

# Competitiveness Analysis Railway Propulsion System Industry in Indonesia - Pre Feasibility Study

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**Abstract**— *Competitiveness analysis, manufacturing capability and pre-feasibility studies have been carried out in the rail propulsion system industry in Indonesia, particularly the traction motor industry (PT. PINDAD). The results show that currently the propulsion system industry is still less competitive, this is because the price of the products is still expensive. From the pre-feasibility analysis, the unit price of the traction motor for the capacity of 100 kW is still around US \$ 130,000 / unit (with a production capacity of 40 units / year). The high cost of traction motor products of PT. PINDAD is suspected because of a limited market (only domestic), there are still many components imported and the manufacturing process is still not optimal. Therefore, to meet the feasibility scale, the unit price must be reduced to at least US \$ 100,000 / unit (reduces 23%). This can be achieved if the production capacity is at least 100 units per year by penetrating the market and optimizing the production process.*

**Keywords**— *competitiveness, Capability, Feasibility, Traction Motor Industry.*

## I. INTRODUCTION

The railway industry (component industry and integrator) in Indonesia is seen as one of the strategic industries that can support the realization of the provision of rail-based transportation facilities. Strategic enough because the potential of the domestic market is quite promising. 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). From this plan it is seen that the mode of rail transportation will increase every year in line with the rise of domestic infrastructure projects (Table 1). Not only has the potential to work on the domestic market, PT INKA also has the potential to

meet the demands of foreign markets, especially in the ASEAN region and Africa [1]. Fig. 1. represents the potential of the railway market abroad, especially in developing countries in Africa and Asia.

This potential is a challenge for national industries to increase their ability and competitiveness. The railway industry in Indonesia is currently driven by PT. INKA as its main industry and supported by several component industries that supply materials and components.

This paper examines the manufacturing capability and competitiveness of one of the industries which supplies railway propulsion systems. Manufacturing capability is a system of organizational routines governing the flow of value carrying design information to customers, and manufacturing site is the place where such flows exist [2] Competitiveness as the ability of firms to compete in markets[3] [4].

Table 1. Domestic market potential

Pesanan Masuk	2018	2019	2020	2021	2022
<b>Proyek Kementerian Perhubungan/Pemerintah</b> (PPCW, ZZOW, KA Ukur, K Penolong, TMC, KKBW, K. Inspeksi)	94.177	25.047	81.411	70.197	86.787
<b>Proyek PT KAI (Persero)</b>					
Kereta K3/K1/Sleeper	1.880.000	1.334.297	793.376	872.714	
LRT Jabodebek	1.813.500				
PPCW (Trans Sumatra, Kalimantan)		375.608	432.382	267.380	1.196.448
LRT Bandung			527.936		
KRL Adi Sumarmo			547.420		
KRL Juanda				1.024.771	
KRL Adi Sucipto				741.223	
KRL Ahmad Yani					883.865
KKBW					1.546.450
<b>Service &amp; Retail</b>	80.600	189	8.673		
<b>Diluar Kemenhub-PT KAI (Persero)</b>					
TramKot Surabaya	291.200				
LRT Medan	351.000				
<b>Produk Pengembangan</b>					
Bus (Kopaja, Mayasari, DAMRI)	260.000	600.000	348.000	500.000	900.000
Lori Listrik Otomatis		1.031.162		1.305.037	
Coal Container		12.000			
<b>Total</b>	<b>4.770.477</b>	<b>3.378.303</b>	<b>2.739.198</b>	<b>4.781.322</b>	<b>4.613.550</b>

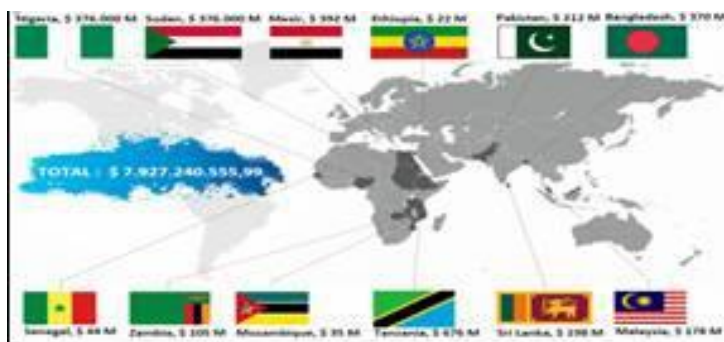


Fig.1. Overseas Potential

II. METODOLOGI

The method used to see manufacturing capabilities by looking at the machining facilities owned and the human resources involved. while to see the industrial competitiveness of the propulsion system by using the Diamond Porter model approach. As seen in Figure 2.

