

AI-Powered Customer Journey Mapping and Experience Personalization: Examining Their Influence on Electric Vehicle Consumer Behavior in Punjab”

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Abstract

This study explores the factors influencing electric vehicle (EV) adoption in Punjab, India, with a focus on mapping the customer journey and evaluating the role of AI-driven personalization in enhancing the purchase and ownership experience. The primary objective is to identify key psychological, economic, and social factors that impact EV adoption intentions and examine the role of AI in personalizing the consumer journey. The research employs a mixed-methods approach, combining both primary data (surveys and interviews) and secondary data from existing literature. Factor analysis and regression analysis were used to identify underlying drivers of EV adoption, and AI's impact was analyzed through customer satisfaction surveys. The findings reveal that environmental concerns ($r = 0.47$) and fuel cost savings ($r = 0.51$) are the strongest motivators for adoption, while range anxiety ($r = -0.35$) and high upfront costs ($r = -0.48$) serve as significant barriers. Additionally, AI-driven personalization, including tailored recommendations and predictive maintenance, has a positive influence on consumer satisfaction, though its direct impact on purchase intention needs further exploration. This research contributes to a deeper understanding of EV consumer behavior in emerging markets and highlights the potential of AI to improve customer engagement and satisfaction. However, challenges related to data privacy, cost of implementation, and skepticism toward AI, particularly in rural areas, remain. Future research should explore the relationship between AI tools and purchase intent more comprehensively, particularly in rural and semi-urban settings.

Keywords: Electric Vehicles, Consumer Behavior, Customer Journey Mapping, Personalization, Punjab, AI

1. INTRODUCTION

The global automotive industry is undergoing a transformative shift with the growing adoption of Electric Vehicles (EVs), driven by the urgent need to reduce greenhouse gas emissions, curb air pollution, and mitigate climate change. EVs represent a critical component of sustainable urban mobility, offering an alternative to traditional internal combustion engine (ICE) vehicles. In countries like India, where air pollution levels are among the highest in the world and reliance on fossil fuels remains substantial, the adoption of EVs is seen as a strategic solution to these challenges (Shukla et al., 2020).

In the Indian context, the government has been proactive in promoting the adoption of EVs through various fiscal incentives, including subsidies for buyers, tax exemptions, and the development of charging infrastructure (Kumar & Patil, 2021). However, despite these efforts, the pace of EV adoption remains slower than anticipated. A variety of socio-economic and psychological factors influence consumer behavior towards EVs, and these factors are often compounded by regional disparities, which significantly affect adoption rates (Pallavi & Singh, 2022). Punjab, a northern state in India, offers an interesting case for understanding EV adoption dynamics, as it reflects both urban and rural mobility patterns that influence vehicle purchasing decisions in distinct ways (Rani et al., 2021).

Punjab's vehicle market is witnessing rapid growth, with an increasing number of consumers considering EVs. The state's economic composition with both industrialized urban centers and agriculturally dominated rural areas provides a unique environment to study EV consumer behavior. Urban areas like Chandigarh and Ludhiana have seen growing interest in electric cars due to rising pollution levels and increasing fuel costs. At the same time, rural areas face challenges like limited charging infrastructure and lack of awareness, which hinder the widespread adoption of EVs (*Sood & Arora, 2020*).

Understanding the factors that drive or deter EV adoption in Punjab is crucial for manufacturers, policymakers, and service providers who aim to design targeted strategies for the region. While several studies have focused on consumer behavior in the context of EVs at a broader national or global level (*Chakraborty et al., 2020*), there is a lack of region-specific insights, particularly concerning rural and semi-urban areas (*Singh et al., 2021*). This study aims to fill this gap by using AI-powered customer journey mapping and experience personalization frameworks to investigate how consumers in Punjab interact with the EV market.

A key aspect of this research is the integration of AI-driven Customer Journey Mapping (CJM), which offers an innovative approach to track the consumer's decision-making process from initial awareness to post-purchase behavior. CJM can help identify the critical touchpoints that shape consumer decisions and highlight areas for improvement (*Lemon & Verhoef, 2016*). Moreover, personalization strategies powered by artificial intelligence can significantly enhance customer experiences by providing tailored content, offers, and communication based on consumer preferences, thus increasing engagement and satisfaction (*Davenport et al., 2020*).

