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UNIVERSITAS SAM RATULANGI (JMBI UNSRAT)

**LEAN SUPPLY CHAIN MANAGEMENT MODEL FOR BEST PRACTICE**

**Umari Abdurrahim Abi Anwar, Asni Mustika Rani, Rabiatal Adwiyah, Tasya Aspiranti**

Universitas Islam Bandung

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Corresponding author:

**Umari Abdurrahim Abi Anwar**

umari.abdurrahim@unisba.ac.id

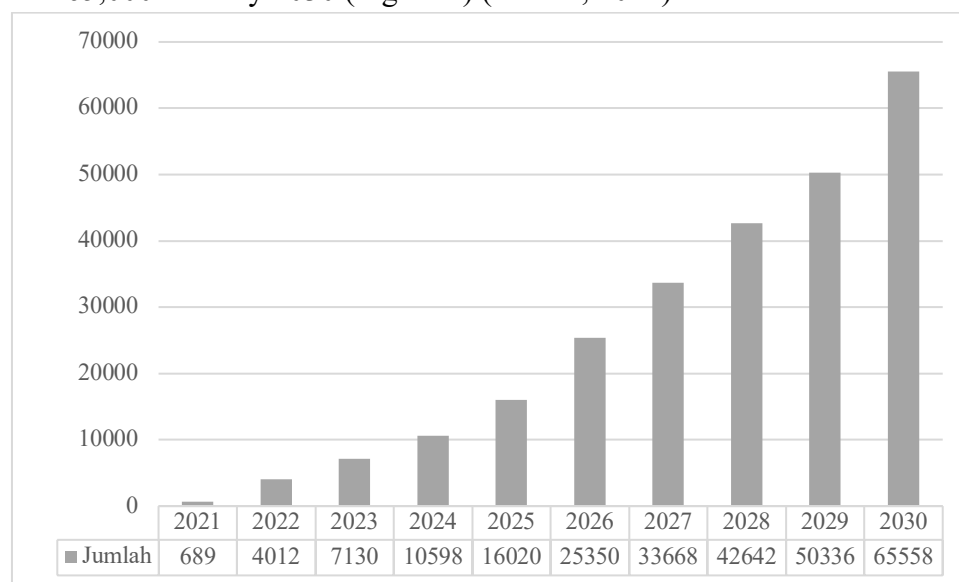
**Abstract.** *In Indonesia, the automotive industry is still the pillar of the manufacturing sector. However, the automotive industry faces major challenges, especially in developing environmentally friendly automotive products and supply chains for domestic and global needs. The EV supply chain is becoming more challenging to mass-produce. This research will develop a model that will lead to a lean supply chain in the EV industry in Indonesia as an effort to develop EV in the world. Qualitative descriptive research with a case study approach is used in this study. Case studies on five companies in the EV industry in Indonesia were selected for investigation by collecting various kinds of information from annual reports and other literature which were then processed to obtain a solution so that the problems revealed could be resolved. Lean supply chain management systems are able to add value for customers and for the business and are customer driven. In addition to developing the supply chain on the production side, the accessibility of electricity supply must also be considered when EVs are widely used by the public.*

**Abstrak.** Di Indonesia, industri otomotif masih menjadi penopang sektor manufaktur. Namun industri otomotif menghadapi tantangan besar, terutama dalam mengembangkan produk dan rantai pasok otomotif ramah lingkungan untuk kebutuhan domestik dan global. Rantai pasokan kendaraan listrik menjadi lebih menantang untuk diproduksi secara massal. Penelitian ini akan mengembangkan model yang akan mengarah pada lean supply chain pada industri EV di Indonesia sebagai upaya pengembangan EV di dunia. Penelitian deskriptif kualitatif dengan pendekatan studi kasus digunakan dalam penelitian ini. Studi kasus terhadap lima perusahaan industri EV di Indonesia dipilih untuk diselidiki dengan mengumpulkan berbagai macam informasi dari laporan tahunan dan literatur lainnya yang kemudian diolah untuk mendapatkan solusi sehingga permasalahan yang terungkap dapat diselesaikan. Sistem manajemen rantai pasokan yang ramping mampu memberikan nilai tambah bagi pelanggan dan bisnis serta didorong oleh pelanggan. Selain pengembangan rantai pasok di sisi produksi, aksesibilitas pasokan listrik juga harus diperhatikan ketika EV banyak digunakan oleh masyarakat.

