Service Gaps and Customer Expectations in EV Battery Service Businesses in Upper Northern Thailand: Implications for Independent Service Centers and Circular Economy–Based Business Models*

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ABSTRACT

This study examines service gaps in electric vehicle (EV) battery service businesses in Upper Northern Thailand and proposes sustainable business model strategies for independent service providers. A mixed–methods approach was employed, utilizing questionnaires and open–ended questions. Quantitative data from 370 EV users were analyzed using descriptive statistics and paired–sample t–tests, while qualitative insights were evaluated via thematic analysis. The analytical framework integrates the 8Ps service marketing mix with the service expectation gap theory. The results indicate statistically significant gaps ($p < .05$) across most service dimensions, particularly in product reliability, pricing transparency, technical expertise, and service accessibility. Structural challenges include restrictive battery–replacement practices and limited service infrastructure in remote areas. The findings also reveal that peer–based knowledge sharing significantly influences consumer trust, while traditional marketing has minimal impact.

The study proposes a decentralized " repair–first" model that incorporates modular battery repair and hub–and–spoke service networks aligned with circular economy principles. Policy implications highlight the need for public–private collaboration to support SME capability development in advanced diagnostics and regulatory reform regarding the "right to repair" for fair repair practices and fair market competition.

Keywords: Electric Vehicles, Service Quality Gap, Modular Battery Repair, Circular Economy, Service Marketing Mix (8Ps)

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Introduction

The global transition toward electric vehicles (EVs) has accelerated significantly over the past decade as governments seek to reduce greenhouse gas emissions and achieve sustainable transportation systems. Many countries have introduced policies promoting EV adoption through tax incentives, charging infrastructure development, and regulatory reforms (International Energy Agency, 2023).

Thailand has emerged as a major EV manufacturing and consumption hub in Southeast Asia. Government initiatives such as the EV 3.0 and EV 3.5 policies aim to position the country as a regional center for EV production and adoption. While these policies have successfully stimulated EV sales, the rapid expansion of EV ownership has simultaneously revealed critical gaps in the after-sales service ecosystem, particularly in the maintenance and repair of EV battery systems.

EV batteries are among the most complex and expensive components of electric vehicles. Unlike conventional internal combustion engine (ICE) vehicles, EV battery systems require specialized diagnostic tools, high-voltage safety protocols, and advanced technical expertise (Lutsey & Nicholas, 2019). Consequently, the availability of qualified service providers becomes a crucial factor influencing consumer confidence in EV adoption.

In geographically diverse regions such as Upper Northern Thailand, where mountainous terrain and long-distance travel are common, the lack of EV service infrastructure poses significant challenges for vehicle owners. Most EV service centers are currently concentrated in major urban areas, leaving rural and semi-rural regions underserved. To illustrate this structural disparity, recent statistics indicate that while EV registrations in Upper Northern Thailand reached 3,946 units in 2023, the number of EV dealers and service facilities remains disproportionately low at only 22 locations across the region (Department of Land Transport, 2024).

Moreover, EV owners frequently report concerns related to battery repair costs, limited repair options, and a lack of transparency in pricing structures. Some consumers have experienced " battery replacement bundling" practices, where manufacturers require full battery pack replacement rather than allowing modular repairs. Such practices may increase maintenance costs and reduce consumer trust in EV service ecosystems.

Despite the rapid growth of the EV market, previous studies in ASEAN and other emerging economies have predominantly focused on consumer adoption barriers and charging infrastructure development (Chaopaisarn et al., 2025). There remains a significant research gap regarding the after-sales service ecosystems in developing, geographically diverse regions. This study contributes to the existing literature by integrating to the existing literature by intersecting three critical domains: EV after-sales service dynamics, circular economy implementation, and regional SME development. Given these emerging challenges, there is a need to better understand service gaps between consumer perceptions and expectations regarding EV battery services in regional contexts. Understanding these service gaps is particularly important for small and medium-sized enterprises (SMEs) operating independent repair centers, which may play a critical role in expanding the EV service ecosystem.

