--|------------|-------------------------------|------|-------|
|  |            | No                            | Yes  |       |
| Technology transfer for using in management  | Count      | 40                            | 0    | 40    |
|  | % of Total | 8.3%                          | 0.0% | 8.3%  |
| Transfer knowledge for development of partner network                                | Count      | 23                            | 17   | 40    |
|  | % of Total | 4.8%                          | 3.5% | 8.3%  |
| Transfer knowledge in financial management for future development                    | Count      | 36                            | 4    | 40    |
|  | % of Total | 7.5%                          | 0.8% | 8.3%  |
| Transfer knowledge of customer network development.                                  | Count      | 32                            | 8    | 40    |
|  | % of Total | 6.7%                          | 1.7% | 8.3%  |
| Transfer knowledge of factory location strategies                                    | Count      | 30                            | 10   | 40    |
|  | % of Total | 6.3%                          | 2.1% | 8.3%  |
| Transfer knowledge of human resources development.                                   | Count      | 21                            | 19   | 40    |
|  | % of Total | 4.4%                          | 4.0% | 8.3%  |
| Transfer knowledge of machine layout strategies                                      | Count      | 22                            | 18   | 40    |
|  | % of Total | 4.6%                          | 3.8% | 8.3%  |
| Transfer knowledge of new technologies that can support more accurate of management. | Count      | 22                            | 18   | 40    |
|  | % of Total | 4.6%                          | 3.8% | 8.3%  |

**Table 5.13** (Continued)

| Categories   |            | Answer of<br>technology transfer |       | Total  |
|--|------------|----------------------------------|-------|--------|
|  |            | No                               | Yes   |        |
| Transfer knowledge of<br>supplier's negotiation  | Count      | 35                               | 5     | 40     |
|  | % of Total | 7.3%                             | 1.0%  | 8.3%   |
| Transfer knowledge of value<br>adding to brand awareness and<br>the reputation of company.                 | Count      | 21                               | 19    | 40     |
|  | % of Total | 4.4%                             | 4.0%  | 8.3%   |
| Transfer knowledge of<br>warehouse location strategies   | Count      | 23                               | 17    | 40     |
|  | % of Total | 4.8%                             | 3.5%  | 8.3%   |
| Transfer technology used to<br>manage production, for<br>example, Toyota Production<br>System, Lean System | Count      | 4                                | 36    | 40     |
|  | % of Total | 0.8%                             | 7.5%  | 8.3%   |
| <b>Total</b>   | Count      | 309                              | 171   | 480    |
|  | % of Total | 64.4%                            | 35.6% | 100.0% |

#### Chi-Square Tests

|                    | Value                | df | Asymp. Sig. (2-sided) |
|--------------------|----------------------|----|-----------------------|
| Pearson Chi-Square | 110.346 <sup>a</sup> | 11 | .000                  |
| N of Valid Cases   | 480                  |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.25

**Source:** Primary data, 2018.

Results (From table 5.13):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all Technology Transfer questions on management. In this case, N = 480, and N (Missing) is the number of faulty responses to the question which is 0. The sum of the responses to all questions (Total N) is 480.

B: The Cross Tabulation table of technology transfer on management consisted of 12 questions. From 40 local auto parts manufacturers, which were joint ventures with at least 50% Thai shareholders and the companies with 100% Thai shareholders, there were 309 responses to 'not receiving process technology transfer', which accounted for 64.4%, and 171 responses to 'receiving process technology transfer', which accounted for 35.6. %

C: Sig value is .000, so independent variables affect dependent variables significantly.

D: The Pearson Chi-square value is calculated at 110.346, with the Degree of Freedom (DF) at level 11 with the standard value of 3.053, with a confidence level of 0.99 or 99%, which is higher than the standard. From this can be concluded that Car Makers did not participate in the transfer of process technology to local auto parts manufacturers.

However, in the subgroup of each group of questions, to some questions the 40 respondent companies answered that there was no transfer technology. Considered in detail, the following questions answered by all 40 companies was that there was no technology transfer. In the aspect of Technology Transfer of Product, there were 4 questions which were knowledge transfer on how to design new products, knowledge transfer on how to design the system of new products, knowledge transfer on how to creating the plan of new products, and knowledge transfer on how to produce the new products. In the aspect of Technology Transfer of Process, there were 3 questions which were knowledge transfer of product testing, Transfer knowledge of production process, and knowledge transfer of quality control process. In the aspect of Management Technology Transfer, there was 1 question which was Technology transfer for use in management.

### **5.5.2 Technology Transfer Method**

There are mainly 3 methods Car Makers used to transfer technology to local auto parts manufacturers. The first method is to review the result of cooperation between the organizations, such as the use of the Evaluation form. The second method is through conferences and seminars on various kinds of knowledge. The third method is the provision of related business documents, such as the supply chain system, or the

audit documents of the operation plan, and other means, such as employee training, by enabling the companies to engage directly with businesses that promote technology and management knowledges, by allowing employees within the auto parts manufacturer companies to learn the technology available in the Car Makers companies, by transferring key personnel to the auto parts manufacturer organization and by permitting personnel in the auto parts manufacturer companies to learn the manufacturing process and the operation of machinery onsite. The number of responses to questions on the methodology of technology transfer is as follows. There were 20 companies that did not have technology transfer through 'Transferring important person to your organization' and another 20 companies have transferred technology through this method. There were 15 companies that have not received technology transfer by 'Allows you to engage the activities directly that promote technology and management's knowledge' and there were 25 companies that have had transferred technology by this method. For technology transfer through 'There are seminars to provide knowledge', there were 7 companies which have not received technology through this method while 33 companies have had transferred technology through seminars. There were 4 companies that have not had transferred technology through 'Performance review between organizations', such as using the evaluation form, while 36 companies have received technology by this method. 12 companies have not had transferred technology through 'To support the training of employees' while 28 companies have received technology transfer through this method. For technology transfer by 'To provide relevant business documents such as supply chain system or auditing plan', there were 10 companies that have had transferred technology by this method while the other 30 companies have received technology transfer through this method. There were 22 companies that have not received technology transfer through 'Allows you or your company's employees to learn the manufacturing process and operation of the machinery' while another 18 companies have had transferred technology through this method. Out of the sample group of 40 companies, there were 16 companies that have not received technology transfer through 'Allows you or your company's employees to learn the technology which is available in the company' while the remaining 24 companies have had transferred technology through method. From the results, it can be concluded that the least

popular method of technology transfer was ‘Allows you or your company's employees to learn the manufacturing process and operation of the machinery’. The results from the analysis using the SPSS program are shown in the following table (See Table 5.14).

**Table 5.14** Analysis of Results of Technology Transfer Methods.

|                                       | <b>Case Processing Summary</b> |         |         |         |       |         |
|---------------------------------------|--------------------------------|---------|---------|---------|-------|---------|
|                                       | Cases                          |         |         |         |       |         |
|                                       | Valid                          |         | Missing |         | Total |         |
|                                       | N                              | Percent | N       | Percent | N     | Percent |
| Answer on technology transfer methods | 360                            | 100%    | 0       | 0.0%    | 360   | 100.0%  |

| <b>Answer on technology transfer methods (Cross-tabulation)</b>  |            |                               |      |       |
|--|------------|-------------------------------|------|-------|
| Categories   |            | Answer of technology transfer |      | Total |
|  |            | No                            | Yes  |       |
| Allows you or your company's employees to learn the manufacturing process and operation of the machinery | Count      | 22                            | 18   | 40    |
|  | % of Total | 6.1%                          | 5.0% | 11.1% |
| Allows you or your company's employees to learn the technology which is available in the company.        | Count      | 16                            | 24   | 40    |
|  | % of Total | 4.4%                          | 6.7% | 11.1% |
| Allows you to engage activities directly that promote technology and management's knowledge.             | Count      | 15                            | 25   | 40    |
|  | % of Total | 4.2%                          | 6.9% | 11.1% |

**Table 5.14** (Continued)

| Categories   |            | Answer of           |       | Total  |
|--|------------|---------------------|-------|--------|
|  |            | technology transfer |       |        |
|  |            | No                  | Yes   |        |
| By other methods   | Count      | 37                  | 3     | 40     |
|  | % of Total | 10.3%               | 0.8%  | 11.1%  |
| Performance review between organizations, for example, using the evaluation form.    | Count      | 4                   | 36    | 40     |
|  | % of Total | 1.1%                | 10.0% | 11.1%  |
| There are seminars to provide knowledge.   | Count      | 7                   | 33    | 40     |
|  | % of Total | 1.9%                | 9.2%  | 11.1%  |
| To provide relevant business documents such as supply chain system or auditing plan. | Count      | 10                  | 30    | 40     |
|  | % of Total | 2.8%                | 8.3%  | 11.1%  |
| To support training of employees.  | Count      | 12                  | 28    | 40     |
|  | % of Total | 3.3%                | 7.8%  | 11.1%  |
| Transfer important person to your organization.                                      | Count      | 20                  | 20    | 40     |
|  | % of Total | 5.6%                | 5.6%  | 11.1%  |
| <b>Total</b>   | Count      | 143                 | 217   | 360    |
|  | % of Total | 39.7%               | 60.3% | 100.0% |

**Source:** Primary Data, 2018.

Results (From table 5.14):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all questions on the method used to transfer the technology. In this case, N = 360, and N (Missing) is the number of responses to the question which in this case is 0. The sum of the responses to all questions (Total N) is 360.

