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Analysis of lean-agile-resilient-green (LARG) implementation in the electric car industry in Indonesia

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Vehicle type approval (VTA) total registration of electronic vehicles in Indonesia for the accumulation period until August 2023 is 81,525 units with a composition of 4-wheeled vehicles 18,300 units. The use of electric vehicles is still a tiny portion compared to the motorized vehicle population in Indonesia, which will reach more than 146 million units in 2022. It is different from developments in Europe, the United States, and China, where more research into the use of electric vehicles is being carried out. The readiness of the automotive industry system to produce electric vehicles is absolutely necessary to achieve superior productivity levels. National automotive companies need to anticipate that changes in production systems will also change along with changes in processes and components in electric vehicles. In the next few years, world-class manufacturing production systems will refer to LARG (lean, agile, resilient, and green) aspects. Lean, agile, resilient, and environmentally friendly manufacturing industrial operations are critical. This research aims to determine the level of application of LARG aspects in the electric vehicle automotive industry. The method used was exploratory, and a questionnaire was filled out with industry experts and analyzed using the analytical hierarchy process (AHP) and objective matrix (OMAX). The results of this study confirm that all aspects of LARG require improvement. Resilience (R) and green (G) have performance below 10 percent, so these two aspects are priorities for improvement by the electric car industry in Indonesia.

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1. INTRODUCTION

Indonesia has 31% of Southeast Asia's total market share, making it the largest automotive market in the region [1]. A large population with an ever-increasing per capita income makes this archipelagic state have promising automotive market potential. Southeast Asia's car market share in 2021 shows total sales of 2.79 million units (an increase of 14% compared to 2020). The largest car sales were in Indonesia (887,202 units), Thailand (754,254 units), Malaysia (508,911 units), Vietnam (304,149 units), the Philippines (223,488 units), Singapore (58,953 units) and Myanmar (9,350 units). Based on data from the Association of Indonesian Automotive Industries (Gaikindo), total car sales in Indonesia in 2022 are 1,048,040 units, which is predicted to increase in 2023.

Indonesia's commitment to overcoming

climate change within the framework of the Paris Agreement is to expand the use of renewable energy through the development of low-carbon emission vehicles. Electric cars are a promising technology for achieving a sustainable mass transportation sector due to their simplicity, low carbon emissions, and low noise levels, where electric cars are almost silent [2]. Based on data from the Gaikindo, the Indonesian government targets the use of electric cars to reach 400,000 units (2024), increase to 600,000 units (2026), and 1,000,000 units (2030) through the regulatory and intensive schemes provided. The number of electric cars in Indonesia continues to increase yearly: 687 units in 2021, 10,327 units in 2022, and 20,414 units in 2023. This data confirms that the growth in the number of electric vehicles in Indonesia is moderate. Most electric cars are priced at more than IDR 600 million, while the Indonesian automotive market is dominated by cars priced below IDR 300 million. Two leading brands manufacture most electric vehicles sold in Indonesia, while other manufacturers prepare supporting infrastructure. Compared with 1,005,802 ICE (internal combustion engine) based cars in 2023, the transition of consumers to electric vehicles is relatively slow. Price factors, readiness of supporting infrastructure (such as availability of charging stations), product knowledge, and others are still inhibiting factors. Applying LARG to electric vehicle manufacturers is expected to increase competitiveness, thereby adding value to consumers.

Aspects related to humans, such as inefficient production processes, are generally related to human factors involved in industry. Research by Palange and Dhatrak [3] confirmed that lean manufacturing is important in all manufacturing sectors, such as the automotive industry. The other research also shows that the application and analysis of the overall LARG aspect in the automotive industry has not been widely carried out. Research on the lean, agile, resilient, and green (LARG) approach in the electric car industry in Indonesia is very important, especially considering the global change towards sustainable mobility and the need for innovation in the automotive industry. The lean approach can improve operational efficiency by eliminating waste in the supply chain and production process of electric vehicles. The agile approach allows electric car manufacturers to be responsive to relatively rapid changes by developing products and services that meet consumer demands. The resilient approach can help the electric car industry build an even stronger system that can adapt quickly to various situations and conditions. Meanwhile, the green approach can make the electric car industry aware of the importance of developing environmentally friendly electric vehicles in all business processes.