Research Objectives

1. To examine the current conditions of EV battery service businesses in Upper Northern Thailand.

2. To identify service gaps between perceived service performance and customer expectations.

3. To explore business model opportunities grounded in circular economy principles for independent EV service providers.

Conceptual Framework

Based on empirical findings and theoretical synthesis, this study proposes a conceptual model for developing sustainable EV battery service ecosystems in regional markets. Unlike previous studies that view service gaps merely as operational failures, this study reinterprets them as catalysts for strategic innovation. The model integrates three theoretical perspectives, each specifically informing a component of the research model:

1. Service Marketing Mix (8Ps): Represents the service design and customer experience dimensions, serving as the diagnostic tool to identify exact discrepancies between expected and perceived service quality.

2. Resource-Based View (RBV): Represents the internal capabilities of SMEs. It explains how independent centers must cultivate unique resources, such as technical skills, diagnostic tools, and access to knowledge, to bridge the identified service gaps.

3. Circular Economy principles: Represent sustainable battery lifecycle management. It provides strategic direction for the business model (repair, reuse, recycling) to overcome the industry's replacement bundling practices.

Building on these perspectives, the theoretical foundation of this conceptual model is further strengthened by integrating service-dominant logic and advanced sustainability frameworks. Teece (2018) argued that sustained competitive advantage depends on firms' abilities to develop dynamic capabilities and continuously reconfigure organizational resources in response to technological change. Within the EV after-sales sector, independent service centers must therefore cultivate specialized diagnostic expertise, modular battery repair capabilities, and flexible service models to remain competitive in an increasingly technology-driven mobility ecosystem. This internal capacity-building aligns with Vargo and Lusch's (2016) service-dominant logic, which posits that value is co-created within service ecosystems rather than delivered through physical products.

As the global transition toward sustainable mobility accelerates (International Energy Agency, 2023; Rezvani et al., 2015; Deloitte, 2024), traditional automotive service structures must evolve to meet new technological demands. Furthermore, embedding circular economy principles into EV battery management requires actionable pathways for module reuse and recycling (Antony Jose et al., 2024). The operationalization of these sustainable practices increasingly depends on adopting digital frameworks for battery circularity and the development of robust recycling industry systems (Baars et al., 2021).

Consequently, this proposed model demonstrates how integrating strategic service marketing (Lovelock & Wirtz, 2016) with these multi-disciplinary frameworks enables SMEs to bridge current service expectation gaps while fostering a sustainable, circular EV economy. The conceptual framework illustrates how service expectation gaps can serve as a catalyst for the development of innovative EV battery service models.

The conceptual framework illustrates how service expectation gaps can serve as catalysts for the development of innovative EV battery service models. The conceptual framework developed in this study is presented below.