B: In the Cross Tabulation table, there were 8 questions on the methodology of technology transfer. From all 40 companies in the sample group, the total number of responses to all questions is 360. The sum of all responses to not receiving technology

transfer through the specified methods was 143 responses or 39.7% and there were 217 responses to receiving technology transfer through the specified method or 60.3%.

### 5.5.3 Effectiveness from Technology Transfer

The results from the overview of the effectiveness from technology transfer were not very different, it did not contribute much to effectiveness. The results obtained from the analysis using the SPSS program are shown in the following table (See Table 5.15).

**Table 5.15** Analysis of Results of Efficiency from Technology Transfer

| <b>Case Processing Summary</b>                |       |         |         |         |       |         |
|---|-------|---------|---------|---------|-------|---------|
|   | Cases |         |         |         |       |         |
|   | Valid |         | Missing |         | Total |         |
|   | N     | Percent | N       | Percent | N     | Percent |
| Answer on efficiency from technology transfer | 720   | 100%    | 0       | 0.0%    | 720   | 100.0%  |

| <b>Answer on the efficiency from technology transfer (Crosstabulation)</b> |            |                               |       |        |
|--|------------|-------------------------------|-------|--------|
| Categories   |            | Answer of technology transfer |       | Total  |
|  |            | No                            | Yes   |        |
|  |            | Efficiency on Management      | Count |        |
|  | % of Total | 28.6%                         | 26.9% | 55.6%  |
| Efficiency on Process  | Count      | 29                            | 51    | 80     |
|  | % of Total | 4.0%                          | 7.1%  | 11.1%  |
| Efficiency on products   | Count      | 130                           | 110   | 240    |
|  | % of Total | 18.1%                         | 15.3% | 33.3%  |
| <b>Total</b>   | Count      | 365                           | 355   | 720    |
|  | % of Total | 50.7%                         | 49.3% | 100.0% |

**Table 5.15** (Continued)

| <b>Chi-Square Tests</b> |                    |    |                       |
|-------------------------|--------------------|----|-----------------------|
|                         | Value              | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square      | 7.939 <sup>a</sup> | 2  | .019                  |
| N of Valid Cases        | 720                |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 39.44

**Source:** Primary Data, 2018.

Results (Table 5.15):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all the questions on the effectiveness from the technology transfer. In this case, N = 720, and N (Missing) is the number of responses to the question, which is 0 in this case. The sum of the responses to all questions (Total N) is 720.

B: The Cross Tabulation table shows the information obtained from the questionnaire. There were 355 responses indicating that the automotive parts manufacturers have received effective technology, representing 49.3%, and there were 365 responses to the 'transfer of technology did not contribute to effectiveness', which accounted for 50.7% of the total number of responses to the total of 18 questions.

C: Sig. Value is equal to .019, so independent variables affect dependent variables significantly.

D: The Pearson Chi-square value is calculated as 7.939, with the Degree of Freedom (DF) at level 2 with the standard value of 0.020. The confidence level is 0.99 or 99%. The value is higher than the standard. It can be concluded that the technology transferred from Car Makers did not contribute to increase effectiveness to local auto parts manufacturers.

Considering each subgroup of effectiveness from technology transfer, from the results it can be concluded that the overall results of the effectiveness from product-related technology transfer were not very different. The two answers on effectiveness from technology transfer showed more than 50% admitting that technology transfer

contributed to effectiveness through the innovations that help increase productivity and new innovation on better product quality control. The two answers on effectiveness from technology transfer with the second level of answer were that technology helps the companies to develop new approaches to innovations, cost effective innovations and creation of new products yearly or every other yearly. The answer on effectiveness from technology transfer with the lowest answer was the technology transfer helps contribute to research & development strategies.

The results from the analysis by the SPSS program are shown in the following table (See Table 5.16).

**Table 5.16** Analysis Results of Efficiency from Product-related Technology Transfer

|   | <b>Case Processing Summary</b> |         |         |         |       |         |
|---|--------------------------------|---------|---------|---------|-------|---------|
|   | Cases                          |         |         |         |       |         |
|   | Valid                          |         | Missing |         | Total |         |
|   | N                              | Percent | N       | Percent | N     | Percent |
| Answer on the efficiency<br>from product-related<br>technology transfer | 240                            | 100%    | 0       | 0.0%    | 240   | 100.0%  |

**Answer on the efficiency from product-related technology transfer  
(Crosstabulation)**

| Categories  |            | Answer of<br>technology transfer |      | Total |
|---|------------|----------------------------------|------|-------|
|   |            | No                               | Yes  |       |
| New innovations so that product<br>quality can be improved                | Count      | 20                               | 20   | 40    |
|   | % of Total | 8.3%                             | 8.3% | 16.7% |
| There are innovations that can<br>be used for increasing<br>productivity. | Count      | 19                               | 21   | 40    |
|   | % of Total | 7.9%                             | 8.8% | 16.7% |
| There are innovations that can<br>be used for reducing costs.             | Count      | 21                               | 19   | 40    |
|   | % of Total | 8.8%                             | 7.9% | 16.7% |

**Table 5.16** (Continued)

| Categories  |            | Answer of           |       | Total  |
|---|------------|---------------------|-------|--------|
|   |            | technology transfer |       |        |
|   |            | No                  | Yes   |        |
| There are new products every year or almost every year. | Count      | 22                  | 18    | 40     |
|   | % of Total | 9.2%                | 7.5%  | 16.7%  |
| There are strategies for research and development       | Count      | 25                  | 15    | 40     |
|   | % of Total | 10.4%               | 6.3%  | 16.7%  |
| There are the ways to develop new innovations.          | Count      | 23                  | 17    | 40     |
|   | % of Total | 9.6%                | 7.1%  | 16.7%  |
| <b>Total</b>  | Count      | 130                 | 110   | 240    |
|   | % of Total | 54.2%               | 45.8% | 100.0% |

| <b>Chi-Square Tests</b> |                    |    |                       |
|-------------------------|--------------------|----|-----------------------|
|                         | Value              | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square      | 2.350 <sup>a</sup> | 5  | .799                  |
| N of Valid Cases        | 240                |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.33

**Source:** Primary Data, 2018.

Results (Table 5.16):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all questions of effectiveness received from product technology transfer. In this case, N = 240, and N (Missing) is the number of faulty responses to question which is 0. The sum of the responses to all questions (Total N) is 240.

B: In the Cross Tabulation table, are the number of responses from all 16 questionnaire questions from all 40 local auto parts manufacturers which were either joint ventures with at least 50% Thai shareholders or companies with 100% Thai shareholders. There were 110 responses to the ‘technology received contributed to effectiveness’, which amounted to 45.8% while there were 130 respondents who answered that the technology received did not contribute to effectiveness, which amounted to 54.2%.

C: Sig. Value is .799, so independent variables do not significantly affect dependent variables.

D: The Pearson Chi-square value is calculated at 2.350, with the Degree of Freedom (DF) at level 2 with the standard value of 0.554. The confidence level is 0.99 or 99%. The value is higher than the standard. From this can be concluded that the transfer of technology from Car Makers does not relate to the effectiveness of the local auto parts manufactures.

Effectiveness from the Transfer of Process Technology, based on the total of two questions. Effectiveness gains from process technology transfer in the overview is a positive trend, given that the proportion of responses in the questionnaire is more than 60%, in terms of increased productivity and waste reduction from the production process. This contributed to effectiveness in many organizations. The results from the analysis by the SPSS program are shown in the following table (See Table 5.17).

**Table 5.17** Analysis of Results of Efficiency from Process-related Technology Transfer

| <b>Case Processing Summary</b>   |       |         |         |         |       |         |
|--|-------|---------|---------|---------|-------|---------|
|  | Cases |         |         |         |       |         |
|  | Valid |         | Missing |         | Total |         |
|  | N     | Percent | N       | Percent | N     | Percent |
| Answer on the efficiency<br>from management-related<br>technology transfer | 80    | 100%    | 0       | 0.0%    | 80    | 100.0%  |

| <b>Answer of the efficiency from process-related technology transfer<br/>(Crosstabulation)</b> |            |                               |       |       |
|--|------------|-------------------------------|-------|-------|
| Categories   | Count      | Answer of technology transfer |       | Total |
|  |            | No                            | Yes   |       |
| Productivity increase for<br>production  | 40         | 15                            | 25    | 40    |
|  | % of Total | 18.8%                         | 31.3% | 50.0% |

**Table 5.17** (Continued)

| Categories                                |            | Answer of technology transfer |       | Total  |
|---|------------|-------------------------------|-------|--------|
|   |            | No                            | Yes   |        |
| Reduce waste from the production process. | Count      | 14                            | 26    | 40     |
|   | % of Total | 17.5%                         | 32.5% | 50.0%  |
| <b>Total</b>                              | Count      | 29                            | 51    | 80     |
|   | % of Total | 36.3%                         | 63.8% | 100.0% |

#### Chi-Square Tests

|                    | Value             | df | Asymp. Sig. (2-sided) |
|--------------------|-------------------|----|-----------------------|
| Pearson Chi-Square | .054 <sup>a</sup> | 1  | .816                  |
| N of Valid Cases   | 80                |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.50

**Source:** Primary Data, 2018.

Results (Table 5.17):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all questions of effectiveness received from process technology transfer. In this case, N = 80, and N (Missing) is the number of faulty responses to questions which is 0. The sum of the responses to all questions (Total N) is 80.

