A Study of Technopreneur ship on Market Penetration and Product Development (Case Study PT. Batex Energi Mandiri)

Cindy Saraswati
Master Program of Industrial Engineering Department,
Faculty of Engineering Universitas Sebelas Maret
Surakarta, Indonesia
cindysaraswati007@student.uns.ac.id

Wahyudi Sutopo
Professor, Department of Industrial Engineering
Head of Industrial Engineering and Techno-Economics Research Group
Universitas Sebelas Maret (UNS), Surakarta, Indonesia
President, IEOM Indonesia Chapter
wahyudisutopo@staff.uns.ac.id

Renny Rochani
Research Group Industrial Engineering and Techno-Economic,
Industrial Engineering Department, Faculty of Engineering,
Universitas Sebelas Maret, Jl. Ir. Sutami, 36 A, Surakarta, Indonesia
rennyrochani@staff.uns.ac.id

Abstract

The use of renewable energy to minimize the current impacts of climate change has become a global issue that has captured the world's attention. The increasing concentration of greenhouse gas emissions, particularly carbon dioxide, in various sectors such as transportation, industry, and others, has led society to start harnessing renewable energy in their daily lives. The utilization of renewable energy is closely tied to the role of batteries as energy storage devices. Apart from being used in electric vehicles, batteries can also be utilized in power generation systems, information technology, and other applications. This has resulted in a wide and diverse battery ecosystem. These conditions require battery manufacturers to continuously innovate and develop products to meet market demands while considering the preferences of buyers. In general, buyers desire batteries that possess certain criteria, such as long lifespan, high capacity, fast charging, affordable prices, environmental friendliness, and recyclability. However, creating products that meet these buyer preferences still requires further research and support from relevant parties, primarily due to the constraint of high prices of lithium-ion battery raw materials, which consequently affects battery prices. This study aims to provide an overview of product and business analysis for the development of lithium-ion batteries in PT. Batex, utilizing the technopreneur ship model, SWOT analysis, and Business Model Canvas (BMC). From this research, it can be concluded that the technopreneur ship model plays a significant role in the development of products and businesses.

Keywords
Lithium-Ion Battery, Innovation System, Technopreneur ship, Business Model Canvas, SWOT Analysis

1. Introduction

Climate change is one of the most pressing global issues that has captured the attention of researchers, policymakers, and other stakeholders. The increasing concentration of greenhouse gas emissions, especially carbon dioxide, is considered the most prominent contributor to climate change (Liu et al. 2019) and has motivated researchers to explore mitigation strategies and carbon minimization (Shi and Yin 2021). In this regard, the transportation sector has become a primary focus as it is challenging to decarbonize and represents the largest consumer of fossil energy (IEA 2020). However, according to the Indonesian Petroleum Association (IPA), fossil energy consumption is projected to far exceed fossil energy production, resulting in a projected gap of 64.4% by 2030. Therefore, there are several alternative solutions to address this issue, including the use of electric vehicles and the utilization of Renewable Energy Sources (RES).

As energy users and energy sources, electric vehicles, and RES require a device to store the generated energy for later use. In this case, the energy storage system that receives the most attention is the battery. Lithium-ion is the currently developed type of battery (Perdana 2020) due to its rechargeable and long-lasting properties (Kristiyono et al. 2022). The utilization of batteries, particularly in electric vehicles, has garnered government attention in creating a favorable ecosystem for the development of batteries and electric vehicles, specifically in Indonesia (Aqidawati et al. 2020). Government support for the electric vehicle and battery ecosystem (Wijaya et al. 2021), along with the surging demand for electric vehicles, has resulted in an annual increase in battery demand. According to data from the International Energy Agency (IEA), the demand for automotive lithium-ion (Li-ion) batteries is projected to increase by approximately 65% to reach 550 GWh in 2022, up from around 330 GWh in 2021 (International Energy Agency 2023). However, the production of Li-ion batteries in Indonesia is still minimal in meeting the soaring battery demand. This situation has led to research on Li-ion batteries and ultimately the establishment of PT. Batex Energi Mandiri is Indonesia's first Li-ion battery manufacturer (PT. Batex Energi Mandiri 2020).

