

Towards Electric Vehicle Era in A Developing Country: Review of Research on Automotive Component Industry in Indonesia from Industrial Engineering Perspective

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Abstract

Automotive industry is believed to be the pioneer in pushing the growth of manufacturing industry in Indonesia. Electric vehicles (EV) entry to the Indonesian automotive market at the moment is relatively new, with market penetration being modest at best. It is estimated that 30% of automotive component suppliers in Indonesia will disappear because EVs have fewer components than current conventional vehicles. An effective strategy is needed so that the automotive industry is able to face the transformation towards electric vehicle. the objectives of this research are 1) Understanding Indonesian research trends based on themes and keywords from industrial engineering and 2) Discover what research is increasingly getting momentum. The results show that Supply Chain Management is the most favourite knowledge area for a study of automotive component industry, recorded 13 papers from 2010 to 2021. The second most favourite is Engineering Management with 12 papers between 2010 and 2021. The keywords trends and Scival Topic Prominance are also discussed in this paper.

Keywords

Automotive industry, automotive component industry, electric vehicle, Indonesia.

1. Introduction

Today, the global automotive industry is at a crossroads as electric vehicles (EVs) are becoming increasingly important for a new generation of environmental technologies (Natsuda 2021), including in Indonesia. In the Indonesian Automotive Industry Roadmap, as mandated by Government Regulation number 14 of 2015 concerning the Master Plan for National Industrial Development (*Rencana Induk Pengembangan Industri Nasional* or RIPIN), Presidential Regulation Number 22 of 2017 concerning National Energy Policy, as well as follow-up to the government's commitment to COP21 Paris related to reducing greenhouse gas (GHG) emissions, the Indonesian Automotive Industry leads to Low Carbon Emission Vehicle (LCEV) (Ministry of Industry Data and Information Center 2021). The LCEV development is divided into two stages, Stage I (2013-2017) and Stage II (2017-2035). In the first stage, it leads to Motorized Vehicles Efficient Fuel and Affordable Prices (*Kendaraan Bermotor Hemat Bahan Bakar dan Harga Terjangkau* or KBH2) or better known as Low Cost Green Car (LCGC) vehicles with the aim of increasing the use of domestic products, increasing competitiveness, opening export access and growing energy-efficient and environmentally friendly products. The development of LCEV stage II leads to electric vehicles with no carbon emissions, this is to support the target of reducing GHG emissions by 29 percent from business as usual (BAU) by 2030 (Ministry of Industry Data and Information Center 2021). Electric-based cars (electrified and hybrid vehicles) are expected to account for 20% of vehicle sales by 2025, with ICE (internal combustion engine) vehicles accounting for the remaining 80%. (Ministry of Industry Data and Information Center 2021). Battery Electric Vehicle (BEV), Fuel Cell Electric Vehicle (FCEV), Hybrid Electric Vehicle (HEV), and Plug-in Hybrid Electric Vehicle (PHEV) are examples of electrified vehicles (Natsuda 2021).

Competing with Thailand, Indonesia aims to establish an EV hub in the region by providing tax incentives with local content rules, which may include HEV and PHEV (Natsuda 2021). In this context, the localization of the automotive industry has been driven by the program (Natsuda & Thoburn 2020). In line with this, the Government of Indonesia is committed to reducing Greenhouse Gas (GHG) emissions by encouraging an acceleration program for battery-based electric vehicles for land transportation through Presidential Regulation number 55 of 2019 concerning the

Acceleration of the Battery Electric Vehicle Program for Road Transportation. In article 3, the Government encourages the acceleration of the Battery-Based KBL program through: 1) accelerating the development of the domestic Battery-Based KBL industry, 2) providing incentives, 3) providing electricity charging infrastructure and setting electricity rates for Battery-Based KBL, 4) compliance with the provisions Battery-Based KBL, and 5) environmental protection. With this regulation, the Ministry of Industry projects that business opportunities and investment in the electric vehicle battery industry and its supporting industries will continue to grow and develop in the country (Ministry of Industry Data and Information Center 2021).