Thus, research on lean, agile, resilient, and green approaches in Indonesia's electric car industry is crucial for the industry's progress and meeting global challenges related to sustainable mobility and environmental protection. Previous research tends only to analyze the implementation of one or two aspects of LARG. The machine learning models can create effective soft sensors that can predict an enterprise's lean manufacturing level based on its manufacturing flexibilities [4]. Research conducted by Alefari *et al.* [5] analyzed aspects of lean leadership quality to maintain and improve employee performance in a lean production system. This approach is classified as something different because it analyses lean from a leadership perspective in a lean production system to improve employee performance.

Haq and Boddu [6] researched the implementation of agile supply chain management by identifying the most appropriate agile enablers for companies to implement based on the characteristics of the related market by linking competitive bases, agile attributes, and agile enablers. Research by Galankashi *et al.* [7], conducting an agility assessment in the manufacturing industry on the supply chain contract aspect, aims to develop a framework for evaluating the agility of manufacturing companies.

Digital manufacturing systems can aid resilience within the industrial sector and contribute to wider societal goals, but the biggest impact is likely to be at the lowest level [8]. The research conducted by Sambowo and Hidayatno [9] analyses the resilience index, which has four main factors: robustness, resourcefulness, redundancy, and rapidity. Research on supply chain resilience in Iran shows that the automotive industry in Iran should resist five elements of vulnerability and embrace nine elements of capability [10].

Research by Nunes and Bennett [11] confirmed that the world's three major car manufacturers are pursuing various environmental initiatives involving the following green operations practices. Research on the Indian automobile industry shows a contextual relationship between these practices and the implementation of green supply chain management [12]. Research

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Table 1. Comparison of the contribution of previous research

No	Authors	Subject	Tools	Result/Contribution
1	Govindan *et al*. [13]	Identify the critical lean, green, and resilient practices on which top management should focus to improve the performance of automotive supply chains.	Structural Self-Interaction Matrix (SSIM) and ISM Model	A major contribution of this research lies in developing linkages among various lean, green, and resilient practices and performance measures through a single systemic framework. The utility of the proposed ISM methodology in imposing order and direction on the complexity of relationships among system elements assumes a handy research method for decision-makers.
2	Cabrita *et al.* [14]	Creating an ideal type of business model to integrate the LARG paradigm	Business Model Canvas (BMC)	The existing literature shows a clear gap between these two research areas. This paper addresses this knowledge gap, contributing to the discussion on creating an ideal type of BM adapted to the LARG paradigm.
3	Aisyah *et al.* [15]	Analyze the implementation of the LARG issue in bean-to-bar chocolate SMEs in Indonesia.	Rich Picture and Importance Performance Analysis (IPA) method	A comparison of the LARG index calculations shows the LARG index implementation is still deficient at 3.66 while the interest, according to Experts, is 4.39. SMEs must improve the performance of the LARG issue in order to increase sustainable competitiveness.
4	Aisyah *et al.* [16]	Analyze the implementation of the LARG approach in Indonesian automotive as one of the bases for the Asian automotive industry.	Importance Performance Analysis (IPA) method	The results of this study confirm that several LARG sub-indicators have not been appropriately implemented, with an implementation index value of 4.41.
5	This Paper	Analysis of Lean-Agile-Resilient-Green (LARG) Implementation in the Electric Car Industry in Indonesia	Analytical Hierarchy Process (AHP) and Objective Matrix (OMAX).	The results of this study confirm that all aspects of LARG require improvement. Resilience (R) and Green (G) have performance below 10 percent, so these two aspects are priorities for improvement by the electric car industry in Indonesia.

conducted by Duarte and Machado [17] revealed that high scores came from good interactions between green and lean implementation in automotive companies.