In summary, while EV adoption in Punjab is at an early stage, understanding the underlying consumer behavior is crucial for shaping effective marketing strategies and policies. This study leverages the power of AI and CJM to offer valuable insights that could help both industry players and policymakers better navigate the transition towards a sustainable, electric mobility ecosystem in Punjab.

2. LITERATURE REVIEW

2.1 EV Adoption and Consumer Behavior

India's electric vehicle (EV) market, while growing, is still in its early stages, with several barriers limiting widespread adoption. A comprehensive study by *Thakur & Haan (2022)* aimed to explore the key factors influencing consumer adoption of EVs in India. Their objective was to understand the psychological, infrastructural, and economic factors that affect EV purchasing decisions. The study had a sample size of 450 participants from urban and semi-urban areas of India, with data collected through structured questionnaires and in-depth interviews. The primary tool for analysis was factor analysis, which helped identify the main barriers to adoption, such as price sensitivity, lack of charging infrastructure, and range anxiety. The findings revealed that while many consumers are aware of the environmental benefits of EVs, the high upfront cost and insufficient charging stations remain the top deterrents. The study concluded that to drive EV adoption, there is a need for more robust infrastructure development, better financing options, and consumer education on the long-term benefits of EV ownership. *Singh & Sharma (2021)*, in contrast, explored the role of government incentives and environmental awareness as key drivers of EV adoption. Their study, conducted with a sample size of 350 consumers in major cities like Delhi, Mumbai, and Bangalore, used regression analysis to assess the impact of these drivers on purchase intentions. The study found that government subsidies and increasing environmental awareness are significantly boosting consumer interest in EVs. However, similar to *Thakur & Haan (2022)*, barriers such as price sensitivity and range anxiety were also highlighted as critical challenges.

2.2 Consumer Journey Mapping in the EV Sector

While consumer decision-making in the automotive industry is well-studied, there is a paucity of research focusing on the Customer Journey Mapping (CJM) specific to EV consumers. *Vazquez et al. (2020)* aimed to develop a framework for CJM in the retail sector, focusing on how Artificial Intelligence (AI) can enhance customer experience by analyzing touchpoints in a consumer's journey. Their study, with a sample size of 2000 consumers across different sectors, used AI-driven data analytics to map key moments in the consumer journey, from awareness to purchase and post-purchase feedback. The study identified that personalized marketing efforts at every stage of the journey could significantly improve customer engagement and conversion rates.

Malik et al. (2021) extended this approach to the automotive sector, studying EV consumer journeys specifically. Their research, which involved 300 EV buyers and prospective buyers from Delhi and Pune, aimed to assess how various touchpoints such as dealership interactions, test drive experiences, and post-purchase customer support influenced the final purchase decision. Using path analysis and regression models, the study found that consumers who experienced a personalized dealership interaction and had access to a well-organized test-drive process were more likely to make a purchase. However, the study concluded that there was still a lack of consistent touchpoints for post-purchase support, which could affect long-term satisfaction and brand loyalty. The findings highlighted the importance of a seamless journey that addresses both pre-purchase concerns and post-purchase needs.

2.3 The Role of Personalization in Customer Experience

Personalization in customer experience has proven to be a key strategy for increasing customer engagement and improving satisfaction. *Zhang et al. (2022)* aimed to investigate the impact of AI-driven personalization on customer experience in the retail and e-commerce sectors. Their study, which included a sample of 500 online shoppers, used machine learning algorithms to track consumer behavior and tailor marketing communications. The results showed that personalized recommendations and targeted communications significantly increased consumer engagement and conversion rates, as consumers felt that the brand was attuned to their preferences.

Gupta & Rathi (2020) extended this concept to the automotive sector, focusing on EV consumer behavior. They studied 350 participants who were considering purchasing an EV, using A/B testing and personalization algorithms to test how personalized offers and communications (such as tailored financing plans and localized charging station information) influenced their decision-making. The study found that personalized offers had a positive impact on consumers' purchase intentions and satisfaction levels. Consumers who received personalized outreach reported higher levels of trust in the brand and were more likely to proceed with a purchase. The study concluded that personalization, when implemented effectively, could be a significant driver in accelerating EV adoption, particularly in markets like India where consumers are still navigating through the information overload and new technology.

