

**EXPORT COMPETITIVENESS ANALYSIS OF THAILAND  
PLASTIC RESINS TO CHINESE MARKET.**



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By                                      Miss Petcharat Kananuruk  
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The aim of the research was to quantitatively and qualitatively analyze Thailand's competitiveness in exporting plastic resins to China and to develop a strategy which will help increase the nation's plastic resins export potential to China. Quantitative Analysis includes a comparative advantage analysis of Thailand's plastic resins exports to the Chinese market using the Revealed comparative advantage (RCA), as well as a Constant market share (CMS) analysis utilizing annual time series data from 2012 to 2020. The Qualitative analysis uses Porter's diamond model, SWOT and TOWS analysis study to factors that affect the plastic resins industry's competitiveness and develop a strategy which will help increase the nation's plastic resins export potential to China from a broad perspective. The Revealed comparative advantage (RCA) and Constant market share (CMS) in plastic resins exports from 2012 to 2020 reveal that Thailand has an RCA value more than one in the Chinese market while global market's expansion and increase in demand is the key factor to maintain market share in an international market for plastic resins. Furthermore, high-efficiency of Thailand labor market also plays a key role to attract investment from important operators. However, there are still weaknesses that must be addressed, such as research and development of technological skills, which must be coordinated between the public and private sectors, in order to maintain the export industry's competitiveness and future growth potential.

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## 1. Introduction

Thailand 4.0 is a blueprint for restructuring the country's economy in order to generate a "value-based economy" or one that is "innovation-driven." Empowering the country's major industries to propel the country forward will enable to escape the "middle income trap" and achieve position of "developed countries" or high-income countries. As the office of industrial promotion and development, the Ministry of Industry has developed a strategic vision for 2017 to 2021 that is congruent with the strategic framework, policy proposals at various levels and in accordance with the situation and context of the country can be implemented in accordance with the Thailand 4.0 policy with the objective of boosting the manufacturing sector's capacity, supporting potential key industries, and laying the groundwork for key industries through the development and implementation of five important industries that respond to global trends: (1) agricultural processing, (2) vehicles and parts, (3) power and electronics, (4) petrochemicals and plastics, and (5) textiles and garments.

Plastic resins are one of the key industries manufactured by converting intermediate petrochemical monomers into a range of polymers or plastic resins for downstream petrochemical applications. Plastic resins are categorized according to the Thai customs harmonized system using the harmonized system codes 3901 to 3915. Ethylene, polypropylene, styrene, vinyl chloride acrylic polymer, polyacetal, and polyamide amino resin are among them. Plastic resins deliver a variety of qualities; they are extremely flexible, lightweight, resistant to heat and certain chemicals, impervious to water and fat penetration, and affordable. This enables diverse plastic characteristics to be converted into finished items such as plastic bottles, plastic bags, insulating wires/cables, kitchen appliances, stationery, water pipes, and auto parts by manufacturers in industries such as packaging, automotive, electrical and electronic, construction, and medical devices.

Plastic resins industry is important to the Thai economy. It contributes hundreds of billions baht to the country's economy each year. Besides, it is connected to thousands of entrepreneurs, the majority of whom operate small and medium-sized businesses. According to the Information and Communication Technology Center, Office of the Ministry of Commerce, the top five industrial items with the largest export values are as follows: 1. Automobile, its equipment, and its components 2. Computers, its equipment, and its components 3. Gems and precious metals 4. Rubber products 5. Plastic resins.

Prior to Covid-19, plastic resins was the rapid growth rate rising of the industrial sector's top five export values. During 2015 to 2020, its exports total 278,322.18 million baht, 270,501.65 million baht, 293,551.45 million baht, 330,156.09 million baht, 284,263.00 million baht, and 247,316.19 million baht, respectively, with an expansion rate of -10.52 percent, -2.81 percent, 8.52 percent, 12.47 percent, -13.90 percent, and -13.00 percent. It demonstrated that Thailand's plastic resins export business continues to thrive, responding to a variety of factors that complement one another.

Table 1 Thailand top five export values in 2015 to 2020.

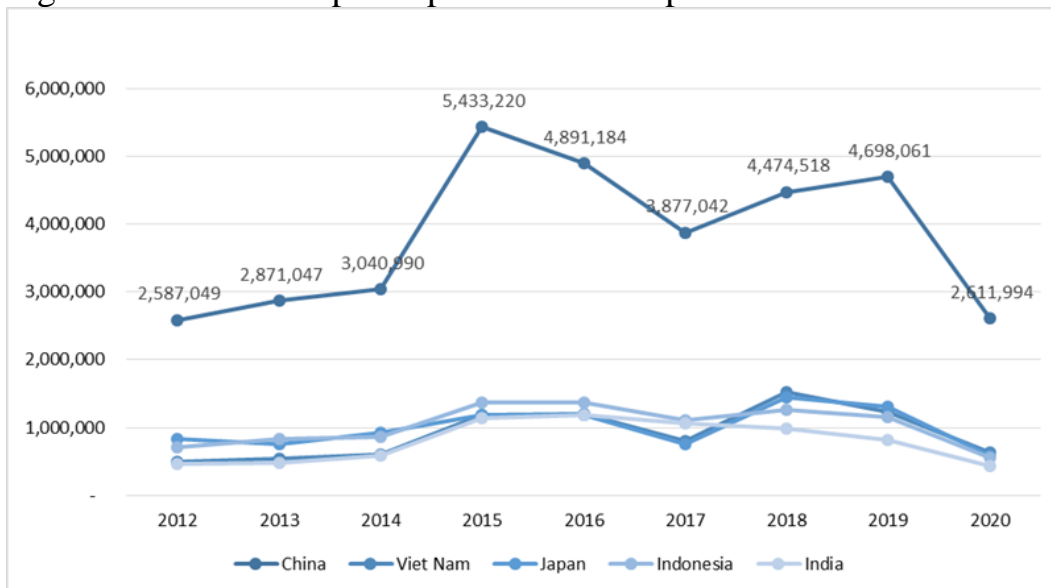
Product	Unit : Million Thai baht					
	2015	2016	2017	2018	2019	2020
1. Automobile, equipment, and components	863,828	905,925	914,344	927,501	846,435	659,510
2. Computers, equipment, and components	595,419	587,204	624,896	633,150	564,627	579,000
3. Gems, precious metals	371,072	501,124	434,891	383,977	486,216	567,046
4. Rubber products	230,169	246,203	346,897	353,443	347,650	375,388
5. Plastic resins	278,322	270,502	293,551	330,156	284,263	247,316

*Resource: The Information and Communication Technology Center, Office of the Ministry of Commerce*

Thailand is the world's 11th largest exporter of plastic resins and the ASEAN's second largest after Singapore. The success was built on the National Petrochemical Policy in 1980 to 2018, which included the National Petrochemical Master Plan and petrochemical factory investment. Thailand can produce up to 9.0 million tons of plastic resins and import only 2.2 million tons in 2019, one year since the Ministry of Industry published a Thailand's plastics industry development strategy 2017-2021. As an outcome, 56% of plastic resins will be exported. (Krungsri research, 2020). This enables Thailand to produce plastic resins rather than relying on expensive imports and provides Thailand with a competitive edge. The plastic resins business continues to grow, owing to a comprehensive, robust industrial supply chain, fulfill the world's strictest quality standards and can be shipped to a wide variety of countries.

According to the Information and Communication Technology Center, Office of the Ministry of Commerce, the top five countries by value of plastic resins exports from Thailand in 2020 are China with a 37.20 percent share, Vietnam with a 9.01 percent share, Japan with a 7.89 percent share, Indonesia with a 7.82 percent share, and India with a 7.53 percent share. All these nations have an FTA with Thailand.

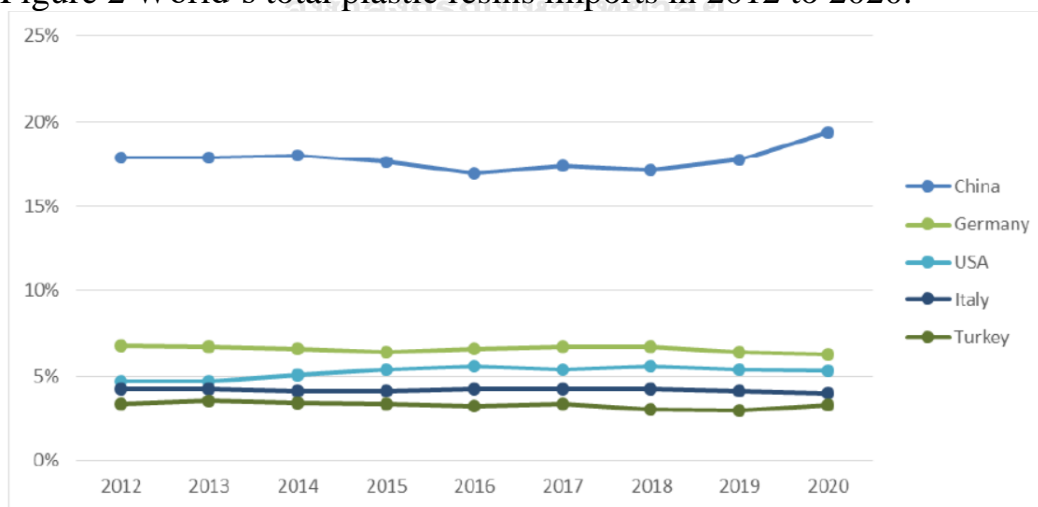
Figure 1 Thailand's top five plastic resins export markets in 2012 to 2020.



Resource: The United Nations Commodity Trade Statistics Database (UN Comtrade).

China is the world's fastest expanding consumer market. Additionally, China, frequently referred to as the "World's Factory," is the world's largest manufacturing, importer, and exporter of plastic resins. (UNCTAD, 2020) According to the United Nations Commodity Trade Statistics Database (UN Comtrade). The figure below indicates that prior to Covid-19, China has a strong need for plastic resins, but its domestic production capability is insufficient, necessitating imports.

