

User Characteristics and the Adoption of Electric Beca (eBECA) Technology in Malaysia's Heritage Tourism Context

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DOI Link: <http://dx.doi.org/10.6007/IJARBSS/v16-i1/27378>

Published Date: 15 January 2026

Abstract

There is a growing need for sustainable mobility solutions in heritage tourism, where the environment should be reconciled with cultural preservation. In Malaysia, the electric beca (eBECA) was developed as part of efforts to improve traditional trishaw services without neglecting their cultural and socio-economic roles. This study aims to establish the level user characteristics as a factor in the adoption of eBECA technology in Malaysia heritage tourism context in Bandar Hilir, Melaka and Pasar Payang, Terengganu. Data from 388 respondents including locals, tourists and beca customers were collected through a quantitative research design. A Pearson correlation and multiple linear regression were used to explore the relationships among product field commitment, innovation-related core benefit, expected financial benefit and user–manufacturer interaction factors, as well as eBECA acceptance. Findings were that, although the relation with adoption readiness for all variables is positive, product field commitment was the only significant predictor of the intention to adopt eBECA. The regression model is 43.5%, indicating an acceptable amount of explanation power. These results indicate that the intrinsic adherence, engagement and long-term involvement of users with the product field of beca is more important for adoption than technological novelty, financial incentives or manufacturer interaction. The research extends the literature on sustainable mobility and heritage tourism by highlighting the significance of values-led, user-focused strategies for promoting green transport innovations.

Keywords: Electric beca (eBECA), Technology Adoption, User Characteristics, Heritage Tourism, Sustainable Mobility

Introduction

Beca or a rickshaw is an important cultural scene in Malaysia, it has always been used as a mode of transport and tourist attraction especially for heritage cities like Melaka and

Terengganu. More than a mode of transport, the beca embodies local identity, traditional skill and community livelihoods and therefore is an integral part of Malaysia's heritage tourism family. In view of growing environmental concerns and the worldwide transition to sustainable mobility, traditional beca has transformed technologically as electric beca (eBECA) that consist of an electric or solar system, while maintaining its cultural identity and tourism fun factor (Musa et al., 2024; Musa et al., 2025a).

The inclusion of electric mobility in heritage tourism is part of a global movement to promote sustainable transport and low-carbon urban systems (Almansour, 2022). Following the Diffusion of Innovations theory (Rogers, 2003), successful adoption relies on social compatibility and relative advantage in user's perspective, local culture and identity need to be taken into account in innovation diffusion models. For Malaysia's heritage tourism, the electric beca (eBECA) is a result of environmental progress with aspects of cultural sustainability and socio-economic upliftment among local communities. Both technological modernization and cultural preservation are reflected, placing the eBECA project in wider sustainability and social innovation frames (Gruber, 2020; Huang & Qian, 2021).

The previous works pertaining to the development of eBECA in Malaysia reiterated that this innovation signifies more than just a technological enhancement but rather a user-centric and value-driven solution towards sustaining heritage transportation with an approach to balance between environmental sustainability and socio-cultural conservation (Musa et al., 2025b). Hence, the success of eBECA implementation is contingent not only upon technological capabilities but also users' attributes, commitment towards product domain and their attitude concerning to compatibility perception between innovation and heritage values that emphasizes the necessity to understand user's perspective in order to assure long term sustainability of eBECA impact on Malaysia's heritage tourism context.

Despite growing interest in electric vehicle (EV) adoption, few studies that investigate how user factors influence the acceptance of culturally ingrained transport innovations such as eBECA. Previous studies on EV mainly have focused on technical efficiency and not paid enough attention to social and cultural factors influencing adoption (Asadi et al., 2021; Goel et al., 2023). The absence of empirical evidence on the impact of heritage identity and product familiarity among users on the adoption of innovation poses a gap in Malaysia's tourism mobility literature. Filling this gap is valuable to sustainable tourism literature as well as to applied innovation management in developing countries (Noppers et al., 2019).

The central research issue that the research addresses is the insufficient knowledge of user-centered factors in adopting sustainable transport technologies in heritage contexts. Whilst contemporary discussions in social sciences highlight the diffusion of technology and change of behaviour (Breschi et al., 2023; Han & Yang, 2020), fewer nod to how identity, cultural affiliation and socioeconomic context interact with innovation uptake. Therefore, this study aims to combine TAMs with socio-cultural frameworks in order to create a more comprehensive understanding eBECA adoption in Malaysia's heritage cities.

In addition, policy packages to stimulate EV adoption like eBECA ought to be more human-oriented giving preference to climate and social targets which may contribute even more strongly toward sustainable diffusions (Breschi et al., 2023). Utilization of electric beca

(eBECA) technology as an environment friendly mode of transportation has attracted considerable interests. The solar-powered electric technology (eBECA) is one of the innovative transport solutions recently launched in Malaysia (Bernama, 2022). Previous research in the field of electric vehicle adoption has identified several important factors that influence user behavior, such as environmental concern, perceived usefulness, perceived ease of use, and social norms (Asadi et al., 2021).

Nevertheless, very few studies emphasise users and even rickshaw pullers characteristics in the acceptance of eBECA technology within Malaysia. This gap in the literature is addressed by this study, which seeks to understand distinct demographics and preferences among adults who are interested in adopting eBECA. An understanding of these factors is important for policy makers, manufacturers and city planners to promote and facilitate the use of eBECA technology (Abbasi et al., 2021).

Recent real-life empirical research in emerging markets has revealed that social and cultural context plays a significant role in moderating the effect of adoption of technology (Kapsler & Abdelrahman, 2020; Manutworakit & Choocharukul, 2022). Based on these arguments, this study advances current models by addressing the effect of product field commitment, i.e., the long-term engagement and identity connectedness with beca as a user, on eBECA adoption behavior. By concentrating on Malaysia's cultural heritage tourism, this paper provides new empirical evidence to the debate concerning sustainability mobility transitions in culturally sensitive regions (Musa et al., 2025a; Musa et al., 2025b).

In addition, Asadi et al. (2021) developed two theoretical models called the Norm Activation Model (NAM) and the Theory of Planned Behavior (TPB) to better understand consumer attitudes towards EV adoption. Research on heritage tourism highlights the significant role of tourist characteristics in economic growth, especially in modern times (Md Khairi et al., 2020). The application of Rogers' Diffusion of Innovation theory indicates that the younger, wealthier and sustainability-devoted generations who have a previous positive experience with electric cars are more prone to adopt EVs. Therefore, in order to better understand the determinants of eBECA adoption among Malaysians, additional empirical studies on diffusion of innovation models might be necessary.