2.4 EV Adoption in Punjab: A Regional Perspective

Punjab presents unique challenges and opportunities in the adoption of electric vehicles, especially given its rural-urban mix and the state's heavy reliance on traditional internal combustion vehicles for both personal and commercial use. *Singh & Kapoor (2021)* aimed to understand the specific factors driving or hindering EV adoption in Punjab, focusing on high fuel costs, pollution levels, and government incentives as major motivators. The study targeted 400 respondents across urban (Chandigarh, Ludhiana) and rural (Patiala, Jalandhar) areas. Using descriptive statistics and correlation analysis, the researchers found that urban residents were more likely to adopt EVs due to higher environmental awareness and a greater focus on reducing fuel costs. Conversely, rural areas faced challenges such as limited infrastructure (few charging stations) and higher initial costs. The study concluded that while there is an interest in EVs, adoption is slower in rural areas due to infrastructural limitations and cost concerns. To address these challenges, the study recommended targeted policies and incentives, including subsidies for rural buyers, investment in charging infrastructure, and awareness campaigns highlighting the long-term savings and environmental benefits of EVs.

Research Gaps

1. **A lack of region-specific studies** on consumer adoption of EVs in Punjab, with an emphasis on the rural-urban divide and regional socio-economic factors.
2. **Limited application of AI in Customer Journey Mapping (CJM)** within the EV sector, particularly in understanding and optimizing key touchpoints for prospective EV buyers.
3. **Insufficient exploration of AI-driven personalization** in EV marketing and sales strategies, specifically tailored to meet the needs of Indian consumers.
4. An **inadequate focus on psychological and social factors** that may influence EV adoption decisions, particularly in the socio-cultural context of Punjab.

5. A lack of understanding of post-purchase experiences and how customer satisfaction and loyalty are shaped by factors such as charging infrastructure, maintenance services, and vehicle reliability.

Addressing these gaps through further research will provide a more nuanced understanding of EV adoption in emerging markets and will help manufacturers, policymakers, and other stakeholders to create more effective strategies for promoting sustainable transportation in regions like Punjab.

3. RESEARCH METHODOLOGY

3.1 NEED AND SIGNIFICANCE OF THE STUDY

- **Regional Insights for Punjab:**
 - Limited research on EV adoption in Punjab, with a focus on urban vs. rural consumer behavior.
 - Understanding the unique challenges and motivations specific to Punjab is critical for targeted policies and marketing strategies.
- **AI in Customer Journey Mapping (CJM):**
 - Limited application of AI-powered CJM in the EV sector, especially in emerging markets.
 - Mapping the full EV customer journey helps optimize touchpoints (awareness, consideration, purchase, post-purchase).
- **Personalization in EV Market:**
 - Growing need for AI-driven personalization to tailor EV offers and communication.
 - Personalized experiences can improve consumer trust, engagement, and purchase intent.
- **Post-Purchase Experience:**
 - Little focus on post-purchase satisfaction in the EV sector.
 - Understanding maintenance, charging infrastructure, and vehicle performance influences long-term adoption and brand loyalty.
- **Policy and Strategic Implications:**
 - Provides insights for regional policies and market strategies for EV adoption in Punjab.
 - Helps design subsidies, incentives, and infrastructure improvements tailored to local needs.
- **Practical Insights for Manufacturers and Dealerships:**
 - Offers actionable recommendations to improve customer engagement.
 - Helps tailor marketing campaigns, product offerings, and personalized experiences based on consumer preferences.
- **Contributions to Academic Literature:**
 - Fills research gaps in regional EV adoption, AI in CJM, and personalization in automotive sector.
 - Adds new knowledge on consumer behavior and technology adoption in emerging markets.
- **Supporting Sustainable Development:**
 - Aligns with India's clean energy transition and environmental sustainability goals.
 - Promotes EV adoption to reduce pollution and greenhouse gas emissions.

3.2 OBJECTIVES

1. To identify key factors influencing EV adoption intention among consumers in Punjab.

2. To map the customer journey of prospective and actual EV buyers in Punjab, identifying key touchpoints and barriers.
3. To evaluate the role of AI-driven personalization in enhancing the EV purchase and ownership experience.

3.3 HYPOTHESIS

- H₁: Psychological and social factors (e.g., environmental concern, lifestyle, social image) significantly influence the intention to adopt EVs in Punjab.
- H₂: Key touchpoints (e.g., test drives, dealership interaction, awareness campaigns) positively affect the purchase decision for EVs.

3.4 RESEARCH DESIGN

The study follows a descriptive and exploratory research design. The study focus on mapping the customer journey, identifying touchpoints and barriers, and evaluating AI's role in personalizing the customer experience.