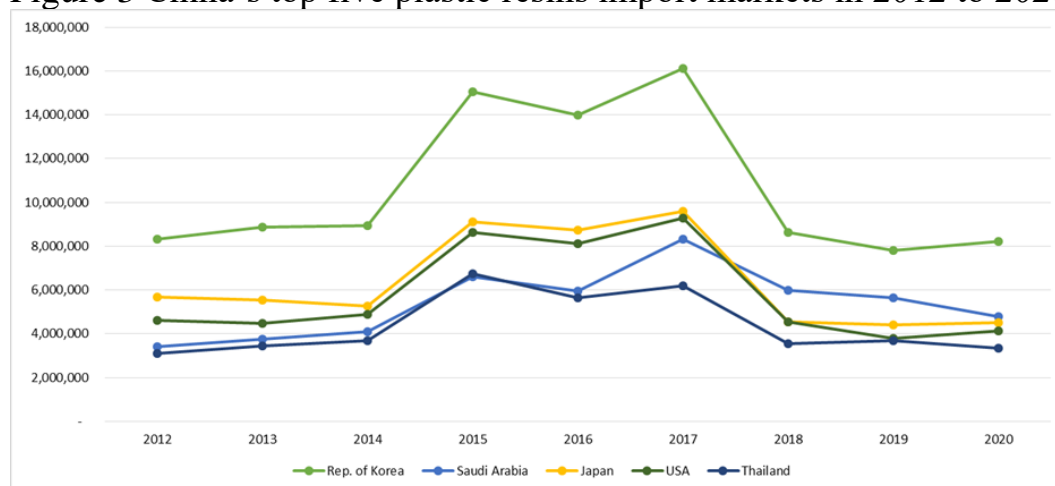
Figure 2 World's total plastic resins imports in 2012 to 2020.



Resource: The United Nations Commodity Trade Statistics Database (UN Comtrade).

The top five countries by values of plastic resins exports to China are Republic of Korea with a 15.68 percent share, Saudi Arabia with a 9.15 percent share, Japan with an 8.64 percent share, United States with a 7.95 percent share, and Thailand with a 6.37 percent share.

Figure 3 China's top five plastic resins import markets in 2012 to 2020.



Resource: The United Nations Commodity Trade Statistics Database (UN Comtrade).

Thailand's plastic resins export industry is unsteady each year due to a multitude of circumstances such as sluggish world economy, crude oil prices fluctuate, and labor cost etc. The shift in market destination will have an effect on Thailand's share of marketing and export values of plastic resins. Government-supported businesses need to adapt in order to thrive in a world of intense competition, as Thailand is a country with a growing petrochemical sector and a robust plastic resins processing industry. It is critical to determine Thailand's export competitiveness for plastic resins since this will serve as a guide for field development and competitiveness enhancement. Due to the fact that China is our largest customer, the main research objectives of this study are as follows:

1. To quantitatively and qualitatively analyze Thailand's competitiveness in exporting plastic resins to China.
2. To develop a strategy which will help increase the nation's plastic resins export potential to China.

The findings of this study may aid in the development of effective adaptation strategies that will enable Thailand's plastic resins industry to grow in revenues and enhance international potential.

## 2. Literature reviews

### 2.1 The export competitiveness measurement

Export competitiveness is a phrase that is frequently used in research publications. Numerous studies in economics and business have examined the measurement of international competitiveness. World Bank (2016) accurately speaks of the “the Trade outcomes indicators” that will assist in examining the performance of exports at the country level along a variety of dimensions such as the growth in value or the growth in export composition, which together provide a broad picture of trade competitiveness. Numerous authors have used the index of comparative advantages to study changes in international trade in the global or regional market. Bojnec and Fertő (2014) investigate of dairy products export competitiveness of the European Union countries from 2000 to 2011 measure by Revealed comparative advantage (RCA). They found that Belgium, Denmark, France, Ireland, and the Netherlands are countries with competitive dairy exports as well as Long (2021) investigate the China’s agricultural products export competitiveness by using Revealed comparative advantage (RCA) and found that China's agricultural export competitiveness was weak and projected to decline during 1994–2013.

In case of Thailand, Kuldilok et al., (2013) computed revealed comparative advantage (RCA) to investigate the tuna in cans export competitiveness in Thailand from 1996 to 2006. The result shown that Thailand had comparative advantages in the major export markets. These advantages have been consistent in the United States, the Middle East, Japan, and Canada. Also, Suwannarat (2017) used the RCA and found that Thailand had a comparative advantage over the China in the export of plastic resins and Thailand's market share of plastic resins in China risen considerably during a four period in 2010 to 2013. The findings suggest that Thailand had a comparative advantage in China for this product, and continuously export growth of plastic resins was possible in the future. Both studies revealed that Thailand's competitiveness was largely due to its low labor costs and economical tariff rate. (Kuldilok et al., 2013; Suwannarat, 2017).

Due to the fact that RCA does not include sources of advantage, as a country's market share changes, its competitiveness in that market

changes as well. Additionally, a large number of studies use the CMS to decompose the export modifications to highlight the components of advantage. Dieter and Englert (2007) analyzed the factors reducing export expansion of German forest industry during 1993-2002 using Constant Market Share (CMS). They found that world growth effect from slowdown in German forest industry sector. In addition, Siddique et al., (2016) analyzed bilateral commercial relations between Australia and Thailand during 1990 to 2011. A constant market share analysis (CMS) was used to determine changes in trade competitiveness. They found that Thailand's export competitiveness had a key importance in the spectacular rise of exports to Australia over the period, and the two countries' biggest trade link has been the export of automobile engines from Thailand to Australia. Thai exporters already benefited from minimal tariffs previous to the TAFTA's adoption.

Another approach to assess export performance at the country level is through the use of determinant-oriented indicators, which is based on a linkage between factors and a country's competitive position. According to Herciu (2013), sources of competitive advantage in Romania based on Porter's Diamond model, are quality of overall infrastructure, low investment in R&D, and firm-level technology absorption. In addition, Huo et al., (2020) determined that the sources of competitive advantage of emerging markets in agriculture industry during 2000s are hydrated land area, competitive labor costs, and export market potential. They also found that national competitive advantages are intrinsic tied to a nation's industrialization strengths and thus can also be used to forecast a country's industrial competitiveness to a large extent.

In case of Thailand, Weerathamrongsak and Wongsurawat (2013) shown an overview of changes in the natural rubber trade and determined the important criteria for decide Thailand's competitiveness in natural rubber sector. Based on Porter's diamond model, they found that Thai rubber sector's success was attributed from the competitiveness of domestic industries in the upstream sector and the leadership of large multinationals in the downstream sector. To further boost competitiveness, a determined effort was needed to promote innovation and technology absorption by domestic downstream industries. By applying Porter's diamond model, Watchravesringkan et al., (2010)



revealed that the understanding on how Thailand's textile industry had responded to rising competitive environment was important, the key drivers that promoted the Thai textile industry were natural and human resources, low labor-costs, innovation in business, and rising domestic demand. Additionally, the Thai government was reported to have a higher influence, by offering assistance to Thai businesses in order to increase their worldwide competitiveness.

## **2.2 The export competitiveness development strategy**

To increase competitiveness, a strategy is required. Numerous researchers assert that SWOT analysis is a circumstantial analytical technique that helps to recognize the internal environment's strengths and weaknesses, as well as the external environment's opportunities and threats, and even the impact on all types of businesses. Moreover, Porter's establishment of the industrial organization paradigm through his diamond models elevated the external environment of a corporation and increased the popularity of SWOT analysis.

According to Weihrich (1999) implementing SWOT and TOWS Matrix to obtain a competitive advantage of the West Germany industries through Porter's diamond model. SWOT analysis revealed that West Germany's educated and competent labor force had aided the country in achieving and maintaining its competitiveness. Additionally, Germany's industrial strengths in chemicals, automobiles, manufacturing, and banking contributed importantly to the country's success. As a result of TOWS matrix, West Germany's stakeholder should entailed capitalizing on its strengths in order to seize chances not just within the European Union, but also in North America, Eastern Europe, Asia, and Pacific Rim countries. Baudino et.,al (2017) used SWOT to analyze the internally and externally market factors and apply TOWS Matrix to create strategies for enhance Italy's kiwifruit in world market. According to the findings, Large-scale oriented, Berry fruits oriented, Export and organic oriented and Niche oriented were the key strategies to expand the industry.

In case of Thailand, Pholpuntin et al. (2014) implementing TOWS Matrix to enhance Thai Cuisine in ASEAN market. The SWOT analysis was conducted to analyze the internal and external market factors. The TOWS matrix study was then used to correlate internal strengths and

weaknesses with external opportunities and threats. They determined that Thai food industry in Laos and Cambodia were in SO (strength-opportunity), meaning that Thai food industry had both strength and opportunity in future investment. The SO strategy indicated firms or business units to leverage their strengths to seize opportunities. According to the findings, a totally owned or joint venture Thai food industry was advised, to oversee their quality of the food and image in the market.