The government of Malaysia wants to create green technology cities, through the incorporation of climate-sensitive urban planning principles that optimize natural resources and stimulate economic prosperity while protecting biodiversity. This project, and sustainable transportation like eBECA, leads to energy efficiency and decreases greenhouse gas emissions (Almansour, 2022). Furthermore, the high adoption of EVs by users is because they are interesting in terms of features and technology (Ullah et al., 2021).

According to the Ministry of Tourism, Arts, and Culture Malaysia (MOTAC), eBECA will showcase Malaysia's unique heritage, culture, and societal values, creating awareness among visitors (Bahrain News Agency, 2021). A study by Manzoor et al. (2019) emphasizes that high recognition in tourism can positively impact GDP and employment rates. Although extensive literature on user characteristics exists, additional research on eBECA adoption is still limited due to varying findings across innovation studies in diverse contexts.

Technology has been integrated to the traditional beca with eBECA, there is no longer need for physical force for pedaling and transporting passengers than in past versions. On the other hand, eBECA relies on solar powered technology for motion. Nevertheless, elements such as user-acceptance, cost-efficiency, the environmental settings that will host them, their socio-economic value and age-vs.-wear-modeling considerations may appear as challenges for the beca community. Many must read in trying to figure out the actions and motivations of all concerned. A major problem surfaced in a mStar article report last year which sought to address eBECA impact towards the traditional rickshaw puller income and industry (New Straits Times, 2023). The government has retorted that it is what is transforming Malaysia into a nation of green economy, and benefits all parties except the beca cycle community must get their facts right to adopt.

Moreover, Bakar (2020) claims that rickshaw pullers in Bandar Hilir, Malaysia may spend a lot on light displays and decorations to appeal to the clients. While these changes may be exciting for tourists, they serve to dilute the signature heritage of trishaws. Bernama, (2022). Some citizens believe that such decorations are not representative of the Malaysian identity; therefore, understanding trishaw users' standard with the decoration is important to ensure that the benefits of eBECA adoption accrue to all stakeholders.

Trishaw peddlers tend to be old dudes, but not everybody involved in the trishaw biz is terminally geriatric. A survey conducted in Bandar Hilir revealed the active involvement of the youth and their innovative element to attract gig-economy tourism (Tazali, 2022). A boom in Malaysia's gig economy has created job opportunities, especially for the youth who suffered as a result of the economic crisis (Business Today, 2022). Nevertheless, the age of trishaw pullers can affect their productivity (Hanpatthan Nuson, 2021). As Al-Lawati (2019) mentioned that, traits of personality and technical knowledge and work values are contributors of generational gaps, there is a need to understand the differences to successfully assimilate. In an attempt to help rickshaw pullers, earn a living, the previous government suggested a 'free car zone' near Jonker Walk, however problems such as lack of parking and traffic jams have not been fixed (Yaacob, 2019).

Traders fear, recent reports in The Star (2023) suggest that it might negatively affect businesses that rely on tourism. This raises concerns for tourists who have to trek longer distances to shop. The vague notion of "range anxiety" in EV acceptance has a large effect on driver comfort as affected by charging infrastructure availability is comparable to overall driver stress. In response to this, the UAE has invested heavily in charging infrastructure with recent research highlighting the importance of access to reliable charging facilities (Chamberlain & Majeed, 2021). Similarly, Wang et al. (2021) emphasize that improving the quality of charging service is important to attract a greater number of EV drivers, increasing the penetration rate of sustainable transportation.

According to Noppers et al. (2019), a primary objective of the innovation literature is to determine the attributes of individuals that influence the adoption of an innovation. There were several steps that users needed to complete before implementing the innovation. Users acknowledged the potential of the innovation by utilizing their skills and abilities in their decision-making process regarding its adoption. The support from top management and the technological infrastructure within an organization have a significant influence on innovation

(Rajan et al., 2020). Gaining adequate legitimacy is a crucial factor for the success of technology adoption within organizations. This is because acceptance from top management is necessary to ensure the realization of expected benefits and to overcome any potential barriers.

Consequently, these circumstances have sparked interest in exploring the adoption of innovations across these levels (Ren, 2019). Meanwhile, empirical study from the (Fritsch & Wyrwich, 2019) clearly indicates that users play a critical role in a new product advancement. This is supported by (Whittle et al., 2019) and (Huang & Qian, 2021) claim that, in the realm of innovation, policy interventions must consider the preferences, needs, experiences, and identities of users in order to be both effective and sustainable. Moreover, the users' capability for innovation exerts a beneficial influence on both the general and average levels of ideas declared by (Han & Yang, 2020).

The scope of this study focuses on the characteristics of users toward the adoption of eBECA in Bandar Hilir, Melaka and Pasar Payang, Terengganu Malaysia. The respondents for this research are the public with no experience or experience riding the beca, including both local residents and tourists, as well as the rickshaw pullers. This study aims to collect data on the adoption of eBECA in Malaysia in order to identify how it can be implemented and adopted effectively. Furthermore, a quantitative study could provide justification for the adoption of eBECA in Malaysia. This would help in identifying the best approach to implementing the eBECA technology. The main target of this study is to benefit the beca riders by providing them with a better and more comfortable ride, as well as contribute to the tourist attraction in the area.

This study is expected to contribute emergent insights toward uptake of eBECA in Malaysia and the community. It stresses that the time is ripe for government to carry out efforts to revitalize beca as a Malaysian cultural heritage, so as to achieve overall development especially in caring for the well-being of who depends on being for source of income. It is important to understand the end-users, rickshaw pullers, as it aids in determining some of the main factors influencing the adoption for this innovation. The beca community as a whole (charioteers and users) also benefits considerably from that research. With greater knowledge of their needs and preferences, more developers, and everyone in society can get involved in the development and improvement of eBECA, resulting in a more vigorous community.

Literature Review

Historical studies on the adoption of electric bicycles (eBECA) in Malaysia found that user's acceptance, heritage compatibility and sustainability are key factors to the adoption outcome. Earlier work by Musa et al. (2023) have pointed out, adoption of eBECA is not merely a technological matter for heritage tourism users in this context; it is how they perceive the need to preserve traditional identity as well.

Musa et. (2024) reported that user acceptance of eBECA was influenced by perceived compatibility on innovation and heritage value especially in the context of a heritage city such as Melaka. Recent studies have also revealed the high level of motivation offered by eBECA as a sustainable mobility innovation from the perspective of users, since personal

dedication to eBECA service and long-term commitment in the beca product domain are key elements that can influence adopter behavior (Musa et al., 2025a; Musa et al., 2025b). Altogether these findings contribute to a body of evidence which lend themselves to the argument that sustainable heritage transport innovation can only be based on suitable balance between technology push and social cultural pull if long term sustainability is to be achieved.