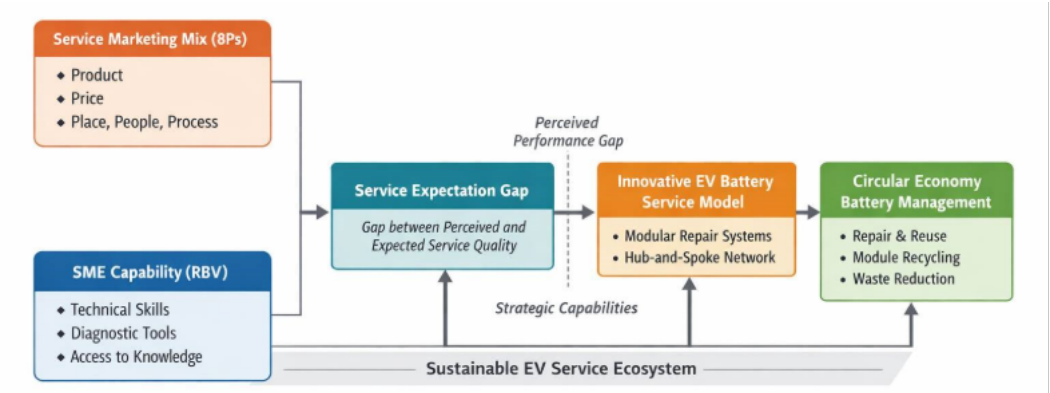

Figure 1: Conceptual Framework for Sustainable EV Battery Service Ecosystems

Figure 1 presents an integrative and context-sensitive framework that conceptualizes how service gaps within regional EV battery service markets function as catalysts for systemic innovation and sustainability. The model begins with the service marketing mix (8Ps), which shapes users' perceived service performance and interacts with their expected service quality, generating measurable service gaps that reflect structural inefficiencies in emerging service ecosystems (Lovelock & Wirtz, 2016). Extending beyond traditional gap analysis, the framework reinterprets these discrepancies as strategic signals that inform organizational adaptation, aligning with dynamic capabilities theory, which emphasizes a firm's ability to sense, seize, and transform in response to environmental change (Teece, 2018). These service gaps stimulate the development of SME capabilities—particularly technical expertise, diagnostic infrastructure, and localized responsiveness—consistent with the resource-based view (RBV), where firm-specific competencies underpin sustained competitive advantage (Barney, 1991).

Furthermore, the model incorporates an innovative response layer in which SMEs translate capabilities into actionable business models, such as modular battery repair and hub-and-spoke service networks. This transformation reflects principles of business model innovation, where firms reconfigure value creation and delivery mechanisms to respond to unmet market needs (Foss & Saebi, 2017). Simultaneously, these innovations align with circular economy logic by prioritizing repair, reuse, and lifecycle extension, thereby enhancing both economic efficiency and environmental sustainability (Geissdoerfer et al., 2017). Importantly, the framework integrates a feedback loop grounded in service-dominant logic, highlighting how value and trust are co-created through continuous interactions among firms, users, and communities (Vargo & Lusch, 2016). This feedback mechanism also reflects contemporary customer engagement theory, suggesting that sustained interaction,

collaborative knowledge sharing, and service transparency enhance customer trust and long-term loyalty in complex technology-driven service environments such as the EV after-sales sector (Rather et al., 2019).

By synthesizing service marketing, RBV, dynamic capabilities, business model innovation, and circular economy perspectives, the framework offers a novel contribution to the business administration literature. It demonstrates how structurally constrained regional markets can transition toward sustainable service ecosystems through capability-driven and innovation-led pathways, thereby extending existing theories into the emerging domain of EV service ecosystems in developing contexts. Importantly, the updated conceptual framework explicitly depicts a feedback loop grounded in service-dominant logic. This loop highlights how value and trust are co-created through continuous interactions among firms, users, and communities.

Research Methodology

1. Sample

The sample size of 370 respondents exceeded the recommended sample size threshold for behavioral research suggested by Hair et al. (2019), thereby ensuring sufficient statistical power and reliability for quantitative analysis. The survey sample consisted of 370 EV users in Upper Northern Thailand, specifically the provinces of Chiang Mai, Chiang Rai, Lampang, and Lamphun. Data were collected between May and July 2025 through various methods, including face-to-face administration, online surveys, mail, and direct handouts of the questionnaires.

Purposive sampling was employed to recruit information-rich participants with direct experience in the EV ecosystem, enabling the study to obtain contextually grounded insights from individuals possessing specialized knowledge and practical involvement in the field (Campbell et al., 2020). To strengthen the reliability and relevance of the data, specific inclusion criteria were applied, requiring participants to have owned and regularly used an EV for a minimum of one year before participation. The resulting sample represented a diverse cross-section of EV users across demographic characteristics, including gender, age, duration of EV use, and EV brand ownership.

For the qualitative component, 17 key informants were purposively selected to provide in-depth cross-sectoral perspectives on supply-side readiness and operational constraints within the regional EV service ecosystem. A maximum variation sampling strategy was employed to capture diverse industry viewpoints and experiences. The qualitative sample comprised EV industry experts

(n = 5), EV service center owners and managers (n = 6), traditional automotive repair shop owners (n = 3), and academic researchers or industry consultants (n = 3). Most informants were male and between 25 and 44 years of age. All participants possessed at least five years of direct professional experience in the automotive or EV sector.

2. Research Instruments

This study employed a predominantly quantitative mixed-methods design supplemented by qualitative inquiry. The quantitative survey instrument was developed by adapting and contextualizing the service marketing mix (8Ps) framework proposed by Lovelock and Wirtz (2016) to measure consumer perceptions and expectations regarding EV battery maintenance and repair services. The questionnaire consisted of 37 items distributed across eight dimensions: product (6 items), price (5 items), place (4 items), promotion (4 items), people (5 items), process (4 items), physical evidence (4 items), and productivity and performance (5 items).

