

MANUFACTURING INDUSTRIAL DEVELOPMENT POLICY FOR ELECTRIC PROPULSION SYSTEM TO IMPROVE LOCAL CONTENT OF RAILWAY INDUSTRY

KEBIJAKAN PENGEMBANGAN INDUSTRI MANUFAKTUR SISTEM PROPULSI ELEKTRIK UNTUK MENINGKATKAN TKDN INDUSTRI KERETA API

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Abstract

To fulfill the demand for a number of railroad products, the national railroad industry, in this case PT. INKA as a train integrator industry in Indonesia still has to import components. Local content electric train is still low. Railway propulsion systems can be classified into three groups, namely: Electric propulsion systems, Diesel Electric propulsion systems and Diesel Hydraulic propulsion systems. Import dependence, of course, cannot be allowed to continue because it will weaken the competitiveness of the national railroad industry. From the results of the analysis using the "Porter Diamond Condition" method various internal and external factors were identified through the SWOT method to formulate alternative policy formulations for the development of the railroad electric propulsion system industry in Indonesia. Qualitative SWOT data is changed to quantitative, and through calculation SWOT analysis is known with certainty the real position of the organization. From the results of the analysis, and calculations using the SWOT Method, the position of the railway propulsion system industry is in the Quadrant IV position, so it is best to use a Defensive Strategy. In this position the Company faces a very unfavourable situation, the company faces various threats and internal weaknesses. For this reason, it is necessary to prioritize strengthening strategies in the Matrix (W-T).

Key Words: Electric propulsion; Industrial development; Strategy

Abstrak

Untuk memenuhi permintaan sejumlah produk perkeretaapian, industri perkeretaapian nasional, dalam hal ini PT. INKA sebagai industry integrator kereta api di Indonesia masih harus mengimpor komponen. TKDN kereta berpengerak masih rendah. Sistem propulsi kereta api dapat digolongkan dalam tiga kelompok yaitu : Sistem propulsi Elektrik, sistem propulsi Diesel Elektrik dan sistem propulsi Diesel Hidrolik. Ketergantungan impor tentu saja tidak dapat dibiarkan terjadi terus menerus karena akan melemahkan daya saing industri perkeretaapian nasional. Dari hasil analisis menggunakan metode "Porter Diamond Condition" diidentifikasi berbagai factor internal dan eksternal melalui metode SWOT untuk kemudian dirumuskan alternative rumusan kebijakan untuk pengembangan industri sistem propulsi elektrik kereta api di Indonesia. Data SWOT kualitatif dirubah menjadi kuantitatif, dan melalui perhitungan analisis SWOT diketahui secara pasti posisi organisasi yang sesungguhnya. Dari hasil analisis, dan perhitungan menggunakan metode SWOT, posisi industri sistem propulsi listrik kereta api berada pada posisi kuadran IV, sebaiknya menggunakan strategi defensif. Pada posisi ini perusahaan menghadapi situasi sangat tidak menguntungkan, perusahaan tersebut menghadapi berbagai ancaman dan kelemahan internal. Untuk itu perlu diprioritaskan penguatan strategi dalam matrik (W-T).

Kata kunci: Propulsi Listrik; Pengembangan Industri; Strategi

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INTRODUCTION

Electric traction has become increasingly important for the collective transport of people and goods since it effectively contributes to the mitigation of congestion and pollution caused by road traffic. In its long history, which began at the end of the nineteenth century, it has experienced remarkable development and, in every era, it promptly made the most of progress in electrical engineering, mechanical engineering, power electronics, and also automation, often creating an incentive for new technology research and a valuable testing ground ¹⁾.

At present, the railroad industry in Indonesia is considered quite strategic because of the domestic market potential. The potential is based on plans to develop railway networks in Java, Sumatra, Kalimantan, Sulawesi, Papua, Bali, Batam and Madura. In addition, the development of dual lines and electrification in Java, the construction of rail-based mass transportation in big cities, the construction of airport trains, and the rejuvenation of the fleet by KAI in the medium term (around 900 units to 2019) ²⁾. From the plan, it is seen that the mode of rail transportation will increase every year along with the rise of domestic infrastructure projects.

Not only has the potential to work on the domestic market, but PT INKA also has the potential to fulfill the demands of foreign markets, especially in the ASEAN region and Africa ³⁾.