Compared to research aimed at increasing industrial competitiveness through implementing LARG, assessments on lean, agile, resilient, and green aspects have not been widely carried out. The lean and green approach evaluates new product development in small and medium enterprises [18]. An assessment of the implementation of lean, agile, resilience, and green (LARG) aspects in the automotive industry in Indonesia has been carried out through research conducted [16] by producing a LARG implementation index value. A business model that integrates the LARG paradigm can drive sustainable competitive advantage where organizations can adapt and create new business models [14].

Research examining aspects of LARG, both whole and in part, in the automotive industry is rarely carried out. In line with the trend of increasing use of electric cars worldwide (including in Indonesia), this research aims to assess all aspects of lean, agile, resilient, and green in the electric car industry. This research also provides alternative priorities for developing LARG sub-criteria using the analytical hierarchy process

(AHP) and objective matrix (OMAX) methods (Table 1). Through OMAX, several performance values from various performance factors or criteria are combined into one single performance value so that the overall performance picture can be seen more clearly. Through the AHP method, a hierarchical structure is arranged as a consequence of the selected criteria, where the paired matrix values are filled in by experts with experience in the automotive industry, specifically in electric car development. Agility assessment in manufacturing companies using the AHP method is then categorized based on the main perspective of agility [19]. Performance assessment of each LARG sub-indicator is carried out using the AHP and OMAX methods. The novelty of this research is knowing the performance of LARG in the electric vehicle industry so that the competitiveness of the automotive industry can be planned for improvement.

2. RESEARCH METHODS

The method or stages used in this paper are:

1. The first step in this research is to identify LARG sub-indicators that are most suitable for the electric car industry in Indonesia from various sources and references from various articles, direct observation, and FGDs with experts in the automotive industry, especially in the electric car industry (Stakeholder: industry, government, academics, automotive association)
2. Create a questionnaire about the most important LARG sub-indicators implemented in the electric car industry in Indonesia. 7 respondents who are experienced in the automotive industry will fill out the questionnaire, especially in the electric car (Stakeholder: The seven respondents used were two from the automotive industry. We chose a resource person who has a general manager position, approximately 15 years of experience in the national and international car industry, and is part of a team developing electric cars in the industry. Three people from the government whose positions are at least echelon 2, namely the Ministry of Industry, the Ministry of Energy and Mineral Resources, and the State Electricity Company. They understand the electric vehicle industry's development roadmap and policy direction. Apart from that, one person from the automotive association will find out the industry's readiness and sustainability in developing electric cars. One person from the academic community focused on electric vehicles to discover the obstacles in developing electric cars and the acceptance phase of new products and technology in society.)—the results of this questionnaire selected five sub-indicators from each LARG indicator. The five sub-indicators are taken from each sub-indicator's first five highest values. The experts agreed on this so that the industry could focus on improving these five sub-indicators.
3. Determine the weight of the 5 sub-indicators of each LARG indicator using AHP.
   AHP was used to determine five sub-indicators for each LARG indicator. 5 sub-indicators were chosen because the number of sub-indicators for each LARG indicator was different.
4. Calculating the performance level of LARG implementation in the electric car industry using OMAX.
   Omax is used to determine the performance of each sub-indicator when implementing the LARG indicator in the Indonesian automotive industry (Fig. 1).