## INTRODUCTION

Apart from the Covid-19 pandemic, the automotive industry is still the supporter of the manufacturing sector in various countries, including Indonesia. However, the automotive industry must face various major challenges, especially in developing environmentally friendly automotive products and supply chains for domestic and global needs. Electric cars were developed to reduce dependence on petroleum use and environmental impact through diversification of transportation energy sources (Onat & Kucukvar, 2022). Advances in technology for making electric cars are very important to manage and internalize the benefits to the maximum for the benefit of a sustainable global community (Woo et al., 2017). Several countries in Europe have made policies related to climate change mitigation efforts, financial incentives from the government, to reducing the cost of electric vehicle (EV) batteries to help the EV market survive and grow. The years 2020-2021 have seen success for the EV market and the EV supply chain globally (Tsakalidis et al., 2020).

In Indonesia, EV sales have also increased from 2019 to 2021 for plug-in hybrid electric vehicles (PHEV), hybrid electric vehicles (HEV), and battery electric vehicles (BEV) (*Indonesian Electric Vehicles Industry Development Gains Momentum*, n.d.). EV could grow rapidly in Indonesia. Sales, utilization, and technology development of this type of vehicle are predicted to increase in the future (Maghfiroh et al., 2021). The increase in EV use is expected to grow significantly in the next ten years. Based on the projection of the State Electricity Company (PLN), electric cars used in Indonesia will reach more than 65,000 units by 2030 (Figure 1) (Yoshio, 2021).



**Figure 1. Projection of Electric Vehicles Used in Indonesia**

The EV supply chain is quite different from the traditional internal combustion engine (ICE) supply chain in that it is mechanically simple but technologically complex. The EV supply chain is becoming more challenging to mass-produce. The most essential component of an EV is the battery which is worth 40% of the total value of an EV vehicle. Asia, especially China, Japan, and Korea dominate the current EV battery market.

Lithium-ion batteries are becoming the most popular battery because they are small and very light, but are able to store a lot of energy (Chen et al., 2021). The main raw materials needed to produce lithium-ion batteries are lithium, nickel, and cobalt (Nitta et al., 2015). The raw materials are mostly produced in China, South Africa, Indonesia and the Democratic Republic of the Congo (DRC). The biggest challenges in the production process are labor conditions, work environment, and the availability

of technology that can speed up the production process, so EV manufacturers must be able to find various alternative suppliers.

Indonesia is known as the world's largest nickel producer and exporter, which controls 27 percent of global market needs. So that Indonesia has the potential to become a major supplier of nickel raw materials because Indonesia has the largest nickel reserves in the world. Currently there are nine companies that support the battery industry, five companies are providers of pure nickel raw materials, and four other companies are battery manufacturers. Thus, Indonesia is ready to manufacture EVs starting from battery assembly, cell battery production, manufacturing battery management systems, mining battery raw materials (battery material), to battery recycling (end of life/recycling), so that in the end Indonesia will have a battery industry. integrated.

Reflecting on the increasing demand for EVs, Indonesia needs to maximize revenue from nickel. This condition should be an opportunity for Indonesia to dominate the world EV battery market, by implementing nickel downstreaming to produce electric batteries domestically. With abundant raw materials not making Indonesia able to easily become a superior in the EV industry, optimal supply chain management needs to be carried out.