In addition to the Likert-scale questions, the survey included four open-ended questions designed to capture deeper qualitative insights and user-generated recommendations regarding EV battery maintenance services. Participants were encouraged to describe their personal experiences, service-related challenges, and expectations toward future EV support systems in the region.

For the qualitative component, semi-structured interview guidelines were developed to explore stakeholder perspectives on EV service readiness, operational barriers, infrastructure limitations, and future development opportunities within the regional EV ecosystem.

Content validity was established through expert evaluation by a panel of five specialists in business management, automotive services, and EV-related industries. The Index of Item–Objective Congruence (IOC) values ranged from 0.60 to 1.00, exceeding the acceptable threshold for content validity assessment. Internal consistency reliability was evaluated using Cronbach' s alpha coefficients for each construct within the 8Ps framework. The resulting coefficients ranged from 0.782 to 0.882, with all constructs exceeding the recommended threshold of 0.70, thereby indicating strong internal reliability and consistency of the measurement instrument.

3. Data Collection

Quantitative data were collected between May and July 2025 using structured questionnaires administered through offline channels. Offline data collection was conducted through face-to-face distribution at EV charging stations, automotive service centers, and EV-related community events in Upper Northern Thailand. The questionnaire was designed to measure

respondents' perceived service performance, expected service quality, and primary concerns regarding EV maintenance and repair services.

To complement the quantitative findings and provide a deeper operational context, qualitative data were collected concurrently through open-ended survey questions and semi-structured interviews. The survey instrument included four open-ended questions that encouraged respondents to share detailed feedback, personal experiences, and perspectives regarding EV battery maintenance services.

In addition, semi-structured interviews were conducted with 17 purposively selected key informants representing EV industry stakeholders, service providers, repair shop operators, and academic experts. Interviews were conducted face-to-face, and each session lasted approximately 30 minutes. The interviews explored operational feasibility, infrastructure limitations, and emerging service models, including modular repair workflows and SME collaboration structures. Interview responses were documented through note-taking and transcription for thematic analysis.

4. Data Analysis

Quantitative data were systematically analyzed using descriptive statistics and paired-sample t-tests. Specifically, paired-sample t-tests were conducted to compare respondents' current service perceptions with their expected service levels across various service dimensions.

To complement the quantitative findings, qualitative data obtained from the open-ended survey questions were analyzed using thematic analysis. This method was employed to systematically code and identify recurring patterns, underlying insights, and practical approaches for implementing a "repair-first" business model.

Results and Model Development

This section presents the empirical findings of the study and develops a conceptual service ecosystem model for EV battery service businesses in Upper Northern Thailand. The results are organized according to the three research objectives as follows.

1. Current Conditions of EV Battery Service Businesses in Upper Northern Thailand

The results indicate that overall perceptions of EV battery service performance are at a moderate level. Among the eight service dimensions, respondents rated the technical expertise of service personnel, service safety, and repair reliability as the most important

factors influencing their satisfaction with EV battery services. However, several service limitations were identified.

Firstly, the accessibility of EV battery repair services remains limited outside major urban areas such as Chiang Mai. Many EV users reported difficulties in finding qualified service providers when traveling to remote provinces.

Secondly, EV users expressed concerns about the lack of transparency in battery repair pricing. Some respondents reported that manufacturers or authorized service centers require the replacement of entire battery packs instead of repairing individual battery modules. Such practices significantly increase repair costs and reduce perceived fairness in the service market.

Thirdly, the availability of specialized diagnostic tools and technical expertise remains a significant concern for the regional service infrastructure. Analysis of the open-ended responses from EV users revealed that many consumers perceive a critical lack of technical readiness among independent service providers, particularly regarding access to proprietary diagnostic software and certified high-voltage training. These findings suggest that the EV battery service ecosystem in Upper Northern Thailand is still in an early stage of development and lacks the sufficient infrastructure and technical transparency required to support the rapidly growing EV user base.

2. Service Expectation Gap Analysis

The paired-sample t-test results clarify the structural disparities between perceived service performance and expected quality across the 8Ps service marketing mix, identifying three critical areas of concern (Table 1).