The manufacturing industry sector is expected to drive Indonesia's economic growth to achieve the targeted average growth of 6% per year in the next five years (Budiono, Nurcahyo, & Habiburrahman 2021). Automotive industry is believed to be the pioneer in pushing the growth of manufacturing industry in Indonesia (Nurcahyo & Wibowo 2015), however it has not been matched by the number of local suppliers that leads to dependency to imported raw materials (Maulida Hakim, Oktapiani Zaqiah, & Teuku 2018). The Indonesian automotive manufacturing industry is still unable to compete with Malaysia and Thailand even though many companies have implemented ISO 9001 (Nurcahyo, Zulfadlillah, & Habiburrahman 2021). As the free trade Asean Economic Community (AEC) causes the tougher competition, it is important that Indonesia's automotive industry have high competitiveness as well (Aisyah, Purba, Jaqin, Amelia, & Adiyatna 2021; Amran & Yose 2018). By implementing manufacturing strategy, the industry will get its performance improved (Nurcahyo & Wibowo 2015).

Automotive component manufacturer is an important part of automotive industry (Nurcahyo & Wibowo 2015). Electrified vehicles (EV) entry to the Indonesian automotive market at the moment is relatively new, with market penetration being modest at best (Nuryakin et al. 2019). Many countries have supported the development of sustainable technology in the automotive sector by making innovations for Electric Vehicles (EV). Indonesia is one of the countries that supports this program. With this program, it is estimated that 30% of automotive component suppliers in Indonesia will disappear because EVs have fewer components than current conventional vehicles (Nurhadi, Nurcahyo, & Gabriel 2021). An effective strategy is needed so that the automotive industry is able to face the transformation towards electric vehicle (Ministry of Industry Data and Information Center 2021).

The popularity of electric vehicles, such as HEV, PHEV and BEV, will continue to increase in line with the Government's push to achieve the GHG emission reduction targets set. Electric vehicles have different components from conventional cars. Likewise the number of components, electric vehicles have fewer components compared to conventional vehicles. Based on these external factors, automotive component manufacturing companies in Indonesia need to develop strategies to deal with the phenomenon of the increasing popularity of electric vehicles, one of which is by reviewing research conducted by universities and research institutions in Indonesia.

1.1 Objectives

To address the current phenomena, the objectives of this research are:

1. Understanding Indonesian research trends based on themes and keywords from industrial engineering
2. Discover what research is increasingly getting momentum

2. Literature Review

2.1 Industrial Engineering

Institute of Industrial and Systems Engineers (2021) stated that Industrial and systems engineering (ISE) is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems. The Industrial and Systems Engineering Body of Knowledge (ISEBoK) is composed of fourteen knowledge areas as shown in Figure 1. Each knowledge area is represented by an outline that defines what needs to be known to achieve a mastery in the field of ISE. A list of references is included in each knowledge area providing the reader with a resource to the requisite detail necessary to obtain a mastery of the areas provided in the ISEBoK.

2.2 Scival Prominence

SciVal Elsevier (2020) explained Prominence as a new indicator of the momentum/movement or visibility of a particular Topic. Prominence does not signify 'Importance'. Calculating a Topic's Prominence combines three metrics to indicate the momentum of the topic:

1. Citation count in year n to papers published in n and n-1
2. Scopus views count in year n to papers published in n and n-1
3. Average CiteScore for year n

Due to the nature of certain research fields there are Topics which will never become 'prominent'. However, this does not mean the Topic is not important. Topic Prominence in Science enhances SciVal's capabilities as an advanced evaluative and analytical tool and an important part of strategic research planning.

IISE Body of Knowledge



Figure 1. IISE body of knowledge

3. Methods

One of the important sources in formulating strategies is by reviewing scientific publications from universities and research institutions in Indonesia. The publications are a significant indicator of the performance of scholarly activities, the production of knowledge, and the achievement of recognition among communities (Aboagye et al. 2021). For this reason, the bibliographic method is one of the most common and accepted techniques for analyzing the evolution, productivity, and quality of research publications (Pranckutė 2021). The first step in performing the bibliographic analysis of a research field is to select the available databases (DBs), their suitability, and the consequences of using one over another. They are vital parts of the investigation, as they enable the analysis of the scientific activity conducted by researchers, institutions, regions, and countries, and identify trends in the research. It is widely known that Scopus is the bibliographic DBs strongly considered the most comprehensive data sources (Pranckutė 2021).