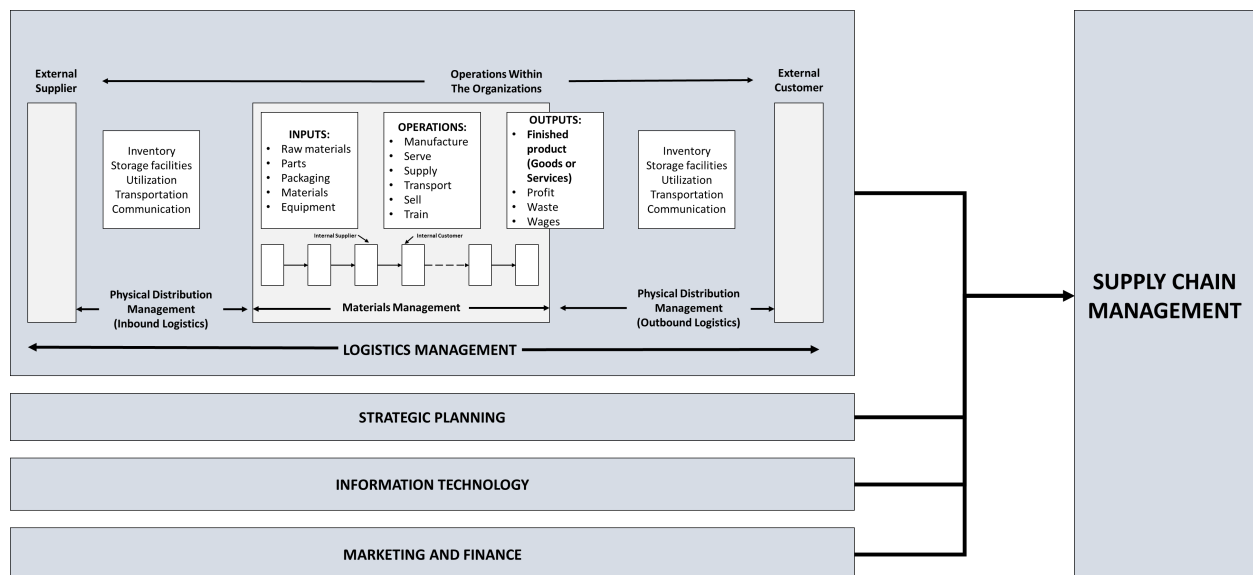
The automotive company developed the concept of lean supply chain which is a supply chain strategy based on cost and time reduction of the entire supply chain process to increase effectiveness (Boonthonsatit & Jungthawan, 2015; Wee & Simon, 2009). A key ingredient to the success of this system is a highly skilled workforce. The main concept of a lean system is about doing more with less – a philosophy for identifying and eliminating waste across all business activities (Daud & Zailani, 2011; Jassim, 2018). It is also about adding value for the customer and for the business and is customer driven (Ambe & Badenhorst-Weiss, 2010). This research will develop a model that will lead to a lean supply chain in the EV industry in Indonesia as an effort to develop EVs in the world.

## LITERATURE REVIEW

Supply chain is a series of business processes that connect several actors to increase the added value of raw materials/products and distribute them to consumers (Power, 2005; Saroha & Yadav, 2013). It should be seen that the main objective of the supply chain is in terms of increasing added value. Thus, each actor in the supply chain network will contribute in the form of specific inputs or processes that can increase the value of a product.

The supply chain is broad not only in terms of increasing added value, but also to meet consumer demand, increase competitiveness, increase profits, and build good relations between actors in the supply chain (Latuconsina, 2021; Shekarian et al., 2020). Thus, it is not true that the supply chain only focuses on factories or production processes, but there are other components that must be considered, one of which is building coordination and collaboration with other actors along the supply chain. The supply chain is not only limited to factories and suppliers, but also needs to look at the condition of distributors, warehousing, retailers and even consumer needs (Fernie & Sparks, 2019; Lu, 2011; Waters, 2003).