Table 1.
The ability of local content of the National Railway Industry

<i>Product</i>	<i>Integrator</i>	<i>Supporting Industry</i>	<i>Local Content</i>
Carriage of goods	PT. INKA: Frame Construction	PT. Barata Indonesia PT. Pindad PT. BBI	80-90%
Passenger Train	PT. INKA: Frame Construction, bogie	PT. Pindad PT. Len Industri IRC, Inkaba PT. Indo Spring PT. New Armada Mekar Jaya-Bama PT. Puncak Persada, Semko, Actel PT. Alkasa	60-80%
Electric rail train	PT. INKA: Frame Construction, bogie	PT. Len Industri PT. Pindad PT. Barata Indonesia	±40%

<i>Product</i>	<i>Integrator</i>	<i>Supporting Industry</i>	<i>Local Content</i>
		PT. KS	
Locomotif	PT. GE Lokindo	PT. INKA PT. Barata	±40%
AC Economy Class Passenger Train (K3)	PT. INKA	PT. Indo Spring PT. Barata	57.60%

To fulfill the demand for a number of railroad products, the national railroad industry, in this case, PT. INKA as a train integrator industry in Indonesia still has to import components. The average utilization of local content in PT INKA's railroad production and industry components is illustrated on the local content capability map as shown in Table 1.

From the table above it can be seen that the local content of the train is still low. For this reason, it is time to prepare the industrial development of the national railway propulsion system components and even have a very urgent nature. Import dependence, of course, cannot be allowed to continue because it will weaken the competitiveness of the national railroad industry.

LITERATURE REVIEW

Train Propulsion System

Railway propulsion systems can be classified into three groups, namely: Electric propulsion systems, Diesel Electric propulsion systems and Diesel Hydraulic propulsion systems ⁴⁾.

Electric Propulsion Systems are generally used on electric train where the power source is obtained directly from the Catenary cable through the Pantograph. In this system, there is a change in the form of energy from electrical energy to mechanical energy used to drive the train wheels. Electric power as the main power source will be used to rotate the electric motor through a converter. The main components in the Electric Propulsion are electric Motors or Traction Motors and Drive Systems. During its development, the voltage used can be a direct voltage (DC) or an alternating current (AC).

A. Electric Motor (Traction Motor)

There are several types of traction motors used in trains, including DC motors and AC motors, and the most modern ones are Linear Motors used on Maglev trains. The DC type motor is the most suitable

electric motor used as a traction motor due to its high starting torque characteristics. However, due to the need for intensive maintenance, the traction motor shifts using an AC motor which is easier to maintain and easier to control.



Figure 1.
Motor Traction

B. Drive Control System (Converter)

To be able to move while controlling the rotation of the traction motor, a component called Drive Control is needed. Drive Control for DC motors and AC motors is different. For Drive Control a common DC motor is to use a resistor control and DC Chopper or DC to DC Converter. In the Resistor Control, the resistance will be adjusted so that there is a change in the voltage of the DC motor connected in series with the resistor.

While the Drive Control for an AC motor uses a DC to AC Converter which is called an Inverter. In the inverter, the input voltage in the form of DC voltage will be converted into AC voltage through the switching process. The generated AC voltage will have a frequency and voltage that can change to produce a motor rotation that changes too so that in general the inverter used to drive the motor is referred to as a VVVF Inverter (Variable Voltage Variable Frequency Inverter).

C. Pantograph

In order to get the flow of electric current from the catenary, a component called pantograph or Current Collector is used. On the pantograph, there is contact with the catenary that uses carbon material so it is called a carbon strip. The carbon strip will continuously rub against the catenary wire by continuing the electric current from the wire to the train's electrical system.

Porter Diamond Condition

The strength of the industrial structure which is expected to increase capabilities

and competitiveness can be reviewed and mapped through several methods. One of them is the method initiated by Porter through the Diamond Cluster. According to Porter, a country gains a competitive advantage if the company is competitive. A country's competitiveness is determined by the ability of industries to innovate and improve their capabilities. The company receives benefits from competition in the domestic market, aggressive domestic suppliers, and local markets that have high demand. Companies become competitive through innovation which can include technical improvement of production processes or product quality⁵⁾.

According to Porter, there are four determinant factors that influence the superiority of industrial competitiveness: among others: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure and rivalry.