PT. Batex Energy Mandiri, a Battery Industry must continuously improve, maintain, or enhance the quality of its products (Jansmyr and Graas 2012) such as battery cells, battery packs, power walls, and others. Additionally, PT. Batex utilizes a Technology Transfer Office (TTO) in collaboration with various stakeholders, such as educational institutions and other organizations, to ensure diverse and innovative product innovation. Before the products are introduced to the market, a feasibility analysis needs to be conducted to minimize potential losses for the company. This includes economic feasibility (O.Nwazor and Samuel Otonye 2019; Gaspar et al. 2021; Rotella Junior et al. 2021), market study, and technical feasibility (Atikah et al. 2014; Kurniyati et al. 2017). Once deemed feasible, the products are then distributed to consumers using both online and offline marketing strategies, either directly or through intermediaries. From the explanations above, it is evident that technopreneurship plays a crucial role in the development and success of the company. Therefore, this research will discuss the role of technopreneurship in the battery industry at PT. Batex Energi Mandiri.

Several previous studies have examined the technopreneurship system and lithium-ion battery innovation. One such study focused on the role of the Technology Transfer Office (TTO) in the battery innovation process using the technopreneurship model, and the results showed that TTO played a key role in successful battery innovation management (Aqidawati et al. 2020). Furthermore, there is research that presented evidence of the effectiveness of university TTOs in enhancing commercialization efforts using the Data Envelopment Analysis (DEA) model and proposed indicator matrices to measure performance in decision-making units (Sutopo et al. 2022). This research aims to propose a suitable framework for technology-based entrepreneurship development in technology innovation at PT. Batex Energi Mandiri.

1.1 Objectives

This research aims to provide an overview of product development and business analysis of lithium-ion batteries and PT. Batex by utilizing the technopreneurship model, SWOT analysis, and Business Model Canvas (BMC).

2. Literature Review

The literature review refers to the theories related to the technopreneurship approach and its application, as well as the innovation system to understand the innovation management process.

2.1 Innovation as a Management Process

Innovation management is a highly interactive process, yet it is also complex and risky. It stems from continuous knowledge exchange among various stakeholders, where the contributions of each team member have the potential to influence the outcomes (Cooke et al. 1998). Failure analysis of companies indicates that several innovative firms struggle to translate technological creativity into profitable business operations. Failure analysis is followed by the risk of failures, including low satisfaction levels, employee fatigue, excessive costs, and time, among others. Therefore, the challenges faced by companies involved not only innovation creation but also proper and standardized management to generate profits for the company (Carayannis et al. 2015). Innovation is not an isolated event but rather a series of interconnected events or activities. Innovation is described as a process that involves (1) responding to needs or opportunities that depend on the context, (2) creative efforts that, if successful, result in new things, and (3) the need for further change.

2.2 Innovation System

The innovation system can be defined as "all the important factors such as economic, social, political, organizational, and other factors that influence the development, diffusion, and use of innovations" (Edquist 1997). The purpose of the innovation system is the creation, dissemination, and utilization of innovation. According to Edquist, the components of the innovation system include organizations (formal structures with explicit goals that are intentionally created) and institutions (a set of customs, routines, practices, rules, or laws that govern the interactions between individuals, groups, and organizations).

2.3 Technological Entrepreneurship (Technopreneurship)

The essence of technopreneurship lies in the innovative application of technical knowledge and individual expertise of those who create and manage businesses and are willing to take financial risks to achieve their goals. The technology development cycle is related to technical advancements that enable businesses to create, produce, and deliver their goods and services using practical technical knowledge and skills (Prodan 2007). Thus, the involvement of technopreneurs in technopreneurship creates value by generating novelty, initiating and managing change (Olusegun et al. 2019).

Technopreneurs differ from entrepreneurs. Technopreneurs are formed through education and training-based expertise acquired in academia or through experimentation. Technopreneurs utilize technology as the main element for product development, rather than just focusing on networks and demographic market selection. Thus, technopreneurs are modern entrepreneurs based on technology. A technopreneur is also characterized by creativity and innovation to produce outstanding products as the foundation for knowledge-based national economic development.

