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The Road towards a Resilient Base Petrochemical Industry in Indonesia: A Transformative Scenario Planning Approach

Tri Yudo Harisasono[1], Yos Sunitiyoso[2]
[1,2] School of Business and Management Institut Teknologi Bandung, Indonesia

ABSTRACT: Petrochemical industry is a strategic industry for a nation because it has a big impact on society at large. Petrochemical derivative products are an inseparable part of our modern life. With the development of technology, humans can synthesize innumerable combinations of petrochemical molecular structures to obtain materials with certain properties suitable for the final products to be made, from clothing, packaging, pharmaceutical, households, etc. All these products are mostly produced based on six building blocks of petrochemical, which are ethylene, propylene, butylene, benzene, toluene, and xylene. They, collectively, are called base petrochemical. However, the chemical sector and its derivatives contributed to the Indonesian Current Account Deficit. In 2019, The Indonesian Central Bureau of Statistics reported that imports of chemicals and goods derived from chemicals reached USD 21.51 billion. Meanwhile, the export activity of this sector was only USD 12.65 billion. Thus, The Government of Indonesia through the Ministry of Industry (MoI) pays special attention to the industry as stipulated in the National Industrial Development Master Plan (*Rencana Induk Pengembangan Industri Nasional* - RIPIN). RIPIN 2015, which is spanned between the years 2015 to 2035, is a guideline for the government and industry players in planning and developing the national industry. Considering the importance of the base petrochemical industry, this research was conducted to find plausible scenarios for the industry in Indonesia. The time horizon in this research is the year 2035 which is in line with RIPIN document. In obtaining possible scenarios, a literature review was carried out and followed by interviews with several relevant and competent sources. This research produced four scenarios namely "The Ruptured SBR", "The Abandoned ABS", "The Aromatic Painkillers", and "The Flying Polyester". The approach employed is a Transformative Scenario Planning (TSP) according to Adam Kahane's work. This research does not focus on one particular entity or institution, but on the national basic petrochemical industry as a whole which consists of various stakeholders with different interests. So that in implementing the results of this research, it is important to realize that all parties need to contribute to achieve the desired future.

KEYWORDS: Base Petrochemicals, Petrochemical Industry, RIPIN 2015-2035, Scenario Planning, Transformative Scenario Planning.

1. INTRODUCTION

Industrial sector is the main driver of national economic development. It makes significant contributions in increasing added value, employment, foreign exchange power, as well as being able to make a major contribution to the formation of national competitiveness. With Law number 3 of year 2014, regarding Industrial Affairs, the Government of Indonesia intends to direct the national economy to grow faster and catch up with other countries that are economically more advanced. Petrochemical industry which provide the raw materials for manufacturing industries, is considered the foundations of a nation's industry. However, technically speaking, base petrochemical industry is the mother of all groups in petrochemical industry. This is due to the fact that base petrochemical industry takes raw commodities such as crude oil and natural gas as its feedstock, then produces base chemicals which become the raw material to manufacture other chemicals (Sulaiman, 2016). Further in 2018, in the official release of "Making Indonesia 4.0: Industrial Revolution 4.0" by MoI, chemical industry is mentioned as one of the five sectors with significant impact to Indonesian economy. In the document, GoI explicitly aims to increase domestic production and reduce the import of base petrochemical products. GoI acknowledged that Indonesia is the largest target market in the region. However, the industry still failed to meet local demand. For example, more than 50% of ethylene and polyethylene are imported. Thus, it is critical to ensure the resilience of the petrochemical industry in Indonesia, especially the base petrochemical industry, in order to reduce the Current Account Deficit, strengthen Indonesia's economy, and ultimately prosper the people.