Table 1: Paired–sample t–test results comparing perceived and expected service quality

Construct	Current situation Mean		Expected situation Mean		t–test	Mean Diff.	Gap Interpretation
	$\bar{x}$	SD	$\bar{x}$	SD	p–value		
Product	3.9	0.96	4.3	0.84	0.002**	0.36	Significant gap: customers demand higher product reliability, safety, and warranty coverage beyond current service levels.
Price	3.6	0.93	3.8	0.85	0.009**	0.22	Strong gap: cost remains a major concern; customers are willing to pay more for quality, but also expect fair pricing and government incentives.

Table 1: (continued)

Construct	Current situation Mean		Expected situation Mean		t-test	Mean Diff.	Gap Interpretation
	$\bar{x}$	SD	$\bar{x}$	SD	p-value		
Place	3.7	0.96	3.8	0.94	0.012*	0.11	Clear gap: customers seek more conveniently located and sufficient service centers, highlighting infrastructure limitations.
Promotion	3.7	0.94	3.7	0.99	0.633 ns	-0.01	Limited gap: advertising has little impact, but government incentives and extended benefits are seen as crucial motivators.
People	3.6	0.94	3.8	0.86	0.004**	0.21	Significant gap: customers emphasize the role of certified technicians, fast service, and future-ready skills (e.g., battery swapping).
Process	3.7	0.93	3.8	0.88	0.041*	0.07	Moderate gap: customers expect standardized, efficient services and independent centers, but are less concerned about digital booking/payment systems.
Physical Evidence	3.7	0.96	3.8	0.95	0.227 ns	0.10	Small gap: waiting area comfort is valued, but tools, cleanliness, and signage meet basic expectations.
Productivity	3.6	0.93	3.9	0.80	0.002**	0.36	Strong gap: customers expect consistent battery quality, advanced technology, and ongoing service expansion to maintain confidence in service providers.

Note: * $p < .05$, ** $p < .01$, *** $p < .001$, ns = not significant.

Critical Service Deficits (Product and Productivity): The largest service expectation gaps were identified in the Product and Productivity dimensions, both showing a statistically significant mean difference of 0.36 ($p < .05$). These findings suggest that EV users in Upper Northern Thailand are more concerned with service reliability, operational safety, and long-term battery support than with driving range alone. Consumers expressed particularly high expectations regarding comprehensive battery warranties, consistent service quality, and the use of advanced diagnostic

technologies, all of which were perceived as insufficiently developed within the current regional EV service ecosystem.

The Trust Gap in People and Processes: The People and Process dimensions revealed statistically significant gaps of +0.21 and +0.07, respectively ($p < .05$). These findings indicate the emergence of an increasingly informed consumer base that expects high levels of professional accountability, particularly in relation to certified technicians and standardized, verifiable repair procedures. Such expectations appear to be driven by concerns over safety risks and potential human error associated with high-voltage battery system maintenance.

Limited or Non-Significant Gaps (Promotion and Physical Evidence): Conversely, the Promotion and Physical Evidence dimensions exhibited either limited or statistically non-significant gaps. Traditional advertising and the aesthetic appeal of service facilities appeared to have relatively little influence on EV users' decision-making processes. This finding suggests that the regional EV market is increasingly reliant on technical credibility, service transparency, and peer-based information, with consumers prioritizing technical expertise and repair reliability over conventional marketing incentives or physical amenities.

Overall Service Gap Implications: The service expectation gap analysis highlights a "Market Ready, Service Lags" phenomenon within the EV ecosystem of Upper Northern Thailand. The identified gaps appear to stem less from demands for convenience and more from concerns related to safety, trust, and long-term service reliability. Therefore, strategic development within the regional EV battery service sector should move beyond conventional marketing approaches toward a more repair-oriented service model. Service providers should prioritize investments in standardized diagnostic procedures, transparent repair systems, and formal technical competency certification to reduce consumer uncertainty, narrow the expectation gap, and strengthen long-term competitiveness within a sustainable regional EV market.