A technopreneur will eliminate irrelevant products and services and replace them with new ones that align with the market and utilize new technology (Roos and Roos 1997). Additionally, a technopreneur will creatively combine available resources to generate innovations that align with market opportunities (Penrose 1959). Therefore, technopreneurs require skills in creativity, innovation, and the ability to recognize existing opportunities. This aligns with the main goal of technopreneurship, which is to commercialize innovations developed by scientists in academia through patents, licenses, start-up formation, and partnerships between universities and relevant companies or industries (Lakitan 2013). The development of technopreneurship requires a synergistic collaboration among relevant stakeholders, including academia, entrepreneurs, and the government, known as the triple helix technopreneurship model (Carayannis et al. 2015).

2.4 SWOT Analysis

SWOT analysis is a strategic planning method used to evaluate the strengths, weaknesses, opportunities, and threats in a project or business venture. SWOT analysis involves setting specific objectives for a business or project and identifying internal and external factors that support or hinder the achievement of those objectives. The results of analyzing the four SWOT factors are then interpreted in the SWOT matrix, which shows how strengths can leverage advantages from existing opportunities, how weaknesses can be addressed to prevent advantages from existing opportunities, how strengths can face existing threats, and finally, how weaknesses can be overcome to prevent or create new threats (Hariyono and Andriani 2020).

2.5 Business Model Canvas (BMC)

The Business Model Canvas (BMC) was first introduced by Alexander Osterwalder. The purpose of the BMC is to simplify the writing of business plans and reduce errors and risks during business execution. The Business Model Canvas is divided into 9 business aspects (Osterwalder and Pigneur 2010; Kemkominfo RI 2020), which are:

Value propositions, describing the combination of goods you sell and services for customers
Customer Segments, divides customer types into several groups of individuals based on certain methods.
Customer Relationship, by fostering a good customer relationship, it will be known whether the customer is satisfied after using the services offered.
Channels, describes how a company communicates with and reaches Customer Segments to provide Value Propositions
Key Activities, describes the most important things that must be done by a company for its business model to succeed.
Key Resources, describes the most important assets needed for the product and business to run smoothly.
Key Partnership, describes the network of suppliers and partners that make the business model work. The goal is to reduce risk and be able to get new resources.
Cost Structure, covers all the costs involved in key resources, channels, and key activities.
Revenue Stream, all revenue generated by the company from each customer segment.

3. Methods

This article will analyze the development of battery technology in Indonesia using the technopreneur ship approach and the innovation system to understand relevant innovation management processes. Additionally, it will explore how the technopreneurship model is applied. The aspects to be examined include the development of technology, whether it falls under market pull or demand push, and the innovation paradigm and level of product innovation, whether it is classified as closed innovation or open innovation. Furthermore, the product development process model and innovation management model will also be considered. The involvement of the technology innovation ecosystem and the role of the Technology Transfer Office (TTO) in each innovation to commercialize the technology will also be taken into account. Data collection will be done through interviews with the CEO of PT. Batex Energi Mandiri and utilizing the Google search engine by typing relevant keywords related to technopreneur ship in the battery industry. Figure 1. shows the research flow used in this study.

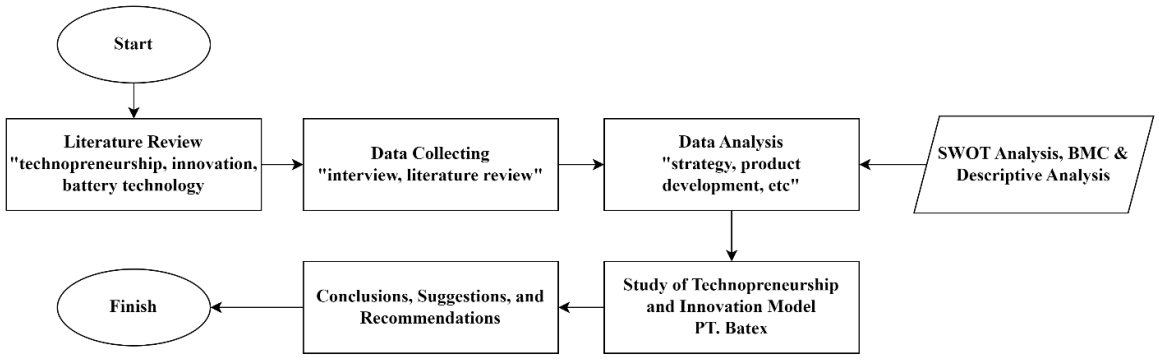

Figure 1. Research Flow

4. Data Collection

The data for this research was collected through two methods, namely interviews and a literature study. Interviews were conducted with the CEO of PT. Batex Energi Mandiri to gather information about the company's history, overall internal conditions, administration, and documentation. All the responses from the interviewees were recorded to minimize information discrepancies, and proper consent was obtained from the respondents. In addition to conducting interviews, the CEO also had the right to validate the research findings based on the actual conditions within the company to ensure alignment.