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2. BUSINESS ISSUE EXPLORATION

A. Conceptual Framework

This research imitates the five steps of TSP method as introduced by Adam Kahane (2012). The five steps are:

1. ***Convening a team from across the whole system:*** In the first step, the project initiator(s) must invite stakeholders representing the whole system who share the same concern that the situation in the system must be change, and at has the potential to influence the future if they work together. An optimum number of team member must be carefully determined. Too small team will make it unlikely to represent the whole system and eventually difficult to make an influence. On the other hand, overwhelmingly big team will make it difficult to build close relationship and discussion during the process.
2. ***Observing what is happening:*** During the second step, the scenario team need to look past what they already know and see with new perspectives. They come from different places in the system, and have different -sometime contradictive- ideas about it. It requires them to see more of the whole system, not just their part of it. They need to be open, ask questions, and learn. The purpose is for them to get a general idea of what is going on in the system they are a part of and want to change.
3. ***Constructing stories about what could happen:*** The third step in the process is for the team to develop several useful scenarios in the future about what could happen in and around their system. The scenarios must be relevant, challenging, plausible, and easy to understand. Thus, in the later stages, the stakeholders may respond to the scenarios by reshaping their mental model of the system, and act accordingly to influence the system in the favorable direction.
4. ***Discovering what can and must be done:*** TSP process does not stop at generating scenarios. It goes further to produce actionable lists to influence the system. The fourth step of the process is the key for this purpose.
5. ***Acting to transform the system:*** As the final step in the process, the team will take real actions based on the actionable lists from the previous step to influence the system and transform the undesired situation. This is the moment for the scenario group to take public actions.

While original work consists of five steps, the scope for this report will cover only steps 1 to 3.

B. Analysis of Business Situation

Base petrochemical industry is a business with complex global supply chain system. The raw feedstocks such as crude oil, natural gas, or naphtha may be imported from other countries, while the resulting products are purchased by off-takers both from domestic and overseas to satisfy the ever-growing demand. In response to the increasing demand around the world, producing countries are increasing their production capacity. Countries like the People's Republic of China and the United States will significantly increase its capacity in the near future.

The United States' share of the world market for ethylene made from steam cracking is expected to rise from 20% in 2017 to 22% in 2025. Between 2017 and 2025, China's coal-based methanol-to-olefins capacity will almost double, giving it more raw materials for its large manufacturing base (International Energy Agency, 2018). On the other hand, in the long-term, Asia and the Middle East each gain 10 percentage points of the market for high-value chemicals (HVC), while Europe and the United States lose market share. Together, India, Southeast Asia, and the Middle East will make about 30% of the world's ammonia by 2050.

In regional basis, Indonesia is far behind the other ASEAN countries in term of production capacity. The domestic production capacity for olefin and polyolefin are 2.038 KTA and 2.076 KTA respectively. These values are a fraction of the production capacity of Thailand as the biggest producer in the region. Thailand can produce up to 7.154 KTA of olefin and 5.675 KTA of polyolefin.

Table 1: Regional petrochemical production capacity. Source: MoI, 2022

NO	ASEAN COUNTRY	OLEFIN		TOTAL (KTA)
		C2 (KTA)	C3 (KTA)	
1	THAILAND	4978	2176	7.154
2	SINGAPORE	4055	2466	6.521
3	MALAYSIA	3075	2337	5.412
4	INDONESIA	900	1138	2.038
5	PHILIPPINES	480	250	730
6	AUSTRALIA	472	35	507

NO	ASEAN COUNTRY	POLYOLEFIN			TOTAL (KTA)
		HDPE (KTA)	LLDPE (KTA)	PP (KTA)	
1	THAILAND	1920	1450	2305	5.675
2	SINGAPORE	400	2155	1485	4.040
3	MALAYSIA	855	470	1540	2.865
4	INDONESIA	586	600	935	2.076
5	VIETNAM			1000	1.000
6	PHILIPPINES	335,34	110	300	745,34
7	AUSTRALIA	204	125		329

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Currently, there are only a handful plants producing base petrochemical products in Indonesia. Aromatics group is produced by PT Trans-Pacific Petrochemical Indotama in Tuban, East Java, with capacity of 600.000 ton of paraxylene annually. Another paraxylene producer is Pertamina RU IV Cilacap in Central Java with capacity of 200.000 ton annually. On the other hand, the olefin group is mostly supplied by PT Chandra Asri Petrochemical in Cilegon, Banten which produces olefins, polyolefins, and other groups of petrochemical derivatives. Pertamina RU VI in Balongan also produces olefins with smaller capacity than that of Chandra Asri.