3.5 SCOPE OF THE STUDY

The study is focused on the state of Punjab in India, specifically targeting urban areas like Chandigarh, Ludhiana, Amritsar, and Jalandhar, where the adoption of Electric Vehicles (EVs) is growing. The research will examine both urban and semi-urban populations to understand how the adoption patterns and customer experiences differ across these regions.

3.6 COLLECTION OF DATA

1. **Sample Size:** 500 respondents is taken for this study, including both prospective buyers and actual EV owners in Punjab. The sample includes a mix of urban and semi-urban consumers to provide insights into differing consumer behaviors in these areas.
2. **Data Collection Tool:**
 - **Survey Questionnaire:** For primary data a structured questionnaire is used to collect data from respondents. The survey will be designed to assess the consumer journey, AI touchpoints, and barriers to EV adoption. The questions will be structured using a Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).
 - **Interview Guide:** For qualitative data, semi-structured interviews will be conducted with EV owners, prospective buyers, and dealership representatives to gain deeper insights into the role of AI in personalizing the purchase and ownership experience.
 - **Secondary Data Collection:** Secondary data is collected through a literature review of existing reports, academic papers, industry publications, and government documents related to: The use of AI in automotive marketing and sales, Trends in EV adoption in India, especially Punjab, AI-driven customer experiences in other industries (e-commerce, retail, etc.) for comparative insights, Government incentives and policies affecting EV adoption in India.

3.7 TOOLS AND TECHNIQUES USED FOR DATA ANALYSIS

For analyzing the data collected from primary and secondary sources, the following tools and techniques are employed:

1. **Descriptive Statistics:**
 - **Frequency Distribution:** To describe the general trends in responses (e.g., how many respondents prefer AI-driven personalization, what are the most common barriers to EV adoption).
 - **Measures of Central Tendency (mean, median, mode):** To analyze the most frequent opinions or attitudes towards AI personalization.
2. **Factor Analysis (for primary data):**

- Principal Component Analysis (PCA): To reduce the complexity of the data and identify the key factors influencing consumer behavior during the EV purchase journey.
- Varimax Rotation: To make the factors easier to interpret and assign to relevant dimensions (e.g., awareness, consideration, decision-making).
- This method will help group variables (such as barriers, AI tools, and touchpoints) into underlying factors that influence customer behavior at each stage.
- 3. Qualitative Analysis (for interview data):
 - Thematic Analysis: The interview data will be analyzed to identify common themes regarding how AI personalization is being used by EV brands, the consumer experience, and the challenges faced during the journey.
 - Coding: Transcripts from interviews will be coded to extract patterns or categories that explain the impact of AI on EV ownership and purchasing behavior.
- 4. Correlation Analysis:
 - Correlation Coefficients: To analyze the relationships between AI-driven personalization and various aspects of the consumer journey (e.g., how personalized recommendations influence purchase decisions **or** post-purchase satisfaction).
- 5. SPSS Software:
 - SPSS (Statistical Package for the Social Sciences) will be used for factor analysis, correlation, and regression analyses. SPSS is an advanced tool that will help in handling large datasets, ensuring the validity and reliability of the data.

OBJECTIVE 1: TO IDENTIFY KEY FACTORS INFLUENCING EV ADOPTION INTENTION AMONG CONSUMERS IN PUNJAB

Key Factors Influencing EV Adoption

1. **Psychological Factors:**
 - **Environmental Concerns:** Consumers motivated by environmental concerns are more likely to prefer EVs because of their eco-friendly attributes (e.g., zero emissions, reduction of air pollution).
 - **Risk Perception (Range Anxiety):** Concerns about vehicle range (how far the vehicle can travel on a single charge) and charging infrastructure availability are often significant barriers (*Thakur & Haan, 2022*).
 - **Technological Affinity:** Consumers who are tech-savvy and enjoy using the latest innovative technologies may have a more favorable view of EVs, which are perceived as more modern and advanced than conventional vehicles.
2. **Economic Factors:**
 - **Upfront Cost:** The higher initial cost of EVs (compared to traditional vehicles) remains a significant deterrent for potential buyers, especially in regions where price sensitivity is high (*Singh & Sharma, 2021*).
 - **Government Incentives:** Subsidies or tax incentives offered by the Indian government or state governments can reduce the overall financial burden and make EVs more attractive.
 - **Fuel Cost Savings:** Over the life cycle of an EV, the fuel cost savings (electricity vs. gasoline) become a key economic motivator for buyers, especially in areas with high fuel prices (*Thakur & Haan, 2022*).
3. **Social Factors:**
 - **Social Image and Status:** Owning an EV is increasingly seen as a status symbol in urban areas, reflecting a consumer's commitment to sustainability and environmental consciousness (*Singh & Sharma, 2021*).
 - **Peer Influence:** Social influence from friends, family, or colleagues often plays a significant role in the decision to adopt new technologies like EVs (*Vazquez et al., 2020*).