Electric vehicle (EV) technology is increasingly becoming a vital part of sustainable urban mobility in the tourism sector, driven by environmental, social and cultural imperatives. Challenges faced include moving from the traditional beca or trishaw to electric beca (eBECA) in heritage area like Melaka and Terengganu which shows efforts for equilibrium cultural preservation with environmental protection (Nurathirah & Haslinda, 2023). This section reviews the main literature on eBECA adoption, highlighting design, relative advantage, complexity, compatibility and observability factors to adopt sustainable mobility across different contexts.

Adoption Factors

Design Considerations eBECA

The characteristics of users are positively associated with all the types of innovations; thus, it is critical to identify different types of innovations towards the adoption (Demircioglu et al., 2019). This is supported by (Xia et al., 2022) and (Lashari et al., 2021) from their empirical study which indicates that user's adoption towards the EV can be effectively influence by three important innovation characteristics namely, perceived compatibility, perceived complexity, and perceived relative advantage. Apart from that, study from (Xu et al., 2020b) state that users' driving experience also have an impact on adoption intentions as well as (Ma et al., 2019) confirm that EV aesthetics play a significant role in consumer choice. Moreover, (Asadi et al., 2021) claim that top management role in terms of tax redemption, price advantage and guarantee battery life are significant towards the users in making decisions. This is supported by (Jeon et al., 2021), (Ma et al., 2019) and (Chew et al., n.d.) as top management commitment has many implications in boosting competitive advantage through strategy and policy development

Commitment to Product Field

Commitment to a product field refers to a person's dedication, loyalty, and long-term involvement in a specific area or industry related to a particular product. It signifies a deep level of engagement, passion, and investment in understanding, developing, and advancing products within that field. Previous studies have found that customer satisfaction and customer commitment have a substantial influence on sustainable customer purchasing (Hongsuchon et al., 2022). A study from (Featherman et al., 2021) states that, product-related knowledge encompasses understanding about the product's architecture, the materials and technologies used in the existing products in the market. Users must have this knowledge to transform their needs and demands, expressed in the customer language, into concrete technical product and service specifications in the language of engineer, in order to understand well this new adoption of eBECA technology.

Basically, based on Theory Planned Behaviour (TPB) framework, many companies understand that acquiring new customers can be costlier than retaining existing ones, in

results loyalty programs have become a popular customer relationship management tool for businesses to cultivate and sustain relationships with their customers as well as generate revenue to the company (Seridaran & Mohd Noor, 2021).

Some research addresses the theory of Customer Engagement (CEN), experiences and satisfaction in relation to companies, as it may have hedonic effects on customers and drive behaviors like giving product recommendations, participating in word-of-mouth promotion, making repeat purchases and contributing with feedback for improving products (Rasoolimanesh et al., 2021; Kumar et al., 2019).

This points to the need of understanding the user's profile in order to experience a new technology, since eBECA as an innovation is not yet perceived by the beca community. They argue that this innovation will serve to suppress and eliminate the traditional or heritage values of beca whereas the state government argued that this innovation is in accordance with Malaysia's vision towards greener state and concern for environment (New Straits Times, 2023).

Other than that, more confusion is piled up regarding the understanding of user behavior towards this product field, which is eBECA. According to the local news Harian Metro (2021), one of the rickshaw pullers decorates their beca with popular cartoon characters such as Spiderman and Frozen to attract tourists. These cartoon characters are famous among tourists and satisfy both parents and kids who are riding the beca. The LED lights also play a vital role in attracting tourists by bringing joy and sentimental values. However, some people claim that this kind of innovation would undermine the heritage of Malaysia (Bakar, 2020). Thus, this shows that studying the commitment towards the product field is vital as it becomes complex when involving human behaviors.

Furthermore, perceived usefulness and perceived ease of use from innovation products have significant effects on users' satisfaction, investment size, and quality of available alternatives, and these three constructs influence users' relationship commitment towards the innovation product, which influences users' continuing intention (Cho et al., 2020). Other than that, users who are experiencing driving or riding the EV shown a significant direct effect towards the EV adoption intentions (Xu et al., 2020). Proven research from Tarei et al. (2021) suggests that barriers related to electric vehicles (EVs), such as performance and range limitations, the total cost of ownership, shortage of charging infrastructure, and lack of consumer awareness about EV technology, critically influence the adoption of EVs.

Other proven studies by Sovacool et al. (2019) and Chen et al. (2020) claim that people that have higher income are more likely to own the EV car. This is also supported by Mandy (2021) that early adopters with higher levels of education and higher income are more likely to use the EV car. While Krishnan and Koshy (2021) claim that people who commute short distances, have a lower income, a better education, and more experience driving conventional vehicles are more likely to embrace EVs. This contradicts opinions shown that it is important to understand factors that would influence the character of users in adopting the EV.

Innovation Related Core Benefit

Abbasi et al. (2021) state that the Theory of Planned Behavior (TPB) is a psychological theory that explains the psychological phenomena of human behavioral intention. Explaining human behavior is a difficult task and complex, innovation literature proposed that people who adopt technological innovations have indicated that individual preferences towards innovations are influenced by the preferences of others and this indicates that conformity with group norms and mutual contagions play a significant role in shaping individual inclinations (Breschi et al., 2023). According to the research by Ullah et al. (2021) state that in his finding, the adoption rate of electric vehicle (EV) across the globe are still meager even though the spreading of word-of-mouth among the social circle are effective, but there are still have limitation to encourage others in adopting EV. One of it is related to the safety features of the EV.

Study from Deng et al. (2020) safety is one of the concerns in using EV. The structure of electric rickshaws is highly fragile, unstable, and prone to toppling. These vehicles lack safety devices such as safety belts or anti-lock braking systems (ABS). Unlike cars, electric rickshaws have not been designed to withstand collisions and ensure crashworthiness (Priye & Manoj, 2020). Riders have expressed feelings of fear while traveling in electric rickshaws, yet there is a dearth of academic studies examining public experiences in the literature (Khazaei & Tareq, 2021). This is supported by Tu and Yang (2019) by designing safer electric vehicles will promote safe driving behaviors and create a safer driving environment.