B: In the Cross Tabulation table, there were 2 questions. From all 40 local auto parts manufacturer companies which were either joint ventures with at least 50% Thai shareholders or companies with 100% Thai shareholders, the responses from all respondents to the 'technology transfer contributed to increase effectiveness' were 51 responses, representing 63.8%, and the responses to the technology transfer did not contribute to increase effectiveness were 29 representing 36.3%.

C: Sig. Equals .816. Therefore, the independent variables do not affect the dependent variables significantly.

D: The Pearson Chi-square value is calculated as 0.054, with the Degree of Freedom (DF) at level 1 with the standard value of 0.000 with the confidence level of 0.99 or 99%. From this can be concluded that the technology that Car Makers have transferred did not contribute to increase effectiveness for local auto parts manufacturers.

For effectiveness from the transfer of management technology, the overview results were not very different. The effectiveness from the technology transfer with more than 50% responses were that technology transfer helps create production strategies which accounted for 70% of all responses, the technology transfer help create new logistic management strategies accounted for 65% of all responses, the technology transfer helps enable employees in the organization to increase capability and contribute to the development of innovation accounted for 60% of the responses, the technology transfer helps enable employees in the organization increase capability and create new strategies for the organization accounted for 55% of the responses. The effectiveness from the transfer of technology with lesser responses were ‘technology transfer helps increase the revenue of the companies due to receiving new technologies’ accounted for 47.5% of all responses, technology transfer helps the companies to create new markets and new customers by entering diversified markets, technology transfer helps the companies to create new markets and new customers by expanding their customer bases and enables the organizations to adopt new human resource management strategies accounted for 45% of all the responses. The results from the analysis by the SPSS program are shown in the following table (See Table 5.18).

**Table 5.18** Analysis of Results of Efficiency from Management-related Technology Transfer

|  | Case Processing Summary |         |         |         |       |         |
|--|-------------------------|---------|---------|---------|-------|---------|
|  | Cases                   |         |         |         |       |         |
|  | Valid                   |         | Missing |         | Total |         |
|  | N                       | Percent | N       | Percent | N     | Percent |
| Answer on the efficiency from management-related technology transfer | 400                     | 100%    | 0       | 0.0%    | 400   | 100.0%  |

**Table 5.18** (Continued)

**Answer on the efficiency from management-related technology transfer  
(Crosstabulation)**

| Categories  |            | Answer of           |      | Total |
|---|------------|---------------------|------|-------|
|   |            | technology transfer |      |       |
|   |            | No                  | Yes  |       |
| Companies can create new markets and new customers by entering different markets.           | Count      | 22                  | 18   | 40    |
|   | % of Total | 5.5%                | 4.5% | 10.0% |
| Companies can create new markets and new customers. Increase the number of customer base.   | Count      | 22                  | 18   | 40    |
|   | % of Total | 5.5%                | 4.5% | 10.0% |
| Employees in the organization are more capable and contribute to the innovation development | Count      | 16                  | 24   | 40    |
|   | % of Total | 4.0%                | 6.0% | 10.0% |
| Employees in the organization are more capable and create new strategies for organization   | Count      | 18                  | 22   | 40    |
|   | % of Total | 4.5%                | 5.5% | 10.0% |
| New strategies on the other side (if any)   | Count      | 39                  | 1    | 40    |
|   | % of Total | 9.8%                | 0.3% | 10.0% |
| The company's revenue has increased due to better management knowledge.                     | Count      | 20                  | 20   | 40    |
|   | % of Total | 5.0%                | 5.0% | 10.0% |
| The company's revenue has increased due to the acquisition of new technologies.             | Count      | 21                  | 19   | 40    |
|   | % of Total | 5.3%                | 4.8% | 10.0% |
| The organization has a new strategy for human resource management.                          | Count      | 22                  | 18   | 40    |
|   | % of Total | 5.5%                | 4.5% | 10.0% |

**Table 5.18** (Continued)

| Categories  |            | Answer of           |       | Total  |
|---|------------|---------------------|-------|--------|
|   |            | technology transfer |       |        |
|   |            | No                  | Yes   |        |
| The organization has a new strategy for logistics management. | Count      | 14                  | 26    | 40     |
|   | % of Total | 3.5%                | 6.5%  | 10.0%  |
| There is management strategy for production                   | Count      | 12                  | 28    | 40     |
|   | % of Total | 3.0%                | 7.0%  | 10.0%  |
| <b>Total</b>  | Count      | 206                 | 194   | 400    |
|   | % of Total | 51.5%               | 48.5% | 100.0% |

#### Chi-Square Tests

|                    | Value               | df | Asymp. Sig. (2-sided) |
|--------------------|---------------------|----|-----------------------|
| Pearson Chi-Square | 49.084 <sup>a</sup> | 9  | .000                  |
| N of Valid Cases   | 400                 |    |                       |

**Note:** 0 cells (0.0%) have expected count less than 5. The minimum expected count is 19.40

**Source:** Primary Data, 2018.

Results (Table 5.18):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all questions on the effectiveness from the transfer of management technology. In this case, N = 400, and N (Missing) is the number of error responses to question which is 0. The sum of the responses to all questions (Total N) is 400.

B: In the Cross Tabulation table, there were 10 questions and responses from all 40 local auto manufacturers. These companies were either joint ventures with at least 50% Thai shareholders or companies with 100% Thai shareholders. The responses from the responding companies admitting that technology transfer contributed to effectiveness was 194 responses or 48.5% and 206 responses which is 51.5% admitting that technology transfer did not contribute to effectiveness.

C: Sig value is .000, therefore independent variables affect dependent variables significantly.

D: The Pearson Chi-square is value calculated as 49.084, with the Degree of Freedom (DF) at 9, with the standard value of 2.088. The confidence level is 0.99 or 99%. The value is higher than the standard. From this can be concluded that the technology that Car Makers have transferred did not contribute to increase effectiveness for local auto parts manufacturers.

## **5.6 Data Analysis**

The Analysis of the research was conducted in 5 parts as follow: 1) Whether the Car Makers have transferred technology to local auto parts manufacturers and the types of technologies that have been transferred. 2) The methods of technology transfer. 3) Whether the technologies transferred are effective. 4) Whether the differences in the number of the Thai shareholders of the companies affect the nature of technology transfer. 5) Supportive approaches that local auto parts manufacturers require from the government or government agencies. In the analysis of the results in Part 1, 3 and Part 4, the researcher compared the answers obtained from the two methods of data collection to see whether they were in the same direction. In Part 2, the researcher used the information obtained from the questionnaire to analyze the methods used from the technology transfer. For Part 5, the researcher used the information obtained from interviews to analyze the present situation.

From the data collected from the interviews and the questionnaires, the answers given in the overview of the technology transfer were in the same direction. There were partial technology transfers and only to some companies. From the results of the interviews, companies in the sample group have received product-related and management-related technology but there was no transfer of the process-related technology. However, the results obtained from the questionnaire indicated that there was technology transfer for all 3 types of technology which were the product, process and management technology. However, the amount of received technology transfer was less than the amount of technology transfer not received. The results analyzed by the SPSS program using the Chi-square analysis model showed that the Car Makers

did not participate in the transfer of technology to local auto parts. Therefore it can be concluded that both the quantitative and qualitative data collection were in the same direction.

From the questionnaire, it can be concluded that the most common approach the Car Makers used to transfer technology to the local auto parts manufacturers is by using the Corporate Performance Review. This includes the use of evaluation forms to inform the companies of the weaknesses in their operations, along with the use of activities that Car Makers use as their working principle to increase efficiency. The seminar is the second most common method used in the transfer of knowledge. Two interesting methods which unfortunately are least commonly used are allowing the employees of the auto parts manufacturers to learn the production process and the use of various machineries in production, and the transfer of key personnel to the auto parts manufacturer companies. Both of these methods are an important activity that helps the transferees to better understand the technology.