To achieve the purpose of this work, a comprehensive analysis of Indonesian automotive component industry research publications was performed. The investigation was begun by collecting high-quality scientific publications. In order to ensure the downloaded data was appropriate to the research objective, we used the this criteria:

- Publication type. The aim of this study is to map research on automotive component industry research in Indonesia. All publication types, such as research articles, conference papers, reviews, book chapters are included.

- Quality of Publication. High-quality content ensures the validity and reliability of output research. Here, the publications were only taken from an indexed-reputable database (Scopus-indexed).
- Affiliation. This research only select the publications that display Indonesian universities/research institutions in the affiliation (has at least one Indonesian institution in the affiliation).
- Timeframe. The timeframe is the last ten years (2010-2021).
- Content. This study aims to investigate publications from industrial engineering perspective affiliated with Indonesian institutions concerned with automotive component industry. The title, abstract, and keywords include “automotive component industry” or “automotive suppliers” are included.

4. Data Collection

The aforementioned criteria can be directly applied in the Scopus filtering section. In this work, three main keywords, “automotive component industry”, “automotive suppliers”, and “Indonesia” were adopted in order to harvest the data. The filter setting in Scopus was based on (TITLE-ABS-KEY (automotive AND components AND industry) OR TITLE-ABS-KEY (automotive AND suppliers) AND AFFILCOUNTRY (indonesia)) AND PUBYEAR > 2009). It extracted any documents from Indonesian affiliations that had “automotive component industry” and “automotive suppliers” in their title, abstract, and keywords. Documents are collected on 19th October 2021, it harvested 87 publications. It is expected that some documents may not represent the objective data. Therefore, the data validation was performed by careful abstract checking based on the criteria, especially to ensure the industrial engineering perspective. Finally, 43 articles are used in this work.

5. Results and Discussion

This section deals with the evolution of research in terms of publication during the last ten years of Indonesia’s automotive component industry research. The analysis is structured into four parts: overview; 2010-2018 period; 2019-2021 period; and the Scival Prominence.

5.1 Overview

In total, 43 papers are reviewed in this article (Table 1). Supply Chain Management is the most favourite knowledge area for a study of automotive component industry, recorded 13 papers from 2010 to 2021. The second most favourite is Engineering Management with 12 papers between 2010 and 2021. From 43 articles, the most frequent words in the keywords are automotive (14); manufacturing (14); industry (8); chain (7); performance (7).

Table 1. Number of articles for each knowledge area

Knowledge Area	2010-2018	2019-2021	Total
Work Design & Measurement	1	0	1
Operations Research & Analysis	0	0	0
Engineering Economic Analysis	0	3	3
Facilities Engineering & Energy Management	0	0	0
Quality & Reliability Engineering	1	2	3
Ergonomics & Human Factors	0	0	0
Operations Engineering & Management	0	3	3
Supply Chain Management	7	6	13
Engineering Management	2	10	12
Safety	0	0	0
Information Engineering	3	0	3
Design and Manufacturing Engineering	2	1	3
Product Design & Development	1	1	2
System Design & Engineering	0	0	0
Total	17	26	43

5.2 2010-2018 Period

One paper is presented in the Operations Research & Analysis knowledge area. Yazid, Rijal, M Shahrour, and Sari (2015) provided a systematic pattern recognition using T Method-3 by constructing a scatter diagram which could support decision making of particular industry. This is necessary because an unsystematic of pattern recognition

system based historical data caused the industrial practitioners failed to predict in a short time either the part can be rejected or remanufactured. In a worst case, the justification is really weak without any particular analysis that only depend on a traditional inspection to make a decision. Consequently, the outcome of this work is the client will be more convince on the development of remanufacturing process and the human's perspective will be that remanufactured product be thought as second hand, of poor quality and will be improved.

In Quality & Reliability Engineering knowledge area, Hartono, Raharno, Martawirya, and Arthaya (2018) described a methodology to monitor the availability of products in a production unit in the automotive component industry. By recording the condition of the product at each stage of production, company is able to identify the availability of the product in a production unit in the form of a raw material, the product being processed and the finished product.