### **3. Conceptual framework**

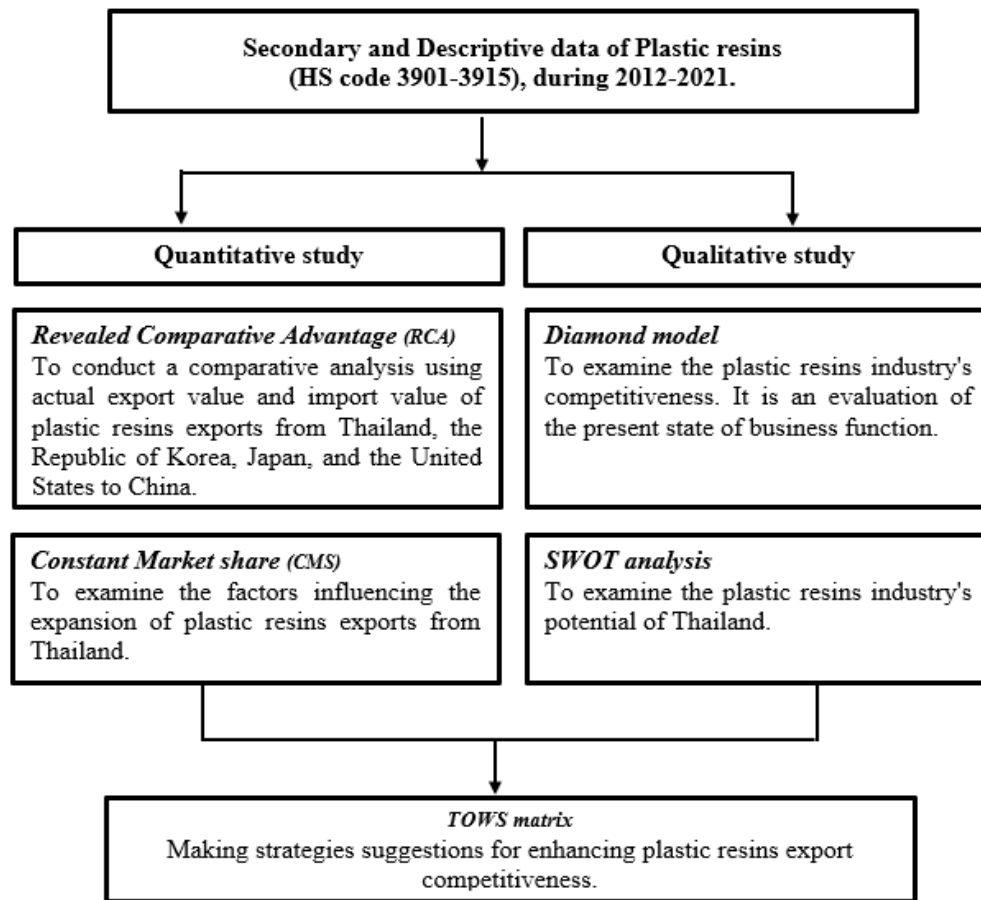
This study separated the data analysis into two parts: Quantitative analysis and Qualitative analysis.

- Part 1: To discover a competitiveness analysis of Thailand's plastic resins exports to China, this study uses a quantitative analysis to determine whether Thailand's plastic resins have a comparative advantage in the China market, as well as using the Constant Market Share model to determine Thailand's ability to export plastic resins to China.
- Part 2: To study of the factors affecting the plastic resins industry's competitiveness, this study conducts Qualitative study based on the Diamond model. Then, use a SWOT analysis to determine Thailand's plastic resins industry's potential and make strategies for enhancing plastic resins export competitiveness using the TOWS matrix.

Scope of this study:

This study compares Thailand's export competitiveness to three other key exporters to China, namely the Republic of Korea, Japan, and the United States because they are the China's top five largest plastic resins exporters.

Figure 4 Conceptual framework diagram.



## 4. Methodology จุฬาลงกรณ์มหาวิทยาลัย

The research methods for this study are separated into two parts.

***Part 1: To discover a competitiveness analysis of Thailand's plastic resins exports to China.***

### 4.1 Quantitative Analysis

#### 4.1.1 Revealed Comparative Advantage (RCA)

The comparative advantage index is as following, assuming that comparative advantage is used to define the pattern of international trade.

$$RCA_{i,p-j} = \frac{X_{iA-p} / X_{A-j}}{X_{iC-p} / X_{C-j}}$$

Where,  $X_{iA-p}$  is the country  $i$ 's exports of plastic resins to China,  $X_{A-j}$  is the country  $i$ 's total exports,  $X_{iC-p}$  is China's imports of plastic resins, and  $X_{C-j}$  is the China's total exports.  $i$  is Thailand, the Republic of Korea, Japan, and the United States.

When the RCA index is greater than 1 ( $RCA > 1$ ), it suggests that the country's plastic resins exports contribute for a greater proportion of total exports than its imports contribute for a greater proportion of total China exports, or that the country benefits a comparative advantage in the export of plastic resins. Reversing it, if the RCA index is less than 1 ( $RCA < 1$ ), at that time there is no comparative advantage in the export competition of plastic resins.

#### 4.1.2 Constant market shares analysis (CMS)

The Constant market share model is considering a country's exports while assuming that the country can maintain its current market share. The following form was utilized in the model analysis;

$$V' - V = rV + (r_i - r)V_j + (V'_j - V_j - r_j V_j) + \{[V'_j - r_i V_j] - [(V'_j - V_j - r_j V_j)]\}$$

Where,  $V$  is the value of a country's exports of  $i$  products to all market,  $V_j$  is the value of a country's exports of  $i$  products to each market,  $r$  is the rate of growth in global exports of  $i$  products overall,  $r_j$  is the rate of growth which product  $i$  from country's exports of  $i$  is being exported to each market.

It is composed of the following four terms; the first term is referred to as the *world growth effect*. This reveals the portion of growth that can be attributable to an increase in plastic resins global exports. The second term is called *Market effect*. When exports are concentrated in rapidly growing markets, the portion of growth attributable to composition of the country's exports is positive. The third term is the *Competitiveness effect*. When export shares are constant, there is a residual effect, which reflects discrepancy between actual export growth and the growth that would have occurred if the export shares had remained constant. An increase in "competitiveness" is seen as a favorable result of a positive value. Lastly, the fourth term is called *Interaction Effect*. This effect reflects the

exporting country's efforts to increase exports in a contracting market or decrease exports in an increasing market, in which case the result of correct or incorrect export adjustments will be negative. By contrast, if a country opposes exports in order to boost exports in expanding markets or cut exports in contracting areas, the value of this result will be positive.

#### 4.1.3 Selection of variable

Plastic resins exports to China were examined using a collection of plastic resins with Harmonized System codes 3901 to 3915 as defined by the Customs department, Ministry of Finance. Secondary data were used to obtain the statistics for the quantitative study. Annual time series data were analyzed from 2012 to 2020; but the analysis is separated into before the Ministry of Industry launched a development strategy for the Thai plastics industry in 2017 and after the Ministry of Industry launched a development strategy for the Thai plastics industry in 2017.

A total of 126 data sets were studied. The variable is as follow; Plastic resins export value is the export value of plastic resins (HS code 3901 to 3915) of exporter such as Thailand, the Republic of Korea, Japan, and the United States in the US dollar, originated from UN Comtrade. However, the study's limitation is that the UN comtrade has not yet published the export value of each country in 2021.

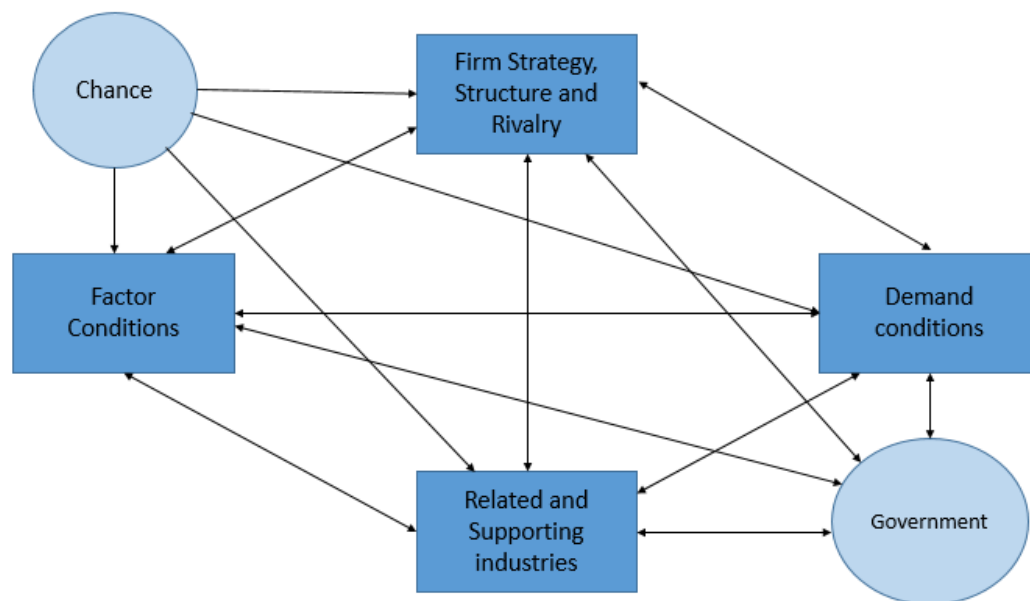
***Part 2: To study of the factors affecting the plastic resins industry's competitiveness.***

## 4.2 Qualitative Analysis

### 4.2.1 Porter's diamond model

This part examines the plastic resins exports competitiveness using Porter's diamond model is which based on six components, notably factor condition, demand condition, supporting and related industries, firm strategy, government, and chance. Descriptive data from research articles, news, private and government publish of various agencies related to the Thailand's plastic resins were used to employ in this study.

Figure 5 Porter's diamond model of country's competitiveness.



Resource: Porter (1990, p. 127)

#### 4.2.2 SWOT analysis

The SWOT analysis is used to analyze five criteria: (1) Technology and innovation (2) Human development (3) Infrastructure system (4) Natural resources and (5) Rules and regulations, in comparison with China's plastic resins key trading such as Thailand, the Republic of Korea, Japan, and the United States. The (1), (2) and (3) criteria are based on the WEF the Global Competitiveness Report 2019. The (4) and (5) are based on the data from research articles, news, private and government publish of various agencies related to countries' publication.

#### 4.2.3 TOWS matrix

This study will analyze and interpret the exporting country's internal and external environment by SWOT and Tows matrix. Four-dimension strategies are:

- **S-O Strategy:** A strategy that consider how to increase Thailand plastic resins competitiveness by using existing strengths in able to capitalize on opportunities available of the nation.
- **W-O Strategy:** A strategy that attempt to strengthen Thailand’s internal weakness by capitalizing on external opportunities of the nation.
- **S-T Strategy:** A strategy that attempt to strengthen Thailand’s existing strengths to devise strategies for avoiding or mitigating the impact of external obstacles or limitations of the nation.
- **W-T Strategy:** A strategy that is a self-defense designed to eliminate Thailand’s internal weakness and avoiding external obstacles.

However, when developing strategies based on strengths, weaknesses, opportunities, and threats, it is also important to consider the plan's practicality and prioritize if whether strategy was executed prior to and after.