Nowadays, innovative solutions typically involve a mix of diverse technologies, institutions, and user behaviors, which are interdependent and co-evolve making understanding the adoption of innovation is limited such as electric mobility (Gruber, 2020). Many researchers had stated that users often play a vital role in development of new products. Lashari et al. (2021) claim that understanding users' attitudes and perceptions in purchasing the electric vehicle (EV) would be helpful in developing marketing strategies to improve the applicability of current policies regarding EV adoption. Research on innovation by "lead users" suggests that high benefit expectations are often linked to the experience of new needs that are not addressed by existing market offerings (Featherman et al., 2021). Users who seek to fulfill new needs through the use of a particular new product are likely to exhibit innovative behavior. Thus, identifying users with new and unfulfilled needs is a promising strategy for identifying innovative users.

In addition, alongside the diffusion of electric rickshaw and EV in Malaysia had shown prominence towards the economy. The cooperation between the state governments and local companies will provide long-term benefits in strengthening the development of the automotive industry in Malaysia from the investment received. Besides, this novel action would bring enormous benefits in boosting Malaysia's economy such as job opportunities as well as creating a downstream industry within the local automotive industry (News Straits Times, 2022).

Tazali (2022) states that the profession of trishaw pullers indeed has a place among the younger generation, who are capable of carrying on the legacy of the state's proud heritage. (Lam, 2022) argue that with the rise of the gig economy, young people now have alternative means to generate income that, in some cases, may be financially more rewarding

than regular employment. While the gig economy no doubt offers quick money, it may provide less stability, security, and earning potential than a more "regular" career in the long term. Therefore, the introduction of high-tech, user-friendly, and innovative eBECA will not only benefit the existing rickshaw pullers but also attract the interest of the younger generation to enter this field (Adlan, 2022).

Apart from that, rickshaw pullers are satisfied with the innovation of eBECA since it is more practical and easier for them to use (Bernama, 2022). It has been revealed that this new eBECA is equipped with an LED screen for information and promotional displays, as well as an attractive audio system that can invigorate the rickshaw industry. Additionally, the use of eBECA not only reduces the physical exertion of the rickshaw pullers but also can shorten travel time by up to 15 minutes. Lack of facilities such as charging stations will influence user acceptance in travel time and waiting time (Asna et al., 2023).

Expected Financial Benefit

According to a recent study conducted by Goel et al. (2023) it has been found that there exists a positive relationship between the financial attributes and psychological traits of individuals who choose to adopt electric vehicles (EVs). Based on the study, it also confirms the validity of the norm activation model (NAM) in explaining how consumers' attitudes towards environmentally friendly decision-making and their strategies for social responsibility impact their perceptions and intentions regarding travel making decisions. Additionally, by 2020 Malaysia has set a goal to transform into a state that prioritizes and embraces green technology. Malaysia Green Technology and Climate Change (MGTC,2023) have committed to achieve zero greenhouse gas emissions by 2050.

Through the 2023 budget, the government also provides full exemption on import and excise duties, as well as sales tax, for EV to support the development of the local EV industry. There are also incentives on rental and subscription fees of EV charging facilities (Natrah, 2021). Findings from Gai et al. (2020) claim that it is likely that users desire not only benefited from utilizing a product but also financial compensation for adopting the innovation. There is no criticism of the relationship between users' characteristics and financial incentives. According to (Lashari et al., 2021; Goel et al., 2023; Asadi et al., 2021) the expected financial benefits in adopting the EV are often involved with government incentives, EV recharging infrastructure, environmental benefits, and safety rides.

Apart from that, the expenses of using the battery in commuting the e-Rickshaw might differ for each rickshaw puller. This is due to the varying distances travelled based on their different locations, which can significantly impact the battery usage. This is supported by Sun et al. (2019) and Tirpude (2020) power system generation and delivery costs can be further reduced by adopting a flexible EV charge/travel schedule, with most EV users benefiting from the optimization of transportation, charge/discharge, and power system supply schedules. Moreover, funding is necessary to offer financial assistance, such as incentives, to users in order to promote the advancement of green technology initiatives, particularly in the electric vehicle (EV) sector (Abas et al., 2019).

User - Manufacturer Interaction

In previous studies, several words were employed to define users and manufacturers. According to Hasan (2021), users are any organization or person who expects to derive benefits from the use of services or products. Meanwhile, a manufacturer is any organization that seeks to profit from providing its services or products to others. As a result, during the innovation process, users and manufacturers can be separated based on acquisition and benefit costs (Liu et al., 2020). Interaction is essential for exchanging information about a new product, which has motivated large corporations to use information technology to develop networks for outsiders that encompass all of their marketing operations. This is declared by (Broadbent et al., 2021) as increased EV procurement by businesses may improve prospects for positive information distribution through the peers.

Innovation benefits are not necessarily related solely to the outcome of user inventions. Innovating consumers should also benefit from the innovation process itself. Users can enjoy solving problems during the development process and have the opportunity to utilize their abilities and knowledge to gain satisfaction (Arranz et al., 2020). Furthermore, the role of top management in using the EV usually influences decision-making procedures in the adoption of technology in a corporation (Rejikumar et al., 2020).

Methodology

A research design is a framework or blueprint for conducting the study and for collecting, managing, and analyzing data. It guarantees that the research aims are approached in a logical and systematic way (Saunders et al., 2019). It is generally accepted that research designs may be broadly categorized as: exploratory description and explanatory (Creswell & Creswell, 2018).

The research design employed in this study is quantitative with descriptive and explanatory components. Descriptive information is employed to recognize the characteristics, perceptions, and attitudes of users towards adopting technology. This is appropriate when one seeks to summarize the patterns or relationships within a population and numerical data are involved (Sekaran & Bougie, 2020).

The explanatory part of the design is used to investigate the connections between n user-related factors and adoption intention. Explanatory research can be used by investigators to trial theoretical relationships and analyze the impact of independent variables on dependent variable using statistical techniques (Hair et al., 2022). This technique is suitable when the research question seeks to report why selected variables significantly affect the adoption behavior.

A quantitative methodology is chosen since it allows for quantitative measurement and statistical analysis. Through quantitative methods it is possible to analyze data by means of correlation and regression analysis that can reveal the strength, direction, and significance of relationships between variables (Field, 2018). This provides evidence that findings can be generalized to the population of study.

In general, a descriptive explanatory quantitative research design is appropriate for studies that aim to describe and explain adoption behavior. The design corresponds to the

results of the study, because it offers with empirical material which user characteristics have a substantial impact on technology adoption under methodological stringency and analytical transparency.

