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Research article

Optimizing R&D to Enhance Local Content (TKDN) in Electric Motor Components for National Industry Independence

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A B S T R A C T

The electric motor industry in Indonesia is a strategic sector that supports national economic growth; however, it faces challenges in competitiveness, particularly in utilizing local components. Strengthening the Domestic Component Level (TKDN) is crucial for enhancing industrial independence, boosting the local economy, and reducing import dependency. This study calculates and analyzes TKDN levels in electric motor products, evaluating their impact on local industry development and economic growth. Using literature review, regulatory analysis, and primary data from industry stakeholders, the research adopts a case study approach based on Government Regulation No. 28/2024. The expected outcomes include documenting TKDN calculations and providing policy recommendations to increase TKDN and support sustainable local technology development. The findings aim to promote industrial self-reliance, create employment opportunities, and enhance the global competitiveness of Indonesian products.

1. INTRODUCTION

The electric motor industry is a strategic sector that plays a crucial role in national economic development. Its rapid growth in recent years, primarily driven by increasing demand in the transportation, manufacturing, and consumer goods sectors, has made this industry a key driver of domestic industrial growth [1]. Although the TKDN (Domestic Component Level) policy offers significant opportunities for strengthening the national industry, its implementation still faces various challenges. The availability of local raw materials, product quality, and cost efficiency are among the main obstacles in achieving optimal TKDN realization. Therefore, an in-depth analysis is needed to understand the current position of the electric motor industry in the context of TKDN, as well as to identify strategic steps that can be taken to increase its local content Score sustainably [2]. This study aims to provide an overview of the challenges and opportunities for improving the Domestic Component Level (TKDN) within the electric motor industry, while also producing practical policy recommendations. Accordingly, the findings of this research may contribute to the development of a self-reliant, efficient, and highly competitive national

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industry [3]. The electric vehicle (EV) industry in Indonesia has entered a highly dynamic phase, supported by increasingly strong government policies. As part of the energy transition and efforts to reduce greenhouse gas emissions, the Indonesian government issued Presidential Regulation No. 55 of 2019, which aims to accelerate the adoption of battery electric vehicles (BEVs). This initiative aims to enhance the contribution of local industries in supporting the electric vehicle program, with a particular focus on developing the domestic electric battery industry, which is currently being spearheaded by the Indonesia Battery Corporation (IBC).

In 2024, Indonesia's first electric battery factory is expected to commence operations, supporting the development of the electric vehicle (EV) ecosystem more affordably and sustainably. However, the market penetration of electric vehicles in Indonesia remains very low. In 2021, battery electric vehicles (BEVs) accounted for only 0.1% of total motor vehicle sales in the country, while hybrid vehicles made up just 0.3% [4]. This suggests that, despite the presence of supportive policies and regulations, the adoption of EVs continues to face challenges related to cost, infrastructure, and market readiness. Therefore, a well-defined roadmap for the development of the national automotive industry is essential, along with clear quantitative targets to guide its implementation and growth. [5].

In a more in-depth review, studies on the impact of the TKDN (Domestic Component Level) policy on the development of the electric motor industry—particularly in terms of reducing production costs, increasing employment, and improving the quality of local products—remain limited [6].