The scope of the supply chain is composed of the following aspects: Logistics Management, Strategic Planning, Information Technology, and Marketing and Finance (Figure 2).



**Figure 2. The Scope of Supply Chain Management**

Lean supply chain management (LSCM) is a system in which various operating parties interact with each other with a cooperation-based approach to continuous improvement with a primary focus on eliminating non-value-added activities in the supply chain (Afonso & Cabrita, 2015; Wee & Simon, 2009). LSCM practitioners will be guided by lean principles to align cross-functional activities of the company to manage business relationships with customers and suppliers (Jasti & Kodali, 2015). While many companies have experienced the benefits of lean in manufacturing processes, few are aware of the potential benefits that lean offers on the supply chain side. They understand that lean can provide value, but have not yet moved to a full-scale lean supply chain implementation. One of the reasons may be the lack of mental readiness among various parties to work fully together to achieve the targets in the supply chain. The main principles of LSCM include: eliminating all waste until only value remains (Anand & Kodali, 2008), showing consumption to all parties involved in the supply chain (Adamides et al., 2008), reducing lead time (Rossini et al., 2022), creating flow levels (Bevilacqua et al., 2019), using pull systems (Takeda Berger et al., 2019), increasing speed and reducing variation (Madhani, 2019; Oko, 2016), collaborating (Binder & Clegg, 2007; Sukati et al., 2012), and focusing on total costs fulfillment (Felea & Albăstroiu, 2013).

## RESEARCH METHODS

Qualitative descriptive research with a case study approach is used in this study. Case studies on five companies in the EV industry in Indonesia were chosen to be investigated by collecting various kinds of information from annual reports and other literature which were then processed to obtain a solution so that the problems revealed could be resolved. Narrative review was also used through gathering a number of literatures in the subject area of supply chain management and synthesizing them. The aim is to provide a comprehensive background, identify and describe a problem, and understand the knowledge or highlight the importance of the new research (Demiris et al., 2019)

## RESULTS AND DISCUSSIONS

The importance of supply chain management in the EV industry in Indonesia must involve not only automotive companies and suppliers of raw materials, but also the government. Building a lean

supply chain for EVs is also a challenge. Based on interviews with three automotive companies that have produced EVs, and two companies that supply EV raw materials, there are several driving factors in building a lean supply chain.

### 1. Waste Reduction

To develop and improve the performance of automotive companies, continuous improvement is needed. There is a lot of waste that occurs in the company without the perpetrators realizing it, even though waste has the potential to reduce the efficiency of the company (Purnomo & Lukman, 2020). The elimination of waste is one of the principles of lean manufacturing to produce efficient products by reducing production costs through efficiency (Mahendran et al., 2015). As a company that pioneers the lean concept, one of the companies consistently reduces waste in various production activities. Waste can be found in all business activities, such as time, inventory, redundant processes and defective products. The five companies have reduced the use of water in their factories to ensure that the wastewater has gone through a purification process before being re-flowed into and out of the company.

Based on the results of the interviews, the five companies stated that it is important for companies to ensure that all members of the supply chain work together to identify and eliminate all wasteful and non-value added elements. The direct consequence of eliminating waste in the production process is the reduction of supply chain costs (Abu Seman et al., 2022). It is important for companies to assess waste from a supply chain perspective rather than an individual company perspective.

One company also revealed that the supply chain should emphasize waste rather than cost. That is, if the company's emphasis is only on cost cutting, it often creates conflicts of interest between parties in the supply chain. The wastage of resources in the supply chain that does not involve suppliers in the early stages of product development often cannot be identified. So all parties in the supply chain need to have a collaborative approach and policy as well as a multifunctional team that is able to effectively identify the waste and waste hidden in the gaps in the supply chain.