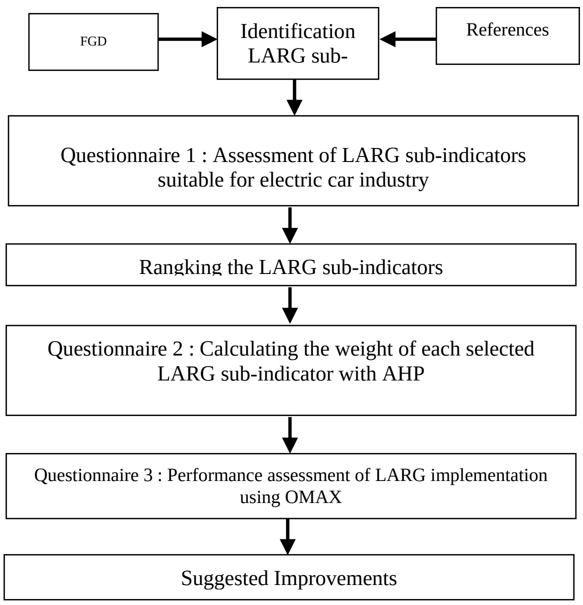

Fig. 1. The stages in the research method

Determination of Lean sub-indicators refers to research Mostafa *et al.* [20], Vinodh *et al*. [21], Wahab *et al*. [22], Rahman *et al*. [23], Bhamu and Sangwan [24], Pinto and Mendes [25], Fullerton *et al*. [26], and Piercy and Rich [27]. Determina-

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Table 2. The rank of LARG sub-indicators

Sub-indicator	Symbol	Average	Rank
LEAN			
Minimise resource inventory (raw materials, work in process, finished goods, labor, machinery, and tools)	L1	4.571	3
Ensure all components are quality-tested	L2	4.571	4
Giving workers the confidence to make continuous improvements so that their knowledge and skills grow	L3	4.429	5
Minimise inventory and resource usage	L4	4.286	10
Improving resource utilisation	L5	4.286	11
Strive to shorten lead time, cycle time, and set-up time	L6	5	1
Innovation in performance appraisal	L7	4.286	12
Multifunctional workforce	L8	4.286	9
Customer satisfaction priority	L9	4.429	6
Just in time	L10	4.429	7
Continuous improvement	L11	4.286	8
Manufacture according to customer wishes	L12	4.714	2
AGILE			
Maximum utilization of worker's skills, knowledge, judgment, experience and intelligence	A1	4.429	6
Provide and facilitate the continuous development of worker's knowledge, skill, and experience	A2	4.286	11
Multi-skilled and flexible workers	A3	4.571	5
Workers and customer satisfaction priority	A4	4.429	7
Speed in identifying and solving problems	A5	4.714	2
Use IT to integrate/coordinate all production/manufacturing activities	A6	4.714	1
Rapid ability to reconfigure production plans and processes	A7	4.429	9
Speed in improving customer service, reliability of delivery, and response to market changes	A8	4.714	3
Develop business practices that are difficult to replicate	A9	4.000	15
Awareness of technological developments and striving to be a leader in the use of the latest technology	A10	4.429	8
Design and produce a product that is in accordance with consumer desires and provides great added value	A11	4.714	4
Using centralized planning and collaboration	A12	4.286	12
Speed in reducing development and production cycle times	A13	4.143	14
Increase the frequency of new product introductions	A14	3.714	16
Responsive to changing market needs	A15	4.429	10
Ability to maintain and grow close relationships based on trust with customers and suppliers	A16	4.286	13
RESILIENCE			
Ability to take corrective action when disruptions are identified quickly	R1	4.571	2
The ability to continuously innovate to remain resilient to unavoidable disruptions	R2	4.571	3
Availability of real-time information through improved management information systems	R3	4.429	4
Using raw material sourcing strategies for possible supplier changes	R4	4.143	11
Flexible utilization of raw material sources	R5	4.143	12
Create an inventory strategy for both raw materials and finished goods	R6	4.143	13
Commitment through a contract with the supplier	R7	4.000	15
Design a production system that can accommodate multiple products and real-time changes	R8	4.429	5
Develop cooperation across all production activities to help reduce risk	R9	4.286	9
Implement demand-driven management	R10	4.429	7
Make improvements in maintenance, especially preventive maintenance	R11	4.286	10
Using a flexible transport system	R12	4.857	1
Endeavor to reduce lead time and operating costs	R13	4.429	6
Using multi-skilled labor	R14	4.143	14
Strategies to increase market share	R15	4.429	8
GREEN			
Design products and processes using environmentally friendly materials	G1	4.429	6
Consider the required energy consumption of the product/process	G2	4.857	1
Ease of recycling of designed products	G3	4.286	14
Ease of reuse of materials used	G4	4.286	12
Ease of remanufacturing	G5	4.429	7
Using the least polluting manufacturing facility	G6	4.429	8
Waste management according to regulations	G7	4.857	2
Using production technology to minimize pollution	G8	4.429	9
Reduction in the amount of waste	G9	4.714	3
Implement an energy-efficient manufacturing process	G10	4.571	5
Water saving in the manufacturing process	G11	4.286	13
Product or service customization	G12	4.000	18
Invest in greener design and technology	G13	4.286	16
Management that considers environmental aspects	G14	4.429	10
Efforts to develop green technology	G15	4.571	4
Participation in socialization/training activities conducted by the government or related institutions	G16	4.143	17
Division of roles and responsibilities	G17	4.286	15
Evaluation of existing business processes	G18	4.429	11