Table 2 The concept of TOWS matrix

Internal factors External factors	<b>Internal Strengths (S)</b> Internal environmental factors that influence the core export business of the nations, such as Natural resource, Human resource, Technology innovation, Government policies, Investment etc.	<b>Internal Weakness (W)</b> Internal environmental factors that have a detrimental effect on the core export business of the nations, such as internal political unrest.
<b>External Opportunities (O)</b> The external environmental factors that influence the core export business of the nations, such as present and future circumstances, social changes, product innovations, and technologies.	<b>S-O Strategy</b> To consider how to manage by using existing strengths in able to capitalize on opportunities available of the nations.	<b>W-O Strategy</b> An attempt to strengthen internal weaknesses by capitalizing on external opportunities of the nations.
<b>External Threats (T)</b> The external environmental factors that have a detrimental effect on the core export business of the nations, such as a severe labor shortage or a shift in consumer preferences.	<b>S-T Strategy</b> An application of existing strengths to devise strategies for avoiding or mitigating the impact of external obstacles or limitations of the nations.	<b>W-T Strategy</b> Self-defense designed to eliminate internal weakness and avoiding external obstacles.

Resource: Weirich, H. (1982). *The TOWS matrix – A tool for situational analysis. Long range planning, 15(2), 54-66.*

## 5. Results

### *Part 1: To discover a competitiveness analysis of Thailand's plastic resins exports to China.*

#### 5.1 Revealed Comparative Advantage (RCA)

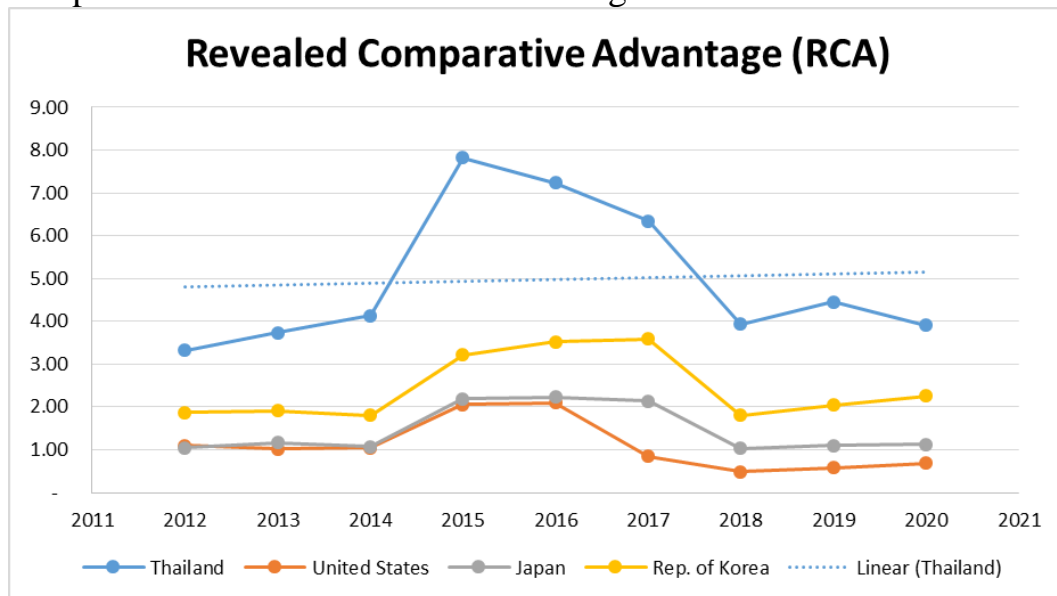
An investigation of Thailand's comparative advantage over its competitors in the Chinese market (the Republic of Korea, Japan, and the United States) from 2012 through 2020 shows that Thailand, Republic of Korea, and Japan have RCA value greater than one, which indicates that the proportion of plastic resins exported by Thailand, Republic of Korea, and Japan to total exports of each country is greater than the global proportion of total plastic resins exports to China. This implies that the mentioned countries gain a comparative advantage in plastic resins exports. In comparison to its key competitors, Thailand has the greatest RCA value, indicating that it has a higher relative competitiveness than its competitors at the moment.

The United States maintained a value of RCA greater than one through 2012 to 2016, however the comparative advantage has been progressively fading from 2017 to 2020. The RCA value is less than one. Indicating that the US has lost its ability to export plastic resins to China and has no comparative advantage in exporting plastic resins to China due to the United States, particularly under President Donald Trump's leadership, has implemented a protectionist policy through import tariffs in order to minimize its trade deficit with China.

Thailand's comparative advantage was 3.33 in 2012 and increased dramatically to 7.24 in 2016. However, the study found that the trend was downward between 2016 and 2020, similar to Republic of Korea, where the RCA value remained increased since 2012 to 2017 but was downward in 2018. In 2019 to 2020, Thailand and Republic of Korea benefitted from a comparative advantage, owing to China's increasing demand for plastic resins from countries other than the United States as a result of the US-China trade war, whilst Japan maintains its comparative advantage.



Figure 6 The comparative advantages of Thai plastic resins over key competitors in the Chinese market during 2012-2020.



Resource: author's calculation.

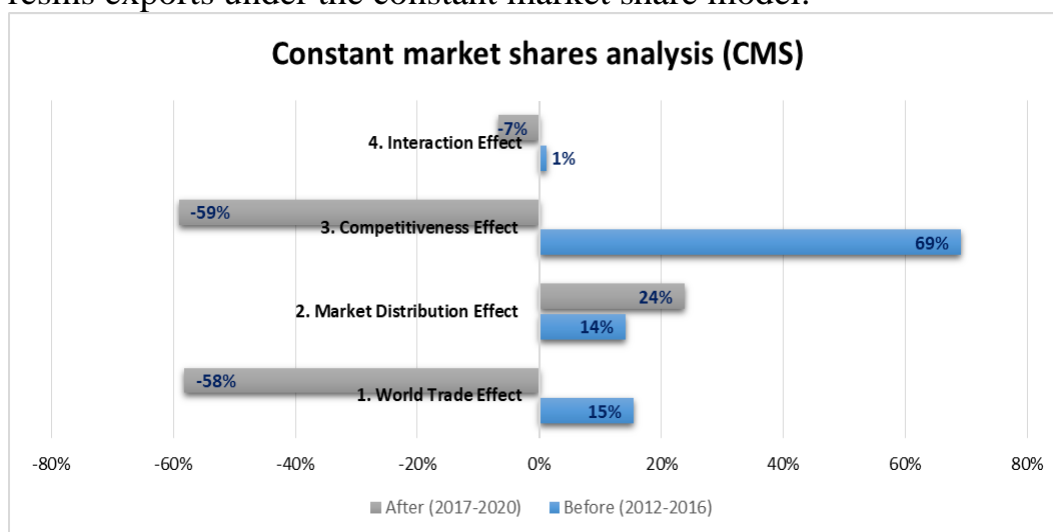
## 5.2 Constant market shares analysis (CMS)

The factors influencing the changes in Thai plastic resins exports that are expected to compete with international countries to determine how Thailand's plastic resins products compare to global exports. The four components that explain the change in export value are as follows: 1) World trade effect 2) Market distribution effect 3) Competitiveness effect 4) Interaction effect.

As the office of industrial promotion and development, the Ministry of Industry has developed a strategic vision for 2017 to 2021 with the objective of boosting the manufacturing sector's capacity, supporting potential key industries, and laying the groundwork for petrochemicals and plastics industry that respond to global trends. Thus, this part of the study separates the periods of study which are:

1. Before the Ministry of Industry launched a development strategy for the Thai plastics industry in 2017.
2. After the Ministry of Industry launched a development strategy for the Thai plastics industry in 2017.

Figure 7 Factors influencing the change in the value of Thailand plastic resins exports under the constant market share model.



Resource: author's calculation.

### 5.2.1 Before the Ministry of Industry launched a development strategy for the Thai plastics industry in 2017.

The change in the value of Thai plastic resins exports is shown in Figure 7. Thailand's plastic resins export value was 30,866,877.08 thousand USD in 2016, up from 13,798,342.21 thousand USD in 2012, or an increase of 80.84 percentage. When evaluating the components that contributed to the increase of Thai plastic resins export value using the constant market share model, the components of growth may be classified as follows:

*1. World trade effect:* Thailand's plastic resins export value grew by 13,798,342.21 thousand US dollars, a rise of 80.84 percent above 2012 export value. The analysis discovered that the primary factor driving Thai exports during this period was the 2,131,651.34 thousand US dollar World Trade Effect, which accounted for a 15.45 percent rise in growth.

*2. Market distribution effect:* The study discovered that the structure of the Thailand plastic resins market distribution from 2012 to 2016 aided in the growth of Thai plastic resins exports to 1,961,025.63 thousand US dollar, a 14.21 percent increase. Throughout these periods, the structure of Thailand's plastic resins export market for each product was spread across potential markets or had a faster rate of import growth than the global average.

3. *Competitiveness effect*: The analysis discovered that the increase in Thailand plastic resins exports from 2012 to 2016 was a result of Thailand's competitiveness being enhanced by an estimated 9,542,317.75 thousand US dollars, or a component of the Thailand's export value climbed by 69.16 percent of a change in export value, indicating that the country had an increase in level of competitiveness. However, when each market is analyzed separately, Thailand's lost the export competitiveness in Chinese market, its primary market with the biggest export value, by a total of 711,011.57 thousand US dollars.

4. *Interaction Effect*: The result of exports in Interaction effect equaled 163,348.50 thousand US dollars, indicates a growing in exports to China at a faster rate than the global export growth rate.

Based on the results of the constant market share model, the total value of Thailand's plastic resins exports increased by 13,798,342.21 thousand US dollars from 2012 to 2016. Global plastic resins exports to China, Vietnam, Indonesia, India, and other markets are expected to rise to 30,866,877.08 thousand US dollars in 2016, based on a 0.12 percent growth rate for the world plastic resins exports in 2012. Additionally, it is discovered that the Competitiveness effect was shown to be the most important component driving Thailand's plastic resins export value between 2012 and 2016, resulting in a rise of 9,542,318.75 thousand dollars. The World trade effect was shown to be the second most important component, resulting in a rise of 2,131,651.34 thousand US dollars. This might be because export to China rose by 1.17 percent, faster than the rate of growth of Thailand plastic resins exports to all markets. However, the initial versions proposed by Leamer and Stern (1970) contain several limitations regarding the computation and interpretation of the residual component such as re-export value that may reducing the dependability of the competitiveness results.