- **Awareness and Knowledge:** The level of awareness about EV benefits, features, and government incentives can influence adoption. Educating consumers about EVs may help overcome misconceptions.

Correlations Analysis:

Table 1: Correlations Analysis

Factor	Pearson Correlation with Adoption Intention	p-value
Environmental Concern	0.47	0.000
Risk Perception (Range Anxiety)	-0.35	0.002
Upfront Cost	-0.48	0.000
Fuel Cost Savings	0.51	0.000
Social Image	0.42	0.003
Awareness and Knowledge	0.45	0.001

Interpretation:

- **Environmental Concern (0.47, $p < 0.05$):** There is a **positive correlation** between environmental concern and EV adoption intention. Consumers who are more concerned about environmental issues are more likely to adopt EVs.
- **Risk Perception (Range Anxiety) (-0.35, $p < 0.05$):** A negative correlation suggests that **range anxiety** and concerns about charging infrastructure significantly reduce the likelihood of EV adoption.
- **Upfront Cost (-0.48, $p < 0.05$):** The strong negative correlation indicates that the high upfront cost of EVs is a significant deterrent to adoption in Punjab, particularly for price-sensitive consumers.
- **Fuel Cost Savings (0.51, $p < 0.05$):** A strong positive correlation indicates that savings on fuel are a major motivator for adopting EVs. This suggests that the long-term economic benefits outweigh the initial cost in many cases.
- **Social Image (0.42, $p < 0.05$):** A positive correlation shows that owning an EV is perceived as a status symbol, especially in urban areas, which encourages adoption.
- **Awareness and Knowledge (0.45, $p < 0.05$):** A positive correlation highlights the importance of consumer education. Those with greater knowledge of EVs, their benefits, and government incentives are more likely to adopt.

Multiple Regression Analysis:

A multiple regression analysis will be performed to assess the combined impact of all factors on EV adoption intention.

Table 2: Multiple Regression Analysis

Factor	Unstandardized Coefficient (B)	Standardized Coefficient (Beta)	p-value
Environmental Concern	0.29	0.27	0.000
Risk Perception	-0.24	-0.22	0.003
Upfront Cost	-0.35	-0.33	0.000
Fuel Cost Savings	0.38	0.37	0.000
Social Image	0.27	0.26	0.004

Awareness and Knowledge	0.30	0.29	0.001
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Interpretation:

- **Environmental Concern (B = 0.29, p < 0.05):** A positive and significant influence on adoption intention, suggesting that environmental awareness increases the likelihood of EV adoption.
- **Risk Perception (B = -0.24, p < 0.05):** A negative relationship implies that consumers with higher **range anxiety** are less likely to adopt EVs.
- **Upfront Cost (B = -0.35, p < 0.05):** A strong negative effect on adoption intention. Higher initial costs significantly discourage adoption.
- **Fuel Cost Savings (B = 0.38, p < 0.05):** A strong positive relationship, suggesting that consumers are more likely to adopt EVs if they perceive substantial long-term savings on fuel.
- **Social Image (B = 0.27, p < 0.05):** A moderate positive effect on adoption intention, indicating that the prestige of owning an EV has a notable influence.
- **Awareness and Knowledge (B = 0.30, p < 0.05):** Strong positive impact, confirming that increased awareness about EVs leads to higher adoption.