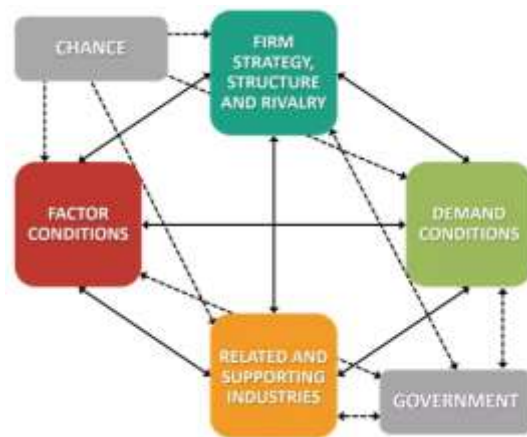


Figure 2.
Porter's Diamond Model

SWOT Analysis

SWOT is a strategic planning method used to evaluate strengths, weaknesses, opportunities, and threats in a project or business speculation⁶⁾.

SWOT analysis is an analysis based on the logic that can maximize strengths and opportunities, but simultaneously minimize weaknesses and threats⁷⁾.

This analysis is based on the assumption that an effective strategy will minimize weaknesses and threats. When applied accurately, this simple assumption has a large impact on the design of a successful strategy⁸⁾.

This process involves setting specific goals for business or project speculation and

identifying internal and external factors that support and which do not achieve these goals. SWOT analysis can be applied by analyzing and sorting out various things that affect the four factors, then applying it in the SWOT matrix image, where the application is how strengths can take advantage of the opportunities available, how to overcome weaknesses (weaknesses) that prevent the advantages (advantages) of opportunities (opportunities) that exist, then how strengths can deal with existing threats, and finally how to overcome weaknesses that can make threats become real or create a new threat.

SWOT Analysis is a very popular method used by organizations for strategic management and marketing. It is a tried-and-true tool of strategic analysis. It is possible to mention many characteristics that affect the preferability and usability of SWOT Analysis. These characteristics that can also be evaluated as advantages can be listed as follows ⁹⁾:

- SWOT Analysis is an analysis technique that has a general perspective and presents general solutions. Details and specific issues are not the focus of SWOT Analysis, but the other analyses that would follow. In this sense, SWOT Analysis is a road map that guides one from the general to the specific.
- SWOT Analysis is an interactional analysis technique that makes macro evaluations possible. As an analysis tool, SWOT provides the opportunity to focus on positive and negative aspects of the internal and external environment of the organization, in other words the elements in this environment that add plus and minus value, all together in a related perspective. In this regard, it is also possible to describe SWOT Analysis as 'Two-by-Two Matrix'.
- SWOT Analysis can help organizational managements to uncover opportunities to take advantage. By understanding weaknesses, threats can be managed and eliminated. To examine an organization and its competitors through SWOT Analysis, strategies that help distinguish a company from competitors can be formulated.

METHODOLOGY

There is no doubt that strategic management tools and techniques are important parts of the strategic management process. They are designed to support

managers in all stages of the strategic management process ¹⁰⁾.

SWOT analysis is a tool for analysis of internal and external conditions of an organization that is used as a basis for designing strategies and work programs. The internal analysis includes an assessment of strengths and weaknesses (Weakness). Meanwhile, the external analysis includes opportunity factors (Opportunity) and challenges (Threats).

From the results of the analysis using the "Porter Diamond Condition" method, various internal and external factors were identified through the SWOT method to formulate alternative policy formulations for the development of the railroad electric propulsion system industry in Indonesia.

Qualitative SWOT data is changed to quantitative, and through calculation SWOT analysis developed by Pearce and Robinson (1998) is known the exact position of the organization.

The calculation is done through three stages, namely: **1)**. Doing the score calculation (a) and weight (b) point factor as well as the total number of multiplication score and weight ($c = a \times b$) on each factor S-W-O-T; Calculating the score (a) of each factor point is carried out independently of each other (the assessment of a factor point must not be influenced or influence the evaluation of other factor points).