tion of Agile sub-indicators refers to research by Singh and Vinodh [28], Sangari and Razmi [29], Gligor *et al*. [30], Matawale *et al*. [31], Yang [32], and Purvis *et al*. [33]. Determination of the Resilient sub-indicator refers to research by Pramanik *et al*. [34], Rajesh [35], Ali *et al*. [36], Sahu *et al*. [37], and Hosseini and Al Khaled [38]. Determination of the Greensub indicator refers to research by Zobel [39], Banaeian *et al*. [40], Ghazilla *et al*. [41] and Kusi-Sarpong *et al*. [42].

3. RESULTS AND DISCUSSION

3.1. Result

The stage results, searching and identifying indicators and sub-indicators from various reference articles and discussions with electric car experts, obtained 12 sub-indicators for lean, 16 for agile, 15 for resilience, and 18 for green. The identified sub-indicators are different from the LARG sub-indicators in the article on the implementation of LARG in the automotive industry in Indonesia [16]. In this paper, LARG is explicitly implemented in the electric car industry. The questionnaire was created and distributed to determine the level of importance of each sub-indicator. The results of the questionnaire from 7 experts were obtained using simple statistics. The results of the calculation and ranking of each sub-indicator (Table 2).

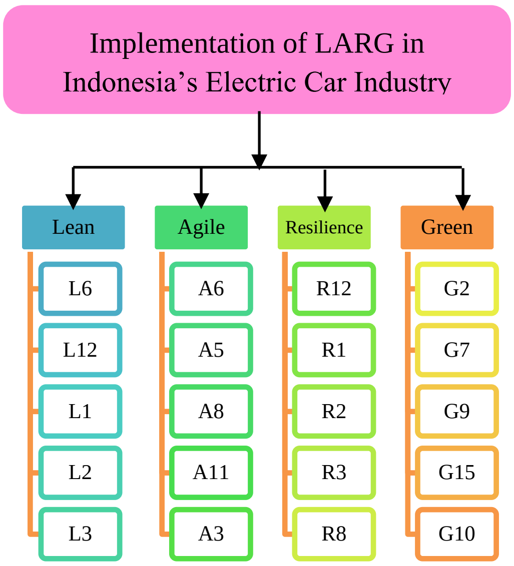

Fig. 2. The LARG implementation measurement hierarchy structure

The first 5 ranks of each sub-indicator were selected to calculate the importance weight using AHP. The AHP structure of LARG implementation in the electric car industry (Fig. 2). The AHP calculation stage only focuses on calculating the weight of each sub-indicator because, in this study, each indicator is considered equally important, so the weight is the same 0.25.

The questionnaire results were processed and converted into a pairwise matrix, and the geometric mean value (Table 3, Table 4, Table 5, and Table 6). Then, the value was normalized by dividing the value of each cell by the number of values in the column where the cell was located so that the overall normalization value (Table 7, Table 8, Table 9, and Table 10). The normalization rows were summed and averaged.