The massive imports of basic petrochemical products contributed to Indonesia's Current Account Deficit. To improve the situation, Indonesian government is encouraging the development of the national base petrochemical industry by issuing economic stimuli. The industrial sector responded by making investments to increase plant capacity. The increased petrochemical production capacity is intended to satisfy domestic demand by substituting imports stream. On top of that, it also aims to compete in the global market. According to the report issued by Ministry of Industry, Indonesia is predicted to be a major producer in ASEAN region. The production capacity for olefins will be increased from 4.609 KTA to 6.647 KTA by 2028, while polyolefins will be increased from 6.230 KTA to 8.351 KTA in the same year.

3. BUSINESS SOLUTION

A. First Step: Convening a Team from Across the Whole System

In the first step, there are eight persons invited as interviewees who come from four different stand points of the industry. Ideally, according to Kahane, the source persons should interact directly, to make bonds, align their vision and the spirit of togetherness to overcome problems that become a common concern. The interaction could mean a physical assembly or a distant participation utilizing technology such as teleconference. However, in this study, the direct interaction among them could not be established. Instead, they were interviewed individually to capture their mental model regarding the current condition of base petrochemical industry, the driving forces, and the various plausible futures lay ahead. The results of the interview are then studied, summarized, and combined to obtain the components of scenario planning. The following table describes the different groups of participants in this study.

Table 2: Interviewees Profile

Interviewee Code Name	*Stakeholder Group*	*Years of Experience*
Ind01	The Industrialist	24 years
Ind02	The Industrialist	10 years
Ind03	The Industrialist	32 years
Gov01	The Government	23 years
Gov02	The Government	36 years
Aca01	The Academia	16 years
Asc01	The Association	28 years
Asc02	The Association	36 years

B. Second Step: Observe What is Happening

1. ***Driving Forces:*** The second step in a TSP project is to get a general idea of what is going on in the system under study. It is important to understand the elements composing the system and the interrelation between them. Those elements are called the driving forces. The methods used to analyze the business environment are literature review and panels interview with PESTEL framework. PESTEL stands for Political, Economic, Social, Technology, Environment (Ecology), and Legal. The output of the process is a list of driving forces ruling the base petrochemical industry in Indonesia.

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Table 3: The driving forces obtained from each interviewee

Interviewee Code Name	*POLITICAL*	*ECONOMIC*	*SOCIAL*	*TECHNOLOGY*	*ENVIRONMENT*	*LEGAL*
Ind01	• Government consistent support	• Market access • Import of end-product • Demand of end-product • Infrastructure		• Production capacity • Downstream production technology • Technology access	• "Green" derivatives	• FTA • Plastic banned • Tax incentive
Ind02	• Government consistent support	• Current Account Deficit • Demand of end-product • Economic growth • Financing access • Trader's action		• Technology trend • Integrated plant	• "Green" derivatives • Decarbonization • People's awareness	• Import limit
Ind03	• Government consistent support		• Bonus Demography • Culture			• FTA
Gov01	• Government consistent support • Cohesion between government bodies	• Financing access • Demand of end-product			• Microplastic	• Local content regulation
Gov02	• Geopolitical stability • Government consistent support	• Foreign investment	• Industry initiatives	• Technology access • Technology trend • Integrated plant	• Resource availability	• Limit commodity export • Gas pricing for industry • Local content regulation • FTA • Tax Incentives • Harmonized import duty