The choice of the range of scores greatly determines the accuracy of the assessment but the commonly used is from 1 to 10, assuming a value of 1 means the lowest score and 10 means the most important score. The weight calculation (b) of each factor point is carried out interdependently. That is, the assessment of one-factor point is to compare the level of importance with other factor points. So, the calculation formula is the value that has been obtained (the range of values is equal to the number of factor points) divided by the number of factor points). **2)**. Make a reduction between the total number of factors S with W (d) and factors O with T (e); The acquisition of numbers ($d = x$) then becomes the value or point on the X-axis, while the acquisition of the number ($e = y$) then becomes the value or point on the Y-axis. **3)**. Look for the position of the organization indicated by the point (x, y) in the SWOT quadrant.

RESULTS AND DISCUSSION

The propulsion system is a supporting component of the railway which has the largest budget proportion in the value of

production and the sale value of the train, but until now the technology has not been fully mastered by PT. INKA. However, if it is able to be developed by domestic industries, it can create promising business potential values.

For business protection of traction motor products, from the survey and discussion with the management of PT. Pindad, with the current demand conditions, the production carried out cannot produce products with competitive selling power, because the burden of production costs is high so the price of the product becomes uncompetitive¹¹⁾.

Estimated calculations that can produce products with competitive selling power in production will be achieved if the demand for tractive motor trains reaches a minimum of 100 units/year (2/3 of installed production capacity). For the record, with the inclusion in economies of scale, the price can be

reduced by around 23 -25% in order to be competitive with competitor prices (imports).

The competitor's price range is currently around US\$ 100,000/unit. This will be possible with a note if it is supported by an update on some machinery facilities so that it can support production.

Competitiveness Analysis with Diamond Porter Models

In accordance with the Diamond Porter model, the analysis of the competitiveness of PT. Pindad is carried out by outlining its strengths and weaknesses in 6 (six) components, namely Condition Factors, Related and supporting industries, Firm Strategy Structure and rivalry, Demand Conditions and Government. The six components are described as set out in Table 2

Table 2.
Competitiveness Analysis of PT. PINDAD

<i>Variabel</i>	<i>Superiority (+)</i>	<i>Weakness (-)</i>
Condition Factor	<ul style="list-style-type: none"> a. The initial capital ownership as a BUMN comes from the government. b. Having facilities and infrastructure of a fairly complete traction motor manufacturer c. Having competent and professional human resources in their fields d. Located in a strategic area in West Java with an area of 66 hectares. 	<ul style="list-style-type: none"> a. The manufacturing facilities only cover the production of 100-250 kWh motor-traction b. The manufacturing process still uses manual equipment so that production capacity is limited
Related & Supported Industri	<ul style="list-style-type: none"> a. Some components in Tier 1 have been produced by PT. Pindad, while some of them are subcontracted by PT. Pindad to the local supplier industry b. Partnered with PT Len (BUMN) in supporting the propulsion system 	<ul style="list-style-type: none"> a. There is no component industry in Indonesia b. Procurement components at the Tier 2 level are mostly imported mainly raw materials. c. Purchase of raw materials & components in unit prices because in small quantities so the price is much more expensive d. Limited inventory stock due to the purchase of raw materials and components in limited quantities e. Because the supplier industry mostly imports, order requires more time and costs
Demand Condition	<ul style="list-style-type: none"> a. The potential railroad needs for the development of rail-based urban transportation modes until 2030 as set out in the Indonesian railroad Master Plan are increasing. b. Already have a special customer, PT INKA. 	<ul style="list-style-type: none"> a. The demand for motor-traction is currently very limited and not continuous, only around 40-50 units per year, most of which only rely on requests from PT INKA. b. The least demand causes idle capacity
Firm Strategy & Rivalry	<ul style="list-style-type: none"> a. There is no similar competitors' domestic industry b. Classified as a national strategic industry (BUMN). 	<ul style="list-style-type: none"> a. Similar competing industries come from abroad. b. There is no regulation that directs the railroad industry (PT. INKA) to be fully supported by local supporting industries (including PT. Pindad) to fulfill their needs. c. Idle production is used for the production of motor-traction electric vehicles (Gesits)

Government	<ul style="list-style-type: none"> a. Regulation on the formation of a national strategic industry owned by the government including PT Pindad b. Plans for developing rail-based urban transportation modes in the national railroad master plan c. Regulations related to local content d. Regulation of incentives (research) and fiscal incentives in the Government Borne Import Duty scheme 	<ul style="list-style-type: none"> a. The implementation of incentive regulations is still too complicated and bureaucratic b. Not yet optimal implementation of local content regulations especially in the calculation procedures that are still burdensome for the industry. c. There is a regulation on the import of used capital goods
Chance	<ul style="list-style-type: none"> a. Free trade 	<ul style="list-style-type: none"> a. Free trade

The following is an explanation of the various factors above.