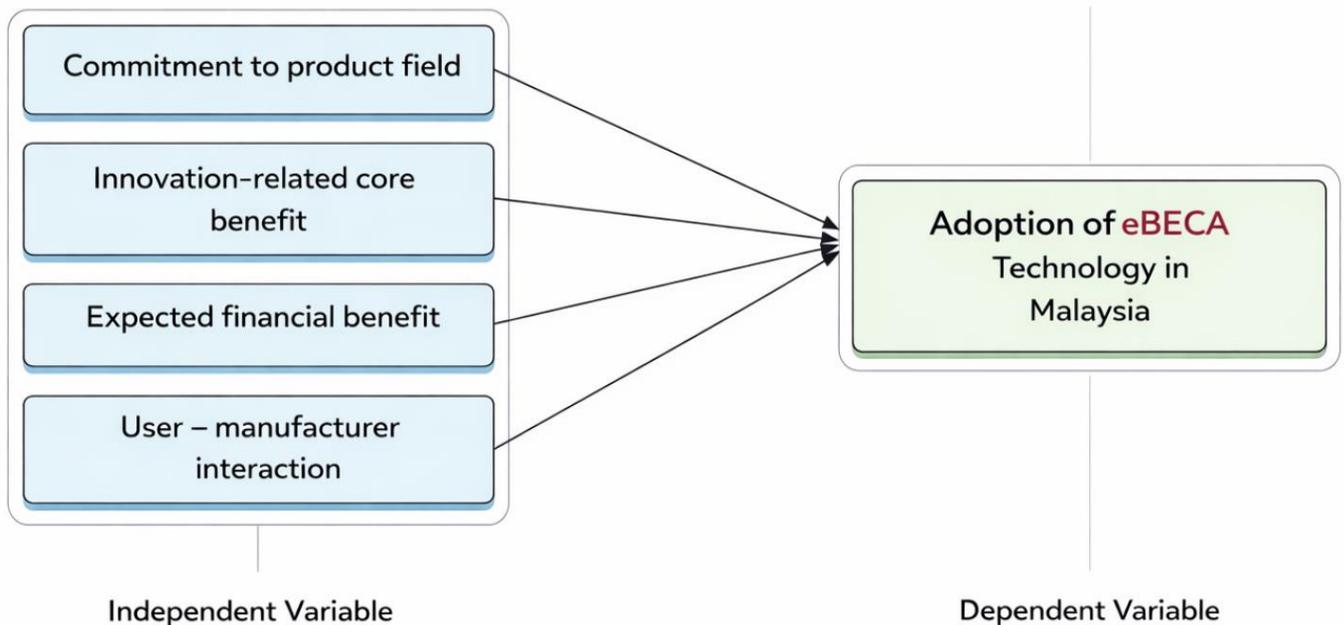


Figure 1: The Research Model

Finding and Observations

Pilot Test

A sample of 30 respondents with prior experience using the beca technology was required to participate in the questionnaire survey. This step aimed to enhance the questionnaire's quality for future data collection efforts. The researcher utilized SPSS software version 27.0 to assess the survey's reliability based on the gathered data. The reliability results of the pilot test are presented in Table 4.1 below. The questionnaire comprises 22 items. Additionally, the calculated Cronbach's Alpha value is 0.958, surpassing the threshold of 0.7. This high value categorizes the internal consistency as excellent. Consequently, the pilot test analysis demonstrates robust reliability, affirming the questionnaire's dependability (Saunders et al. 2019).

Table 1
Summary of The Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.958	22

Demographic Analysis

This descriptive analysis encompasses demographic information about respondents, covering factors such as age, gender, citizen, respondent type, experiences when utilizing or riding beca, awareness of eBECA technology and user's views on the eBECA Technology in

Malaysia. the data reveals that the majority of respondents, comprising 61%, fall within the age range of 18 to 30, totaling 236 individuals. Following this, there are 113 respondents, accounting for 29%, aged between 31 and 50. Additionally, there are 18 respondents aged 51 and above, making up 5% of the total, while those below 18 years old constitute 5%, with 21 respondents. The age group of 18 to 30 has the highest representation among the respondents, while the lowest participation is observed in the categories of respondents below 18 and those aged 51 and above.

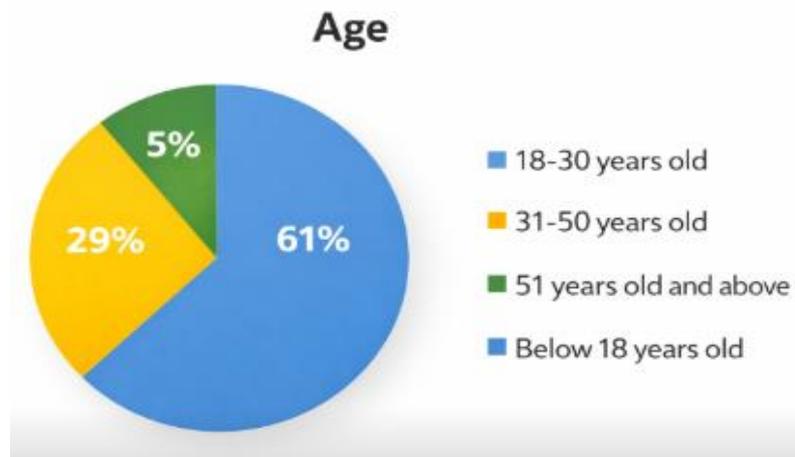


Figure 2: The age distribution of the respondents

Figure 3 depicts those 218 female respondents, constituting 56% of the total, and 170 male respondents, accounting for 44%. Notably, the female demographic exhibits a higher response rate compared to their male counterparts. The analysis of the data from 388 respondents suggests that females were more actively involved, possibly influenced by their communication and engagement preferences. Women may be more inclined to express their opinions or offer feedback through surveys. It's important to emphasize that this research is conducted randomly, without any bias or deliberate gender selection during the questionnaire distribution process.