Table 3. Pairwise comparison matrix for lean sub-indicators

Sub-indicators	**L6**	**L12**	**L1**	**L2**	**L3**
L6	1	3.302	1.260	2.621	1.817
L12	0.303	1	0.404	2.289	2.289
L1	0.794	2.466	1	2.924	2.924
L2	0.382	0.437	0.342	1	0.271
L3	0.550	0.437	0.342	3.684	1

Table 4. Pairwise comparison matrix for agile sub-indicators

Sub-indicators	**A6**	**A5**	**A8**	**A11**	**A3**
A6	1	1.913	0.630	0.523	5.593
A5	0.523	1	1.710	1.609	1.710
A8	1.587	0.585	1	1.710	6.257
A11	1.913	0.621	0.585	1	7.612
A3	0.179	0.585	0.160	0.131	1

Table 5. Pairwise comparison matrix for resilience sub-indicators

Sub-indicators	**R12**	**R1**	**R2**	**R3**	**R8**
R12	1	0.523	0.621	1.710	7.000
R1	1.913	1	1.913	5.593	7.612
R2	1.609	0.523	1	7.612	7.612
R3	0.585	0.179	0.131	1	2.080
R8	0.143	0.131	0.131	0.481	1

Table 6. Pairwise comparison matrix for green sub-indicators

Sub-indicators	G1	G7	G9	G15	G10
G1	1	0.430	0.143	0.212	0.212
G7	2.327	1	0.342	0.585	0.160
G9	7.000	2.924	1	1.609	0.395
G15	4.718	1.710	0.621	1	0.111
G10	4.718	6.257	2.530	9.000	1

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In order to obtain the maximum λ sum of λ each sub-indicator was carried out, then the average, the consistency index was calculated using equation (1) to determine the accuracy of the respondent's assessment.

$$CI = \frac{\lambda\,\text{maks} - n}{n-1} \quad (1)$$

where CI is the consistency index λmak: maximum eigen value; and n: number of samples. After the CI value is known, the consistency ratio value is obtained with equation (2).

$$CR = \frac{CI}{RI} \quad (2)$$

where CR: Consistency Ratio and RI: Random Consistency Index

According to Saaty [43], an acceptable CR value is ≤ 10% or ≤ 0.1. If the result is more than 10%, the judgment is likely random and must be corrected.

Table 7. Normalization of pairwise comparison matrix and weight of lean sub-indicators

Sub-indicators	L6	L12	L1	L2	L3	Weight
L6	0.330	0.432	0.376	0.209	0.219	0.313
L12	0.100	0.131	0.121	0.183	0.276	0.162
L1	0.262	0.323	0.299	0.234	0.352	0.294
L2	0.126	0.057	0.102	0.080	0.033	0.080
L3	0.182	0.057	0.102	0.294	0.120	0.151

Table 8. Normalization of pairwise comparison matrix and weight of agile sub-indicators

Sub-indicators	A6	A5	A8	A11	A3	Weight
A6	0.192	0.407	0.154	0.105	0.252	0.222
A5	0.100	0.213	0.419	0.324	0.077	0.226
A8	0.305	0.124	0.245	0.344	0.282	0.260
A11	0.368	0.132	0.143	0.201	0.343	0.237
A3	0.034	0.124	0.039	0.026	0.045	0.054

Table 9. Normalization of pairwise comparison matrix and weight of resilient sub-indicators

Sub-indicators	R12	R1	R2	R3	R8	Weight
R12	0.190	0.222	0.164	0.104	0.277	0.191
R1	0.364	0.425	0.504	0.341	0.301	0.387
R2	0.307	0.222	0.263	0.464	0.301	0.311
R3	0.111	0.076	0.035	0.061	0.082	0.073
R8	0.027	0.056	0.035	0.029	0.040	0.037

In lean indicators, the biggest weight is L6 (Efforts to shorten lead time, cycle time, and set-up). The biggest weight of the agile indicator is A8 (Speed in improving customer service, delivery reliability, and response to market changes). The resilience indicator's biggest weight is R1 (Ability to take corrective action when disruptions are identified quickly); in the green indicator, the biggest weight is G10 (Implement energy-efficient manufacturing process). The calculation of the consistency index (CI) and consistency ratio (CR) shows that the questionnaire results are consistent because they have a value of less than 10% or 0.1, so they can proceed to the following process (Table 11).