Condition Factor

PT. Pindad is one of the strategic industries with the status of state-owned BUMN engaged in the defense equipment. PT Pindad has 2 major divisions namely ammunition division, which is located in Malang, and the Weapon Division, Mechanical Division, Electrical Division, Forging & Casting Division, Stamping Business Unit, and Laboratory Business Unit located in Bandung.

The composition of Pindad production is 20% military products and 80% commercial or non-military. The main task of Pindad is to supply and produce products needed by the Ministry of Defense such as light munitions, heavy munitions and other military equipment to eliminate dependence on others. The second main task is to produce commercial products such as machine tools, forging products, air brake systems, special tools and equipment. Because of the status of BUMN, the initial capital comes from the government. Assets owned by PT. Pindad has increased in recent years.

The Company takes a capital structure policy by maintaining a maximum liability to equity ratio of 3:1 to balance the risk and return occurs and maximize the value of the Company. In 2018, the ratio of liabilities to money equity illustrating the capital structure of the Company was 370.07%, increased compared to that of 2017 which was 357.11%. It was due to an increase in Profit for the Year¹²⁾.

In 2019, the ratio of liabilities to the equity that represents the Company's capital structure was 370.90% or 3.71 times, which is due to the increase in the value of bank debt in 2019. This figure is quite stable when compared to the capital structure in 2018 of 370.07% ¹³⁾.

The Forging and Cast Division is part of the business of PT. Pindad (Persero) which

supports the development of Indonesia's railroad infrastructure through railroad infrastructure products including motor-traction.

The number of Pindad's employees in 2019 is 2,588 employees, increasing 3.5% compared to 2019 which total was 2,500 employees. The increase is due to the result of the recruitment process to fill the required various position in order to support Pindad's business activities. The Recruitment & Selection Program is organized by Pindad to meet the workforce requirement both in terms of numbers and competencies to support the Company's performance ¹³⁾.

The total number of PT. Pindad's Human Resources is 2,588 people with an allocation of human resources in the Bandung area of 1,808 people, where the number of human resources in the Forging Equipment and Railroad Division is 238 people (9.52%). Human Resources have professional competencies and abilities according to their fields.

Related & Supported Industry

Currently PT. Pindad in fulfilling the production needs of its traction motorcycles PT Pindad is partnering with various vendor suppliers, both from within (local) and from abroad.

In carrying out its production, the majority of component requirements are taken from outside suppliers and local suppliers. Here are some types of local and non-local components used by PT. Pindad in its production.

Local components in general include:

- Endshield DE & NDE
- Motor Coil
- Rotor Shaft
- End Plate
- Supporting Accessories

Import components in general include:

- Stator & Rotor Core (Silicon Steel)

- Copper Wire
- Permanent Magnet
- Sensor
- Raw Material

Types of components that can already be manufactured by PT. PINDAD can be seen in Table 3.

Table 3.
Parts of Traction Motor Components and Supplier Origin

<i>Traction Motor Components</i>	<i>Types of Raw Materials</i>	<i>Origin Imported Suppliers</i>	<i>Origin Local Suppliers</i>
Ball bearing	Standard Ball Bearing	SKF/FAG	
Bearing Outer cap	Mild Steel Casting		Pindad
Air Cone	Mild Steel		Pindad
Dripproof Cover	Alumunium		Inalum
Stator Coil	Magnetic Wire	AUS, FRA, TUR	
Rotor Fan Blade	Aluminium Casting		Pindad
Stator Core	Electrical Steel Sheet	JPN, CHN	
Frame	Aluminium Casting		Pindad
Lead Clamp	Lead		OEM
Air Outlet	Aluminium Casting		Pindad

Source: PT. Pindad, 2019

From Table 3, it appears that PT. Pindad itself is already capable of casting production especially for steel casting, mild casting and aluminium casting. For other component materials, almost 90% is supplied from overseas and local supplier vendors. Calculation of Domestic Component Level Value of traction motor produced by PT. Pindad is around 40%.