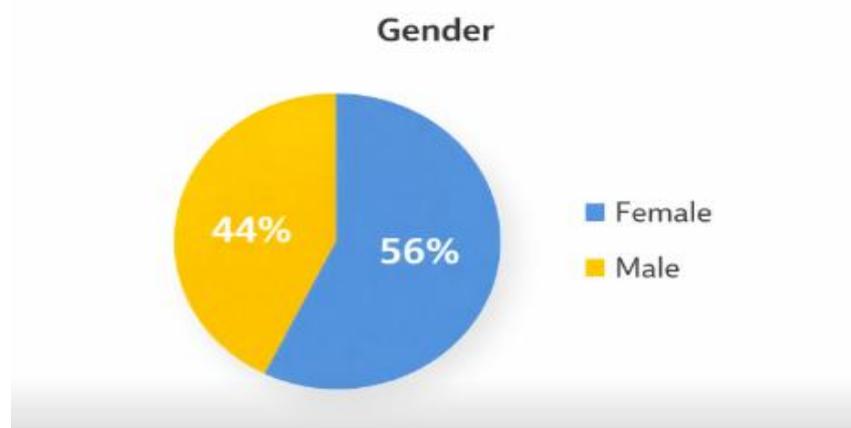


Figure 3: The gender distributions of the respondents

Figure 4 most respondents, totaling 353 individuals or 91%, are from Malaysia. Additionally, 4% of the respondents, comprising 15 individuals, are from America, and 5%, consisting of 20 participants, are from other Asian countries. The data collection involved the

use of both face-to-face interviews and online platforms, with questionnaires distributed through WhatsApp and Telegram channels. Notably, during the data collection in Bandar Hilir and Pasar Payang, the researcher managed to gather responses from 35 individuals residing abroad.

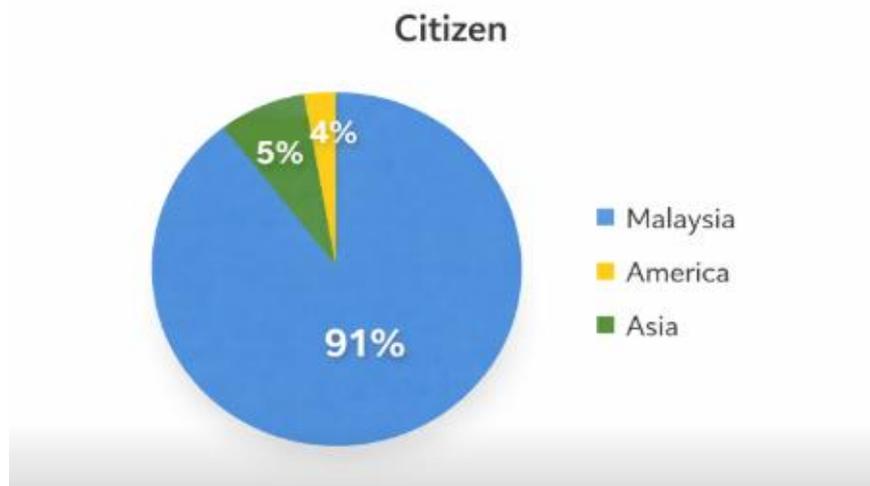


Figure 4: The citizenship distribution of the respondents

Figure 5 illustrates the survey on the adoption of eBECA in Malaysia included 35% of tourists, encompassing 137 respondents, 63% of locals, totaling 244 participants, and 2% of riders, involving 7 respondents. Notably, locals exhibited the highest response rate, while riders had the lowest. The survey data from local respondents were collected through a combination of face-to-face interactions and online channels, with a predominant reliance on the latter for data acquisition.

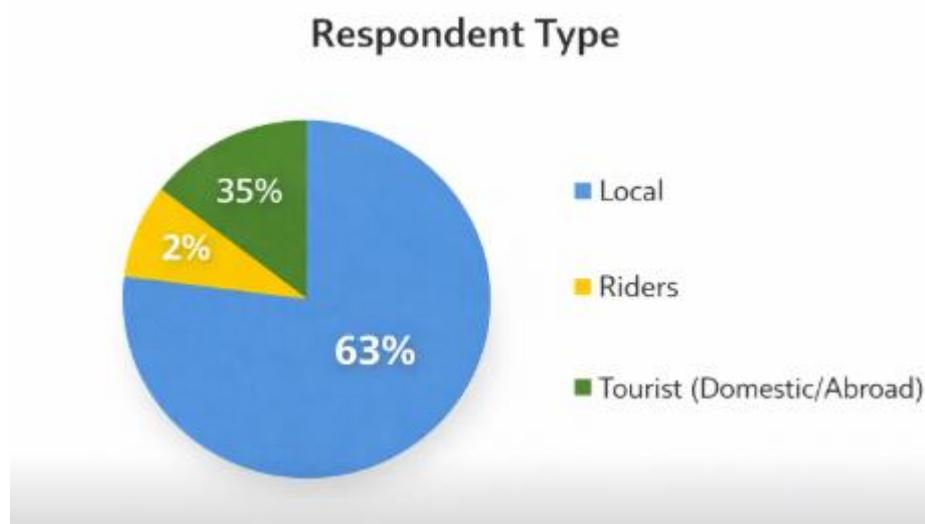


Figure 5: The respondent type distribution of the respondents

As illustrated in Figure 6, the data indicates that 77% of respondents, comprising 297 individuals, have had experiences in utilizing or riding beca, while 23%, or 91 respondents, reported no such experiences. Notably, a larger proportion of females have experiences with

using and riding beca, although there are also males included in those who have such experiences.

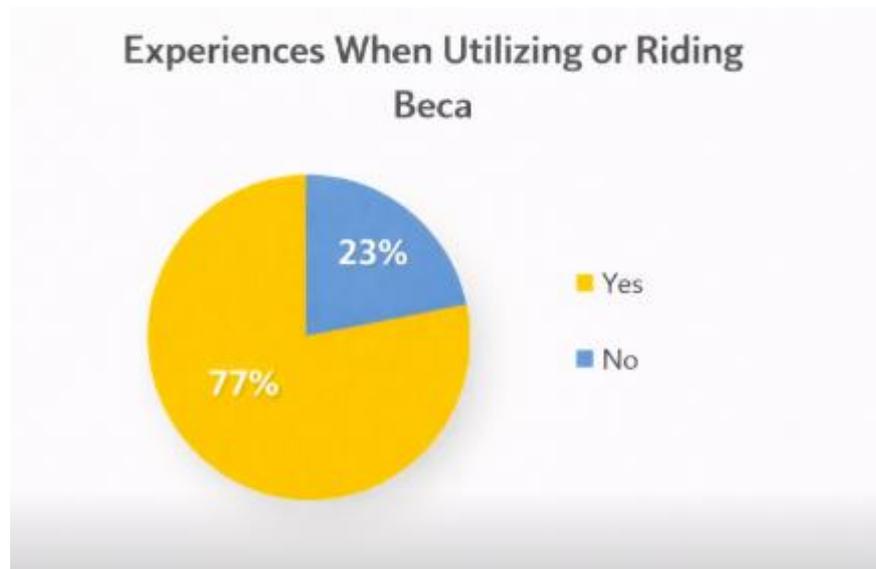


Figure 6: The beca experience distribution of the respondents

In Figure 7, it is revealed that 48% of respondents, totaling 185 individuals, are aware of the eBECA technology in Malaysia, while 52%, representing 203 respondents, lack awareness of this technology in the region. This implies that 185 participants are knowledgeable about the utilization of eBECA by the beca community in Malaysia and Banda Hilir, having gained this awareness through personal observation, hearing about it from various sources, or reading about eBECA. On the contrary, the remaining 203 respondents are uninformed about the existence of eBECA as a means of transportation and tourist attraction in Malaysia.