Apart from interviews, data collection was also carried out through a literature study using the Google Search Engine with keywords related to PT. Batex, lithium battery industry, and others. Consequently, the findings from the

interviews and literature study will be combined and analyzed using SWOT analysis. By applying SWOT analysis, it is expected to derive recommendations for business development in the future.

5. Results and Discussion

5.1 Product Development Analysis

The use of lithium-ion batteries in various industries, such as smartphones, service industries, vehicles, and others, has resulted in heterogeneity in market demands. Therefore, the development process for battery products becomes crucial to be conducted periodically, considering various aspects (Fraunhofer Institute 2022). Referring to this condition, it is important to understand customer requirements regarding products that meet market needs, so that systematic methods, processes, and techniques can be developed to address customer needs from various perspectives (Darmawan et al. 2017). In general, the concept of battery development will focus on safety, long life cycle, high quality, affordability, and high performance as seen in Table 1..

Table 1. Customer Requirements for Lithium-Ion Battery

Production Issue	Environment Issue	Design Issue
Affordable battery price Long battery lifetime Batteries with large capacity Fast charging batteries	Environmentally friendly batteries Recyclable batteries Batteries with second-life usage	Small and lightweight battery size Safe batteries

Modified from (Heimes et al. 2020) and (Darmawan et al. 2017)

Based on the aforementioned, PT. Batex as a lithium-ion battery manufacturer needs to develop various perspectives of user needs by collaborating with experts to develop lithium-ion battery products that are in line with market demands. As an advocate of open innovation, PT. Batex must continuously learn and develop ideas contributed by academics for superior and high-quality products. Although PT. Batex is always open to collaboration with academics for research related to the development of lithium-ion batteries, there are still several studies that have not been followed up. Therefore, it is necessary to oversee these academics to ensure that the resulting research is of higher quality and can be applied at PT. Batex.

5.2 The Ecosystem and The Supply Chain of PT. Batex

The battery ecosystem in Indonesia (Figure 2.) has undergone development, transitioning from the initial triple helix model to the penta helix model. The Penta helix model is an extension of the triple helix strategy by involving various elements of society or non-profit institutions to foster innovation. Through synergistic collaboration, it is expected that innovation supported by various interacting resources can be realized (Lindmark et al 2009). The penta helix ecosystem of lithium batteries in Indonesia involves the collaboration of five types of stakeholders, namely the government, businesses, academia, society, and media. Through synergistic collaboration among these stakeholders, it is expected that innovation supported by various interacting resources can be realized (Muhyi & Chan 2017).