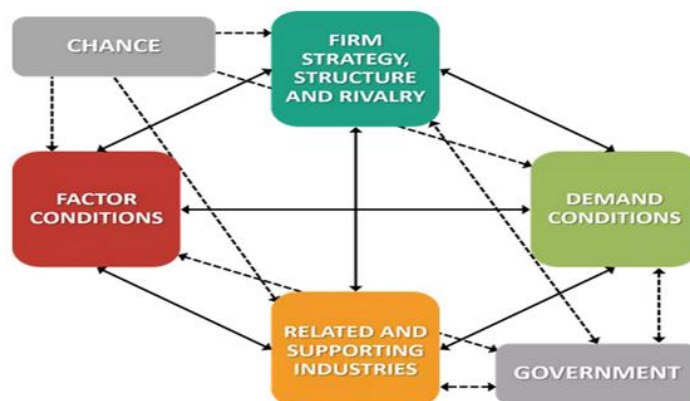


Figure 1: Porter's Diamond Model of National Competitive Advantage

Fig.2. Porter's Diamond Model of Competitive

There are 6 (six) components, which will be used to analyze the competitiveness of the railway propulsion system industry, namely Chance, Condition Factors, Related and supporting industries, Firm Strategy Structure and rivalry, Demand Condition and Government [5].

Each of the 6 (six) components will be analyzed so that their strengths and weaknesses will be known, so anticipatory steps can be taken to further enhance their competitiveness.

### III. INDUSTRIAL RAILWAY PROPULSION SYSTEM

Of the entire propulsion system, the main parts are traction motors and inverters. At present the existence of the traction and investment motor industry in Indonesia is very limited. The current traction motor industry for trains that is still operating, one of which is PT Pindad, which is a State-Owned Enterprise, while the inverter industry that has supplied the inverter is PT. LEN. However, PT. LEN at this time, the research and development of the inverter has not been oriented towards mobility. So that in this discussion more focused on the traction motor manufacturing industry.



Fig.3. Machinery Facilities of PT. Pindad

Source: PT.Pindad

PT. Pindad is basically one of the strategic industries with the status of state-owned BUMN engaged in the

defense equipment. PT.Pindad has land in 2 (two) locations, namely the Ammunition Division 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. Pindad's main task is to provide 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.

Several machinery and other supporting equipment related to railway infrastructure products are shown in Fig. 3.

The total number of PT Pindad's HR is around 2500 HR with an allocation of 1808 people in the Bandung area and the Railway Forging Division of castors and railway vehicles totaling 238 people (9.52%). HR has professional competencies and abilities according to their fields.

The demand for traction motorcycles that enter PT Pindad only comes from PT. Inka as the only industry providing train facilities and integrators in Indonesia.

Traction motor products produced by PT Pindad and other local traction motor industries are still customized (orders) due to the minimal number of requests and have not yet reached the economies of scale so the prices offered are quite high and unable to compete with imported traction motor products. Most of the components used to produce traction motors (Fig. 3) local industry still use imported components, due to the lack of local traction motor component industries.