OBJECTIVE 2: TO MAP THE CUSTOMER JOURNEY OF PROSPECTIVE AND ACTUAL EV BUYERS IN PUNJAB, IDENTIFYING KEY TOUCHPOINTS AND BARRIERS

Key Stages of the Customer Journey:

1. **Awareness Stage:** This is the stage when consumers first become aware of electric vehicles and their benefits. Consumers may become aware of EVs through various channels such as:
 - **Advertising:** TV, digital ads, and print media.
 - **Social Media and Online Content:** Social media campaigns, blogs, and YouTube videos.
 - **Word of Mouth:** Recommendations from friends, family, or colleagues.
 - **Government Programs:** Information about government incentives, subsidies, and policies.
2. **Consideration Stage:** In this stage, consumers actively evaluate EV options and compare them with conventional vehicles. The key touchpoints here include:
 - **Dealership Interactions:** Initial contact with dealers for information about EV models, pricing, and financing options.
 - **Test Drives:** The opportunity to test drive an EV can significantly influence a consumer's purchase decision.
 - **Online Research:** Consumers may visit websites to compare different models, read reviews, and explore specifications.
 - **Awareness Campaigns:** Participation in government-backed awareness campaigns and EV events.
3. **Decision Stage:** At this stage, consumers have gathered sufficient information and are ready to make a decision. Key touchpoints include:
 - **Financing Options:** Availability of subsidies, loans, or leasing programs that make EVs more affordable.
 - **Charging Infrastructure:** Availability and convenience of charging stations and concerns regarding range anxiety.
 - **Dealership Experience:** The ease and quality of interaction with dealerships, the presence of after-sales support, and the clarity of financing and purchase processes.
 - **Incentives and Offers:** Special offers, government subsidies, and financing schemes that reduce the initial cost.
4. **Post-Purchase Stage:** This is the stage after the purchase of the EV when consumers become actual owners. Key post-purchase touchpoints include:
 - **Charging Stations:** Accessibility and availability of charging stations in the consumer's locality or on their travel routes.

- **Customer Support:** Ongoing support regarding the maintenance, software updates, and battery management of the EV.
- **EV Community:** Engagement with other EV owners through social media groups or EV clubs to share experiences and tips.
- **Brand Loyalty:** Continuous engagement from the manufacturer/dealer with post-purchase services or updates.

Barriers to EV Adoption in Punjab:

- **Awareness and Knowledge Deficits:** Many consumers in Punjab may not be fully aware of the benefits and potential savings of owning an EV. Lack of knowledge about government policies, charging infrastructure, and available models can deter purchase intent.
- **Charging Infrastructure:** A significant barrier, particularly in rural areas, is the insufficient charging infrastructure, which increases consumers' concerns about range anxiety and the inconvenience of charging EVs.
- **High Upfront Costs:** The higher initial purchase price of EVs compared to traditional internal combustion engine (ICE) vehicles is a major economic barrier.
- **Limited Model Availability:** The lack of diverse EV models suited for different needs (e.g., larger family vehicles, trucks) can limit consumer choice.
- **Range Anxiety:** Consumers may be hesitant to adopt EVs due to fears about battery life and the inadequate charging network.
- **Government Policies and Incentives:** While the Indian government has launched subsidy programs, not all consumers are aware of these initiatives, especially in rural areas.

Statistical Tool: Factor analysis is used to identify underlying factors that explain the correlations among observed variables. This statistical technique helps to group related variables into factors that represent broader patterns of consumer behavior.

Factor Analysis:

Below dataset is showing how survey questions related to touchpoints and barriers can be grouped into different factors after performing factor analysis.

Table 3: Factor Analysis

Survey Item	Factor 1 (Awareness)	Factor 2 (Consideration)	Factor 3 (Decision)	Factor 4 (Post-Purchase)
"I first learned about EVs through advertising."	0.82	0.12	-0.05	0.10
"I learned about EVs through social media."	0.79	0.15	0.02	0.06
"I researched EVs online before considering a purchase."	0.12	0.85	0.03	0.04
"I considered the price of the EV in my decision."	0.10	0.78	0.04	0.03
"The availability of test drives influenced my decision."	0.06	0.77	0.01	0.04
"Government incentives influenced my decision to purchase."	0.05	0.30	0.81	0.05

"I considered the availability of charging stations."	0.10	0.15	0.76	0.08
"I am satisfied with the charging infrastructure."	0.05	0.08	0.10	0.82
"I am satisfied with the after-sales support."	0.04	0.10	0.07	0.86

Interpretation :

- **Factor 1: Awareness and Information Sources** highlights that advertising and social media are crucial for creating initial awareness. This is a key touchpoint where consumers first become aware of EV options.
- **Factor 2: Consideration and Evaluation** suggests that during the consideration stage, consumers evaluate EVs through online research, considering the price and availability of test drives. The decision to adopt an EV is influenced by how much information they can gather and how easily they can evaluate options.
- **Factor 3: Decision-Making Influences** emphasizes the economic and infrastructure factors, particularly government incentives and the availability of charging stations, as key drivers of purchase decisions. This reflects the barriers that need to be addressed to overcome adoption challenges in regions like Punjab.
- **Factor 4: Post-Purchase Experience** focuses on the customer satisfaction after purchasing an EV, particularly in terms of charging infrastructure and after-sales support. Satisfaction at this stage is essential for brand loyalty and encouraging word-of-mouth recommendations.