5.2.2 After the Ministry of Industry launched a development strategy for the Thai plastics industry in 2017.

From 2017 to 2020, Figure 7 displays the value of Thailand plastic resins exports. It was shown that Thailand plastic resins exports drop in value from 21,809,382.07 thousand US dollars in 2017 to 13,010,318.21 thousand US dollars in 2020, a decrease of -40.35 percent. A study of the effect on Thailand's export value growth after 2017 using the fixed

market share model can be separated into four growth components as follows:

1. *World trade effect*: The study discovered that the factors driving global trade expansion contracted to 5,119,249.93 thousand US dollar, or a 29.15 percent contraction from the value of Thailand plastic resins exports in 2020, but the key finding was that the value of global trade expanded at a slower rate, from 15.45 percent in 2016 to -58.18 percent in 2020. This is another large factor contributing to the value of Thai exports growing at a slower rate than global trade.

2. *Market distribution effect*: the structure of the Thailand market distribution effect from 2017 to 2020 remained a factor supporting the value of Thailand plastic resins exports worth 2,101,351.71 thousands of US dollars, or accounted for a growth of 23.88 percent of Thailand plastic resins exports in 2020, indicating that during this period, the structure of the Thailand plastic resins export market for each product was spread across a potential market, or the rate of plastic resins export growth was moderately higher than the world average. However, it was discovered that the plastic resins supporting factors to the Chinese market, which previously aided Thailand plastic resins export growth from 2012 to 2016, have slowed down, becoming a drag on Thai exports from 2017 to 2020. As a result, the Market distribution effect component indicated a lower value of Thailand plastic resins exports.

3. *Competitiveness effect*: Thailand's competitiveness effect decreased by 5,196,272.01 thousand US dollars in 2020, or a -59.05 percent decline of the growth. The important concern was overall Thailand's competitiveness effect expanding at a slower rate than in 2016. When the export value increased as a result of increased competitiveness for exports to the five major export markets, Thailand was determined to have the largest potential to export to China, increasing by 602,023.03 thousand US dollars.

4. *Interaction Effect*: The result of exporting in the correct or incorrect direction is equal to -584,894.21 thousand US dollars due to Thailand expanding its plastic resins exports to a shrinking Chinese market at a time when global exports of plastic resins are growing at a faster rate.

According to the results of the constant market share model, the total value of Thailand's plastic resins exports declined by 8,799,064.44 thousand US dollars from 2017 to 2020. Global plastic resins exports to China, Vietnam, Indonesia, India, and other markets are expected to drop to 13,010,318.63 thousand US dollars in 2020, down from 21,809,382 thousand US dollars in 2017, based on a -0.23 percent growth rate for the world plastic resins exports in 2017. Additionally, it is discovered that the Competitiveness effect was shown to be the most important component between 2017 and 2020. The World trade effect was shown to be the second most important component. The largest market of Thailand plastic resins exports was China which fell by -0.48 percent, slower than the rate of growth of Thailand plastic resins exports to all markets. However, the computation and interpretation of the residual component such as re-export value could reduce the dependability of the competitiveness results.

***Part 2: The result of the factors affecting the plastic resins industry's competitiveness.***

**5.3 Porter's diamond model**

The Diamond Model, a concept developed by Michael E. Porter, is used explain and outline the key issues in the development of the Thai plastic resins industry's competitiveness.

**5.3.1 Factor conditions**

To pick countries for increased trade and investment in the business sector. The business environment, particularly in terms of inputs and trade facilitation, is important to a business's success in a particular market. The critical characteristics of production that will be used to select a country are as follows.

**5.3.1.1 Natural resources**

Plastic resins are manufactured from monomers derived from petrochemical intermediates to form polymers or a variety of different types of plastic resins that are utilized as raw materials in the manufacture of finished products and downstream industries. The production of plastic resins involves a variety of processes that require advanced technology,

as well as the requirement for industry cooperation to lower production costs. Thailand is an oil and natural gas producer. There is a group of petrochemical industry that provide support for or are related to one another such as (1) *Natural gas industry*; Natural gas is a fossil fuel that was generated when diverse plant and animal remains were deposited on the earth's surface with mud, sand, and sludge to form dense layers under intense heat and pressure. Thailand has explored two natural gas deposits, one at sea, in the Gulf of Thailand, and one on land, near Khon Kaen, Udon Thani, and Kamphaeng Phet. According to the United States Energy Information Administration (2019), the country produced 1.326 quadrillion Btu of natural gas, while using 1.891 quadrillion Btu. (2) *Oil refinery*; According to the United States Energy Information Administration (2019), the country produced 149 million barrels of petroleum and other liquids, while using 423 million barrels. This results in Thailand becoming a net oil importer. The oil refinery business is sensitive to risks and volatility in the exchange rate of refined products and crude oil prices due to imports. It is the price that is determined by the risk factor in relation to the global market price. Prices cannot be established or controlled by the state alone, and both refined and crude oil prices must be traded in futures. Due to Thailand's lack of sufficient crude oil reserves for consumption, it is required to import vast quantities of raw materials from abroad, increasing the cost of production.

At present, there are 2 types of bioplastics factories in Thailand using sugarcane as raw materials, namely Poly Lactic Acid (PLA) and Poly Bio-succinic Acid (PBS). It has a total annual capacity of 75,000 tons of Poly Lactic Acid (PLA) bioplastic resins and an average annual capacity of 150,000 tons of sugar, as well as a total annual capacity of 20,000 tons of Poly Bio-succinic Acid (PBS). In Thailand, an average of 54,000 tons of sugarcane is used to make bioplastic resins each year (Bio Innovation Linkage, 2020). Additionally, Sugarcane is a vital industrial crop for Thailand's economy, as the country is the world's second largest exporter of sugar after Brazil. Due to the government's push for zoning management policies, which include relocating rice planting regions to make way for sugarcane, factories, and other crops. Thailand was discovered to have the sugar cane production of more than 105.0 million tons, positioning it as the fourth largest in world's sugar cane production (Nation Master, 2020).

In term of infrastructure, which mostly consists of government-provided services such as transportation routes, the ability to supply electric power to businesses, as well as telecommunications and telecommunication networks. As a result, the countries that are more prepared can attract more international investment than those that are less prepared. According to IMD (2019), Thailand's infrastructure determinants were ranked 44th from 63 countries. Moreover, water is one of Thailand's greatest resources. The country has 0.1 percent of the groundwater and positioning it as the third largest in ASEAN. (Visual capitalist, 2021)

#### 5.3.1.2 Human resources

Thailand's science and innovation policies are coordinated by the Ministry of Higher Education, Science, and Research and Innovation, which serves as a crucial organization for higher education, science, and research and innovation in Thailand to meet international criteria and improve the country's rating of long-term international competitiveness. According to IMD (2019), Thailand's Scientific infrastructure determinants were ranked 38th from 63 countries. Although, the country's Scientific Infrastructure has been increasing over time, it still remains lower than that of competing countries. Many entrepreneurs confront labor with knowledge and skill shortages, particularly in the production section, forcing many businesses to hire foreign staff, which preventing the company from operating at maximum efficiency in terms of manufacturing and product development. Another huge concern is labor quality since many workers in the business lack expertise on the plastic resins production line and have limited knowledge of plastic resins manufacture and machinery. Workers are unmotivated to improve their knowledge, abilities, and practices. Numerous individuals are unable to fully use the capabilities of existing machine tools (Plastics Intelligence Unit, 2012). Hence, seeking to increase added value and competitiveness through the acquisition and development of knowledge as well as creating an intellectual infrastructure will be important. A key contribution to the development has been to supply high-quality personnel with more potential and to foster a learning culture.

Table 3 Scientific infrastructure competitiveness ranking (IMD) of Thailand by criterion.

Scientific infrastructure Criterion	2018	2019	Change
Number of countries	63	63	●
Scientific infrastructure Competitiveness ranking	42	38	+
1. Total expenditure on R&D (US\$ millions)	34	30	+
2. Total expenditure on R&D per GDP	45	37	+
3. Total expenditure on R&D per capita (US\$)	49	47	+
4. Business expenditure on R&D (US\$ millions)	29	27	+
5. Business expenditure on R&D per GDP	36	27	+
6. Total R&D personnel nationwide (Full-time equivalent: FTE)	17	16	+
7. Total R&D personnel nationwide per capita (FTE)	43	39	+
8. Total R&D personnel in business enterprise (FTE)	20	16	+
9. Total R&D personnel in business enterprise per capita (FTE)	38	39	-
10. Researchers in R&D per capita (FTE per 1000 people)	34	40	-
11. Science degrees (%)	29	30	-
12. Scientific articles (Scientific articles published by origin of author)	36	36	●
13. Nobel prizes	29	29	●
14. Nobel prizes per capita	29	29	●
15. Patents applications	39	40	-
16. Patents applications per capita	55	54	+
17. Patents granted to residents	47	46	+
18. Number of patents in force (per 100,000 inhabitants)	56	54	+
19. Medium- and high-tech value added	--	28	●
20. Scientific research legislation (Law relating to scientific research do encourage innovation)	36	37	-
21. Intellectual property rights are adequately enforced	47	47	●
22. Knowledge transfer is highly developed between companies and universities	34	32	+

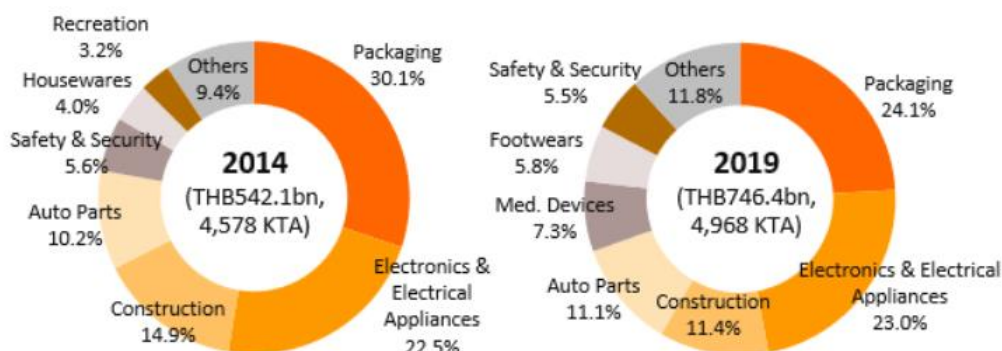
Resource: IMD World Competitiveness Yearbook 2018 – 2019

### 5.3.2 Demand conditions

Demand growth is being fueled by substantial domestic demand. According to Krungsri Research (2020), more than half of all demand in 2019 are made in three industries: Packaging, Electronics and Electrical appliances, and Construction. The value of plastic products is 750 billion baht (about 4.4 percent of GDP), with packaging accounting for the largest share (24.1 percent) of total plastic products value, followed by Electronics and Electrical appliances (23.0 percent) and construction (11.4 percent). However, government policies and campaigns aimed at reducing and eventually eliminating the usage of single-use plastic packaging. The development of ecologically friendly or bioplastics may help to reduce need for common plastic packaging.