In the overview results of effectiveness from technology transfer, the answer from interview mentioned that effectiveness in term of management is contributes to the organization. But they do not receive the effectiveness from product and process due to no technology transfer on process, and only partial knowledge of technology transfer on product which they are unable to apply to product development. On the other hand, answers used in the analysis collected from the questionnaire show that the amount of technology transfer that does not contribute to effectiveness is higher than the amount of technology transfer that contributes to effectiveness. So, the answers are in the same direction both qualitatively and quantitatively. Considering details of the questionnaire, the subgroups of each group of effectiveness from technology transfer, the results can be concluded as follows: 1) effectiveness from the transfer of product-related technology the local auto parts manufacturers received was the innovation that helps increase productivity and better quality control of the products with the least contribution to the research and development strategies. 2) The overview results for effectiveness from the transfer of process-related technology, on the other hand, were in the opposite direction. The answers from the respondents showed that there was more transfer of technology that contributed to effectiveness than the technology transfer that did not contribute to higher effectiveness. The

effectiveness gained through process-related technology transfer is the increase in productivity in production and waste reduction in production processes which contributed to increase effectiveness in many organizations.

The results from the respondents showed that the amount of technology transfer that contributed to effectiveness was less than the amount of technology transfer that did not contribute to effectiveness. The effectiveness from the transfer of management technology includes production management strategies, new strategies for logistics management, employees with increase capabilities that encourage the development of new innovations as well as create new strategies for the organization, and increase in revenue as a result of better management knowledge.

Therefore it can be concluded that the transfer of technology from Car Makers to local auto parts manufacturers does happen in the Thai automotive industry although not in all sections as mentioned above. The local auto parts manufacturers must be responsible for their own development although they may receive some technology transfer from the Car Makers whether in the product, process or management technology to be able to keep up with the ever changing modern world. In the development of product technology, the auto parts manufacturers who do not develop their own products may either form joint ventures with foreign companies to encourage the transfer of product development knowledge or hire specialists in product development as their employees. The potential benefits from increasing capabilities by performing their own product development may help the companies to avoid severe price competition as well as allowing the companies to expand into the Global Platform for worldwide production. The changing nature of operations from produce and sell in the same country to the Global Platform, which uses the same quality standards worldwide, is one of the main factors that increase difficulties in the market competition. The companies without their own technology may have to be in the later part of the supply chain, faced with severe price competition. This may not only be true in term of domestic price competition but may also be at the international level as well. Companies in other countries with sufficient potential to produce the same product may become new competitors resulting in more difficult business operations. In the development process technology, the business owners, executives, and employees need to keep up with new production processes to apply to the

organizations. They may visit others manufacturing plants abroad as well as visiting exhibitions around the world to bring the observed knowledge back to strengthen their own production process, such as the application of Internet of Things (IoT) to the production system to acknowledge the real time information for the production of their manufacturing plants worldwide. Due to the changing global market environment, the competition in the market has changed. In the past, the Car Makers designed and developed products but in the current market situation the suppliers would be the ones responsible for innovations and developments of new technologies leading to the increasing value of products of the Car Makers. In the development of management technology, the companies used the management knowledge they have had transferred to widen their span of knowledge to be more professional. Management systems do not only help with the capability development of an organization but they also help in terms of cost reduction as well. Good management creates efficiency; eliminate losses resulting in zero waste which leads to cost-effective operation.

In the area of product-related technology transfer, the results obtained from the interviews and the questionnaires were in the same direction. Car Makers have transferred product-related technology but only to some companies. Not every company has received technology transfer due to the differences in business conditions. Some companies have their own technology while other companies only manufacture according to the designs from Car Makers. Based on interview data, the companies with their own technology mostly received technology transfer from their overseas joint venture or by importing the technology, paying the Technical Assistance (TA) cost to the owners of the technology or by outsourcing experienced professionals as employees of the companies to encourage technology transfer in product development. Nowadays, companies with their own technology are not receiving new technology from Car Makers. On the other hand, the Car Makers depend on these companies for the development of new and more modern component parts. The Car Makers may be involved in designing the appearance of the products and inform the auto parts manufacturers of their requirements to ensure that the product development would meet the needs of both the current and the future markets. The companies that mainly subcontract from the Car Makers receive drawings of the

product from the Car Makers after the price auction. If the company is subcontracted, the Car Makers would give a detailed description or key position of the component parts. Discussion on the details of the component parts is to minimize the errors that may occur in the production. Therefore, the knowledge received is only partial, not the overall knowledge on the design of each component parts. The Car Makers do not disclose the ideas behind the Design, the reason behind the utility or the principles behind the design of the component parts. These knowledge types are not transferred. In production from prototype, many auto parts manufacturers are doing well in this area. Nevertheless, product development requires a good foundation in the design, whether it is the theme of the design, the utility system design of the product that is appropriate and safe for consumers, materials selection for the product, procedure and production process of each product to achieve the complete product that can be used effectively and efficiently and satisfy the consumers in the market. However, the auto parts manufacturers which produce according to the Drawings face a severe price competition because the Car Makers can find the auto parts manufacturers with similar level of production capabilities and compare their prices to allow the Car Makers to have the lowest possible production costs. Then the Car Makers would evaluate the standard of the production system to ensure that the auto parts manufacturers are capable of producing the product according to the quality required. Therefore, the auto parts manufacturers which produce according to the drawings need to differentiate themselves from the current situation for future development. The data obtained from the analysis of the questionnaire suggested that Car Makers did not participate in the transfer of product technology to local auto parts manufacturers. Product technology is a corporate secret because it helps increase competitiveness as well as enabling the organizations to increase their capability which in turn increases the chance of their survival. Therefore, technology transfer to outside the organization has a very small chance of occurring or none at all. Therefore, the auto parts manufacturer companies must find a way to increase their product technology to create sustainable development and increase the chances of survival in the future.

The different proportion of Thai shareholders for both types of company between joint ventures with at least 50% Thai shareholders and companies with 100%

Thai shareholders, showed in the results of the interviews that the differences between the proportion of Thai shareholders did not affect the transfer of technology from Car Makers. The results from the questionnaire on the same issue apparently went in the same direction. The results showed that the different proportion of Thai shareholders in the companies did not affect technology transfer. The results of both types of data collection concluded that they were in the same direction, that the different nature in proportion of Thai shareholders of the companies does not any affect on the transfer of technology from Car Makers to the auto parts manufacturers. The transfer of technology depends more on whether the companies have their own technology or not. If the companies have their own technology, they may develop a new product and present it to the Car Makers. If the Car Makers are interested and the price is acceptable, the Car Makers may co-design with the auto parts manufacturers. This helps the manufacturers to avoid severe price competition as well as increase the opportunity to be subcontracted in the production more than other auto parts manufacturers. However, if the auto parts manufacturers are subcontracted to produce from the drawings from the Car Makers, they may suffer from severe price competition, especially with manufacturers in other countries with lower level wages. The results from interviews on the conditions of technology transfer are as mentioned above. The analytical results from the questionnaire, the researcher used Cross Tabulation to clearly display the results as shown in the table below (See Table 5.19).

**Table 5.19** Shareholder vs. Product Technology Transfer

|  | <b>Case Processing Summary</b> |         |         |         |       |         |
|--|--------------------------------|---------|---------|---------|-------|---------|
|  | Cases                          |         |         |         |       |         |
|  | Valid                          |         | Missing |         | Total |         |
|  | N                              | Percent | N       | Percent | N     | Percent |
| Shareholder vs. Product<br>technology transfer | 360                            | 100%    | 0       | 0.0%    | 360   | 100.0%  |

**Table 5.19** (Continued)

| <b>Answer of Shareholder vs. Product technology transfer (Crosstabulation)</b> |            |                               |       |        |
|--|------------|-------------------------------|-------|--------|
| Categories   |            | Answer of technology transfer |       | Total  |
|  |            | No                            | Yes   |        |
| Thai J/V   | Count      | 139                           | 32    | 171    |
|  | % of Total | 38.6%                         | 8.9%  | 47.5%  |
| Thai 100%  | Count      | 138                           | 51    | 189    |
|  | % of Total | 38.3%                         | 14.2% | 52.5%  |
| <b>Total</b>   | Count      | 277                           | 83    | 360    |
|  | % of Total | 76.9%                         | 23.1% | 100.0% |

**Source:** Primary Data, 2018.

Results (Table 5.19):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all Technology Transfer questions. In this case, N = 360 responses, and N (Missing) is the number of responses to the faulty question which is 0. The sum of the responses to all questions (Total N) is 360.

B: The Cross Tabulation table shows the proportion of joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders that there is no difference between the two in terms of technology transfer. The proportion of technology transfer of the two types of companies is in the same direction. The proportion with no technology transfer is more than the proportion with technology transfer. There were 32 responses from the joint ventures to receiving the transfer of product technology which accounted for 8.9%, and 51 responses or 14.2% from the wholly owned Thai companies to receiving technology transfer. From the joint ventures, there were 139 responses or 38.6% to not receiving technology transfer, and 138 responses or 38.3% from the wholly owned Thai companies to not receiving technology transfer from the Car Makers.