Seven papers are recorded from Supply Chain Management knowledge area. Research in this knowledge area mainly studied the knowledge management (3 papers) and logistics (2 papers). Due to the increasingly dynamic condition of the environment, Marie, Sugiarto, Surjasa, and Witonohadi (2018) described the process of designing a knowledge management system for risk mitigation in supply chain uncertainty to improve their ability to overcome various uncertainty issues in the environment. Regarding the manufacturer and supplier knowledge management, Ramadhan and Samadhi (2016) identified the influence of inter-organizational trust towards knowledge sharing, and identified factors affecting inter-organizational trust (participation, communication, influence strategy, power, opportunistic behavior, behavioral uncertainty, inter-personal trust). The relationship between manufacturer and supplier in the automotive industry involves process of knowledge sharing that is an important process that may improve manufacturer and supplier performances (Ramadhan & Samadhi 2016). In addition, Handoko, Bresnen, and Nugroho (2018) conducted a comparative case study investigation of two Indonesian automotive component suppliers to better understanding of the impact of social capital on knowledge exchange within supply chains. From logistics sub area, Maulida Hakim et al. (2018) created an optimization methodology, based on Mixed Integer Nonlinear Programming (MINLP) to develop material delivery planning optimization model by determine the type and the number of container used as well as the total optimal material load in each container to reduce total cost of inbound logistics. Moreover, Amran and Yose (2018) produced a model of logistics performance measurement was designed as an evaluation tool for automotive component companies to improve their logistics performance in order to compete in Asean Economic Community (AEC). Outside the knowledge management and logistics sub area, Laraswati, Astuti, Budijanto, Yuniaristanto, and Sutopo (2014) discussed the evaluation of supply chain business strategy related to the indication of vertical restraint based on dealer and customer point of views and Ismail (2018) studied the the opportunity of application of symbiosis industry in supply chain to achieve several goals, such as developing processes, sharing the cost of investments and mitigating the risk.

From Engineering Management knowledge area, Nurcahyo and Wibowo (2015) discusssed the relationship between manufacturing capability and manufacturing strategy with manufacturing performance in Indonesia automotive component manufacturer. The result shows that manufacturing capability significantly influences manufacturing strategy while manufacturing strategy also significantly influences performance of Indonesia automotive component manufacturer. Moreover, Handoko (2017) investigated knowledge exchange in an organization applying hierarchical mechanisms, and the influence of social interactions on knowledge flow across different levels of analysis.

In Information Engineering knowledge area, Amran, Azmi, and Surjawati (2017) created an on-time production system design with Heijunka model so that the product diversity for all models could meet time and capacity requirements, own production flexibility, high quality, meet the customers' demands, realistic in production as well as creating a web-based local components' order information system that supports the Enterprise Resource Planning (ERP) system. In addition, Soebandrija and Pratama (2014) provided the innovation in information technology in both theoretical and empirical study. his paper discusses the major aspects of Innovation, Information Technology, Performance and Competitive Advantage. Moreover, as the increasing demand in auto-refinish industry, workshop has to work their process an order rapidly while some workshops do not accept any new orders as they already have reach the maximum capacity. To overcome the situation, Darmawan (2015) carried out the reengineering process by using of integrated information system between workshop and supplier.

The main purpose of manufacturing industry is to produce goods economically in order to gain profit and be able to deliver products on time (Muhammad & Yadrifil 2018). From Design and Manufacturing Engineering knowledge area, Rahiminezhad Galankashi, Helmi, Hisjam, and Abdul Rahim (2018) developed a framework to assess the leanness of companies in the automotive industry by conducting assessment of the leanness of three manufacturing

companies with regard to different supply chain drivers. Moreover, Muhammad and Yadrifil (2018) provided the study to reduce production waste in the automotive company by using Waste Relationship Matrix (WRM), Waste Assessment Questionnaire (WAQ) and Value Stream Mapping (VSM).

Product Design & Development knowledge area is represented by paper from Fatimah and Biswas (2016) who presented the GHG mitigation potential of technically feasible remanufactured alternators in Indonesian small- and medium-sized enterprises. Since existing remanufactured alternators have not been found to meet the technical criterion for customers' satisfaction, a number of alternative remanufacturing strategies have been explored to identify an option that has not only reduced GHG emissions but also has satisfied reliability, durability and warranty period criterion.