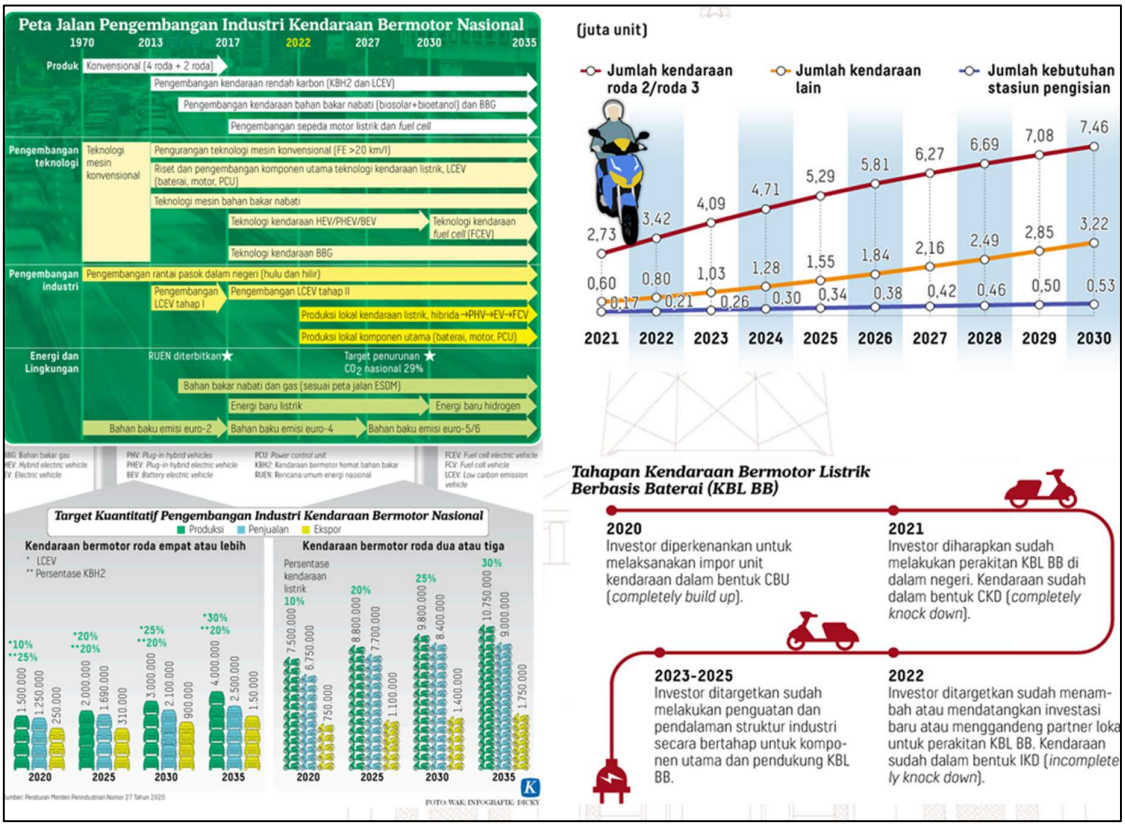


Figure 1. Roadmap of the Automotive Industry and Projected Population of Electric Vehicles [7]

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Therefore, this research aims to fill that gap by further assessing how the implementation of TKDN policies can help enhance the competitiveness of the domestic electric motor industry, create employment opportunities, and reduce dependence on imports.

2. PROBLEM DESCRIPTION

This research holds high urgency as it addresses a fundamental aspect of national industrial development—namely, self-reliance and the Strengthening of industrial structures based on local components. By analyzing and evaluating the implementation of the Domestic Component Level (TKDN) policy within the electric motor industry, this study contributes to strategic decision-making at both the policy and industry levels. [8]. Amid ongoing government efforts to promote import substitution and drive the national economic growth, increasing TKDN serves as a vital instrument with multiplier effects, such as job creation, the development of local technologies, and enhanced competitiveness of Indonesian pro-ducts in the global market. Therefore, this research is highly relevant in responding to current challenges and supporting an inclusive and sustainable path for industrial development. The initial stage begins with a literature review and analysis of applicable regulations, including Government Regulation (PP) No. 28 of 2024 and other policies related to TKDN. The objective is to understand the legal and policy framework underlying the implementtation of TKDN, as well as the calculation standards applied.

Data were collected through observations, structureed interviews with industry stakeholders, and the distribution of questionnaires to companies operating in the electric motor sector. The primary focus of data collection was to obtain technical and managerial information related to the use of local components, production processes, and operational challenges. The collected data were then analyzed to calculate the TKDN value of specific products in the electric motor industry. The calculation was performed based on the methods established by government regulations, taking into account the values of materials, labor, indirect costs, and technology [9-10].

3. METHOD

3.1 Research Process Flowchart

The PDM (Manufacturing Design Development) facility at PT X is engaged in designing and testing to fulfill the Domestic Component Level (TKDN) requirements mandated by the Indonesian government. The research activities begin with preparation and continue through documenttation and dissemination, as illustrated in Figure 2.

The recapitulation of TKDN calculations for the development of electric motor vehicle battery products, aimed at determining the development aspect value based on research activities, is presented in Table 1.

TKDN is a crucial indicator that supports industrial self-reliance, including in the electric motor sector. The TKDN recapitulation, in accordance with Ministry of Industry guidelines, serves not only as a reporting tool but also as an analytical instrument to drive improvement through R&D and innovation based on local content. The production process, also known as Manufacturing Process Mapping (MPM), is presented in Table 2.