**IV. ANALYSIS OF COMPETITIVENESS AND FEASIBILITY**

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

Table 2. Competitiveness Analysis

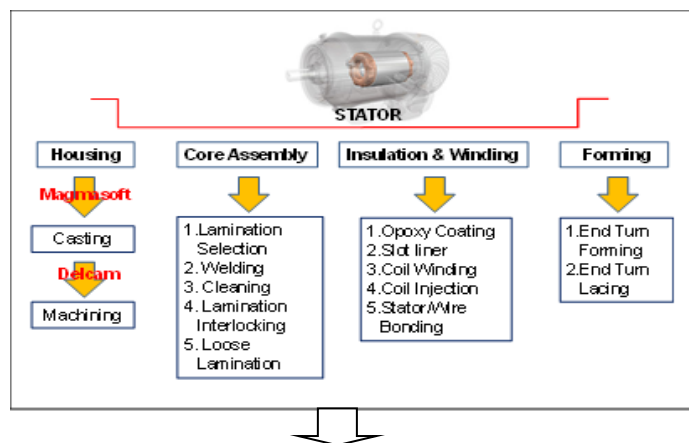
Variable	Excellence (+)	Weakness (-)
<b>Factor Conditions</b>	<p>The initial capital ownership of PT. Pindad as a BUMN comes from the government.</p> <ul style="list-style-type: none"> <li>• Having facilities and infrastructure of a fairly complete traction motor manufacturer</li> <li>• Having competent and professional human resources in their fields</li> <li>• Located in a strategic area in West Java with an area of 66 hectares.</li> </ul>	<ul style="list-style-type: none"> <li>• The manufacturing facilities only cover the production of 100-250 kwh motorcycles</li> <li>• The manufacturing process still uses manual equipment so that production capacity is limited</li> </ul>
<b>Related &amp; Supported Industry</b>	<ul style="list-style-type: none"> <li>• Some components in Tir 1 can already be produced by PT. Pindad, while some of them are subcontracted by PT. Pindad to the local supplier industry</li> <li>• Partnered with PT Len (BUMN) in supporting the propulsion system</li> </ul>	<ul style="list-style-type: none"> <li>• Components at the Tir 2 level are mostly imported, mainly raw materials. Some import supplier partners include countries: China, Japan, etc.</li> <li>• Purchase of raw materials &amp; components in unit prices because in small quantities so the price is much more expensive</li> <li>• Limited inventory stock due to the purchase of raw materials and components in limited quantities</li> <li>• Because most of the supplier's industries import, ordering takes a long time and is expensive</li> </ul>

<b>Demand Condition</b>	<ul style="list-style-type: none"> <li>The potential for special train needs for the development of rail-based urban transportation modes until 2030 as stipulated in Ripnas is increasing.</li> <li>Has a special market / customer, PT INKA.</li> </ul>	<ul style="list-style-type: none"> <li>The demand for railway traction motorcycles is currently very limited and not continuous, only around 40-50 units per year, most of which only rely on requests from PT INKA.</li> <li>Little demand causes idle capacity</li> </ul>
<b>Firm Strategy &amp; Rivalry</b>	<ul style="list-style-type: none"> <li>There are no domestic competitors</li> <li>Enter the national strategic industry (BUMN).</li> </ul>	<ul style="list-style-type: none"> <li>Similar competing industries come from abroad.</li> <li>There is no regulation that directs if the rail transportation industry (PT. INKA) must be fully supported by local supporting industries (including PT. Pindad) to meet their needs.</li> <li>Idle production is used for the production of electric vehicle traction motorcycles (motorcycle Gesits)</li> </ul>
<b>Government</b>	<ul style="list-style-type: none"> <li>Regulation on the formation of a national strategic industry owned by the government including PT Pindad</li> <li>Plans for developing rail-based urban transportation modes as stipulated in Ripnas</li> <li>Regulations related to TKDN</li> <li>Incentive regulation (research with tertiary institutions) and fiscal incentives in the BMDTP scheme</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of incentive regulations is still considered too complicated and bureaucratic</li> <li>Not yet optimal implementation of TKDN regulations, especially in the calculation procedures that are considered still burdensome for the industry.</li> <li>There is a regulation on the import of used capital goods</li> </ul>
<b>Chance</b>	<ul style="list-style-type: none"> <li>Free trade</li> </ul>	<ul style="list-style-type: none"> <li>Free trade</li> </ul>

**Pre-Feasibility Analysis**

Production aspects

Ability to produce domestic propulsion system industry in this case PT. Pindad as a support of traction motors. From the results of the survey conducted to PT. Pindad related to the ability of train traction motor production, obtained data in the capability of PT. Pindad has been able to master the production process of 100-250 kWh traction motor. The following is an overview of the production process of traction motors (Fig.4):