In this period, no papers on Work Design & Measurement, Engineering Economic Analysis, Facilities Engineering & Energy Management, Ergonomics & Human Factors, Operations Engineering & Management, Safety and System Design & Engineering knowledge area.

Most frequent words in keywords are automotive (5); chain (5); manufacturing (5); supply (5); industry (4); assessment (3); knowledge (3); enterprise (2); exchange (2); information (2). Most favourite terms in keywords in this period are "Supply chain" (5 papers), "Automotive industry" (2 papers), "Knowledge exchange" (2 papers), "Lean manufacturing" (2 papers) and "Remanufacturing" (2 papers).

5.3 2019-2021 Period

From Engineering Economic Analysis knowledge area, Dianita, Prayitno, Gunanta, and Hadian (2019) tested the market reaction to the closure of multinational corporation operations by examining the abnormal return around the date of announcement both at competitor companies and companies engaged in the same sector. This study is an event study and uses samples from companies listed on the Indonesia Stock Exchange on manufacturing companies in the various industry sectors, and in the automotive sub-sector and components. Similarly, Pakpahan and Purwanto (2021) analyse the determining factors of profitability and efficiency in automotive and component companies in Indonesia from 2010 to 2019. The research data were taken from the financial statements of seven selected sample companies on the Indonesian Stock Exchange. Moreover, Sarwani and Husain (2021) establish the implications of an empirical model of a firm's value through some determinant factors, i.e., financial ratios with profitability and leverage, intellectual capital with human capital employment, the dividend policy, and audit quality with Big 4 category proxy.

From Quality & Reliability Engineering knowledge area, Jamari et al. (2021) studied the running-in wear analysis of transmission gears, which is rarely discussed in literature, in order to improve SMEs' product. Examination tests between an original equipment manufacturer (OEM) gear and SMEs gear product have been made. Results showed that mass and chemical composition are same but there are clear difference between SMEs and OEM gear from surface roughness and material hardness tests. SMEs gear exhibits a failure mechanism, and OEM gear does not indicate any failure indication during running-in period. From organizational perspective, Nurcahyo, Arsena, and Habiburrahman (2019) studied the implementation of quality management system in a automotive components manufacturer. They found that almost all activity of Quality assurance system are executed and documented almost totally fulfill the requirement, but there is negligence and inconsistent in its daily control.

From Operations Engineering & Management knowledge area, Sri Ngadono and Fitri Ikatrinasari (2020) determined optimum inventory system and inventory cost by use Economic Order Quantity (EOQ) to ensure the production is running well. Ahmad, Rusdiansyah, and Wikarta (2019) studied the Battery Exchange Station (BES) inventory problem and solved the vendor problem related to the distribution of electric batteries. It is proposed by previous research for the establishment of (BES) in several locations in order to meet the availability of electrical energy supply in the form of batteries that are ready to use. Through the battery swapping method, electric motor users will exchange batteries that will run out with a new battery that has been charged 100% (fully charged). This causes the supplier is responsible for distributing the electric battery so that a model is needed to minimize distribution costs while maintaining inventory levels at the customer. In addition, Ismail (2019) worked on industry symbiosis, an environmental management approach that is part of industrial ecology, which looks at the exchange of materials, energy, water and by products. He analysed the influenced of synergy and collaboration to material, energy, by product and water exchange among component automotive companies.