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Aca01	• Government consistent support		• Triple helix interaction	• Technology trend • Tech. access • Research pace • Research facility	• Resource availability • Decarbonization	
Asc01	• Government consistent support • Corruption	• Global demand • Trader's action • Demand of end-product • Market access	• Alignment between stakeholders	• Efficiency of existing plants • Tech. access	• Waste management • "Green" derivatives • Infrastructure	• Import limit • Plastic tax • Carbon tax
Asc02	• Government consistent support • Geopolitical stability	• Financing access • Demand of end-product	• Alignment between stakeholders • Commitment between stakeholders • Population growth	• Research pace • Integrated plant	• "Green" derivatives	• FTA • Import limit

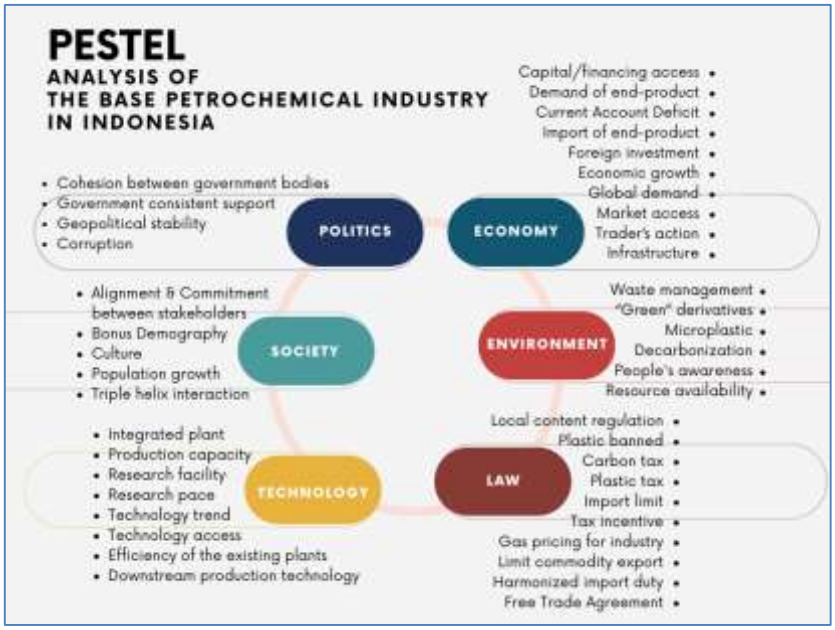

Figure 1: Summary of PESTEL diagram for base petrochemical industry in Indonesia

3. Certainties and uncertainties: The next step is to rank the forces based on its impact magnitude to the system and the uncertainty level. There are several rationales running behind the ranking process. First, the ranking is arranged based on the logical cause-effect relationship between the forces. The force which serves as the cause of another force is considered as having more impact magnitude. Also, the force which has a greater number of effects is considered as more powerful than forces with a smaller number of effects. Furthermore, the uncertainty level is graded by limited knowledge if the force will eventually take place or not, or if the outcome of the forces is unknown.

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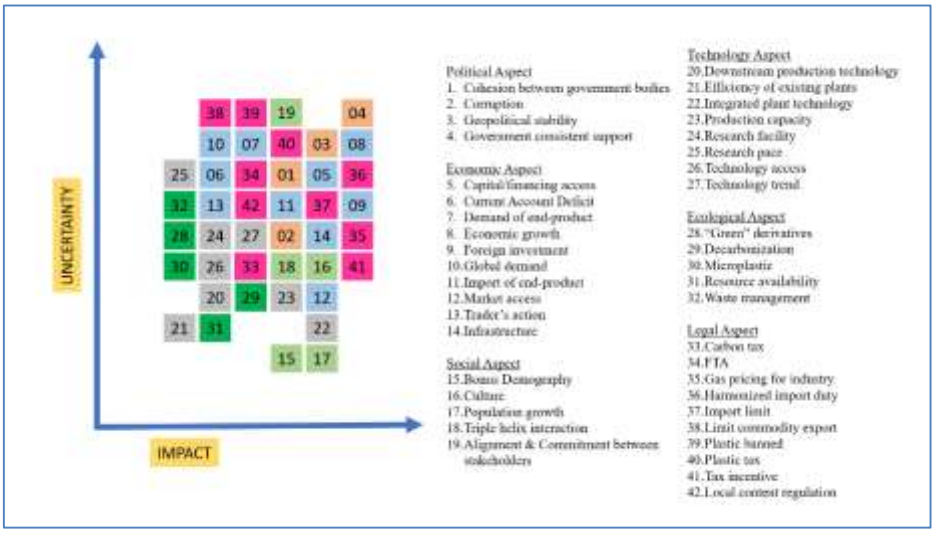