Table 10. Normalization of pairwise comparison matrix and weight of green sub-indicators

Sub-indicators	G1	G7	G9	G15	G10	Weight
G1	0.051	0.035	0.031	0.017	0.113	0.049
G7	0.118	0.081	0.074	0.047	0.085	0.081
G9	0.354	0.237	0.216	0.130	0.210	0.229
G15	0.239	0.139	0.134	0.081	0.059	0.130
G10	0.239	0.508	0.546	0.725	0.532	0.510

Table 11. CI and CR value of each indicator

Indicator	*Consistency Index* (CI)	*Consistency Ratio (CR)*
Lean	0.089	0.079
Agile	0.060	0.054
Resilience	0.046	0.042
Green	0.076	0.068

3.2. Calculating LARG Implementation Performance

The next step is to calculate the performance value of the LARG implementation carried out by the electric car industry in Indonesia. The data used in calculating the performance value is from the questionnaire conducted to 3 respondents. The results of the calculation of LARG implementation performance can be seen in Table 12, Table 13, Table 14, and Table 15. The highest performance is the green indicator at 45%, the lean indicator at 29%, the agile indicator at 15%, and finally, the resilience indicator at 7%. It means that the implementation of LARG in Indonesia's electric car industry still needs to be improved.

3.3. Managerial implications

The electric vehicle industry has a low LARG implementation score, especially in the Resilience and Green indicators. Dramatically improving all aspects of LARG will require substantial resources and investment. Gradually improving each LARG sub-indicator is a more realistic option for developing electric vehicles. As a new business in Indonesia, electric vehicle manufacturers can make LARG an essential aspect for

Table 12. Lean implementation performance

LEAN							
Sub Indicator	**L6**	**L12**	**L1**	**L2**	**L3**	Level	
Performance	8	9	8	8	7		
Expected	10	10	10	10	10	10	
	9.571	9.714	9.429	9.571	9.286	9	
	9.143	9.429	8.857	9.143	8.571	8	
	8.714	9.143	8.286	8.714	7.857	7	
	8.286	8.857	7.714	8.286	7.143	6	
	7.857	8.571	7.143	7.857	6.429	5	
	7.429	8.286	6.571	7.429	5.714	4	
Based	7	8	6	7	5	3	
	5.667	6.333	4.667	5.667	3.667	2	
	4.333	4.667	3.333	4.333	2.333	1	
Worst	3	3	2	3	1	0	
score	6	7	7	6	6		
Weight	31.400	16.20	29.500	8.000	14.900	100	
Value	188.400	113.4	206.50	48.000	89.400	645.7	Current
						500	Previous
						29%	IP

Table 13. Agile implementation performance

AGILE							
Sub Indicator	**A6**	**A5**	**A8**	**A11**	**A3**	Level	
Performance	8	9	8	7	6		
Expected	10	10	10	10	10	10	
	9,571	9,714	9,429	9,571	9,286	9	
	9,143	9,429	8,857	9,143	8,571	8	
	8,714	9,143	8,286	8,714	7,857	7	
	8,286	8,857	7,714	8,286	7,143	6	
	7,857	8,571	7,143	7,857	6,429	5	
	7,429	8,286	6,571	7,429	5,714	4	
Based	7	8	6	7	5	3	
	6,000	6,333	5,667	6,333	3,667	2	
	5,000	4,667	5,333	5,667	2,333	1	
Worst	4	3	5	5	1	0	
score	6	7	7	3	5		
Weight	23,020	23,070	26,250	24,010	3,650	100	
Value	138,120	161,49	183,75	72,030	18,250	573,64	Current
						500	Previous
						15%	IP