There are six articles in the Supply Chain Management knowledge area that investigate the automotive component industry. Kholil, Hendri, David Mangaraja, and Bagus Yosan (2019) and Purba, Fitra, and Nindiani (2019) studied the operation of milk-run as one of the opportunity to reduce cost in one side, and to ensure the performance of just-in-time delivery in the supply chain in other side. Another factor that affects the just in time delivery is supplier performance. companies often experience problems related to the performance of suppliers such as delivery delays and quality mismatches that have been agreed by the company. Kholil, Hendri, and Devina (2019) identified and determined the weight of criteria and subcriteria of supplier performance so that supplier performance can be controlled and improved so it doesn't disrupt the continuity of the company's production. Similarly, Galankashi, Bastani, and Hisjam (2021) develops an integrated step by step approach for Lean-Agile (Leagile) supplier selection of automotive manufacturing companies. While agility is defined as the subsequent step of leanness, Leagility can consider both leanness and agility concurrently. In this regard, Leagile supplier selection aims to include both lean and agile criteria in supplier selection process (Galankashi et al. 2021). Besides supplier performance, Alitosa and Kusumah (2019) stated that it is necessary to identify and analyze critical risks or disturbances that are likely to arise and mitigate risks in operational activities in the component automotive supply chain. To tackle this issue, Surjandy, Meyliana, Spits Warnars, and Abdurachman (2020) studied of the adoption of Blockchain Technology (BT) of the Supply Chain Management System (SCMS) automotive components industry.

There are ten papers that examine the automotive component industry from the perspective of the Engineering Management knowledge area. Budiono et al. (2021); Nurcahyo et al. (2021); Syah (2019) studied the relationship between elements in manufacturing company. Syah (2019) examined the relation between technology transfer, technical exchange, government role, and supplier performance of automotive industry in Jabodetabek, Indonesia. Nurcahyo et al. (2021) examined the relationship between ISO 9001 and operational (productivity, customer satisfaction, and product quality) and business (sales growth, profit rate, and market share) performance of Indonesian automotive component manufacturing industries. Their article also identified major obstacles in the effective implementation of ISO 9001. Similarly, Budiono et al. (2021) examine the relationship between manufacturing complexity, manufacturing strategies (cost, delivery, flexibility, and quality), and manufacturing performance of Indonesian automotive component manufacturing industries. Results indicated that the higher the value of manufacturing complexity, the higher the manufacturing strategies should be prioritized. The manufacturing strategy related to quality, particularly, has a significant positive impact on manufacturing performance. Moreover, Zawawi, Putrawan, and Hamidah (2019) stated that the commitment of employees in an organization is one of the key factors to create competitiveness in doing business for automotive components. They revealed the direct and indirect effects of leadership styles and organizational culture on organizational commitment of employees. Regarding the Electric Vehicle (EV), Nuryakin et al. (2019) discussed two major socioeconomic aspects of EVs in their early ventures in the country. First, they examined the feasibility and the impact of accelerating the development of EV in Indonesia from economic, environmental, and fiscal aspects. Second, they conducted survey to users and prospective car users to elicit the consumers' preferences for electric cars. In addition, Nasrul, Said, and Faidah (2020) attempted to analyse the role of Brand Prominence, Self-Connection and Authenticity in determining customer loyalty in the automotive industry of Indonesia through the mediating role of online trust. From the manufacturer perspective towards the era of EV, Nurhadi et al. (2021) concluded that marketing, financial, and research and development aspects have a strong correlation with the company's strategy in facing the EV era in the future, therefore the choices for automotive component industry are quietly much those are integration strategy, market penetration, market development, and product development. Another topic, Aisyah et al. (2021) analyzed the implementation of the Lean, Agile, Resilient and Green (LARG) approach in Indonesian automotive. The results of this study confirm that there are several LARG sub indicators that have not been implemented properly. Green has the most sub-indicators that need to be improved, namely PG1(ISO 14000 and OHSAS Certificates), PG2(Collaboration with suppliers and customers in protecting the environment), PG6(Carrying out industrial waste recycling), and PG8(Product design that can reduce consumption of energy and raw materials). Next topic, Farmania and Prasetyo (2021) found that many companies use performance measurement which is not quite accurate in knowing the actual condition of the company, therefore, they proposed a better performance measurement. Lastly, quite different from aforementioned papers in engineering management knowledge area, Rusalam, Soemarto, and Munnawar (2020) proposed the authentic assessment in vocational schools so that graduates can meet the demands of the business world and the industrial world.

Abdullah and Pratomo (2020) use the Design and Manufacturing Engineering knowledge area to create an alternate approach of producing a high-quality casting product, has high added value with the utilization of local raw materials which available in Indonesia so that it can reduce the cost of production and dependence on imports of industrial raw materials which are very expensive in the investment casting process.