3.2 Identifying Domestic Components (KDN) and Foreign Components (KLN)

The national industrial policy specifies Domestic Components (KDN) and Foreign Components (KLN) as the basis for determining a product's Local Content Requirement (TKDN). Identifying these components aims to assess the level of industrial self-sufficiency, the contribution to the local economy, and the product's compliance with the TKDN incentive regulation, which requires a minimum of 40% local content for electric vehicles. This calculation is carried out by measuring the contribution of local costs to the total production cost of the product. The basic TKDN formula is based on Regulation of the Minister of Industry No. 28 of 2020.

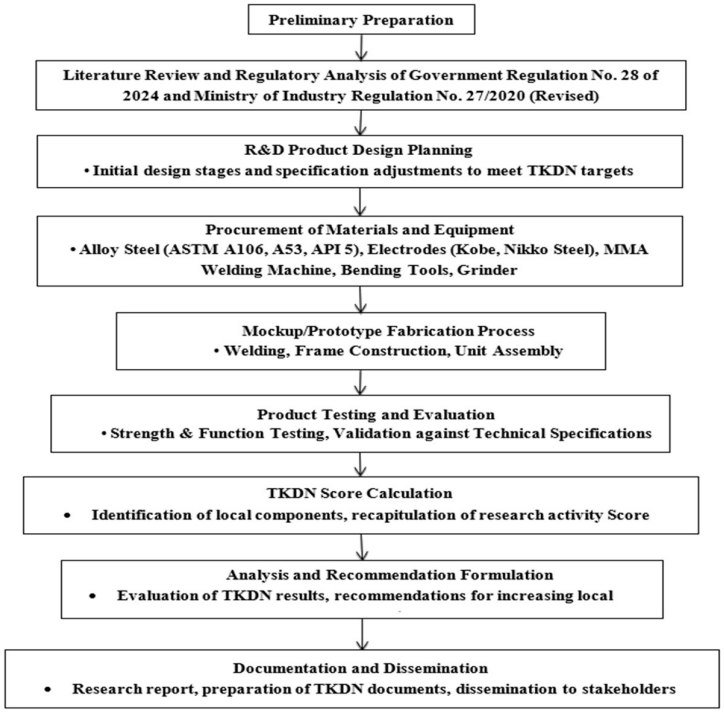


Figure 2. Research Flowchart

Table 1. Development Aspect Score Based on Research Activity

Rekapitulasi Penghitungan TKDN Pengembangan Produk Kendaraan Bermotor Listrik Berbasis Baterai

No.	Kriteria Aktivitas	PIC	Bobot Penilaian	Aspek Penilaian								
				Kepemilikan *)				Kepemilikan Saham Penyedia Jasa **)				
				Dokumen	Divisi atau Bagian	Tenaga Kerja	KDN	DN	DN+LN	LN	KDN	TKDN
I	Penelitian Pasar (Market Research)	BRAND	5,00%	☐	☐	☐	0,00%	☑	☑	☑	100,00%	0,00%
II	Perencanaan Produk (Product Planning)	ASM	15,00%	☐	☐	☐	0,00%	☑	☑	☑	100,00%	0,00%
III	Perancangan Teknis (Design Engineering)	ASM	20,00%	☐	☐	☐	0,00%	☑	☑	☑	100,00%	0,00%
IV	Model Kendaraan (Prototyping)	ASM	20,00%	☐	☐	☐	0,00%	☑	☑	☑	100,00%	0,00%
V	Pengujian Kendaraan (Testing)	ASM	20,00%	☐	☐	☐	0,00%	☑	☑	☑	100,00%	0,00%
VI	Sertifikasi Kendaraan (Licencing)	BRAND	20,00%	☐	☐	☐	0,00%	☑	☑	☑	100,00%	0,00%
Total Nilai TKDN Aspek Pengembangan Berbasis Aktivitas Penelitian dan Pengembangan												0,00%

Table 2. Production Process or Manufacturing Process Mapping (MPM)

Production Stage	*Location*	*Category*	*Description*
Frame and body design	Indonesia	KDN	Uses local CAD software
Drive motor manufacturing	Abroad	KLN	Imported from China
Final assembly	Indonesia	KDN	Involves local labor
RLDA and durability testing	Indonesia	KDN	Conducted at a national laboratory