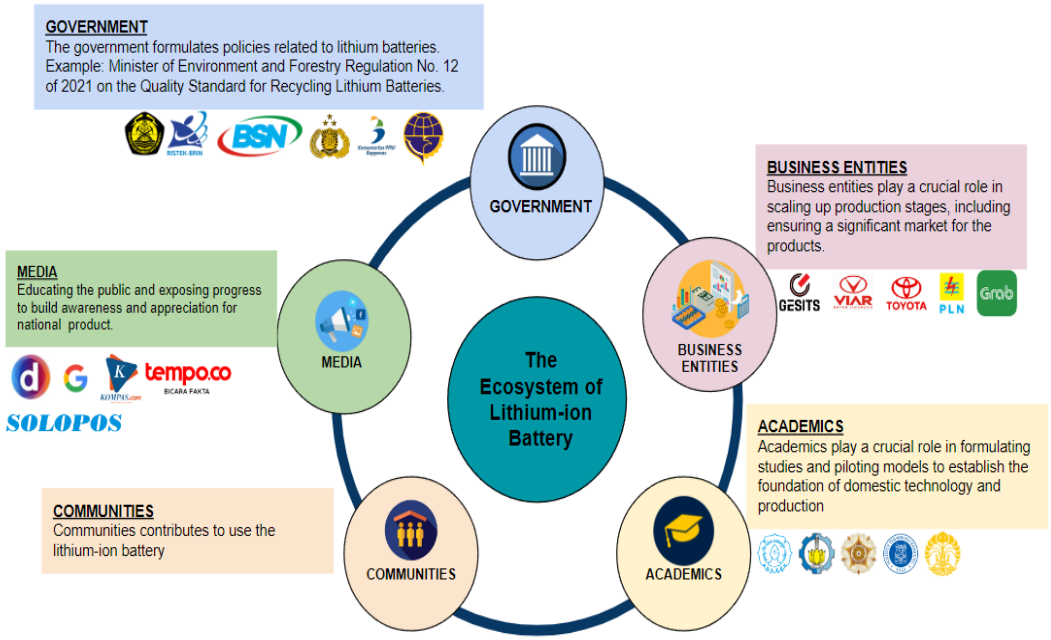

Figure 2. The Ecosystem of Lithium-Ion Battery in Indonesia

The existence of the lithium battery ecosystem is undoubtedly closely tied to the supply chain processes within the battery industry in Indonesia, particularly at PT. Batex. Referring to the lithium battery Penta helix ecosystem in Indonesia combined with the lithium battery supply chain flow at PT. Batex, the following illustration can be depicted in Figure 3.

Figure 3. The Supply Chain of PT. Batex Energi Mandiri

5.3 SWOT Analysis

SWOT analysis is used to identify the strengths, weaknesses, opportunities, and threats for a business. Furthermore, SWOT analysis also serves to monitor and evaluate the company's internal and external environment. The SWOT Analysis results from PT Batex Energi Mandiri can be seen in Table 2.

Table 2. SWOT Analysis of PT. Batex Energi Mandiri

SWOT ANALYSIS OF PT. BATEX ENERGI MANDIRI				
	Helpful			Problem
Internal	**S** Strengths	1. Diverse product range, ranging from lithium cell batteries (LFP, NMC, NCA) and their derivatives (power walls, power banks, converter kits, etc.). 2. Higher local content value of products compared to imported products. 3. Assured product availability (make-to-stock). 4. Awarded as the best startup in 2022 at the Digital Technopreneur Fest by the Ministry of Investment and HIPMI (Indonesian Young Entrepreneurs Association).	**W** Weaknesses	1. Marketing process is conducted from partner to partner. 2. Demand for derivative products is not yet stable (make-to-order). 3. Optimal implementation of battery recycling (sustainability) has not been applied.
External	**O** Opportunities	1. The only lithium cell battery manufacturer in Indonesia to date. 2. Strategic partnerships with Volta, Viar, Toyota, Komatsu, UNS, UGM, ITS, Pertamina, and others. 3. Government policies supporting the development of the battery ecosystem and industry in Indonesia.	**T** Threats	1. The high cost of lithium battery raw materials in Indonesia. 2. The lithium battery ecosystem in Indonesia is not yet stable.

5.4 Business Model Canvas

The Business Model Canvas offers the advantage of providing a comprehensive depiction of the current state of a company based on nine elements: Customer Segments, Value Proposition, Revenue Streams, Channels, Customer Relationships, Key Activities, Key Resources, Key Partners, and Cost Structure. The results of the BMC analysis from PT Batex Energi Mandiri can be seen in Table 3.

Table 3. Business Model Canvas of PT. Batex

BUSINESS MODEL CANVAS OF PT. BATEX				
Key Partners	**Key Activities**	**Value Propositions**	**Customer Relationship**	**Customer Segments**
• UNS (researcher, licensing) • PT. Volta (battery consumers) • PT. Viar (battery consumers) • MIND ID (supplier) • Users of battery-derivative products (electric vehicles, PV, etc.)	• Battery production • Provide battery derivative products • Facilitating academic researchers to research lithium-ion batteries **Key Resources** • Human resources (employees) • Mineral resources (nickel)	• Has a higher Local Content value than imported products • Guaranteed product availability • The only domestic cell battery manufacturer	• Actively participate in certain activities and events to communicate with consumers **Channels** • Social Media • Collaborative partner • Publication	• Electric vehicle manufacturers, such as gesits, viar, etc. • Universities that utilize renewable energy as a learning medium
Cost Structure		**Revenue Streams**		
• Raw material costs		• Bootstrap funding		