Figure 8 Share of Thai plastic products values by end user.



Resource: Krungsri Research (2020)

### 5.3.3 Related and Supporting Industries

The plastic resins industry is under Petrochemical cluster. Thailand's Petrochemical cluster strategy aims to strengthen the value chain by grouping petrochemical businesses such as chemical, petrochemical, plastic, petroleum refining and related organizations that operate in comparable sectors through mutual assistance and connections to strengthen Thailand's petrochemical potential and contribute to the region's and locality's prosperity. The Eco-friendly Petrochemicals and Chemical Product Cluster are located in 2 location which are Map Ta Phut Industrial Estate (MTPIE) located in Rayong province and Sriracha Refinery located in Chonburi province.

Moreover, the plastic resins industry has received assistance from both government agencies and the private sector, as well as those responsible for doing research & development and advising on plastic resins production. Several agencies that aid the plastic resins sector include the following sectors: 1) Academic institution such as Chulalongkorn university (The Petroleum and Petrochemical College), Kasetsart university (Faculty of engineering), Mahidol university (Faculty of science) etc. 2) Private sector such as Petroleum Institute of Thailand (PTIT) and the Thai Plastic Industries Association (TPIA), which were founded by petroleum and plastics operators to serve as a hub for information and to strengthen the Thai petroleum and plastics industries. 3) Government such as Plastics Institute of Thailand (PITH), which is affiliated with the Ministry of Industry.

#### 5.3.4 Firm strategy, Structure and Rivalry

Thailand has two major petrochemical producers: the PTT group, which gain 54 percent of the market share and the SCG group, which gain 29 percent of the market share (Krungsri research, 2019). However, there are also other petrochemical producers specializing on downstream petrochemical products. These include global corporations such as Indorama, Exxon, and Thai manufacturers such as Vinythai. Despite their small size, Thailand's plastic exports make a sizable contribution to the worldwide plastic business. In the past, competition was not intense. This was because the majority of producers produce for the same clients or have their own markets, as plastic resins demand is frequently product specific. In terms of the competitive conditions that motivate manufacturers to export plastic resins, it was believed to play a minor role, as the majority of plastic resins manufacturers were seeking new markets abroad, rather than due to the nature of the product.

#### 5.3.5 Chance

Thailand and the majority of its partners have reduced tariffs to zero percent under the FTA and exempted certain products from some FTAs that retain tariffs or are not required to cut tariffs. However, Thailand will benefit from trading partners broadening their markets to Thailand, allowing more export to partner countries.

On the contrast, due to the popularity of environmentally friendly products in many countries, hugely important markets such as Europe and the United States, are often priced higher, or are legally required, in some countries, that the packaging or the product must be made from recycled raw materials. As a result, the plastic bags used by world-famous shopping malls and high-end brand boxes are typically made of plastic or recycled paper. When large markets need this type of goods, Asian nations must look for recycled materials. And China is the country that produces the most products for this market, creating a huge demand for recycled plastic, but the environmental costs are quite high due to China's recycling industry being out of date. This prompting China to temporarily halt imports of plastic waste in 2017 in order to clean up the country's recycling industry but China continues to import recycled plastic resins due to domestic raw material production being insufficient. Another challenge to overcome is the diminishing trend toward single-use plastic

and move toward biodegradable plastics that are either biodegradable or can be recycled indefinitely. Additionally, initiatives in various countries to ban or minimize the use of plastic have a direct impact on exports.

#### 5.3.6 Government

Thailand's plastic resins business began in 1952, and was considered to be a new industry at the time. Later in 1967, it expanded into a manufacturing industry to compete with imported goods. The Board of Investment of Thailand has been promoting the development of plastic resins industry. The objective is to replace imported plastic resins and add value to the country's natural gas production. Additionally, the government has encouraged and facilitated investment through advantageous taxation. According to Thailand 4.0 policy, the vision for the growth of the Thai petrochemical sector establishes Thailand as a high-value-added petrochemical manufacturing base in the region, with the objective of becoming a specialized petrochemical product and attracting international investment. Thus, the government has issued a policy to attract investment in The Eastern Economic Corridor (EEC).

#### 5.4 SWOT analysis

From the above-mentioned information on Thailand's plastic resins business, the SWOT analysis will give a clearer picture of Thailand's plastic resins industry situation.

##### 5.4.1 Strengths

S1: Thailand is a globally known manufacturer/exporter of plastic resins raw material, with important world factory such as China also importing large value of plastic resins from Thailand each year.

S2: Based on the Global Competitiveness Report 2019, Thailand has a relatively efficient labor market score in comparison to its competitors. This demonstrates how Thailand's labor markets match workers with employment that are a good fit for their skill set as Thailand is known for its high-quality labor and affordable labor forces.

S3: Thai entrepreneurs have shifted their focus to developing more biodegradable plastic resins. Several of them make use of natural raw materials produced locally, such as sugar which Thailand excels at creating due to its vast agricultural resources.

S4: Government-sponsored policy helps promoting the manufacture of specialty plastics. According to Thailand 4.0 Policy, the vision for the growth of the Thai petrochemical sector establishes Thailand as a high-value-added petrochemical manufacturing base in the region.

S5: Thailand does admirably in terms of appropriate infrastructure such as electricity/ water access and transportation accessibility.

#### 5.4.2 Weaknesses

W1: According to the Global Competitiveness Report 2019, Thailand faces a shortage of innovation, structured research and development, and advanced technologies when compared to its competitors.

W2: Thailand lacks its own source of raw materials, notably crude oil. As a result, businesses rely on crude oil imports from other countries.

#### 5.4.3 Opportunities

O1: China is a large market with sizable purchasing power, and its market covers a wide range of plastic resins products that are used as semi-finished raw materials or as components in the manufacture of plastic products in industries such as automotive and parts, electrical and electronic appliances, construction materials, furniture, and processed food packaging.

O2: China's 13th National Economic and Social Development Plan, which focuses on the development of wide variety of industries and the upgrading of the plastic resins and plastics industry that can be used for specialty products. The add would value and meet diverse needs, such as the development of plastic resins for future vehicles or the development of plastic resins used in the medical devices manufacturing process. As a result, China's plastic resins product output has improved in both quality and volume, increasing demand especially for plastic resins for support their business.

O3: The Chinese government has begun to boycott and prohibit the use of single-use plastics, compelling operators to switch to biodegradable plastics, which Thailand excels at producing due to its extensive agricultural resources, and cost advantage relative to other

countries. The value is consistent with the Thailand's 20-year strategy (2017–2036).

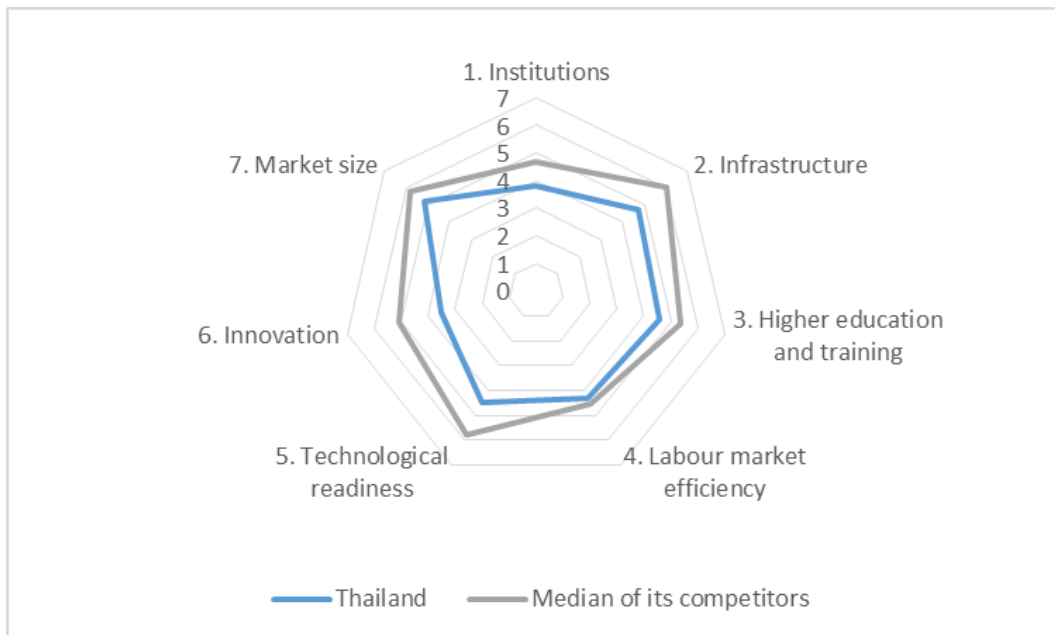
O4: Thailand and the majority of its partners have reduced tariffs to zero percent under the FTA and exempted certain products from some FTAs that retain tariffs or are not required to cut tariffs. In generally, Thailand's accessibility of the plastic resins market to trading partners does not result in Thailand losing benefits, as Thailand's tax structure has been decreased.