In the area of process technology transfer, there were 2 types of results from the interviews and questionnaires. The results from the interviews were that the local

auto parts manufacturers did not receive process technology transfer while the results from the questionnaire were that some companies have received the transfer of process technology in the areas of knowledge transfer on the appropriate production process, knowledge transfer in monitoring for productivity improvement, knowledge transfer on how to utilize the machine to full capacities, and knowledge transfer on loss reduction methods to increase productivity. These issues were the methods of operation improvement in the production process but the issues in the transfer of the quality control process, the transfer of the production process and the transfer of evaluation process which were the basic knowledge of development, none of the companies in this sample group have received transfer of these kinds of knowledge. The results were in the same direction as the results from the interviews. One of the reasons may be that the Car Makers did not develop the component parts by themselves. Therefore, the Car Makers did not have the technology on the production process to transfer to the local auto parts manufacturers. Another reason may be due to the fact that the auto parts manufacturers must already have the technology necessary for the production which assured the Car Makers of their sufficient skills in the production of the component parts. Therefore, the transfer of process technology in the production of new products did not occur. Nevertheless, the technology that has been transferred was production process improvement because improvement in the production processes may benefit the Car Makers in the future cost reduction by decreasing the cost of each component part.

Considering the nature of companies with different proportions in Thai shareholders, the results of both types of data collections is in the same direction - that the differences in proportion of Thai shareholders do not have any effect on the transfer of process technology. The results from the interviews with both the joint venture and the wholly owned Thai companies show that there was no technology transfer for both types of companies. The results from the questionnaire from both the joint ventures and the wholly owned Thai companies show that both types of companies were similar in term of the technology they have had transferred such as the transfer of quality control process, production process and testing process. From the analysis by the SPSS program, the researcher used Cross Tabulation to display the results as shown in the table below (See Table 5.20).

**Table 5.20** Shareholder vs. Process Technology Transfer

|  | <b>Case Processing Summary</b> |         |         |         |       |         |
|--|--------------------------------|---------|---------|---------|-------|---------|
|  | Cases                          |         |         |         |       |         |
|  | Valid                          |         | Missing |         | Total |         |
|  | N                              | Percent | N       | Percent | N     | Percent |
| Shareholder vs. Process<br>technology transfer | 280                            | 100%    | 0       | 0.0%    | 280   | 100.0%  |

| <b>Answer of Shareholder vs. Process technology transfer (Crosstabulation)</b> |            |                                  |       |        |
|--|------------|----------------------------------|-------|--------|
| Categories   |            | Answer of<br>technology transfer |       | Total  |
|  |            | No                               | Yes   |        |
| Thai J/V   | Count      | 94                               | 39    | 133    |
|  | % of Total | 33.6%                            | 13.9% | 47.5%  |
| Thai 100%  | Count      | 84                               | 63    | 147    |
|  | % of Total | 30.0%                            | 22.5% | 52.5%  |
| <b>Total</b>   | Count      | 178                              | 102   | 280    |
|  | % of Total | 63.6%                            | 36.4% | 100.0% |

**Source:** Primary Data, 2018.

Results (Table 5.20):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all Technology Transfer questions. In this case, N = 280, and N (Missing) is the number of faulty responses to the question which is 0. The sum of the responses to all questions (Total N) is 280.

B: The Cross Tabulation table shows there are no differences in the proportion of technology transfer between joint ventures with at least 50% Thai shareholders and companies with 100% Thai shareholders. The proportion of technology transfer for both types of companies is in the same direction in that the proportion of not receiving technology transfer is higher than the proportion that have received technology

transfer. There were 39 responses or 13.9% from the joint ventures and 63 responses or 22.5% from the wholly owned Thai companies declaring that they have received technology transfer while there were 94 responses or 33.6% from the joint ventures and 84 responses or 30% from the wholly owned Thai companies admitting they did not receive technology transfer from the Car Makers.

For the transfer of management technology, the results of the interviews and the questionnaires were in the same direction. Although, local auto manufacturers have received the transfer of management technology, the technology was purely on production management. The knowledge on internal organization management, however, was not transferred as shown from the results of both methods of data collection.

The transfer of management technology is one of an important part of business cooperation with the Car Makers because the auto parts manufacturers must conduct the activities that the Car Makers asked for in order to encourage efficiency in quality, price and delivery. Technology transfer in production management, such as Toyota Production System (TPS), Lean System or 5S management (5S) is the management system to achieve efficiency in the production process. This helps to reduce the costs of production in order to gain full efficiency of the output and zero waste in the production process. These systems also help the auto parts manufacturers to manage with more accuracy and help encourage the companies to increase their brand value and reputation due to their professional operations. Moreover, these various management systems also contribute to the development of human capital for more detailed and systematic thinking. The transfer of management technology is an important part that helps local companies to develop their potential in preparation for entering the global markets by developing the management of the organization to meet the standards accepted worldwide. In the automotive industry, the management standards used are the ISO/TS16949 or ISO/IATF16949 which is the new standard for the automotive industry, active since 2017. In the past, companies in Tier 1 required ISO / TS16949 to be able to operate with Car Makers. If the companies want to operate in the Global Platform, they must have a very high accuracy operational standard, because the Global Platform model is part of the global assembly process under the same standard. As a result, if the companies do not have sufficient efficiency in management systems, it can cause significant damage to Car Makers.

The differences in the proportion of Thai shareholders do not affect the transfer of management technology as with the transfer of other types of technology as had been shown by the results of the interviews and the questionnaires. Both types of companies, the joint venture and the wholly owned Thai companies, have received the same types of technology as well as not having received transfer of the same types of technology. An example of the technology transferred is the technology related to organizational management. The overall result of other types of technology is in the same direction. Both types of companies have received and not received similar technologies. The analysis of the results from the questionnaire on the different proportion of Thai shareholders by the SPSS program is shown in the table below (See Table 5.21).

**Table 5.21** Shareholder vs. Management Technology Transfer

| <b>Case Processing Summary</b>                       |       |         |         |         |       |         |
|--|-------|---------|---------|---------|-------|---------|
|  | Cases |         |         |         |       |         |
|  | Valid |         | Missing |         | Total |         |
|  | N     | Percent | N       | Percent | N     | Percent |
| Shareholder vs.<br>Management technology<br>transfer | 480   | 100%    | 0       | 0.0%    | 480   | 100.0%  |

| <b>Answer on Shareholder vs. Management technology transfer (Crosstabulation)</b> |                                  |        |       |        |     |
|---|----------------------------------|--------|-------|--------|-----|
| Categories  | Answer of<br>technology transfer |        |       | Total  |     |
|   |                                  |        | No    |        | Yes |
|   | Count                            | %      | Count |        | %   |
| Thai J/V  | 151                              | 31.5%  | 77    | 16.0%  |     |
| Thai 100%   | 158                              | 32.9%  | 94    | 19.6%  |     |
| <b>Total</b>  | 309                              | 64.4%  | 171   | 35.6%  |     |
|   | 480                              | 100.0% | 480   | 100.0% |     |

**Source:** Primary Data, 2018.

Results (Table 5.21):

A: From the Case Processing Summary table, N (Valid) is the number of responses to all Technology Transfer questions. In this case, N = 480 responses. The N (Missing) is the number of faulty responses to the question which is 0. The sum of the responses to all questions (Total N) is 480.

B: The Cross Tabulation table shows the different proportion of Thai shareholders of joint ventures with at least 50% Thai shareholders and the companies with 100% Thai shareholders have no effect in the proportion of technology transfer. The types and proportion of technology transfer for both types of companies were in the same direction, that the proportion not receiving technology transfer was higher than the proportion receiving technology transfer. There were 77 responses or 16% from the joint ventures and 94 responses or 19.6% from the Thai companies admitting that there was transfer of process technology while there were 151 responses or 31.5% from the joint ventures and 158 responses or 32.9% from the Thai companies declaring that there was no technology from the Car Makers.

Based on the analysis mentioned above, it can be concluded that the different types of companies between the joint venture and the companies with 100% Thai shareholders do not have any effect on technology transfer from the Car Makers. However, the joint ventures seem to have advantages in the cooperation with the Car Makers because most of the partner companies are located either in the same countries or the same continents as Car Makers. These companies can easily and conveniently contact the Research and Development department of the Head Quarter of the Car Makers. Moreover, they may be using the same language in communications which encourage more trust and understanding as well as more detailed explanations of the information.

This last section is the analysis of the supportive approach that local auto parts manufacturers require from the government or government agencies. However, only some companies in the sample group made suggestions in this part. From the current situation, the most identified problem from the companies in the sample group is the insufficient skill in English language of their employees. This is the case for many Thai companies. Due to poor English language skill, the transfer of knowledge from foreigners is ineffective. The employees cannot clearly understand what the foreigners

try to communicate as well as being unable to ask questions on what they do not understand. In addition, the level of mathematical knowledge in Thailand is low compared to developed countries. If Thailand wants to further develop in the field of engineering, it is necessary to improve the level of education to be more effective. Then the engineers in Thailand would have higher skills as well as being more prepared to accept the technology that flows in. Currently, the auto parts manufacturers in Thailand are good at producing imitation of the prototypes. Due to the lower level of skills, the auto parts manufacturers in Thailand are not trained in product design. Moreover, there are innovation agencies in Thailand. The government should provide the personnel working in these agencies with sufficient income and benefits to encourage them to create innovations with the private sector, to prevent them from choosing to work in private organizations due to the issue of income.