• Maintenance costs • License & patent fees • Building rental costs • Employee costs	• PT Batex product sales

6. Conclusion

In the era of technological advancements, the ecosystem of lithium-ion battery users is expanding, necessitating continuous innovation in lithium battery products. However, the development of lithium-ion batteries using technopreneurship, business model canvas, and SWOT analysis approaches poses its challenges. This is primarily due to the cost of raw materials, particularly nickel, which is still relatively high, resulting in batteries being less affordable for the general public. Innovations in lithium-ion batteries need to align with customer requirements, such as affordability, high quality, large capacity, long lifetime, and others.

Acknowledgment

This research was funded by the institution of Research and Community Services, Universitas Sebelas Maret (UNS), through the program "Penelitian Hibah Grup Riset (HGR-UNS), grant number 28/UN27.22/PT.01.03/2023, March 14, 2023

References

Aqidawati, E. F. et al., The role of technopreneurship and innovation system for commercializing battery technology: A comparative analysis in indonesia, *Proceedings of the International Conference on Industrial Engineering and Operations Management*, August, pp. 1037–49, 2020.

Atikah, N. et al., Technical feasibility for technology commercialization of battery lithium ion, *Proceedings of 2014 International Conference on Electrical Engineering and Computer Science, ICEECS 2014*, November, pp. 308–14, 2014.

Carayannis, E. G. et al., *Innovation and Entrepreneurship*, Springer, Washington DC, 2015.

Cooke, P. et al., *Regional Innovation Systems* First ed., UCL Press, London, 1998.

Darmawan, H. et al., Product development strategy with quality function deployment approach: A case study in automotive battery, *Management Science Letters*, vol. 7, no.12, pp. 601–10, 2017.

Edquist, C., *Systems of innovation: technologies, institutions, and organizations*, Pinter A Cassell imprint, 1997.

Fraunhofer Institute, Development Perspectives for Cell Formats of Lithium-Ion Batteries in Electromobility, Karlsruhe, 2022.

Gaspar, I. et al., Optimisation and economic feasibility of Battery Energy Storage Systems in electricity markets: The Iberian market case study, *Journal of Cleaner Production*, vol. 324, October, 2021.

Hariyono, and Andriani, V. S., *Pengantar Technopreneurship*, CV AA Rizky, Serang, 2020.

Heimes, H. H. et al., Product-requirement-model to approach the identification of uncertainties in battery systems development, *International Journal on Interactive Design and Manufacturing*, vol. 14, no.3, pp. 911–22, 2020.

IEA, Total Final Consumption (TFC) by Sector, World (1990–2019); Data and Statistics: Explore Energy Data by Category, Indicator, Country or Region; IEA, 2020.

International Energy Agency, Global EV Outlook 2023, *Geo*, 2023.

Jansmyr, M., and Graas, R. N., Continuous Improvement in Product Development An Action Research Study for Enhancing Quality Culture, pp. 73, 2012.

Kemkominfo RI, Rintisan #1000StartupDigital, *Majalah Rintisan*, 2020.

Kristiyono, R. et al., Automatic Charging Battery Lithium Untuk Kendaraan Listrik, *Teknika*, vol. 7, no.4, pp. 236–42, 2022.

Kurniyati, I. et al., Technical feasibility for commercialization of lithium ion battery as a substitute dry battery for motorcycle, *AIP Conference Proceedings*, vol. 1902, 2017.

Lakitan, B., Technopreneurship as a strategic mechanism for commercializing university-created technology, *Technopreneurship Seminar*, May, pp. 1–8, 2013.

Lindmark, A. et al., Difficulties of collaboration for innovation - A study in the Öresund region, *Lund University: School of Economics and Management*, 2009.

Liu, D. et al., What causes growth of global greenhouse gas emissions? Evidence from 40 countries, *Science of the Total Environment*, vol. 661, pp. 750–66, 2019.