Figure 2: Driving forces, ranked according to the uncertainty level and the impact magnitude to the base petrochemical industry

C. Third Step: Construct Stories About What Could Happen

1. Critical uncertainties: The next step is to select 2 critical uncertainties as the basis to construct possible stories. There are 3 criteria to be used to select the critical uncertainties, based on Kahane's work. First, it will have high impact. Secondly, it is considered as high uncertainty And third, special to TSP, at least one of the selected uncertainties can be influenced by the stakeholder.

Referring to previous Figure 2 of uncertainty vs impact, we can see that item 03 and 04 are two critical uncertainties for base petrochemical industry in Indonesia. Furthermore, special for TSP, at least one of the uncertainties must be under the domain of one of the stakeholders. In this case, "Government consistent support" perfectly fits the criteria since the factor is under the domain of government which is one of the key stakeholders of the system. Thus, the selected critical uncertainties for the story's development are "geopolitical stability" and "government consistent support".

2. Scenario framework: This thesis will use deductive method, which means the condition for the scenarios are selected prior to the scenario creations. Then the scenario stories are developed by considering the combinations of the selected conditions or key uncertainties. The combination of key uncertainties is laid down on a 2x2 matrix which eventually will lead us to 4 different scenarios. The theme for the scenarios is related with petrochemical derivative products.

Figure 3: Four scenarios of base petrochemical industry in 2035

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a. The ruptured SBR (Styrene-Butadiene Rubber)

SBR stands for Styrene-Butadiene Rubber. It is a synthetic rubber commonly used as automotive tires. A ruptured SBR tire symbolizes when the base petrochemical industry is doomed due to the continued instability of global geopolitics, while at the same time our government pays little attention to the industry. The government may claim to be supportive to the industry, however the support given is less than required. Instead, the government put more focus on other sector. As the result, the industry will burst, unable to sustain itself under the pressure. Global instability gives multiple effect to industry. It will give problems in term of availability of raw materials supply, as well as its accessibility, and the affordability. On the other hand, global instability will also reduce the demand of our products, directly or indirectly.

In the global scale, the early warning signal could be sensed by the escalated confrontation between Russia-Ukraine. There is potential that the conflict will also drag other countries to the war, thereby undermining the peace effort. Other early warning is the continues global recession which make governments, industry, as well as households cut spending.

b. The abandoned ABS (Acrylonitrile Butadiene Styrene)

ABS, or Acrylonitrile Butadiene Styrene, is another petrochemical derivative. The end-products of the substance ranging from the musical instruments, golf club head, kitchen appliances, and Lego® bricks. Lego® has been using the substance since 1958. As one of the most popular toys in the world, with fans come from a wide range of ages, Lego® bricks represent creativity and happiness. It represents the creativity of petrochemical players to create innovative products, to find efficient synthesis routes, to crate beneficial end-use applications, etc. It also represents the happiness it may bring when the domestic base petrochemical industry prospers under improving stability of global geopolitics. However, the potential is not maximized under this scenario due to the government does not properly support the industry. Thus, the name abandoned ABS is selected.