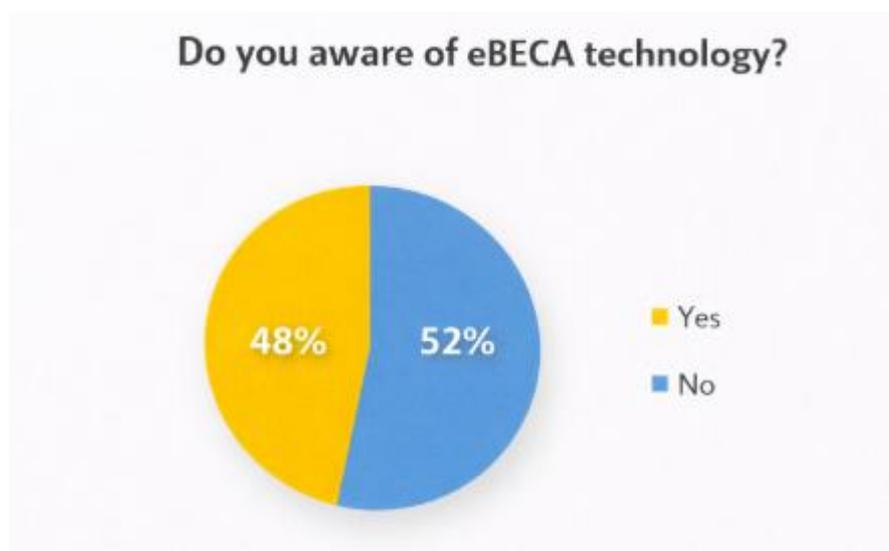


Figure 7: The eBECA technology awareness distribution of the respondents

In Figure 8, it is evident that 90% of the total 388 respondents, amounting to 350 individuals, hold favorable opinions regarding the adoption of eBECA in Malaysia. Conversely,

10%, comprising 38 respondents, do not share positive views on the adoption of eBECA in the region. The data indicates that the majority, 350 respondents, express their positive perspectives on eBECA adoption in Malaysia, while a smaller group of 38 respondents does not offer favorable views or perspectives on the matter.

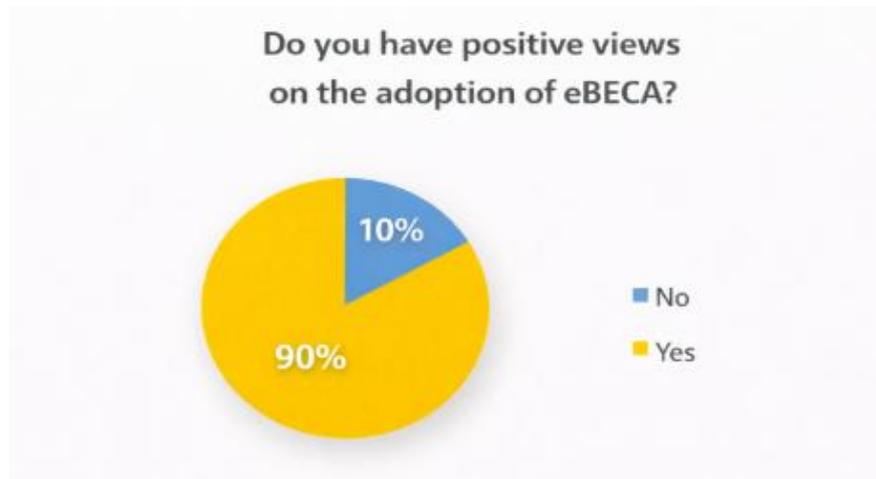


Figure 8: The distribution concerning the positive views on the eBECA adoption in Malaysia of the respondents

Correlation Coefficients

This research incorporates commitment to the product field, innovation-related core benefit, expected financial benefit and user-manufacturer interaction as independent variables, with the adoption of eBECA technology in Malaysia as the dependent variable. The correlation values presented in the table indicate a positive correlation between all independent variables and the adoption of eBECA in Malaysia, with correlation values of 0.643, 0.575, 0.558, and 0.408 for commitment to product field, innovation-related core benefit, expected financial benefit, and user-manufacturer interaction, respectively.

Furthermore, the table provides insight into the significance level of these independent variables in relation to the dependent variable. For commitment to the product field, the correlation value is 0.643 with a highly significant value of 0.000, indicating a strong and positive correlation between commitment to the product field and the adoption of eBECA in Malaysia. Similarly, the correlation value for innovation-related core benefit is 0.575 with a significance value of 0.000, signifying a moderate correlation and strong significance between innovation-related core benefit and the adoption of eBECA in Malaysia.

Likewise, the correlation value for expected financial benefit is 0.558 with a significance value of 0.000, highlighting a moderate correlation and strong significant between expected financial benefit and the adoption of eBECA in Malaysia. Lastly, the correlation value for user-manufacturer interaction is 0.408 with a significance value of 0.000, indicating a robust significant and moderate correlation between user-manufacturer interaction and the adoption of eBECA technology. In summary, the absence of issues in the correlation, as evident in Table 2, leads to the conclusion that there is a positive correlation between the independent variables and the dependent variable.

Table 2

Summary of The Person Correlation Coefficient

Variables	Commitment to Product Field	Innovation-Related Core Benefit	Expected Financial Benefit	User–Manufacturer Interaction	Adoption of eBECA Technology
Commitment to Product Field	1.000				
Innovation-Related Core Benefit	.797**	1.000			
Expected Financial Benefit	.735**	.809**	1.000		
User–Manufacturer Interaction	.491**	.492**	.541**	1.000	
Adoption of eBECA Technology	.643**	.575**	.558**	.408**	1.000

N = 388
*** Correlation is significant at the 0.01 level (2-tailed)*
Values represent Pearson correlation coefficients

Multiple Linear Regression

The multiple regression analysis output provided information on the predicted power of the model for adopting eBECA technology, specifically in terms of the correlation coefficient (R). According to Table 3, the R value of 66% has a significant effect and correlation between the variables in this study, highlighting the characteristics of users, and the adoption of eBECA in Malaysia. Furthermore, the R square value indicates that 43.5% of the variation in the adoption of eBECA in Malaysia can be explained by the four independent variables. Additionally, it is noteworthy that 56.89% of other unaccounted factors may influence and contribute to the impact on the adoption of eBECA in Malaysia.