Table 3. TKDN Development Documentation Results

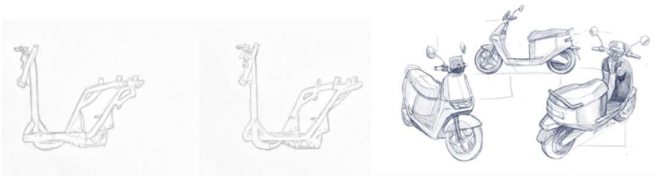
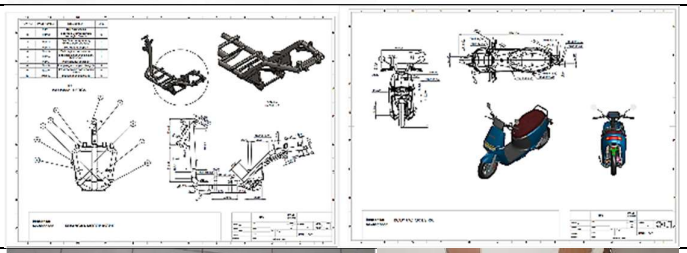
Activity Criteria	TKDN Development Document
Product Planning	
Design Engineering	
Vehicle Prototyping	
Testing	

Table 4. Recapitulation Results of TKDN Development Calculation.

Rekapitulasi Penghitungan TKDN Pengembangan Produk Kendaraan Bermotor Listrik Berbasis Baterai													
				Aspek Penilaian									
				Kepemilikan *)				Kepemilikan Saham Penyedia Jasa **)					
No.	Kriteria Aktivitas	PIC	Bobot Penilaian	Dokumen	Divisi atau Bagian	Tenaga Kerja	KDN	DN	DN+LN	LN	KDN	TKDN	
I	Penelitian Pasar (Market Research)	BRAND	5,00%	☑	☑	☑	100,00%	☑	☑	☑	100,00%	5,00%	
II	Perencanaan Produk (Product Planning)	ASM	15,00%	☑	☑	☑	100,00%	☑	☑	☑	100,00%	15,00%	
III	Perancangan Teknis (Design Engineering)	ASM	20,00%	☑	☑	☑	100,00%	☑	☑	☑	100,00%	20,00%	
IV	Model Kendaraan (Prototyping)	ASM	20,00%	☑	☑	☑	100,00%	☑	☑	☑	100,00%	20,00%	
V	Pengujian Kendaraan (Testing)	ASM	20,00%	☑	☑	☑	100,00%	☑	☑	☑	100,00%	20,00%	
VI	Sertifikasi Kendaraan (Licencing)	BRAND	20,00%	☑	☑	☑	100,00%	☑	☑	☑	100,00%	20,00%	
Total Nilai TKDN Aspek Pengembangan Berbasis Aktivitas Penelitian dan Pengembangan												100,00%	

3.3. Calculation of TKDN Value of Electric Motor Vehicle Products

This research presents the results of the TKDN calculation recapitulation activity related to the development of battery-based electric motor vehicle products. The TKDN development documentation results are presented in Table 3.

Based on the calculations conducted after the development and optimization process of production components, it was found that the Domestic Content Value (TKDN) reached 50% of the total production cost. A recap of the results from the TKDN development calculation is presented in Table 4.

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From this total value, the most significant contribution comes from local material components, which amount to 30%. This includes the use of raw materials and main components, such as the stator core, copper wire, and some magnetic elements that have been substituted with local materials. Meanwhile, the contribution from local labor reaches 20%, reflecting the dominance of domestic human resources in the assembly, testing, and finishing processes.

Based on detailed calculations of the production cost structure, it was found that the value of domestic production cost components (TKDN) for one unit of product reached **47.91%**. The contribution of production elements sourced domestically includes raw materials, manufacturing processes, assembly, and engineering services carried out within the country.

The local industry has sufficiently met the total production cost of the electric motor. This is a positive indication of the increasing independence of the national industry in supplying components locally.

The value of 47.91% also serves as a basis for further evaluation and development strategies, enabling TKDN to continue improving through increased substitution of imported materials and enhancement of domestic production quality. Production cost components per 1 (one) unit of product are shown in Table 5.

Based on the calculations of all production cost components at the development stage, the Domestic Component Level (TKDN) value reached **56.90%**. This value indicates the proportion of local elements' contribution to the total production cost per unit of electric motor product.

4. DISCUSSIONS

The recapitulation results of the Domestic Component Level (TKDN) calculation at the development stage showed an achievement of **56.90%** of the total production cost components for one unit of electric motor product. This achievement reflects that nearly half of the production cost elements utilize domestic resources, including materials, labor, and production processes.