Discussions

The findings highlight structural challenges in the emerging EV service ecosystem in Upper Northern Thailand. First, the significant gap between perceived and expected service quality reflects the early stage of EV service infrastructure development. Similar concerns regarding infrastructure readiness and service support have been identified in previous EV adoption studies, where limitations in supporting ecosystems remain a barrier to consumer confidence (Rezvani et al., 2015). However, compared to international studies that primarily focus on charging anxieties, this study highlights characteristics that may reflect broader

conditions in emerging Southeast Asian EV markets: in geographically challenging terrains like Upper Northern Thailand, post-warranty maintenance anxiety—specifically regarding battery repair—emerges as a major consumer concern. Second, the issue of battery replacement bundling raises concerns about market fairness and consumer protection. Restricting repair options may contribute to market concentration that disadvantages consumers and independent repair providers. This aligns with broader regional trends across Southeast Asia, where early EV adopters are beginning to face steep out-of-warranty costs. Third, the strong influence of online communities suggests that trust in EV service markets is increasingly mediated through peer networks rather than traditional marketing channels. This may reflect the high perceived risk associated with EV battery maintenance, where consumers prioritize technical credibility and peer-based experiential knowledge over conventional promotional activities or service environment aesthetics.

These findings also carry important theoretical implications. From a theoretical perspective, the results support the relevance of service marketing frameworks, alongside the Resource-Based View (RBV) and service-dominant logic, in analyzing emerging service markets. The integration of the 8Ps model with consumer trust and circular economy concepts provides a comprehensive lens for understanding EV service ecosystems. Specifically, the finding that consumers rely heavily on online peer networks illustrates Vargo and Lusch's service-dominant logic, in which value and trust are co-created within the community rather than strictly delivered by the firm. Furthermore, the identified structural gaps highlight the RBV perspective: independent service centers must cultivate specialized diagnostic expertise, software interoperability capabilities, and modular battery repair knowledge to overcome market barriers and achieve sustained competitive advantage.

From a sustainability perspective, modular battery repair offers a significant opportunity to align EV service markets with circular economic principles. By enabling repairs instead of full replacement, service providers can reduce costs, minimize environmental impacts, and extend battery life cycles. However, as highlighted by recent circular economy frameworks, realizing this potential requires more than just mechanical repair capabilities. It necessitates the integration of digital frameworks for battery tracking and the development of robust, regional recycling industry systems to ensure the proper management of end-of-life modules. Therefore, transitioning to a circular EV ecosystem demands a coordinated effort to connect independent repair hubs with wider technological and recycling infrastructure.

Crucially, achieving this circularity is heavily dependent on overcoming proprietary barriers, highlighting the urgent need for "Right to Repair" advocacy in developing EV markets.

Conclusions

This study examined service gaps in EV battery service markets in Upper Northern Thailand. The findings reveal significant differences between current service performance and consumer expectations. Key issues include price transparency, repair accessibility, and limited modular repair options.

Compared with prior international EV service studies that primarily emphasize charging infrastructure limitations, this study highlights the importance of affordable and localized after-sales support in developing EV markets such as Thailand. The substantial expectation gaps in product reliability and technical expertise suggest that the "Market Ready, Service Lags" phenomenon is not unique to Thailand. Rather, it may also be relevant to other developing economies experiencing rapid, policy-driven EV adoption.

The study suggests that independent service providers can play a crucial role in expanding the EV service ecosystem through modular repair services and regional service networks. Future research should explore comparative EV service ecosystems across different regions and examine the long-term economic viability of circular economy-based EV service models.

This study contributes to the growing body of literature on EV service ecosystems by extending service marketing and circular economy perspectives into the context of emerging EV markets. It also highlights the importance of trust, repair accessibility, and localized service capabilities in supporting sustainable EV adoption in developing economies.

Recommendations

Practical Recommendations for Application

1. Shift to a "Repair-First" and Modular Repair Business Model: Local SMEs and independent garages should move away from the traditional "replace-only" approach towards a modular, "pay-as-you-fix" service model. This directly addresses the users' financial concerns about unfair bundling and high replacement costs, enabling local garages to offer a highly competitive and cost-effective alternative to authorized dealer centers.

2. Invest in "Physical Evidence" and High-Voltage Certification to Bridge the Trust Gap: Because consumers are concerns regarding unsafe repair practices, independent service centers must clearly demonstrate their professionalism. Operators should prioritize investments in obtaining official high-voltage technician certifications and use standardized, digital diagnostic screens that can transparently display the State of Health (SOH) of battery cells to the customer. Displaying these certifications and adhering to strict checklists will effectively reduce the perceived risk.