Some components in Tier 1 can already be produced by PT. Pindad, while some of them are subcontracted by PT. Pindad to the local supplier industry. The procurement of components at the Tir 2 level is mostly imported, mainly raw materials. Some import supplier partners are from countries such as China, Japan, etc. PT. Pindad makes an import purchase because most of the required components are not yet available in Indonesia, this is because it is indeed due to the unavailability of the component industry

in Indonesia. The unavailability of this component industry is one of the obstacles faced by PT Pindad, because imported purchases sometimes take a long time and because purchases are made in a number of units due to the minimal number of incoming requests. So, the purchase price becomes higher, and impacts on high production costs and selling price.

Demand Condition

The railroad market potential is quite large, this can be seen from the data on the potential needs of the national railroad up to 2010 as contained in the National Railroad Master Plan as follows:

Table 4.
Potential Needs of National Train 2030

<i>Total Fleet</i>	<i>Java-Bali (unit)</i>	<i>Sumatera (unit)</i>	<i>Kalimantan (unit)</i>	<i>Sulawesi (unit)</i>	<i>Papua (unit)</i>	<i>National (unit)</i>
Passenger Locomotive	2,585	145	20	71	18	2,839
Goods Locomotive	1,010	760	275	360	70	2,475
Train	25,825	1,435	185	475	29	27,949
Carriage	20,115	15,170	5,345	6,522	1,212	48,364
Urban Train	4,038	1,586	-	571	34	6,229

Source: National Railroad Master Plan (RIPNAS), Ministry of Transportation, 2018.

It is hoped that the increase in the need for these trains will also have an impact on the increasing need for traction motors. The production of train traction motors is carried out by PT. Pindad is to support and fulfill the needs of PT. INKA as a national railway integrator industry. For this reason, PT. Pindad's traction motor production currently only depends on PT. INKA. Demand for traction motors from PT. INKA, currently very limited, only around 40-50 units per year. The minimum demand for this has caused idle capacity of 2/3 of the installed capacity. At present, the installed production capacity of traction motor products is 150 units/year. The limited demand from PT INKA was partly due to PT. INKA did not fully order its traction motor needs to PT. Pindad. Consideration of several things such as the need for certain specs, fast turnaround times and low prices are still a consideration of PT. INKA in determining the supplier vendor it deems appropriate. This has led to requests coming from PT. INKA to PT. Pindad is not continuous.

Firm Strategy and Rivalry

PT. Pindad in fulfilling motor-traction competition does not have similar industrial competitors in Indonesia. This can be a strength of PT Pindad, in addition to getting capital support from the government and also having complete manufacturing facilities and infrastructure. However, although at this time PT. Pindad has no competitors at the local level, instead it needs to watch out for competitors from abroad. Some competing industries from abroad which are big players in the railway component industry such as Holec, Caff, Bombardier need to be important notes for PT. Pindad to arrange a competitive strategy because some of them are now also suppliers of railroad components to PT. INKA

This can be seen from the minimal number of train motor-traction requests from PT. INKA, causing idle production capacity. To get around the vacancy of the production capacity of the traction motor, currently PT. Pindad has a strategy by filling the production idle by producing motor-traction for electric motorbikes (Gesit).

Government

The establishment of PT. Pindad was intended to strengthen the national strategic industry. The government has designed the linkages between the national strategic industries and is expected to support the needs of PT. INKA as in the RIPNAS data, the government has launched a policy of developing rail-based transportation modes until 2030. This can certainly be a potential market for the relevant national strategic industries including PT. Pindad. Some other government supports include:

- a. Fiscal incentives in the Government Borne Import Duty (BMDTP) scheme to support the national transportation industry including railroad through exemption from import duties (0%) for railroad materials and components. The latest regulation related to BMDTP is contained in PMK: No. 209 / PMK.010 / 2018 concerning BMDTP for certain sectors. PT. Pindad and PT. INKA have not been optimal in utilizing the incentive scheme.
- b. There are incentives for the development of research and innovation managed by the Ministry of Research, Technology and Higher Education.
- c. There are regulations related to local content to grow and develop domestic

industries contained in the following regulations:

- i. Government Regulation No. 29 of 2018 concerning Industrial Empowerment.
- ii. Presidential Regulation No. 18 of 2016 concerning Procurement of Goods & Services.
- iii. Regulation of the Minister of Industry No. 16 of 2011 concerning Calculating local content.