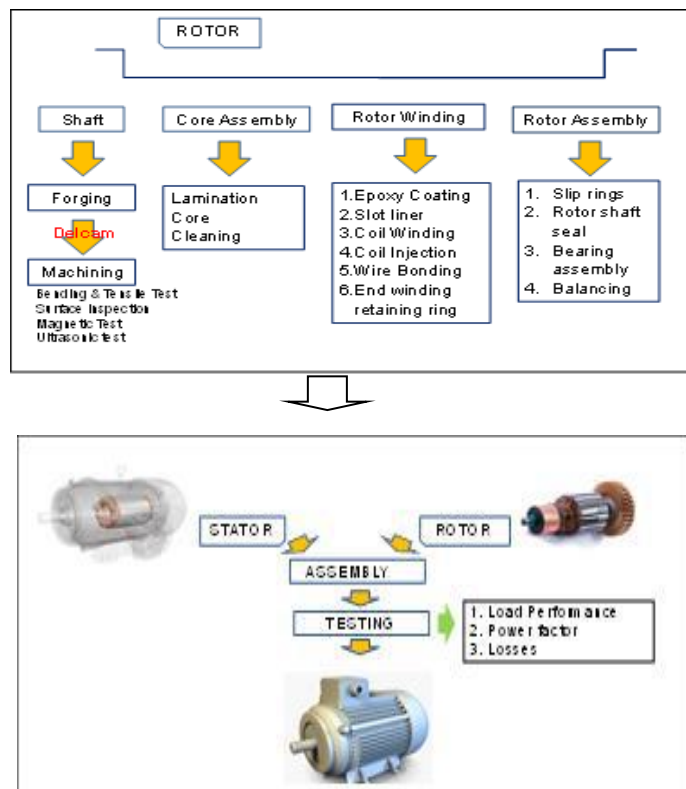


Fig.4. Traction Motor Production Process

From the description in chapter 3, it has been stated that PT. Pindad already has machinery facilities and infrastructure that support the production of traction motors. The ability of PT. Pindad in producing train traction motors began with cooperation with Holec Netherlands for Jabotabek KRL 155 units of 212 units.

Here are some types of traction motor production that has been produced by PT. Pindad [6].

Table 3. Type of Motor Traction on PT. Pindad

No	PT Production	Pindad	Ordering Industry	Years	Number of units	Informtions
1	DMKT 55/18,5, 155 KW		PT. INKA	1994/ 1999	80	
2	DMKT 55/17, 180 KW		Kemhub	2008	48	repowering KRL BN Holec.
3	DMKT 55/29, 200 KW		PT. INKA	2009/ 2010	2	repowering KRL BN Holec.
4	DMKT 55/23,5, 110 KW		PT. INKA	2011		
5	DMKT		PT. INKA	2016		LRT Palembang
6	DMKT		PT. INKA	2019	1 Train set	LRT Jabodebek

Source : PT. Pindad

For installed production capacity, currently PT. Pindad in the production of train traction motorcycles (100-250 kwh) ranges from 150 units / year. Following are the

assumptions for PT Pindad's production capacity calculation:

- Installed Production Capacity: 150 units / year
- Current average production : 50 units / year (1/3 installed production capacity)
- Idle Capacity : 100 units / year (2/3 installed production capacity)

PT. Pindad experienced several constraints to production limitations, these constraints include:

- Most of the machining facilities currently owned are still manual, so the completion of processing time is longer

- The lack of requests due to dependence on orders only on one customer (PT. INKA).

Market Aspects

The potential of the domestic and foreign railway market today and in the future is still very potential, bearing in mind that currently the central and regional governments are developing rail-based transportation modes. This has been stated in the 2010-2030 National Railway Master Plan, as shown in Table 4 [7]. The target of rail-based transportation mode needs in urban areas in 2010-2030 based on Ripnas data is estimated to reach 6229 units or an average of around 311 units per year.

Table 4. Potential Needs of National Railway 2030

Total Fleet	Jawa Bali (unit)	Sumatra (unit)	Kalimantan (unit)	Sulawesi (unit)	Papua (unit)	Nasional (unit)
Passenger Loko	2.585	145	20	71	18	2.839
Loko item	1.010	760	275	360	70	2.475
The train	25.825	1.435	185	475	29	27.949
Boxcar	20.115	15.170	5.345	6.522	1.212	48.364
Urban Train	4.038	1.586		571	34	6.229

Source : Ripnas, 2018

Business Aspects

Seeing the potential of the railway market both at home and abroad that is quite promising, it needs to be studied in more depth how much business potential can be created if the development of supporting components of the propulsion system is developed by the domestic industry, given that several strategic industries of BUMN have been able to master the technology.