The researcher agrees with the conclusion mentioned above. The question here is what can be done to create effectiveness in development. Consideration may be given to the Thai education system and the teaching style compared to the education system of developed countries, to improve and adjust the level of skills, ideas and perspectives in various aspects.

## **5.7 Criticism of Automotive Industrial Development Policy and Strategic Plan for Ministry of Industry**

### **5.7.1 Automotive Industrial Development Policy**

Automotive Industrial Development Policy consists of 4 approaches in developing Automotive and Automotive parts Industry which are 1) Skill Development to Improve Productivity and Support for Future Technologies 2) Product development and the development of production processes to improve competitiveness of the country and promote the use of domestic technology 3) Linking Industries to Stabilize Upstream Raw Materials for the Expansion of the Automotive and Automotive parts Industries. 4) Upgrading Infrastructure to improve the competitiveness of Thai entrepreneurs. All 4 approaches are essential in the development of the automotive industry.

Although the first approach deals with networking between academic institutions and industrial sector to improve productivity and support future technologies, the government should also consider the courses required in the development to promote true knowledge and understanding in the subject in order to produce experts in all fields.

The second approach, Product development requires a large budget. Only companies with sufficient working capital are capable of product development. Small and medium-sized enterprises (SMEs) may find it difficult to perform their own product development without government subsidies or other supporting factors. In addition, high-tech products often require high-tech machinery in production. These machines are normally expensive. Small and medium-sized enterprises (SMEs) may also have difficulty in investing in these high-tech machineries.

In the third approach, at present, Upstream Raw Materials in Automotive and Automotive parts Industries are steel and intermediate metals. However, Innovations in the automotive industry have continually been developed in order to save energy and reduce costs. It is imperative to consider how important steel and metal will be in the future and at the same time considering the appropriate materials to develop future products.

The fourth approach, elevating the infrastructure of the country as a whole is a good element for industrial development. However, increasing the potential of all Thai entrepreneurs to the same level can be difficult as each entrepreneur has different budgets for development. Larger companies may have more budgets which allow them to invest more in research and development. They also have larger capital to invest in more effective and more advanced machinery as well as hiring experts to help in their development. Small and medium-sized companies may not have sufficient budget for these costs of development.

In addition to the automotive industrial development policy mentioned above, the economic policy of the country is one factor that builds up the confidence of investors. Clear Long-term policies help build up confidence among investors, especially main policies such as labor policy and tax policy. Political stability and transparency of the country is another important factor that investors seriously take into consideration when investing in a country.

### **5.7.2 Strategic Plan for Ministry of Industry**

The government has set the framework of the 12th National Economic and Social Development Plan for the development of the industrial sector as follows: 1) Overall economic development, 2) Sectoral economic development, 3) Agricultural development towards Food excellence, 4) Development of human potential and good quality of life, 5) Equality, 6) Regional Development and Linkage 7) Creating eco-friendly economic and social growth.

However, in order for the framework in each of these areas to be successful, domestic personnel must have sufficient potential. In the view of the researcher, the government should set its priority as the development of human potential and the quality of life. The government may continue to develop in various aspects such as improving its infrastructure, supporting the industrial production base for overall economic development, promoting research and development in science and technology or developing labor productivity. All of these developments may fail or may not reach the level of satisfactory success due to inadequate basic skills of domestic personnel to learn and/or make use of and further develop new knowledge and technology. Therefore the development of human potential, including upgrading the quality of education and learning, the development of education systems and the quality of teachers, along with promoting family happiness and welfare, helps enhance the quality of people in the country. This is the reason the government should set its priority on personnel development before the other areas of development.

In terms of policies in promoting SMEs, the government should emphasize developing innovative products and products within the needs of the market. The government should issue supporting measures for SMEs that run their own research and development. The examples of these measures are tax measures, marketing measures and cooperation between public and private sectors to enhance development ideas to increase the potential and strengthen the business of SMEs.

In addition, Adjustment of the Cluster of the inbound investment group may help open a market to SMEs. For example, the automotive industry can be classified into three major groups consisting of Car Makers group, Tier 1 group and Tier 2&3 group. If the investment promotion policy encourages less foreign direct investment in Tier 2&3, the SMEs in the automotive industry may have a better market situation.

This, in turn, would help provide them with more capital for innovation development and improvement of the production system for higher productivity and efficiency. SMEs in the automotive industry must be able to produce quality products in a consistent manner to meet the goals of national development.

Measures to increase the revenue of SMEs should not be limited to providing financial sources, tax measures and increasing capacity of SMEs but also include providing the short-term and long-term markets.

## **CHAPTER 6**

### **CONCLUSION**

#### **6.1 Conclusion**

Many developing countries are trying to attract foreign investors by granting privileges to the investors in their countries. One of the positive impacts which is an important factor in the development of a country is technology transfer. Technology is one of the factors that improve competitiveness. When referring to technology transfer, it is believed that foreign direct investment is one of the channels for the transfer of technology. In developing countries, there is a need for technology development, but unfortunately there is not enough capital. Therefore, developing countries need the transfer of technology from developed countries in order to stimulate various kinds of development in their countries.

The purposes of this research are to study whether local automotive parts manufacturing companies in Thailand have received technology transfer from Car Maker companies. If the local automotive parts manufacturing companies have received technology transfer, what types of technology have local companies received from the Car Makers? what methods have been used in the transfer of technology? and has the technology that has been transferred been effective and beneficial to the organization? Does the nature of the companies affect the technology transfer? What are the supportive approaches expected from the government for sustainable development in Thai industry?

For research in the transfer of technology from Car Makers to local auto parts manufacturers, the researcher collected data from interviews and questionnaires to collect information on the current situation in the automotive industry, especially the manufacturers in Tier1. The companies in Tier1 are the auto parts manufactures who produce the parts directly for Car Makers. Companies in this group can be divided into four types by the proportion of shareholders. These four types of companies are

companies with 100% foreign shareholders, companies with more than 50% foreign shareholders, companies with more than 50% Thai shareholders and companies with 100% Thai shareholders. In this research, the researcher chose to study only the companies in Tier 1 with the proportion of more than 50% Thai shareholders and 100% shareholders. The study does not include companies with 100% foreign shareholders and companies with more than 50% foreign shareholders as the study emphasized local businesses. There were two methods of data collection in this research which were interview and questionnaire. 16 interviews were conducted and 40 questionnaires collected.

The results of the interviews showed that the companies in the sample group received technology transfer in the areas of product and management but not in the area of process-related technology. The results from the questionnaire, by contrast, showed that there was technology transfer in all 3 types of technology, product, process and management although the number of technology transfers was lower than the number of no technology transfer.

On methods of technology transfer, the researcher analyzed the data from the questionnaire and concluded that the most common method the Car Makers used to transfer technology to the local auto parts manufacturers was the operational reviews across organizations. This included the use of evaluation forms to make the companies aware of the weaknesses in their operations and use the activities the Car Makers used as their work principle to improve efficiency of their suppliers. The second most common method used was the transfer of knowledge by seminars. There were two other interesting methods but they were least commonly used. They were allowing the employees of the component parts manufacturers to learn the production processes and the usage of machinery in production, and the transfer of key personnel to the auto parts manufacturers. Both of these methods can help those receiving the technology to understand it better, but unfortunately they are rarely used.

In terms of the efficiency gained from technology transfer, the overall result concludes that the transfer of technology that does not contribute to increase effectiveness is greater than the transfer of technology that contributed to increase efficiency.

Regarding different characteristics of the companies, it can be concluded that the differences in proportion of Thai shareholders between the joint ventures and the wholly owned Thai companies does not affect the technology transfer from Car Makers. The results from the interviews, in the overview, showed that the different nature of the companies between joint ventures with more than 50% Thai shareholders and the companies with 100% Thai shareholders was not related to technology transfer from Car Makers. The results from the questionnaire were in the same direction. They also showed that the different proportion of Thai shareholders of the companies has no relation to technology transfer.

Regarding supportive approach, the government should improve education systems, especially in language courses, engineering courses, and mathematics courses. Moreover, government should support the personnel working on creating new innovations with sufficient income and benefits to encourage them in working for the country.