However, some critical main components have not yet been entirely produced domestically, such as certain types of electronic components and PCB-based control equipment. Dependence on these components remains a constraint to achieving a higher TKDN value.

The TKDN value of 56.90% has exceeded the government's minimum threshold of 40%, required for the product to qualify for incentives or be classified as a domestic product. This shows that the development and optimization efforts undertaken have had a positive impact on increasing production independence. The recapitulation of TKDN calculation results is presented in Table 6.

The TKDN calculation results at the development stage showed a value of 43.20%. This value surpasses the minimum limit set by government regulations (Minister of Industry Regulation No. 16 of 2011), which is 40%, thereby qualifying the product as domestically produced.

This achievement indicates that the development direction of electric motor components is aligned with efforts towards national industrial independence. The use of local materials, utilization of domestic labor, and locally conducted assembly processes are the main contributors to this TKDN score.

5. CONCLUSION

The TKDN value of battery-based electric motor vehicles demonstrates an increasing contribution of local components throughout the development, testing, and system integration processes. This indicates that the domestic industry's capability to supply supporting components for electric vehicles is steadily improving.

Table 5. Production Cost Components per 1 (one) Unit of Product.

Description		ASSESSMENT BY THE PRODUCER			
		Cost per 1 (one) unit of product			
		Cost KDN	Cost KLN	Cost Total	TKDN Percentage
I	**Direct Materials**				
1.	Raw Materials for Direct Materials	367.214,00	602.495,79	969.709,79	31,75
2.	Raw Materials for Other Related Costs	184.700,20	-	184.700,20	15,97
II	**Direct Labor**				
1.	Direct Labor	1.751,78	-	1.751,78	0,15
2	Direct Labor for Other Related Costs	-	-	-	0,00
III	**Factory Overhead (Indirect Costs)**				
1.	Indirect Labor	397,42	-	397,42	0,03
2.	Owned Machinery	69.57	-	69,57	0,01
3.	Leased Machinery	-	-	-	0,00
4.	Other Related Indirect Costs	49,66	-	49,66	0,00
Production Costs		**554.113,06**	**602.495,79**	**1.156.678,42**	**47,91**

Table 6. Recapitulation Results of TKDN Calculation

URAIAN		(%)					TKDN (%)
		BOBOT PENILAIAN	KDN		KLN		
(1)		(2)	(3)		100 - (3)		
I.	TKDN MANUFAKTUR KOMPONEN UTAMA (50%)						
	a. Rangka dan/atau Bodi	5,00%	50,00%		50,00%		2,50%
	b. Baterai	40,00%	36,00%		64,00%		14,40%
	c. Sistem Penggerak Motor Listrik	5,00%	0,00%		100,00%		0,00%
II.	TKDN MANUFAKTUR KOMPONEN PENDUKUNG (10%)						
	a. Sistem Kemudi	2,00%	0,00%		100,00%		0,00%
	b. Sistem Pengereman	2,00%	0,00%		100,00%		0,00%
	c. Sistem Roda dan Transmisi	2,00%	0,00%		100,00%		0,00%
	d. Sistem Elektronik	2,00%	0,00%		100,00%		0,00%
	e. Suspensi	2,00%	0,00%		100,00%		0,00%
III.	TKDN PERAKITAN (30%)	WNI	Min 80%		Min 50%		
			☑		☑		
	a. Tenaga Kerja	15,00%	100,00%		50,00%		15,00%
	b. Alat Kerja	15,00%	Penyambungan Rangka	Pengecatan	Perakitan	Pengujian dan Pengendalian Mutu	
			☑	☑	☑	☑	15,00%
IV.	TKDN PENGEMBANGAN (10%)	10,00%	Aktivitas	Investasi	KDN		10,00%
			☑	☑	100,00%		
TKDN KENDARAAN BERMOTOR LISTRIK BERBASIS BATERAI							56,90%

The most significant contribution to the TKDN comes from non-material components such as engineering design, assembly processes, product testing, and development activities carried out domestically. This demonstrates that local technical capabilities and innovation play an essential role in the product's value-added structure. Local material components remain limited, especially in high-technology parts such as battery cells, battery management systems (BMS), and several electronic com-

ponents. Nevertheless, some mechanical components, vehicle frames, and body structures have achieved a high level of local content. The TKDN calculation recap process ensures compliance with applicable regulations and assessment guidelines, thereby validating the resulting values as a reliable basis for certification, audits, and reporting to stakeholders.

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