Chance

Free trade now provides opportunities and challenges for national industries to compete in the international market. The global market scheme is bound by several agreements or trade cooperation such as MEA, AFTCA and AFTA. This trading scheme is actually quite burdensome considering that imported traction motor product prices are very competitive so PT. INKA has the opportunity to prefer imported products. This condition needs to be an opportunity for PT. Pindad to improve its product competitiveness even better.

SWOT Analysis to Develop Policies on the Development of the Motor-Traction Industry

From the results of the analysis using the "Porter Diamond Condition" method above, various internal and external factors have been identified through the SWOT method to then formulate alternative policy formulations for the development of the railroad electric propulsion system industry in Indonesia.

Identification and Assessment of IFAS and EFAS SWOT (Propulsion System)

SWOT analysis is done through a series of calculations known as IFAS (internal factor analysis summary), EFAS (external factor analysis summary) and SFAS (strategy factor analysis summary) by calculating the weight and rating values.

Internal and external strategy factor analysis is the processing of strategic factors in the internal and external environment by giving weighting and rating to each strategic factor.

Strategic factors are the dominant factors of strengths, weaknesses, opportunities and threats that affect the existing conditions and situations and provide benefits if positive actions are taken.

IFAS SWOT Assessment of the Train Propulsion System Industry

Analyze the internal environment (IFAS) to find out various possible strengths and weaknesses. Strategic issues to be monitored must be determined because these problems might affect the industry in the future. The following table is the result of internal strategy factor analysis:

Table 5.
IFAS SWOT Industrial Railway Propulsion System, Weakness Factors

<i>Internal Factors (IFAS) Strength</i>	<i>Weight</i>	<i>Rating</i>	<i>Weight x Rating</i>
There has been national and regional planning related to the development of rail-based transport modes.	0.30	3	0.900
The availability of the Indonesian railway integrator industry and strategic industries or BUMN (Pindad, Len, Barata, etc.) as industries that have the potential to support the development of railroad production	0.40	3	1.200
The ability of human resources in R&D institutions and academics as well as industry in railroad engineering and design	0.30	2	0.600
<i>Total Score</i>	<i>1</i>		<i>2.700</i>

Table 6.
IFAS SWOT Industrial Railway Propulsion System, Weakness Factors.

<i>Internal Factors (IFAS) Weakness</i>	<i>Weight</i>	<i>Rating</i>	<i>Weight x Rating</i>
The still weak industrial structure supporting components of the Railroad products including the domestic propulsion system	0.2	-4	-0.8

Funding support is not yet optimal in developing railroad propulsion system products considering the investment value needed to build the propulsion system industry is very high

0.2 -3 -0.6

There are no national test and standardization facilities that support the development of propulsion system products

0.2 -3 -0.6

Limited production facilities (machinery), which are still largely conventional, have limited production capacity

0.2 -3 -0.6

The synergy of collaboration between research institutions, academics, industry and government in the development of the railroad industry and its supporting components has not been optimal

0.2 -3 -0.6

Total Score 1 -3.2

EFAS SWOT assessment of the train propulsion system industry

Analyzing the external environment (EFAS) to find out various opportunities and threats. Strategic issues to be monitored must be determined because these problems might affect the railroad industry in the future. The following table is the result of an analysis of external strategy factors:

Table 7.
EFAS SWOT Industrial Railway Propulsion System, Opportunity Factors.

<i>External factors (EFAS) opportunity</i>	<i>Weight</i>	<i>Rating</i>	<i>Weight x Rating</i>
The big train market potential illustrates the huge business potential of the propulsion system and its supporting components if it can be produced domestically	0.40	3	1.200
The railway industry is limited as a competitor in the ASEAN region	0.30	3	0.900

Regulations related to the operation of train operators that have begun to bring up private players or operators	0.30	2	0.600
Total Score	1		2.700

Table 8. EFAS SWOT Industrial Train Propulsion Systems, Threat Factors.

External factors (EFAS) threat	Weight	Rating	Weight x Rating
The selling value of imported railways component products (especially the propulsion system) from large railroad companies is more competitive	0.40	-3	-1.200
The existence of free trade with the AFTA, CAFTA and MEA schemes that facilitates the entry of imported goods including trains and their supporting components at competitive prices (0% import duty)	0.40	-3	-1.200
The lack of support for the government's partisanship in the addition of the allocation of the number of procurements of rail-based urban transportation modes (MRT, LRT, fast train)	0.20	-3	-0.600

Table 9. SWOT Matrix for Industrial Strengthening Railway Propulsion Systems.