3. Implement Educational Community Marketing over Traditional Advertising: Since traditional advertising was found to be statistically insignificant in influencing EV users; businesses should redirect their marketing budgets towards educational engagement. Service providers should act as trusted consultants within model-specific online communities (e.g., Facebook groups, LINE OpenChats) by sharing knowledge on battery maintenance and lifespan preservation, which may help strengthen brand trust and customer engagement.

Policy Recommendations

Implement "Right to Repair" Legislation for the EV Ecosystem: To address the restrictive battery replacement practices, the Thai government and relevant regulatory bodies should introduce "Right to Repair" frameworks. This policy should ensure that EV manufacturers provide independent repair centers with access to diagnostic software, technical manuals, and modular replacement parts at fair prices. Fostering a fair competition environment will protect consumers from exorbitant out-of-warranty costs and actively support the growth of local SMEs in the circular economy.

Recommendations for Future Research

1. Conduct a Comparative Regional Analysis: Future research should replicate the study's framework in other distinct economic and geographical zones in Thailand, such as the Eastern Economic Corridor (EEC) or the Northeast. This will help determine whether the strong preference for a localized "Repair-First" model and the significant gaps in satellite province accessibility persist in regions with different logistical infrastructures and topographical conditions.

2. Perform a Longitudinal Technology Assessment: Since the current expectations andconcerns are based on existing lithium-ion battery technologies, future studies should track how rapid technological advancements (such as the introduction of solid-state batteries or newly extended manufacturer warranties) will affect user expectations and the viability of current repair protocols over time. This would provide further insight into the long-term

adaptability of independent EV service providers under rapidly evolving technological conditions.

References

Antony Jose, S., Dworkin, L., Montano, S., Noack, W. C., Rusche, N., Williams, D., & Menezes, P. L. (2024). Pathways to the circular economy for electric vehicle batteries. Recycling, 9(5), 76. https://doi.org/10.3390/recycling9050076

Baars, J., Domenech, T., Bleischwitz, R., Melin, H. E., & Heidrich, O. (2021). Circular economy strategies for electric vehicle batteries reduce reliance on raw materials. *Nature Sustainability, 4*(1), 71–79. https://doi.org/10.1038/s41893-020-00607-0

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing, 25*(8), 652–661. https://doi.org/10.1177/1744987120927206

Deloitte. (2024). *2024 global automotive consumer study*. Deloitte Insights.

Department of Land Transport. (2024). *Vehicle registration statistics under the Motor Vehicle Act*. https://web.dlt.go.th/statistics/

Foss, N. J., & Saebi, T. (2017). Fifteen years of research on business model innovation. *Journal of Management, 43*(1), 200–227. https://doi.org/10.1177/0149206316675927

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy – A new sustainability paradigm? *Journal of Cleaner Production, 143*, 757–768. https://doi.org/10.1016/j.jclepro.2016.12.048

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

International Energy Agency. (2023). *Global EV outlook 2023*. IEA. https://www.iea.org/reports/global-ev-outlook-2023

Lovelock, C., & Wirtz, J. (2016). *Services marketing: People, technology, strategy* (8th ed.). Pearson.

Lutsey, N., & Nicholas, M. (2019). *Update on electric vehicle costs in the United States through 2030* (Working Paper). International Council on Clean Transportation.

Rather, R. A., Tehseen, S., Itoo, M. H., & Parrey, S. H. (2019). Customer brand identification, affective commitment, customer satisfaction, and brand trust as antecedents of customer behavioral intention of loyalty: An empirical study in the hospitality sector. *Journal of Global Scholars of Marketing Science, 29*(2), 196–217. https://doi.org/10.1080/21639159.2019.1577694

Rezvani, Z., Jansson, J., & Bodin, J. (2015). Advances in consumer electric vehicle adoption research. *Transportation Research Part D: Transport and Environment, 34*, 122–136. https://doi.org/10.1016/j.trd.2014.11.010

Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning, 51*(1), 40–49. https://doi.org/10.1016/j.lrp.2017.06.007

Vargo, S. L., & Lusch, R. F. (2016). Institutions and axioms: An extension and update of service-dominant logic. *Journal of the Academy of Marketing Science, 44*(1), 5–23. https://doi.org/10.1007/s11747-015-0456-3