#### 5.4.4 Threats

TH1: The need to overcome the declining trend toward single-use plastic in order to limit environmental damage, as well as to develop biodegradable plastics that are either biodegradable or infinitely recyclable should be concerned. Additionally, initiatives in China and other countries to prohibit or reduce the use of plastic have a direct influence on exports, which businesses must comply with.

TH2: Thailand's plastic resins industry is inferior to those of the Republic of Korea, Japan, and United States, who are world leaders in technology of the plastic resins in terms of research and development. This will limit Thailand's market expansion.

Figure 9 Global Competitiveness Index of Thailand overall not specific to Plastic resins.



Resource: *The Global Competitiveness Report 2019, World Economic Forum.*

## 5.5 TOWS matrix

TOWS Matrix is the process of analyzing and further developing data collected from SWOT analysis of Thailand plastic resins industry into a strategy that divides SWOT into pairs and determine effective strategies of Thailand plastic resins exports to China. Based on findings in Part 1 and the SWOT analysis, this study used the TOWS Matrix to develop S-O strategies, W-O strategies, S-T strategies, and W-T strategies for Thailand as follows.

### 5.5.1 S-O Strategy

#### Private sector

- To reverse the declining trend toward single-use plastics and mitigate environmental damage, entrepreneurs should accelerate research and development, production, and promotion of the environmentally friendly plastic resin products, in order to replace the conventional plastics.

### Public sector

- Thai authorities should encourage businesses to expand their manufacturing capacity and establish additional ecological friendly plastic resins facilities such as tax exemption.

### 5.5.2 W-O Strategy

#### Private sector

- Entrepreneurs should invest in research and development to discover new approaches to add value to plastic resin products in an ever-changing environment where there are more competitors. Preparation with a strong emphasis on research and development that results in a shift in working style is also important, including the following:
  - Research and development keep entrepreneurs updated of market trends, allowing them to increase our competitiveness on a national and worldwide level.
  - Research and development lead to development of high-quality goods using modern manufacturing technology, which increases production efficiency and hence lowers production costs.
- Entrepreneurs should continuously help foster employees by encouraging a growth mindset and daring to experiment with new ideas, skills, and concepts through participation at various training seminars, experimenting with new things, and collaborating with various research units, among other activities.

#### Public sector

- Thai authorities should adopt a strategy for expanding spending in R&D and innovations.
- Thai authorities should develop businesses and workers in the plastic resins industry to be highly skilled in industries such as manufacturing, technology management, and innovation.
- Thai authorities should develop the educational curriculum and the modernized education in target industries such as science, engineering, and chemical engineering.

### 5.5.3 S-T Strategy

#### Private sector

- Entrepreneurs should organize activities aimed towards promoting an export of their products and turned to producing plastic resins in the plastic composite group with improved qualities, more durable and longer service life such as reusable packaging, automobiles, and construction.

#### Public sector

- Thai authorities should promote the development and production of plastic resins products with high demand in the Chinese market, such as LDPE, POM, and PS during the transition of the China market's changing demand patterns.

### 5.5.3 W-T Strategy

#### Private sector

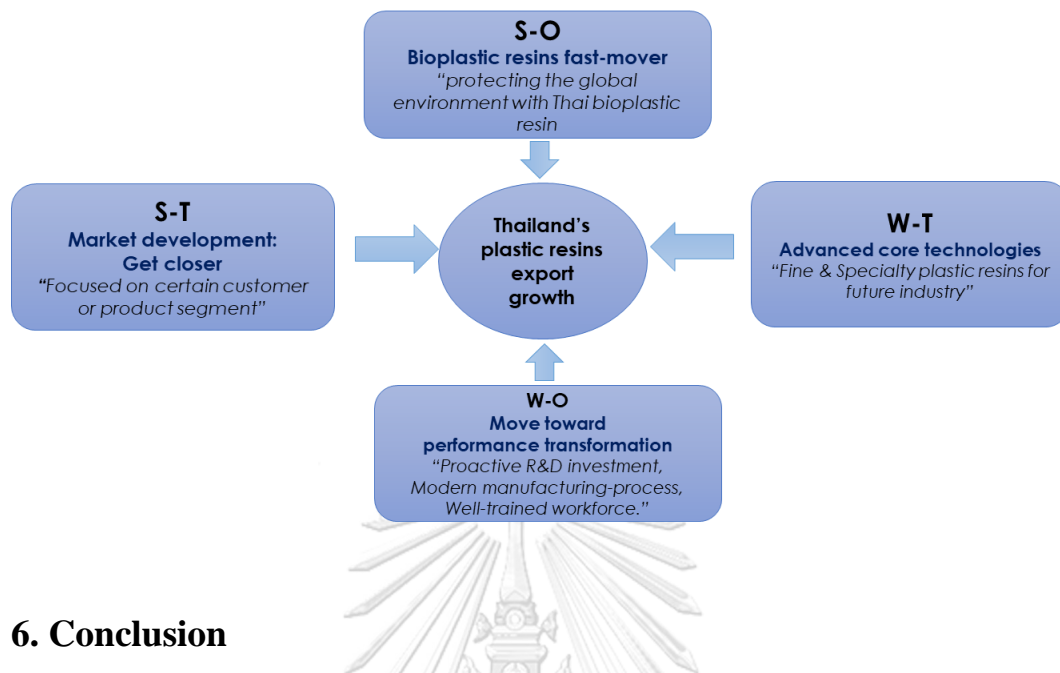
- Entrepreneurs should concentrate on advanced technologies for the production and development of high demand plastic resins, a remarkable business that can serve customers in a variety of industries with an R&D that works closely with customers to innovate and develop products that address specific customer needs.

#### Public sector

- Thai authorities should conduct investigations into the demand for possible plastic resins from major trading partners and the competitiveness of competitors. Then, apply the findings to the development of Thailand's plastic resins industry.
- Thai authorities should support the production which can replace imported crude oil or to educate knowledge needed to make products at a smaller price.



Figure 10 Summay of TOWS matrix strategies.



## 6. Conclusion

By examining Thailand's Revealed comparative advantage (RCA) and market share analysis (CMS), I find that Thailand retains the potential to export plastic resins in comparison to competitors such as Republic of Korea, Japan, and the United States. Thailand had an RCA value more than one in each period and tended to increase in the Chinese market, demonstrating that Thailand retains a competitive advantage in exporting plastic resins to China. The fact that RCA more than one cannot certainly indicate that countries with higher RCA values have a greater capacity to export plastic resins than countries with lower RCA values, and it is difficult to ascertain particularly which factors are influenced by the RCA values. However, RCA shows only a comparative advantage in manufacturing competence that is measured only on the basis of apparent trade value.

The Constant market share (CMS) analysis before the Ministry of Industry launched a development strategy for the Thai petrochemicals and plastics industry in 2017 reveals Thailand's export value of plastics increased by 80.84 percent as a result of the Competitiveness effect, World trade effect and Market distribution effect. The rise in Competitiveness effect was linked to Japan's declining capacity for ethylene-based resins (HS 3901), as three naphtha crackers producing 1.3 million tons of ethylene were closed due to the production situation being

uneconomical. As a result, its importers for this type of plastic resins importing more from Thailand to compensate (DITP, 2017). Furthermore, the positive value of World trade effect and Market distribution effect reflects global trade is expanding at a high rate, and Thailand's plastic resins have been widely distributed across the potential markets.

The Constant market share (CMS) analysis after the Ministry of Industry launched a development strategy for the Thai petrochemicals and plastics industry in 2017 reveals Thailand's export value of plastic resins decreased by -40.35 percent. Thai plastic resins export values has decreased as a result of the World trade effect and Competitiveness effect. The fall in World trade effect expansion was linked to the global economy and trade partners slowing down as a result of the COVID-19 pandemic. Furthermore, the negative value of Competitiveness effect reflects Thailand's falling competitiveness as a result of an increased awareness of environmental protection in the global market. Therefore, Thailand's private sector and public sector should consider preparing and changing their operations in the long run, particularly in terms of environmental friendly manufacturing innovations or high-value-added product, in order to suit client expectations and maintain competitiveness in the market. In the contrast, the positive value of Market distribution effect reflects Thailand plastic resins was still spread across the potential markets.

The Porter's diamond model's competitive advantages analysis shows that Thailand is an oil and natural gas producer, but due to a lack of adequate crude oil reserves for consumption, the country is forced to import large quantities of raw materials from overseas, raising the cost of production. In contrast, the country has adequate supply of natural gas and appropriate infrastructure, including access to power and water for the growth of the plastic resins industry. Additionally, Thailand, as an agricultural country whose major commodity is sugarcane, can use sugarcane as a raw material to produce bio-plastics resins. Thailand should take use of this opportunity to develop and transition existing petroleum-based plastic resins industry operators into producers of bio-based plastic resins in order to adapt to future trends and to strengthen the Thai plastic resin products industry's competitiveness. In terms of demand conditions, it was determined that demand of packaging, which accounts for the largest share of domestic demand, was decided to be

aimed at reducing due to the elimination of single-use plastic packaging. Environmentally friendly or bioplastics may help to reduce the usage of conventional plastic packaging.

In term of firm strategy, structure and rivalry, there are few competitors in this industry, and each business typically has repeat customers, resulting in a low degree of competition in the domestic market, to the point that the country has a few clusters of petrochemicals. As a result, Thailand's plastic resin industry continues to be weakly developed in terms of supporting manufacturing industries. To increase its competitiveness, the plastic resins industry received government support for the development of a high-value-added petrochemical manufacturing base in the region, with the goal of evolving into a specialized petrochemical product and attracting international investment.

According to the SWOT analysis, Thailand's highly efficient labor market is important for attracting investment from leading players. Additionally, there are still areas of concern, such as research and development of technology skills. As a result of this study, Thailand continues to have production and export constraints that must be addressed. The recommendations are as the following:

1. The private sector should invest in research and development to discover new ways to add value to plastic resin products in an ever-changing environment where there are more competitors, and each has leveraged their approach to compete in unique ways.
2. The private sector should also invest in employee development by encouraging a growth mindset and daring to experiment with new ideas, skills, and concepts to foster an environment conducive to learning among employees.
3. The government should adopt a strategy for expanding R&D spending, fostering innovation, and modernizing Thai education in priority areas such as science, engineering, and chemical engineering to develop enterprises and workers in the plastic resins industry.