	STRENGTH	WEAKNESS
S	<ul style="list-style-type: none"> • There are national and regional planning related to the development of rail-based transportation modes. • Availability of the Indonesian railway integrator industry and strategic industries or BUMN (Pindad, Len, Barata, etc.) as industries that have the potential to support the development of railroad production • The ability of human resources from R&D institutions, academics and industry in railroad engineering and design 	<ul style="list-style-type: none"> • The structure of the supporting component industry for the Train product including the domestic propulsion system industry is still weak. • Funding support is not yet optimal in developing Railroad propulsion system products considering the investment value needed to build the propulsion system industry is very high • Lack of test facilities and national standards that support the development of propulsion system products
W		
O		
T		

Total Score	1	-3.000
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SWOT Diagram

From the results of the IFAS and EFAS assessment, the results obtained from IFAS and EFAS are at (-0.3, -0.5) as shown in Figure 3.



Figure 3. SWOT Diagram of Industrial Train Propulsion System

From the results of the analysis, and calculations using the SWOT Method, the industrial position of the train electric propulsion system is in Quadrant IV position (-0.3, -0.5), so it is best to use a Defensive Strategy. In this position the Company faces a very unfavourable situation, the company faces various internal threats and weaknesses. For this reason, it is necessary to prioritize strengthening strategies in the Matrix (W-T). The Policy Strategy Formulation is outlined in the following SWOT Matrix:

- Limited production facilities (machinery), which are mostly conventional, which causes limited production capacity
- Not yet optimal synergy of collaboration between research institutions, academics, industry and government in the development of the Train industrialization

OPPORTUNITY

- The train market potential is quite large which illustrates the huge business potential of the propulsion system and its supporting components if it can be produced domestically
- Limited railway industry as a competitor in the ASEAN region
- Regulations related to the operation of railroad operators that have begun to bring up private players or operators

S-O

- Development of competencies in domestic human resources (R&D & industry) through research collaboration with universities and the international railroad industry, particularly for mastering the development of propulsion system production
- Support the alignment of the use of domestic production through increasing the allocation of railroad procurement by the domestic railroad industry that utilizes local components

W-O

- Strengthening collaboration on the development of propulsion products and traction motors from all relevant stakeholders, especially universities, R&D institutions and industry through a consortium scheme.
- Revitalization of machinery facilities and development of propulsion system workshops including supporting facilities and propulsion testing facilities and traction motors by related industries

THREAT

- The selling value of imported railways component products (especially the propulsion system) from large railway companies is more competitive
- The existence of free trade with the AFTA, CAFTA and MEA schemes that facilitates the entry of imported goods including trains and supporting components at competitive prices (0% import duty)
- Lack of support for support from the government in increasing the allocation of procurement of rail-based urban transportation modes (MRT, LRT, high speed train)

S-T

- Restrictions on the import of trains and their supporting components, especially for products whose technology has been mastered and can be produced domestically.
- Fiscal incentive schemes for FDI are directed at FDI industries that are willing to transfer technology or knowledge.

W-T

- Strengthening the structure of the domestic railway component industry through the implementation of industrial development of supporting components of the train and motor-traction propulsion.
- Support budget allocations (fiscal incentives) for the development of sustainable propulsion products and traction motor from the research stage to commercialization.
- A special fiscal incentive and funding scheme for the domestic import substitution industry (PMDN) that supports the development of the railroad industry (propulsion products and traction motors)

CONCLUSION

From the results of the analysis, and calculations using the SWOT method, the position of the railway propulsion system industry is in the Quadrant IV position, so it is best to use a Defensive Strategy. In this position the Company faces a very unfavourable situation, the company faces various internal threats and weaknesses. For this reason, it is necessary to prioritize strengthening strategies in the Matrix (W-T) as follows:

- a. Strengthening the structure of the domestic railway component industry through the implementation of industrial

development of supporting components of the propulsion and traction motors.

- b. Support budget allocation (fiscal incentives) for the development of propulsion products and sustainable traction motors from the research stage to the commercialization.
- c. There is a fiscal incentive scheme and special funding for the domestic import substitution industry (PMDN) that supports the development of railroad production (propulsion products and traction motors).

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