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. Table 5. shows the calculation of the potential business value that can be generated, if the traction motor industry is built. Assumptions for calculations in Table 5. referring to the product and value of the Palembang LRT contract that PT. INKA by using 100 kwh traction motor. Using these assumptions, the overall business potential for the propulsion system that can be created if the entire

product is produced domestically is Rp. 3,547,732,500,000.

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 uncompetitive.

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 U \$ \$ 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.

In recent decades, manufacturing and production systems have been gradually supplemented by information technology support instruments, because controlling more and more complex technologies, the demands of multi-site production, and supporting logistic processes have become

even more complex tasks. The inevitable role of IT (Information Technology) at companies has transformed both working conditions and efficiency, and its importance is unquestionable [8].

Table 5. Calculation of Industrial Business Potential Propulsion system (Motorized Traction Motor)

<b>POTENTIAL OF PROPULSION FOR URBAN TRAIN (RIPNAS DATA 2010-2030)</b>			
<b>Reference assumption: LRT Palembang 8 trainset contract value: 338 billion</b>			
<b>Details</b>	<b>Volume</b>	<b>Unit</b>	<b>Value</b>
Price of Palembang LRT (8 trainset @ 3 cars @ 2 propulsion)	8	Train units (@ 3 cars)	Rp. 338.000.000.000
	1	Train units (@ 3 cars)	Rp. 42.250.000.000
Price of complete propulsion unit with electric system (36% of total train price budget)	2	Electrical system propulsion	Rp. 15.210.000.000
	1	Propulsion	Rp. 7.605.000.000
Price of propulsion only (27% of total train budget)	2	Propulsion	Rp. 11.407.500.000
	1	Propulsion	Rp. 5.703.750.000
<b>ESTIMATED NEEDS OF TRAIN PROPULSION</b>			
Estimated urban railway requirements for 2010-2030 ripnas data (20 years)	6119	Train Unit	
Estimated average demand per year	311	Train Unit	
Assuming 1 train @ 3 cars (LRT type)			
Estimated train / propulsion requirements (3 cars)	2	Propulsion	
Perkiraan kebutuhan propulsi kereta api 1 tahun	622	Propulsion	Rp. 3.547.732.500.000
<b>POTENTIAL BUSINESS DEVELOPMENT OF TRAIN TRACTION MOTOR</b>			
Price of propulsion	1	Propulsion	Rp. 5.703.750.000
Price of 100kW traction motorbike (US \$ 130,000, exchange rate of Rp 14,000)	1	Traction motor	Rp. 1.820.000.000
Profit potential if produced 100 units / year (23% efficiency)	1	Traction motor Unit	Rp. 418.000.000
	100	Traction motor unit	Rp. 41.860.000.000
Asumsi :			
1. Harga jual motor traksi saat ini dari PT. PINDAD berkisar US\$ 130.000, rata rata produksi 40 unit/tahun			
2. Apabila diproduksi 100 unit/tahun maka harga jual menjadi US\$ 100.000/unit (pengurangan 23%)			

Source: PIMTE-BPPT Transdar Team, processed

## V. CONCLUSION

From the data and description above it can be indicated that :

- In terms of market aspects, the propulsion system is very limited because there is only one customer, PT. INKA

- The local traction motor industry is still unable to compete with imported traction motor products both in price and quality to meet domestic demand. This is related to economies of scale / production capacity.
- From the analysis of the pre-feasibility study, with market potential parameters, the economical scale of



the traction motor industry can be achieved if the sales of traction motor products are at least 100 units / year.

- The selling price can still be lowered again if PT. PINDAD utilizes fiscal incentive policy facilities issued by the government (BMDTP), but this has not been exploited due to the complexity of the bureaucracy
- PT. Pindad needs to improve manufacturing and competitiveness so that its traction motor products can compete both in the domestic and foreign markets

### ACKNOWLEDGEMENTS

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