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## Appendix

### 1. Revealed Comparative Advantage

Appendix 1 The value of Thailand's and competitor countries' exports of plastic resins and other goods to China during 2012-2020.

Year	Thailand		Rep. of Korea		Japan		United States	
	Plastic resins	All product	Plastic resins	All product	Plastic resins	All product	Plastic resins	All product
2012	2,586,907	26,899,634	7,255,691	134,322,396	4,386,172	144,184,828	3,508,577	110,516,536
2013	2,870,733	27,238,224	7,876,731	145,869,498	4,265,380	129,401,394	3,511,368	121,721,076
2014	3,040,846	25,084,369	7,717,197	145,327,704	3,973,961	126,361,386	3,778,665	123,675,623
2015	5,433,182	47,464,915	6,455,494	137,123,934	3,511,306	109,277,767	3,488,121	116,071,709
2016	4,891,127	47,599,222	6,225,823	124,432,941	3,606,978	113,830,234	3,446,238	115,594,770
2017	5,258,404	59,012,000	7,157,707	142,119,046	3,981,398	132,781,187	1,532,114	129,797,515
2018	6,269,472	60,350,892	7,724,653	162,124,668	3,902,320	144,033,052	1,539,750	120,147,866
2019	6,419,711	56,136,926	7,144,599	136,202,533	3,802,584	134,673,080	1,584,176	106,626,645
2020	2,957,500	29,756,612	7,623,536	132,555,008	4,056,259	141,400,000	2,189,064	124,648,508

Unit: thousand US dollar

Appendix 2 The value of China's imports of plastic resins and total imports of all products during 2012-2020.

Year	Plastic resins	All product
2012	52,536,903	1,818,199,228
2013	55,076,453	1,949,992,315
2014	57,496,687	1,959,234,625
2015	98,160,075	3,359,128,649
2016	89,951,380	3,175,841,376
2017	103,360,581	3,687,585,878
2018	56,300,111	2,134,982,615
2019	53,160,535	2,068,950,255
2020	52,257,534	2,055,590,612

Unit: thousand US dollar

## 2. Constant Market Share Analysis

### Appendix 3 The result of Constant Market Share Analysis.

Result	2012-2016		2017-2020	
	Export value (thousand US dollar)	Change in export value (%)	Export value (thousand US dollar)	Change in export value (%)
Plastic resins Export value in period 1	17,068,534.87		21,809,382.07	
Plastic resins Export value in period 2	30,866,877.08		13,010,317.63	
A change in plastic resins export value	13,798,342.21	100.00	-8,799,064.44	100.00
1. World Trade Effect	2,131,651.34	15.45	-5,119,249.93	-58.18
2. Market Distribution Effect	1,961,024.63	14.21	2,101,351.71	23.88
3. Competitiveness Effect	9,542,317.75	69.16	-5,196,272.01	-59.05
4. Interaction Effect	163,348.50	1.18	-584,894.21	-6.65

### Appendix 4 Export value and overall global export growth rate of plastic resins during 2012 to 2016.

Product	(1) World export value 2012	(2) World's export value 2016	(3) = (2) - (1) Change in export value	(4) = [(2)/(1)]-1 World's growth rate
Plastic resins	459,506,401.61	516,893,133.67	57,386,732.06	0.12

Unit: thousand US dollar

### Appendix 5 Export value and growth rate of plastic resins in Thailand's key markets during 2012 to 2016.

Market	(1) World export value 2012	(2) World's export value 2016	(3) = [(2)/(1)]-1 Market's growth rate
China	11,178,827.56	24,207,250.60	1.17
Vietnam	495,037.90	453,721.66	-0.08
Japan	12,920,952.12	11,155,956.03	-0.14
Indonesia	1,027,327.12	956,611.82	-0.07
India	2,434,629.29	2,407,235.76	-0.01
Others	431,449,627.64	477,712,357.81	0.11

Unit: thousand US dollar

### Appendix 6 The result of Market distribution effect of plastic resins exports in Thailand's key markets during 2012 to 2016.

Market	(1) Thai export value 2012	(2) Thai export value 2016	(3) World's growth rate	(4) = (2) - (1) Change in export value	(5) Market's growth rate	(6) = [(5) - (3)]*(1) Change in export value	(7) = [(6) - (4)]*100 % Change in export value
China	2,587,048.74	4,891,126.67	0.12	2,304,077.92	1.17	2,691,998.73	116.84
Vietnam	490,819.22	1,195,163.29		704,344.07	-0.08	-102,261.46	-14.52
Japan	825,466.14	1,191,008.79		365,542.65	-0.14	-215,848.92	-59.05
Indonesia	713,775.68	1,376,653.05		662,877.37	-0.07	-138,274.07	-20.86
India	461,509.04	1,187,525.84		726,016.81	-0.01	-62,829.56	-8.65
Others	11,989,916.05	21,025,399.44		9,035,483.39	0.11	-211,760.08	-2.34
Total	17,068,534.87	30,866,877.08		13,798,342.21		1,961,024.63	

Unit: thousand US dollar

Appendix 7 The result of Competitiveness effect of plastic resins exports in Thailand's key markets during 2012 to 2016.

Market	(1) Thai export value 2012	(2) Thai export value 2016	(3) Market's growth rate	(4) = (2) - (1) Change in export value	(5) Competitiveness's change in export value
China	2,587,048.74	4,891,126.67	1.17	2,304,077.92	-328,342.77
Vietnam	490,819.22	1,195,163.29	-0.08	704,344.07	813,176.55
Japan	825,466.14	1,191,008.79	-0.14	365,542.65	553,973.46
Indonesia	713,775.68	1,376,653.05	-0.07	662,877.37	764,643.24
India	461,509.04	1,187,525.84	-0.01	726,016.81	739,530.45
Others	11,989,916.05	21,025,399.44	0.11	9,035,483.39	6,999,336.81
<b>Total</b>	<b>17,068,534.87</b>	<b>30,866,877.08</b>		<b>13,798,342.21</b>	<b>9,542,317.75</b>

Unit: thousand US dollar

Appendix 8 Export value and overall global export growth rate of plastic resins during 2017 to 2020.

Product	(1) World export value 2017	(2) Worlds export value 2020	(3) = (2) - (1) Change in export value	(4) = [(2)/(1)]-1 World's growth rate
Plastic resins	625,704,394.88	478,834,705.04	-146,869,689.83	-0.23

Unit: thousand US dollar

Appendix 9 Export value and growth rate of plastic resins in Thailand's key markets during 2017 to 2020.

Market	(1) World export value 2017	(2) Worlds export value 2020	(3) = [(2)/(1)]-1 Market's growth rate
China	29,867,956.50	15,484,417.49	-0.48
Vietnam	626,956.39	1,337,334.76	1.13
Japan	12,014,470.51	11,487,722.00	-0.04
Indonesia	1,043,077.90	1,201,434.00	0.15
India	2,947,222.48	3,316,087.28	0.13
Others	579,204,711.10	484,066,138.15	-0.16

Unit: thousand US dollar

### Appendix 10 The result of Market distribution effect of plastic resins exports in Thailand's key markets during 2017 to 2020.

Market	(1) Thai export value 2017	(2) Thai export value 2020	(3) World's growth rat	(4) = (2) - (1) Change in export value	(5) Market's growth rate	(6) = [(5) - (3)]*(1) Change in export value	(7) = [(6) - (4)]*100 % Change in export value
China	3,877,042.15	2,611,994.46	-0.23	-1,265,047.69	-0.48	-957,024.40	75.65
Vietnam	806,094.83	634,721.03		-171,373.80	1.13	1,102,564.92	-643.37
Japan	758,604.07	591,308.06		-167,296.01	-0.04	144,805.47	-86.56
Indonesia	1,112,608.90	558,640.57		-553,968.33	0.15	430,071.33	-77.63
India	1,057,021.14	431,338.00		-625,683.14	0.13	380,404.69	-60.80
Others	14,198,010.98	8,182,315.52		-6,015,695.46	-0.16	1,000,529.70	-16.63
<b>Total</b>	<b>21,809,382.07</b>	<b>13,010,317.63</b>		<b>-8,799,064.44</b>		<b>2,101,351.71</b>	

Unit: thousand US dollar

### Appendix 11 The result of Competitiveness effect of plastic resins exports in Thailand's key markets during 2017 to 2020.

Market	(1) Thai export value 2017	(2) Thai export value 2020	(3) Market's growth rate	(4) = (2) - (1) Change in export value	(5) Competitiveness's change in export value
China	3,877,042.15	2,611,994.46	-0.48	-1,265,047.69	1,161,244.70
Vietnam	806,094.83	634,721.03	1.13	-171,373.80	-508,531.04
Japan	758,604.07	591,308.06	-0.04	-167,296.01	-140,182.65
Indonesia	1,112,608.90	558,640.57	0.15	-553,968.33	-627,600.46
India	1,057,021.14	431,338.00	0.13	-625,683.14	-673,663.00
Others	14,198,010.98	8,182,315.52	-0.16	-6,015,695.46	-4,407,539.55
<b>Total</b>	<b>21,809,382.07</b>	<b>13,010,317.63</b>		<b>-8,799,064.44</b>	<b>-5,196,272.01</b>

Unit: thousand US dollar

## 3. SWOT Analysis

### Appendix 12 Global Competitiveness Index of Thailand.

Criteria	Thailand	Rep. of Korea	Japan	USA	Median
1. Institutions	3.8	4.0	5.4	5.3	4.7
2. Infrastructure	4.7	6.1	6.3	6.0	6.1
3. Higher education and training	4.6	5.3	5.4	6.1	5.4
4. Labour market efficiency	4.3	4.2	4.8	5.6	5.4
5. Technological readiness	4.5	5.6	6.0	6.2	4.6
6. Market size	5.2	5.5	6.1	6.9	4.7
7. Innovation	3.5	4.8	5.4	5.8	5.8

Resource: The Global Competitiveness Report 2019, World Economic Forum.

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