### 2. Demand Management

Demand management is one of the most important factors in the supply chain to be able to compete in the market (Jüttner et al., 2010). Many companies follow the flow of ups and downs in demand by forecasting demand (Kazmi & Ahmed, 2021), although it can be predicted with accuracy, the company's production costs are high and service levels to customers are low. Demand management is proactive (Shamsuddoha et al., 2015), EV producing companies can produce goods by influencing demand patterns. Thus, companies must continue to make significant demand management improvements. The five companies studied stated that the supply chain performance seen by the end consumer largely depends on how consumer demands are managed, met, and satisfied.

Managing demand for automotive products, especially EVs, which are still in the market education stage in Indonesia, can use instrument pricing. Next is management through supply chain execution and cross functional team. When demand for EVs is increasing as an effect of the Indonesian government's plan, EV companies need a harmonious cross-functional team so that from the aspects of production, distribution, warehouse, material procurement including suppliers, they are able to anticipate the increase in demand.

If there is an increase in demand which is the result of an initiative only from sales or marketing people, and is not well communicated to other parties, then suddenly the companies involved in the supply chain receive orders that are larger or higher than usual. , companies in the supply chain will carry out production in a hurry, may end up using overtime hours, resulting in higher costs. A good

program that has succeeded in increasing demand, is then responded to in a way that is not well prepared so that costs will be high which will have a bad impact on the company as a whole.

### 3. Process Standardization

The application of process standardization is important to be carried out immediately in the EV automotive industry in Indonesia. Process standardization will be the way to achieve the effectiveness and efficiency of lean supply chain systems (Baud-Lavigne et al., 2012). Process standardization pays attention to every business process that occurs within the company, both individually and as a whole, to create an effective supply chain system (Tan et al., 2022). This process analyzes the system the company is using, identifies bottlenecks, and finds out what could be improved. The occurrence of queues, batch processing, and the large number of movements of goods through transportation routes are the main obstacles to continuous process flow. A good process flow is when materials and processes are standardized throughout the supply chain through close collaboration between supply chain members. Processes that can be standardized are planning, procurement and production processes from upstream to downstream so that all parties have a thorough understanding of the processes involved.

### 4. People Engagement

The traditional production system will be very different from the production system using a lean system. Implementation of lean processes and lean supply chain development, companies must start by involving people (Deng et al., 2021). The lean concept is not only applied by executives and top management, but must involve everyone in the organization from all departments (Burdon et al., 2022). Ideas for improvement and innovative change often come directly from people doing both technical and managerial work. The five companies concluded that managing the involvement of people in the supply chain is through: 1) exploring the knowledge and expertise of all employees and involving all of them; 2) motivate all parties in the supply chain to follow supply chain paths and policies that have been determined by the company; and 3) instilling an organizational culture to build a lean supply chain.