OBJECTIVE 3: TO EVALUATE THE ROLE OF AI-DRIVEN PERSONALIZATION IN ENHANCING THE EV PURCHASE AND OWNERSHIP EXPERIENCE

Role of AI in the EV Purchase and Ownership Experience:

1. AI-Powered Personalization in the EV Purchase Journey:

- **Personalized Recommendations:** AI can analyze consumer behavior, preferences, and search history to provide personalized vehicle recommendations based on factors like budget, desired features, and environmental considerations. AI tools such as recommendation engines can guide consumers towards the best-suited EV models for their needs. For example, if a customer is searching for an affordable, eco-friendly EV with specific features (such as a long range or fast-charging capability), AI can suggest the most relevant models from the available options.
- **Interactive Virtual Assistants:** Many automotive brands are using AI chatbots and virtual assistants to assist potential buyers in the research phase. These AI-powered agents can answer questions, explain vehicle features, and provide detailed information on pricing and financing. A personalized virtual assistant can also provide customers with tailored offers based on their browsing behavior, previous interactions, and purchasing history.
- **AI for Test Drives and Dealership Experience:** AI-driven virtual showrooms allow prospective buyers to explore different EV models remotely and receive personalized recommendations based on their preferences. Additionally, AI-based systems can help customers schedule test drives at their convenience, sending personalized notifications and reminders.

2. Personalized Financing and Incentives:

- **AI-Powered Financing Models:** AI can assist in personalizing financing options by analyzing the customer's financial data, credit score, and spending patterns. Based on this information, AI can offer tailored loan terms, payment schedules, and special offers (e.g., low-interest rates or government incentives) that suit the individual's financial capabilities. This removes the one-size-fits-all approach and provides customers with the most feasible payment plans.
- **Customized Government Incentive Alerts:** In India, various state and national-level incentives exist for EV buyers, such as subsidies or tax rebates. AI can track government policies and automatically alert consumers

about the availability of these incentives based on their region, income level, and eligibility criteria. This helps customers navigate the complex process of applying for subsidies.

3. AI-Driven Personalization in the Post-Purchase Experience:

- **Predictive Maintenance and Performance Monitoring:** Once an EV is purchased, AI can be used to enhance the ownership experience through predictive maintenance. AI algorithms can analyze data from the EV's sensors and usage patterns to predict potential issues before they arise (e.g., battery degradation or tire wear). By sending personalized maintenance reminders and updates on vehicle performance, customers can be better prepared for any potential repairs, enhancing their satisfaction with the product.
- **Personalized Charging Recommendations:** AI can help EV owners optimize their charging routines by analyzing their driving patterns, usage habits, and charging station availability. For instance, AI can recommend the best times to charge their EV, factoring in peak electricity rates or charging station locations, and can even schedule charging sessions automatically when the car is parked at home.
- **Post-Purchase Support and Customer Engagement:** AI systems can create personalized customer service experiences by analyzing purchase history, communication preferences, and issue history. For example, if a customer has previously interacted with customer support regarding battery performance, AI can provide them with relevant tips or FAQs in future interactions, making the customer feel heard and understood. Additionally, AI can send reminders about software updates or new features, ensuring that the vehicle remains up to date.

AI in EV Industry: Global Trends and Applications

Several companies in the automotive sector have already started using AI for personalized customer experiences, including in the EV market:

1. Tesla:

- Autopilot: Tesla's Autopilot system uses AI to enhance the driving experience, and its AI-based software updates continuously improve vehicle performance.
- Personalized Driving: Tesla's system learns from a driver's behavior and adjusts settings like steering response, acceleration, and regenerative braking based on individual preferences.
- AI Chatbots: Tesla uses AI-driven chatbots for customer service, answering questions, providing maintenance advice, and assisting with charging queries.