From Product Design & Development knowledge area, Darmawan and Suzianti (2020) proposes a knowledge management framework in developing new product in order to improve product quality and shorten time-to-market with involvement of user and supplier perspective. A model was developed based on literature review and expert interview. The proposed model has three dynamic processes: knowledge creation, knowledge diffusion, and knowledge storage.

No papers on Work Design & Measurement, Operations Research & Analysis, Facilities Engineering & Energy Management, Ergonomics & Human Factors, Safety, Information Engineering, and System Design & Engineering.

Most frequent words in keywords are automotive (8); manufacturing (6); management (5); performance (5); exchange (4); industry (4); quality (4); analysis (3); blockchain (3); indonesia (3). In this period, most favorite terms for keywords are “Automotive” (3 papers), “Automotive Industry” (3 papers), “Automotive component” (2 papers), “Electric Vehicle” (2 papers), “Indonesia” (2 papers), “Supplier performance” (2 papers) and “Supply chain” (2 papers). In this period, keywords “electric vehicle” has started to be studied by Indonesian researcher.

5.4 Scival Topic Prominence

Top 8 Scival Topic Prominence are:

1. Topic: Bitcoin | Ethereum | Blockchain with Prominence percentile: 99.980. Represented by paper from Surjandy et al. (2020). Keywords for this topic are Automotive Industry; Blockchain; Blockchain SCM; Blockchain Technology; and SCM.
2. Topic: Green Supply Chain Management | Environmentally Preferable Purchasing | Green Practices with Prominence percentile: 99.937 represented by paper (Aisyah et al. 2021). Keywords in this topic are Automotive; Index; IPA LARG
3. Topic: Alliance Portfolios | Absorptive Capacity | Open Innovation with Prominence percentile: 99.930 represented by papers from (Soebandrija & Pratama 2014) and (Handoko et al. 2018) keywords for this topic Analysis and Design Systems; Communication Systems; Information Technology; Innovation; SMQR Claim, Case study research; Knowledge exchange; Social capital; Supply chain.
4. Topic: Closed-Loop Supply Chain | Remanufacturing | Reverse Logistics with Prominence percentile: 99.823 represented by paper from (Fatimah & Biswas 2016). Keywords in this topic are Greenhouse gas; Life cycle assessment; Remanufacturing; Small- and medium-sized enterprise
5. Topic: Battery Electric Vehicles | Alternative Fuel Vehicles | Electric Car with Prominence percentile: 99.821 represented by papers from (Nuryakin et al. 2019) and (Nurhadi et al. 2021). Keywords in this topic are electrified vehicle; incentives; Indonesia; socioeconomic impacts; total cost of ownership, Electric Vehicle; Filter; Strategic Development
6. Topic: Industrial Symbiosis | Eco-industrial Parks | Circular Economy with Prominence percentile: 99.783 represented by papers from (Ismail 2018, 2019). Keywords in this topic are component automotive company; energy exchange; industrial symbiosis; material exchange
7. Topic: Supply Risk Management | Supply Chain Disruptions | Dual Sourcing with Prominence percentile: 99.752 represented by papers from Alitosa and Kusumah (2019) and Purba et al. (2019). Keywords in this topic are Automotive; Just-in-time; Lean logistics; Milk-run; Supply chain; Transportation value stream mapping;
8. Topic: Lean Manufacturing | Value Stream Mapping | Kaizen with Prominence percentile: 99.541 represented by (Muhammad & Yadrifil 2018) and Rahiminezhad Galankashi et al. (2018). Keywords in this topic are Efficiency of Production System; Lean Manufacturing System; Value Stream Mapping (VSM); Waste Assessment Questionnaire (WAQ); Waste Relationship Matrix (WRM); Automotive industry; Lean manufacturing; Leanness assessment; SCS; Supply chain strategy

6. Conclusion

This article reviews 43 articles in total (Table 1). From 2010 to 2021, the most popular knowledge area for a study of the automotive component industry was supply chain management, with 13 articles published. Engineering Management is the second most popular field, with 12 articles published between 2010 and 2021. The most common terms in the 43 articles are automotive (14), manufacturing (14), industry (8), chain (7), and performance (7). Future research are suggested to consider the Scival Topic Prominence to gain the momentum.

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