## **6.2 The Viewpoint of the Researcher**

In the past, most of the auto parts manufacturers in Thailand began their manufacturing for Car Makers by two main approaches which were manufacturing by the design of Car Makers and by supplying Technical Assistance or TA to the owners of the technology. In the first approach, the Car Makers designed the product and sent the drawings to the auto parts manufacturers. Then the auto parts manufacturers would study the information in the drawings and prepare for the production of the component parts through production process planning, machine selection, Jig and Fixture designing, inspection methods for quality standards, human resource planning, and budget and investment planning. After that, the auto parts manufacturers would bring all the information they from their planning and present it to the Car Makers for approval for the production. In Jig-Fixture designing or the usages of the program of the machine in production, the auto parts manufacturers need the knowledge of the key important points of each component parts such as raw materials, appropriate equipment in the operation, equipment and related operating procedures. Therefore, the designing companies need to transfer the knowledge to the auto parts

manufacturer, especially on the key points of the component parts as well as explain the reasons behind the designs. This enables the employees of the auto parts manufacturers to clearly understand the key points of the designs. In addition, the local auto parts manufacturers need to have the knowledge of the production process of a specific product because they cannot rely solely on the Car Makers. Moreover, the Car Makers need to be certain that the companies they subcontracted have sufficient knowledge to produce the parts as well as having the ability to solve problems as they occur to eliminate all possible risks to the assembly line. In the second approach, the auto parts manufacturers paid for the Technical Assistance or TA to the overseas companies that owned the proprietary rights of the products. This type of operation allowed the auto parts manufacturers to acquire technology in product design and production. This enabled them to learn the technology to produce the product thoroughly which led to further development in product design and product development. Both of these approaches have led to the transfer of technology. In the case of production from the designs, the auto parts manufacturers have had transferred technology from the Car Makers, but not all. This might happen because employees of the Car Makers may be knowledgeable in the production process but do not have the basic knowledge in product design, so they cannot transfer knowledge to the local auto parts manufacturers. In the case of the companies paying for Technical Assistance (TA) to the proprietary right owner, this led to the transfer of technology as well as knowledge on product design of the specific products which allowed the companies to further develop from these knowledges. In the field of management, Car Makers have tried to transfer the knowledge on management to all of their suppliers as this might affect the market and production of the Car Makers. If there were defects in quality or delivery, this could cause a huge impact on the Car Makers. The transfer of management technology from Car Makers happened through various operational forms and activities. Management systems are useful because they can be used to trace back data as well as analyze all the problems.

Apart from the technology transfer mentioned above, considering the nature of the markets, which was producing according to the specification of each country, the separate production in each country is more reasonable. This factor helped local auto parts manufacturers to turn into Tier 1 companies with stronger business operation.

However, to become a Tier 1 company, the companies were required to meet the ISO/TS 16949 standard or ISO/IATF16949 in the present, which was the standard used in the automotive industry.

Currently, most auto parts manufacturers in Thailand continue to manufacture car parts for Car Makers by two main approaches which are producing from the drawings of Car Makers and producing by using their own technology. In the first case, the Car Makers design the product and send the drawings to the auto parts manufacturers. Then the manufacturers study the information in the drawings and prepare for the production of each component part as they have been in the past. In the second case, the auto parts manufacturers use their acquired technology which may come from paying for technical assistance in the past or hiring a specialist in the specific production or forming joint ventures with a specific company in the production. The current situation is different from the past, because nowadays, Car Makers assign their suppliers to perform product development. Therefore at present, technology transfer from Car Makers mostly does not occur. Since the Car Makers are no longer responsible for their own product development, there would be no production process technology to transfer to the auto parts manufacturers. As the auto parts manufacturers develop their own car parts technology, they would in fact be more knowledgeable than the Car Makers, who bring the component parts into assembly. However In the fields of management, Car Makers try to transfer the knowledge of management to all of their suppliers as this is the part that affects the market and production of the Car Makers as in the past. There may be more managerial activities than in the past due to the emphasis on human resource development and increasing potential of the operation.

Considering the current market pattern, the pattern of marketing has changed as 1) the Car Makers focus more on marketing and therefore push the responsibility of product development of sub component parts to their suppliers. These suppliers have to present the products they have developed to the Car Makers. If the Car Makers find the products interesting, they would then co-design with the manufacturers of the parts. 2) The current form of production has changed from producing for a particular country to the Global Platform production. This is production with the same standard used throughout the world. Many Car Makers have to change their operational model

to accommodate the change by assigning their main suppliers to perform all the processes needed to produce the complete component parts ready to be assembled. 3) Higher performance standards due to the change from ISO / TS16949 to ISO / IATF16949. This new standard complies with the ISO9001: 2006 standards which the Tier 1 auto parts manufacturers are required to upgrade to meet the standards.

The change may cause various problems to many local auto parts manufacturers. For example, the Global Platform model which is the model that sets the same standard and quality of production worldwide. As a result, the Global Platform model controls the auto parts manufacturers around the world to operate on the same basis. Companies that want to participate in the global economy have to push themselves to be part of the Global Platform. A joint venture company may have a greater opportunity when facing such conditions. A company with its own technology, but without manufacturing facilities located abroad may find it hard to enter the Global Platform. In some cases, the Car Makers that do not perform their own product design would let the suppliers with their own technology present their products. In other cases, even if the suppliers have their own technology, the Car Makers may not do business with them because the Car Makers may have formed a joint venture or have their own affiliates to produce the particular parts. The Car Makers may let the auto parts manufacturers present the products just to compare prices.

Therefore most manufacturers in Tier 1 need to adapt to the changing environment. Some companies that subcontract to produce by drawings must try to develop their own knowledge and capabilities by starting to develop their own products. Having their own products does not mean doing an OEM business, but they can also expand into the after-market. In addition, cooperation with foreign companies is another method that helps local auto parts manufacturers to expand their markets. The local auto parts manufacturers must have an ongoing development in various fields including production process development and management development. The local auto parts manufacturers can no longer operate on their original principle in the current market situation because of the changing competitive environment including the increasing standards of the automotive industry.

At present, many Thai auto parts manufacturers can develop new technologies and innovations. This may be due to sufficient profits. Therefore there is more capital to spend on the research and development of technology in various fields. This contributes to the competitiveness of the companies. Another reason may be due to the joint investment with foreign companies which encourages development. The local auto parts manufacturers can be divided into 3 types which are manufacturers with their own innovations and global production base, manufacturers with their own innovations, but without a global production base and the auto parts manufacturers that only perform subcontracting. The second type of companies usually partnered with other foreign companies. However, the changing model of the operation causes the second and third types of manufacturers to face many problems. Location restrictions make it hard for the manufacturers to respond to the delivery system of the particular country or continent. Limitations due to the absence of manufacturing facilities or partners in that country or continent which obstruct them from responding to the Global Platform. Although some of the Car Makers have not yet begun to form the Global Platform which may benefit the local companies that only rely on subcontracting, it is not possible to predict when the operating model will change. Last but not least, all the companies that invest are still seeking to maximize their profit which falls into the principles of Capitalism.

From the viewpoint of the researcher, FDI (spell out) is a way to increase the competitiveness of developed countries. FDI may provide the potential benefits of technology transfer but not all companies that make direct investments abroad would provide benefit in terms of technology transfer. This is because technology transfer depends on many factors and whether the company may already have knowledge of the technology required, the nature of the operation and the different policies of each company. This leads to different value added approaches. Nevertheless, FDI has stimulated the need for development in local companies due to the changing marketing style. This is part of the reason that encourages the companies in Thailand to continuously develop. Technology is one of the factors that enhance competitiveness and increase the value of the product as well as possibly reducing the severity of price competition. Therefore companies with their own technology would be competitive as well as would being able to avoid severe price competition. This

encourages businesses in Thailand to develop more. In particular, the changing marketing model such as the global platform, results in the decrease of number of players in the market. The use of Global Platform has caused many local companies to experience increasingly intense competition and makes it harder to become part of the leading manufacturers or the Tier 1 group. Therefore, that foreign direct investment contribute to technology transfer is not always true. Technology is still a secret to be guarded for some companies. It is difficult for these companies to transfer technology seriously without any mutual benefit or without the rules or regulation of the recipient countries. When the investor consider investing in a country, if there are such rules and regulations, the investors would make careful consideration of the level of risk at stake to comply with the regulations of the host country as these factors affect the future competitiveness of the company. However, as the current technology transfer may not occur from the proprietor, it may be possible for potential partners to transfer technology to their customers. The important issue here is whether the technology that enters the markets can respond to the needs of consumers at the price that the overall consumer can reach.

The researcher agrees that government policies that focus on technology development, contribute to sustainable growth. In addition, education is a very important issue as it is the foundation of learning, developing and creating technologies. Today there are many education technologies that are widely used. For example, there are many ways in which we can receive information, such as the internet and other types of media. The question here is how these technologies can be used to satisfy the consumers and how much of them are demanded by the consumers. Technology that does not respond to the current needs of consumers may be lost or it may respond to future consumer demand. Therefore it is not necessary that the current technology will respond to the needs in the future but the current technology may be an important foundation for future technology. Technology is dynamic therefore the users must have the understanding and the ability to meet the needs of the market.

## **6.3 Policy Recommendation**

### **6.3.1 Improvement on Education System and Policy**

According to the result of interviews, due to the poor English language skill of personnel the transfer of knowledge from foreigners is ineffective. In addition, the level of mathematical knowledge in Thailand is low compared to developed countries. If Thailand wants to further develop in the field of engineering, it is necessary to improve the level of education to be more effective. Then the engineers in Thailand would have higher skills as well as being more prepared to accept the technology that flows in.