The early warning signal which could lead to the situation comes from the peaceful closing of the war between Russia-Ukraine and the healing of global economic conditions. On the other hand, domestically, there is no clear support from government of Indonesia regarding the petrochemical industry. One example of the situation is the more Free Trade Agreement (FTA) which hurt the base petrochemical industry.

c. The Aromatic Painkillers

Paracetamol as one of painkillers, is derived from petrochemical. It is synthesized from phenol which is an aromatic group. As a drug, it represents the situation where the external environment is pounding the industry while the government keeps giving necessary support. Similar with our condition, we take painkillers when we are unwell. It may not cure the disease but definitely will ease our pain. In this scenario, the support from the government does not entirely lift the difficulties caused by the instability in global geopolitics, but at least it gives breath to the industry.

The early warning signal of the scenario is similar with “The Ruptured SBR” scenario previously, only the different with this scenario is that the government is giving maximum support to the industry. This support can be in the form of various incentives, support for research related to petrochemicals, as well as protective regulations against imported products.

d. The Flying Polyester

In this scenario, the situation is represented by the colorful flying hot-air balloons. The major component of a hot air balloon is obviously the envelope, or the balloon. It is commonly made of polyester which is an aromatic group of petrochemicals. The successfully flown hot-air balloons represent the condition where the base petrochemical business in Indonesia is flourish. Many stakeholders, far beyond the producers, take the benefit of its development. The stakeholders include the mid-stream and downstream petrochemical producers, academia who gain financial support to develop petrochemical research further, the people who see a lot of job opportunities opened in the industry, and the government who received direct benefit in term of tax or other multiplier effect as new plants are successfully built.

Similar to “The Abandoned ABS”, the early warning signal for this scenario will be Russian-Ukrainian progress towards peaceful action. Other early warning signal also the healthy improvement of global and domestic economic condition. However, the difference in this scenario is the government of Indonesia is giving full support to the base petrochemical industry in line with the strategic plan in RIPIN 2015-2035.

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4. CONCLUSION

According to the examination of the business environment, driving forces, and key uncertainties impacting base petrochemical industry developments in Indonesia, the following may be concluded:

1. Petrochemical industry is a complex business in terms of the production process, variation of products created, value chain network, and conflicting interest of its stakeholders.
2. Petrochemical industry is a strategic industry as it manufactured countless products essential to our life. It is safe to say that petrochemical derived products are inseparable to our modern life.
3. Resilience of base petrochemical industry is of importance to a nation as it provides the raw materials for derivative petrochemical products.
4. Due to the complexity, many factors are driving the base petrochemical industry. However, in the perception of TSP method, the driving forces can be distilled to be two key uncertainties:
   a. Global geopolitical stability
   b. Government consistent support
5. From the key uncertainties above, there are 4 plausible scenarios can be derived:
   a. The Ruptured SBR (Styrene-Butadiene Rubber)

   It is the least favorable scenario where the global geopolitics become unstable and the government give more focus on other sector.

   b. The Abandoned ABS (Acrylonitrile Butadiene Styrene)

   In this scenario, the global geopolitics is relatively stable, which gives healthy environment for the industry growth. Unfortunately, the growth is not maximized due to the government does not pay sufficient support to the industry. It could be due to the dynamics in politics or economic.

   c. The Aromatics Painkillers

   This scenario is a reflection where the government is protective and supportive to the domestic base petrochemical industry. However, global geopolitical instability makes business growth extremely challenging.

   d. The Flying Polyester

   In this scenario, the stable global geopolitics provides environment for the healthy growth of base petrochemical industry. At the same time, government gives sufficient and appropriate support and protection to the industry.
6. The Flying Polyester is the most favorable scenario, though the target time frame for RIPIN 2015-2035 need to be adjusted. To reach the scenario, the different government bodies must synchronize their regulations in favor of the industry. Furthermore, all petrochemical industry players, not limited to the base petrochemical, must unite and aligned their action to ensure the government delivers sufficient and appropriate support, while at the same time to exploit the government support as much as possible. The stakeholders must put aside sectoral ego and instill a common goal in their mind which is the resilient of base petrochemical industry and ultimately manufacturing industry in general.

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