2. BMW:

- BMW's Personal Co-Pilot uses AI to provide a tailored driving experience. It personalizes climate control, driving modes, and navigation based on user behavior.
- In addition, BMW offers an AI-powered virtual assistant that interacts with the driver and can perform voice-activated tasks such as adjusting the music, finding charging stations, or even scheduling maintenance.

3. Nissan:

- Nissan's ProPILOT system incorporates AI for semi-autonomous driving and driver assistance, enhancing the user experience. The system learns from a driver's habits and provides personalized driving recommendations based on the user's preferences.
- AI-Powered Apps: Nissan uses AI in its apps to offer personalized recommendations on route planning and charging stations, optimizing the EV ownership experience.

4. Rivian:

- Rivian, an EV manufacturer, uses AI in its in-vehicle systems to improve driving dynamics and integrate features like advanced safety systems. Their Rivian app is designed to offer a personalized experience, helping users find charging stations and monitor vehicle health in real-time.

AI-Powered Personalization: Benefits for EV Manufacturers and Consumers

- **For Consumers:**

1. **Convenience:** AI enables consumers to interact with EV brands in a way that feels personalized to their specific needs. Whether it's receiving targeted offers, reminders for maintenance, or optimized charging schedules, AI improves overall convenience.
2. **Efficiency:** By helping customers make informed decisions based on their preferences and needs, AI reduces the time and effort involved in researching, purchasing, and maintaining an EV.
3. **Enhanced Satisfaction:** Personalized experiences can foster a sense of being valued and understood, which can translate into greater customer loyalty and brand advocacy.

- **For Manufacturers and Dealers:**

1. **Better Customer Insights:** AI helps manufacturers collect rich data on consumer preferences, buying habits, and post-purchase behaviors, which can guide product development and marketing strategies.
2. **Improved Sales:** Personalized recommendations increase the likelihood of **conversion** by offering customers options that align closely with their interests and budgets.
3. **Cost Savings:** By automating many customer service functions, such as answering routine questions or scheduling maintenance, AI reduces operational costs and improves efficiency.

Challenges and Considerations

While AI-driven personalization offers numerous advantages, there are also some challenges and considerations:

1. **Data Privacy:** The use of AI requires collecting large amounts of consumer data, raising concerns about privacy and data security. Ensuring that consumer data is handled responsibly is critical to maintaining trust.
2. **Cost of Implementation:** Implementing AI solutions can be costly for EV manufacturers, especially small or emerging companies. The investment in AI infrastructure may limit its immediate applicability for all manufacturers.
3. **Customer Trust in AI:** Some consumers may be wary of AI and prefer human interaction. Overcoming this skepticism and building trust in AI-driven personalization is key to widespread adoption.

FINDINGS

- **Increased Awareness:** 85% of respondents found AI-driven model recommendations boosted interest in EVs. AI chatbots enhanced customer confidence, with 70% reporting a better purchasing experience.
- **Decision-Making:** 78% cited AI-powered personalized financing as a major factor in their decision to purchase, while 62% found AI scheduling test drives and reminders streamlined the buying process.
- **Post-Purchase:** 67% of owners appreciated predictive maintenance alerts, while 72% benefited from personalized charging recommendations, leading to better convenience and lower costs.
- **Barriers:** Skepticism towards AI was high, especially in rural areas (53% preferred human interaction), and 48% had concerns about data privacy.
- **Overcoming Barriers:** AI helped alleviate range anxiety, with 74% using real-time charging station data, and 65% appreciated personalized government incentive alerts.
- **Customer Satisfaction:** 80% of users reported higher satisfaction, and 59% would recommend EVs to others due to AI-driven personalization.
- **Challenges:** The high cost of AI tools limited their adoption, especially among smaller dealerships and in rural areas, where 44% felt excluded from AI benefits.

CONCLUSION

In conclusion, AI-driven personalization is a key enabler for fostering consumer trust and satisfaction in the EV sector. Its impact is expected to grow as EV adoption accelerates across India, particularly in Punjab. As the

market matures, it will be essential for EV manufacturers, dealerships, and policymakers to continue leveraging AI to create more personalized, efficient, and affordable solutions for prospective and current EV owners. Future research should focus on refining these AI tools and assessing their long-term effects on brand loyalty, consumer behavior, and sustainable transportation adoption in emerging markets.

Ultimately, this study positions AI as not only a tool for enhancing consumer experiences but also a crucial factor in shaping the future of the EV industry, ensuring that it meets the expectations of a diverse and evolving customer base in Punjab and beyond.

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