Muhyi, H. A., and Chan, A., The Penta Helix Collaboration Model in Developing Centers of Flagship Industry in Bandung City, *Review of Integrative Business and Economics Research*, vol. 6, no.1, pp. 412–7, 2017.

O.Nwazor, N., and Samuel Otonye, J., Economic Feasibility Analysis of Lithium Ion Batteries for Direct Current

Power Supply in Refineries, *International Journal of Engineering Trends and Technology*, vol. 67, no.3, pp. 37–43, 2019.
Olusegun, O. O. et al., Impact of Technopreneurship on Business Performance, *Journal of Economics and Management Research*, vol. 8, 2019.
Osterwalder, A., and Pigneur, Y., *Business Model Generation*, John Wiley & Sons, Inc., New Jersey, 2010.
Penrose, E. T., *The Theory of the Growth of the Firm*, Oxford University Press, Oxford, 1959.
Perdana, F. A., Baterai Lithium, *INKUIRI: Jurnal Pendidikan IPA*, vol. 9, no.2, pp. 113, 2020.
Prodan, I., A model of technological entrepreneurship, In *Handbook of research on techno-entrepreneurship* (ed. F. Thérin), 26–38, 2007.
PT. Batex Energi Mandiri, The Milestone of PT. Batex, 2020.
Roos, G., and Roos, J., Measuring your company's intellectual performance, *Long Range Planning*, vol. 30, no.3, pp. 413–26, 1997.
Rotella Junior, P. et al., Economic analysis of the investments in battery energy storage systems: Review and current perspectives, *Energies*, vol. 14, no.9, pp. 1–30, 2021.
Shi, S., and Yin, J., Global research on carbon footprint : A scientometric review, *Environmental Impact Assessment Review*, vol. 89, February, pp. 106571, 2021.
Sutopo, W. et al., Performance Efficiency Measurement Model Development of a Technology Transfer Office (TTO) to Accelerate Technology Commercialization in Universities, *Applied System Innovation*, vol. 5, no.1, 2022.
Wijaya, N. M. A. et al., Perkembangan Baterai Charger untuk Mendukung Pemasyarakatan Sepeda Listrik di Indonesia, *Spekturm*, vol. 8, no.1, pp. 1–1, 2021.

Biography

Cindy Saraswati is a student in the Master's Program in Industrial Engineering at Universitas Sebelas Maret in Surakarta, Indonesia. She obtained her Bachelor's degree in Industrial Engineering from Universitas Muhammadiyah Surakarta in 2020. She can be contacted via email at cindysaraswati007@student.uns.ac.id.

Wahyudi Sutopo is a Professor of Industrial Engineering and the Chair of the Research Group on Industrial Engineering and Techno-Economics (RGRITE) at the Faculty of Engineering, Universitas Sebelas Maret (UNS), Indonesia. He obtained his Ph.D. degree in Industrial Engineering and Management from the Bandung Institute of Technology in 2011. He has been involved in projects with the Indonesian Endowment Fund for Education (LPDP), Sustainable Higher Education Research Alliance (SHERA), MIT-Indonesia Research Alliance (MIRA), PT Pertamina (Persero), PT Toyota Motor Manufacturing Indonesia, and various other companies. He has published over 160 articles indexed in Scopus, and his research interests include logistics and supply chain management, engineering economics, cost analysis and estimation, and technology commercialization. He is a member of the Indonesian Society of Industrial Engineers (BKTI-PII), Indonesia Supply Chain & Logistics Institute (ISLI), Industrial Engineering and Operations Management (IEOM) Society, and Institute of Industrial and Systems Engineers (IISE). He can be contacted via email at wahyudisutopo@staff.uns.ac.id.

Renny Rochani is a Lecturer and Researcher at the Research Group on Industrial Engineering and Techno-Economics, Industrial Engineering Department, Universitas Sebelas Maret (UNS), Surakarta, Indonesia. She holds a Ph.D. degree from the University of Canberra, Australia, a Master's degree from the Bandung Institute of Technology, and a Bachelor's degree from the Bogor Agricultural University. For over 20 years, she has been involved in business activities, and since November 2021, she has decided to join the academic community at Universitas Sebelas Maret. She can be contacted via email at rennyrochani@staff.uns.ac.id.