### 5. Collaboration

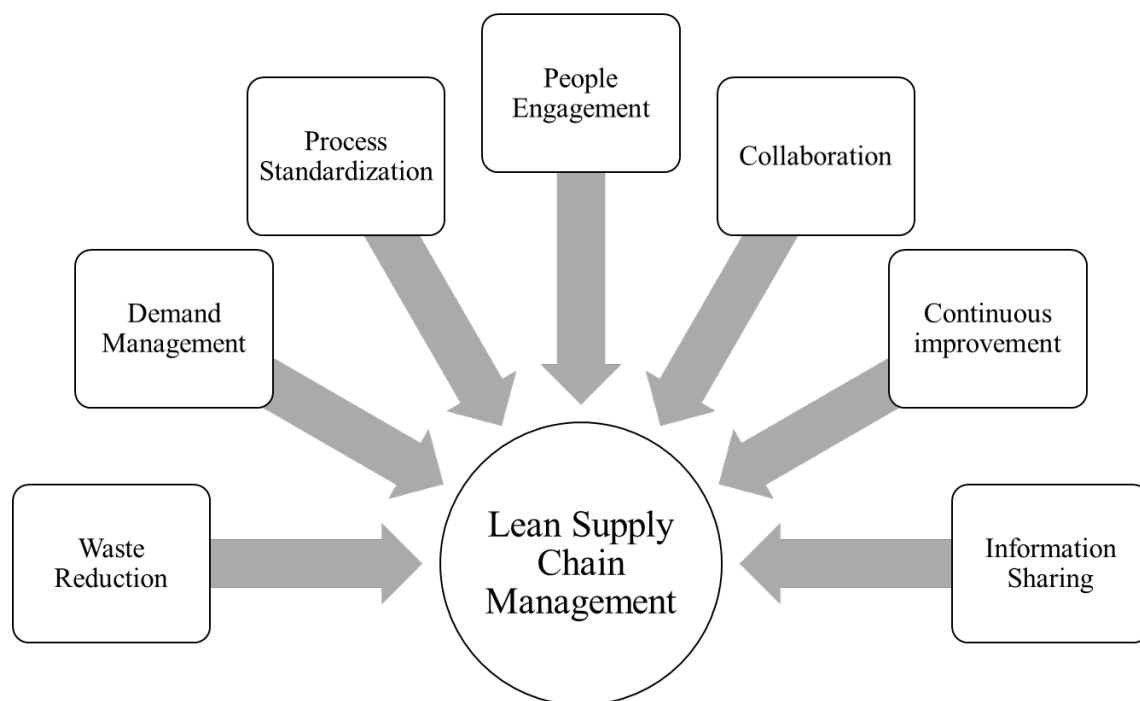
Collaboration in a lean supply chain starts from strategic intentions of top management across the supply chain, which is based on the interests of each stakeholder and the potential benefits of the collaboration (Sahay, 2003). This collaboration is divided into four, the first is collaboration transactions whose purpose is to achieve more effective and efficient transactions. This type of collaboration does not require an understanding of the long-term strategy. The second is cooperative collaboration where to achieve this requires commitment between supply chains to share forecasting information, inventory, procurement of goods, delivery of goods including production capacity. The third is coordinated collaboration which requires a two-way flow of information and the planning and execution processes are aligned and between parties in the supply chain. The fourth is synchronized collaboration, where components in the supply chain work together in product research and development, various assets, capacity, performance, and so on.

### 6. Continuous improvement

Continuous improvement is an important strategic initiative in increasing business competitiveness (Castellanos et al., 2018; Jaber et al., 2010). One of the goals of continuous improvement is to eliminate waste, reduce work-in-process inventory, and, in turn, reduce runtime and manufacturing time, ultimately increasing supply chain speed and flow. Lean philosophy believes that the journey to improve will never end because being good is not enough, you have to be better. Continuous improvement will help the company evaluate as well as find solutions for any problems that occur and make continuous improvements.

## 7. Information Sharing

All information in the supply chain process must be distributed appropriately, quickly and accurately from upstream to downstream (Jayaram et al., 2000). A successful supply chain network synchronizes its activities and data together through the flow of information. The success of the supply chain is highly dependent on the information system, with the information of business partners in the supply chain it can be calculated (Kopanaki, 2022). Information sharing also allows supply chain members to obtain, maintain, and convey the information needed to ensure effective decision making, and is a factor that can strengthen the elements of overall collaboration. The five companies stated that information sharing is the starting point for integrating production planning, synchronizing activities, joint decision making, and others.



**Figure 3. Lean Supply Chain Management Model**

Figure 3 shows a lean supply chain management model built on 7 main drivers, namely waste reduction, demand management, process standardization, people engagement, collaboration, continuous improvement, and information sharing. The application of this lean supply chain management model can improve the overall supply chain performance of the EV industry.

## CONCLUSION

The EV industry in Indonesia must be able to manage and develop its supply chain optimally. Efforts that can be made start from mastering EV technology, increasing human resource capabilities and capacities, to developing lean supply chain management in the EV industry from upstream to downstream. Lean supply chain management systems are able to add value for customers and for the business and are customer driven. In addition to developing the supply chain on the production side, the accessibility of electricity supply must also be considered when EVs are widely used by the public.

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