Table 14. Resilience implementation performance

RESILIENCE							
Sub Indicator	R12	R1	R2	R3	R8	Level	
Performance	6	6	7	7	9		
Expected	10	10	10	10	10	10	
	9,143	9,286	9,429	9,429	9,286	9	
	8,286	8,571	8,857	8,857	8,571	8	
	7,429	7,857	8,286	8,286	7,857	7	
	6,571	7,143	7,714	7,714	7,143	6	
	5,714	6,429	7,143	7,143	6,429	5	
	4,857	5,714	6,571	6,571	5,714	4	
Based	4	5	6	6	5	3	
	3,333	4,000	5,000	5,000	4,000	2	
	2,667	3,000	4,000	4,000	3,000	1	
Worst	2	2	3	3	2	0	
score	6	5	5	5	9		
Weight	19,140	38,69	31,137	7,302	3,728	100	
Value	114,84	193,5	155,69	36,510	33,552	534,05	Current
						500	Previous
						7%	IP

 http://dx.doi.org/10.30656/jsmi.v8i1.7674

Table 15. Green implementation performance

RESILIENCE							
Sub Indikator	G1	G7	G9	G15	G10	Level	
Performance	8	9	9	8	9		
Expected	10	10	10	10	10	10	
	9,571	9,714	9,714	9,571	9,571	9	
	9,143	9,429	9,429	9,143	9,143	8	
	8,714	9,143	9,143	8,714	8,714	7	
	8,286	8,857	8,857	8,286	8,286	6	
	7,857	8,571	8,571	7,857	7,857	5	
	7,429	8,286	8,286	7,429	7,429	4	
Based	7	8	8	7	7	3	
	5,667	6,667	7,000	5,667	6,333	2	
	4,333	5,333	6,000	4,333	5,667	1	
Worst	3	4	5	3	5	0	
score	6	7	7	6	8		
Weight	5,227	8,802	25,005	14,230	46,736	100	Current
Value	31,362	61,614	175,03	85,380	373,88	727.3	Current
						7%	IP

increasing competitiveness. Using a flexible transport system (R12), the production system can be implemented by implementing a practical and efficient system where waste in the movement of people and goods that do not have added value can be reduced or eliminated. Ability to take corrective action when disruptions are identified quickly (R1), carried out by quickly responding to every problem. The ability to continuously innovate to remain resilient to unavoidable disruptions (R2) by carrying out innovation based on continuous improvement. The availability of real-time information through improved management information systems (R3) is carried out by maximizing the information system of all related parts in response to problems. Design a production system that can accommodate multiple products and real-time changes (R8), which is also applied to respond to each change. Consider the required energy consumption of the product/process (G2), which can be done by reducing unnecessary energy consumption. According to regulations (G7), waste management utilizes waste material for production needs. Waste reduction (G9) is carried out by identifying all activities that do not add value. Efforts to develop green technology (G15) by transitioning to renewable energy-based energy supply sources are used. Implement an energy-efficient manufacturing process (G10), where continuous reduction of inefficient energy use in production lines is carried out.

The use of electric vehicles will continue to grow, so manufacturers need to continue to improve LARG's performance. The partial implementation of LARG, which is currently dominantly carried out by the automotive industry, needs to make a breakthrough by including all aspects of LARG simultaneously. Theoretically, the electric vehicle industry's competitiveness can be increased by improving the LARG sub-indicator.

This research confirms that applying LARG aspects can improve company performance, which will impact increasing the competitiveness of the Indonesian automotive industry. This research is similar to previous research. Previous research did not focus on the electric car industry, and this research assesses the application of LARG specifically to the electric car industry in Indonesia. The LARG indicator's overall value is still low, possibly because Indonesia's electric vehicle automotive industry is still in the early stages of development. The weakness of this research is that the data used is only from two automotive companies in Indonesia that already produce electric cars.

4. CONCLUSION

The electric car industry in Indonesia has implemented LARG indicators with different performance levels. The highest level of green performance is 45%, and the lowest is the resilience indicator, which is 7%. However, for the industry to continue to grow and be competitive, implementing the LARG approach must be improved again. Electric car manufacturers can gradually improve each aspect and sub-indicator of LARG, which is a priority for improvement.

Further research can be carried out involving more electric car industries. For further research, we can focus on two groups on the LARG aspect. The Lean aspect is Agile, which focuses on production efficiency; the second is Resilient and Green, which focuses on sustainability.

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