For innovation and technology development in the country, the government should develop the education system emphasizing creating personnel to support new technologies that would lead to more advanced technology, such as sending personnel to study new technology overseas along with planning on how to make the knowledge available for domestic personnel and young people to benefit in the most effective way. Moreover, the government should review the quality of the current education system and methods to improve it in order to achieve the sustainable development goals of Thailand.

### **6.3.2 Adjustment of Investment Policy**

The government should consider the balance of FDI in the automotive industry, and whether there are advantages and disadvantages if the number of FDI companies in Tier 1, Tier 2 & 3 changes.

If there are less FDI companies in Tier 2 & 3, there would be more opportunity for local automotive parts manufacturers as there are less players in the market.

More business, in turn, would help provide them with more capital for innovation development and improvement of the production system for higher productivity and efficiency.

Apart from the balance of FDI and the local automotive parts manufacturers in the market, the government should also consider promoting joint-venture investment due to the gradually change of market platform to global platform.

In order for the local automotive part manufacturers to remain in the supply chain of automotive industry, they need to find joint venture companies to partner with, for the benefit of markets development, products development, and new innovation.

### **6.3.3 Develop the Policy to Encourage Local Automotive Part Manufacturers to Invest More in Research and Development (R&D)**

The cost of Research and Development is very high which is the main obstacle for local automotive part manufacturers, especially local SMEs business to perform R&D. Therefore, the government should consider the policy to support and persuade the local automotive parts manufacturer to do R&D, such as, enterprise tax-reduction when they employ specialists for products development, or tax-reduction if enterprises achieve new product innovation.

### **6.3.4 Improvement on General Policy**

When investors want to invest in a country, they will consider to General policy of the country. If general policy of that country is quite stable and transparent, especially on enterprise tax and labour cost policy, the investor will consider that country more favorably than others.

## **6.4 Limitation and Suggestion for Future Research**

In this research, we investigated the transfer of technology between Car Makers and local Tier 1 manufacturers. The study does not cover the transfer of technology from joint ventures or companies in Tier 2 & 3 that may receive technology from companies in Tier 1, which is a 100% foreign investment or a joint venture with more than 50% foreign ownership. This study may continue in the future to stimulate development throughout the supply chain in the automotive industry. It can also be used to study other businesses that are important to Thailand.

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## **APPENDICES**

**APPENDIX A**

**QUESTIONS FOR INTERVIEW**

## **QUESTIONS FOR INTERVIEW**

### **Technology Transfer Received from Car Makers**

1. Is there a transfer of technology that increases productivity? If there is, please specify.
2. Is there a transfer of technology that reduces waste in production? If there is, please specify.
3. Is there a transfer of technology that increases the efficiency of labor? If there is, please specify.
4. Is there a transfer of technology that helps the R&D department to increase its capabilities? If there is, please specify.
5. Is there a data transfer of technology? If there is, please specify.
6. Is there a technology transfer through joint production? If there is, please specify.
7. Is there a technology transfer in any of the following areas:
  - Finance / Marketing / Purchasing / Warehouse / Human Resources

If there is, please specify.

### **Efficiency Measure**

1. The technology transferred has helped to increase productivity.
2. The technology transferred has helped to improve waste reduction in production.
3. The technology transferred has helped to increase labor efficiency per hour.
4. The technology transferred has helped the R&D department to develop new products that generate profits.

5. The technology obtained from information disclosure can be used in the development of the company.

6. The technology transferred has helped strengthen the competitiveness of the business.

7. The technology transferred in various management areas has helped the company to accomplish tasks and meet objectives.

8. The technology transferred has helped the organization to establish a direction towards the global level.

What kinds of government supports does the company need?

**APPENDIX B**

**QUESTIONNAIRE**

# QUESTIONNAIRE

## Technology Transfer from the Automotive Industry to Local Auto Parts Manufacturers in Thailand

The purpose of this study and questionnaire is to establish whether there is a transfer of technology from foreign automotive industries that have invested in Thailand to local companies. What technologies have been transferred and by what methods? Are the technologies that have been transferred useful to local companies? All data collected will be kept confidential and not disclosed to third parties. The collected data will be used for this doctoral research only. Thank you for your support and cooperation.

### Part 1

Email \_\_\_\_\_

### Part 2 Company Information

Business \_\_\_\_\_

Company Name \_\_\_\_\_

Your company is an auto parts manufacturer in Tier 1.

Yes                       No

### Part 3 Questions about technology transfer from Car Makers to local auto parts manufacturers

Car Manufacturers that invest in Thailand have transferred technology in what areas to your company?

1. Technology transfer in products

1.1 Technology transfer in product design methods

Yes                       No

1.2 Technology transfer in system design methods for product usage

Yes  No

1.3 Technology transfer in methods of product creation planning

Yes  No

1.4 Technology transfer in the production method of the product.

Yes  No

1.5 Transfer of knowledge on new raw materials to increase product quality.

Yes  No

1.6 Transfer of knowledge on solving quality problems caused by raw materials.

Yes  No

1.7 Transfer of knowledge on new raw materials for future development.

Yes  No

1.8 Transfer of knowledge on new machinery that increases to productivity.

Yes  No

1.9 Transfer of knowledge on new equipment that increases the pace of work.

Yes  No

2. Technology transfer in production processes

2.1 Transfer of the production process for a product

Yes  No

2.2 Transfer of the testing process

Yes  No

2.3 Transfer of the quality control process

Yes  No

2.4 Transfer of the method of maximizing utilization of the machine

Yes  No

2.5 Transfer of the method of loss reduction to increase productivity

Yes  No

2.6 Transfer of knowledge for the appropriate production process

Yes  No

2.7 Transfer of knowledge in auditing for increasing productivity

Yes  No

### 3. Technology transfer in the area of management

#### 3.1 Transfer of technology in corporate management

Yes  No

#### 3.2 Transfer of technology in production management, such as Toyota Production System, Lean System

Yes  No

#### 3.3 Transfer of knowledge on the suitable factory locations

Yes  No

#### 3.4 Transfer of knowledge on the suitable location of machinery

Yes  No

#### 3.5 Transfer of knowledge on the proper warehouse establishment

Yes  No

#### 3.6 Transfer of knowledge on negotiation with suppliers to reduce production costs

Yes  No

#### 3.7 Transfer of knowledge on financial management for the survival and development of the organization

Yes  No

#### 3.8 Transfer of knowledge on human resource development

Yes  No

#### 3.9 Transfer of knowledge on partner network development

Yes  No

#### 3.10 Transfer of knowledge on customer base network development

Yes  No

#### 3.11 Transfer of knowledge on increasing brand value and reputation of the company

Yes  No

#### 3.12 Transfer of knowledge on new technologies that help management processes to be more accurate

Yes  No

4. Technology transfer process: Do Car Makers use these methods in the technology transfer process to your company?

4.1 Provide training for employees

Yes  No

4.2 Transfer important personnel to your organization

Yes  No

4.3 Provide relevant business documents, such as supply chain systems or documentation for monitoring operational plans

Yes  No

4.4 Organizing seminars on various knowledge

Yes  No

4.5 Review of performance between organizations such as the use of assessment forms

Yes  No

4.6 Allowing you or your internal staff to learn the technology available in the Car Maker companies

Yes  No

4.7 Allowing you or your internal staff to learn the production process and the operation of machinery

Yes  No

4.8 Giving the opportunity to participate directly in various businesses to help promote knowledge in technology and management

Yes  No

4.9 By other methods (if not available, please answer No)

Yes  No

5. Efficiency gained from technology transfer

5.1 Product

5.1.1 Launching new products every year or almost every year

Yes  No

5.1.2 Innovations that help in cost reduction

Yes  No

## 5.1.3 Innovations that help increase productivity

Yes  No

5.1.4 New innovations that help increase quality control of the products

Yes  No

## 5.1.5 Guidelines for developing new innovations

Yes  No

## 5.1.6 Having Research &amp; Development strategies

Yes  No

## 5.2 Process

## 5.2.1 Increase in productivity

Yes  No

## 5.2.2 Reduction in waste from production processes

Yes  No

## 5.2.3 Having production management strategies

Yes  No

## 5.3 Management

5.3.1 Employees in the organization are more capable and contribute more to the development of new innovations

Yes  No

5.3.2 Employees in the organization are more capable and able to create new strategies for the organization.

Yes  No

5.3.3 The company can create new markets and acquire new customers leading to an increase in customer base.

Yes  No

5.3.4 The company can create new markets and acquire new customers from entering other markets.

Yes  No

5.3.5 Revenue of the company has increased due to better management knowledge.

Yes  No



## **BIOGRAPHY**

### **NAME**

Miss Ninrane Rintharawatth

### **ACADEMIC BACKGROUND**

MBA., Industrial Management  
Thai-Nichi Institute of  
Technology (2010)

### **EXPERIENCE**

Chief Product Advisor,  
Machine Tools,  
Brother Commercial Thailand

Sales Manager,  
Automotive Parts,  
Panasonic Automotive System  
Asia Pacific.

Senior Sales,  
Mold and Dies Components  
Misumi (Thailand) Co., Ltd