The standard error of the estimate (std. error) in this study was 0.56889, which represented the average distance between the observed values and the values predicted by the model. Generally, a lower value indicates a better fit of the model to the data.

Table 3

Multiple Linear Regression Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.660 ^a	.435	.430	.56889

a. Predictors: (Constant), Commitment to Product Field, Innovation Related Core Benefit, Expected Financial Benefit, User - Manufacturer Interaction
b. Dependent Variable: Adoption of eBECA Technology

Table 4 presents the results of the multiple linear regression analysis examining the factors influencing the adoption of eBECA technology in Malaysia. The findings demonstrate that among the four predictor variables, commitment to the product field is the only factor that significantly influences users' adoption of eBECA technology.

Product field commitment in particular, has a significant positive impact on eBECA adoption ($\beta = 0.482$, $p < 0.001$). This implies that users who are more attached, involved or interested in the product domain for extended duration would positively adopt eBECA technology at their disposal. The standardized beta coefficient itself is relatively large as well, which indicates that this predictor is the most powerful one of all predictors in its role, emphasizing the impact of intrinsic motivation and personal commitment instead of incentives by third parties.

Conversely, innovation related core benefit has no significant effect on adoption ($\beta = 0.081$, $p = 0.300$). This result indicates that while eBECA might have value in terms of technology, or enhanced tool functionality, it was not enough to get people using the system. It seems people value technology novelty less than the new PC or deeper personal and value based things.

Likewise, perceived financial benefit is positively associated with adoption ($\beta = 0.129$, $p = 0.099$), but is not a significant predictor. This suggests that expected economic benefits such as cost benefit and income opportunities are not critically determinants of users' intention to use eBECA technology. The finding suggests that financial inducements are an enabler and not a driver of behavioral adoption.

The moderating term user–manufacturer interaction also exhibits a positive but not significant effect ($\beta = 0.141$, $p = 0.069$). Bordering the conventional level of significance, this finding indicates that influences from manufacturers/suppliers were not strong enough to influence adoption levels directly. It could be a reflection of poor engagement, lack of communication or absence of trust-building opportunities between users and providers.

Diagnostically, the tolerance values (0.330 - 0.460) and VIFs (2.170 - 3.030) indicate multicollinearity is not an issue in this model. Because all predictors independently explain variance in adoption behavior, the trustworthiness of regression estimates is increased.

In general, findings of this study show that the eBECA technology adoption is motivated by the user's commitment toward a product domain rather than innovation characteristic, financial expectations or interaction with developers. This underscores the importance of user value, engagement and intrinsic motivation in influencing technology adoption decision when it comes to sustainable transportation system for heritage.

Table 4

Multiple Linear Regression Coefficients for Adoption of eBECA Technology

Predictor Variables	Standardized β	t-value	Sig. (p)	Tolerance	VIF
Commitment to Product Field	0.482	9.870	0.000***	0.410	2.440
Innovation-Related Core Benefit	0.081	1.040	0.300	0.330	3.030
Expected Financial Benefit	0.129	1.660	0.099	0.380	2.630
User–Manufacturer Interaction	0.141	1.820	0.069***	0.460	2.170

Notes:
 β = Standardized regression coefficient
 Sig. = p-value (2-tailed)
 VIF = Variance Inflation Factor
 b. Dependent Variable: Adoption of eBECA Technology

Discussion and Recommendations

This study delves into the exploration of the three research objectives outlined in the initial chapter. These objectives include (1) investigating the characteristics of users in Malaysia concerning the adoption of eBECA technology, (2) identifying the relationship between users' characteristics and the adoption of eBECA technology in Malaysia, and (3) determining the intentions of adopting eBECA technology among users in Malaysia. Additionally, three hypotheses were formulated in Chapter 2 to assess the relationship between independent and dependent variables. The discussion unfolds subsequent to the analysis of data gathered from 388 survey respondents who participated in the eBECA adoption survey in Malaysia, utilizing SPSS software. A pilot test was executed to ensure the accuracy of the research findings and to gauge the respondents' familiarity with the study's instrument. As detailed in the previous chapter, the data analysis involved the utilization of Multiple Regression Analysis and Pearson's Correlation Analysis methodologies on the questionnaire data.

The results of this study are also mostly congruent with the previous eBECA studies on Malaysia, particularly in relation to users' commitment to the product field as an influencing factor of adoption decision. In the earlier studies of Musa et al. (2023) and Musa et al. (2024) as well found that users' emotional commitment, cultural attachment and commitment with beca ecosystem in long-range forgoes resources purely utility or economical in incentivizing adoption. The present results deepen this stream by empirically demonstrating that a commitment in the product field is still the sole factor significantly predicting to eBECA adoption, thus confirming that it is motivation (in terms of value and identity) rather than technical novelty alone that lead to adopt (Musa et al., 2025a). This development demonstrates the evolution of eBECA research trajectory that has shifted from early acceptance and compatibility testing towards an exploration of intrinsic motivations among users on sustainable behavioral intention (Musa et al., 2025b).

The first objective of this research is to figure out the characteristics of users in Malaysia towards adopting the eBECA technology. The researcher finds the relationship between the characteristics of users towards the dependent variables, the adoption of eBECA in Malaysia by using the multiple regression analysis. The researcher identifies each characteristic of the independent variables and determines which can affect the intentions of adopting the eBECA technology among users in Malaysia. From the regression coefficient table (Table 3 and Table 4), the researcher chooses the characteristics that have significance value below 0.05. From the multiple regression table, the independent variable, commitment to product field proves a significance value of 0.000, innovation related core benefit with 0.300, expected financial benefit with 0.099 and user manufacturer interaction 0.069. The result shows that the intention of adopting the eBECA technology among users in Malaysia is because of the commitment to the product field since it has the lowest significant value.

The second objective of this research aims to construct a theoretical framework by exploring the relationship between users' characteristics and their decision to adopt eBECA technology. The researcher investigates the correlation between commitment to the product field, innovation-related core benefits, expected financial benefits, and user-manufacturer interaction with the dependent variable adoption of eBECA technology in Malaysia utilizing Pearson's Correlation Coefficient analysis (Table 2). The correlation values for commitment to the product field, innovation-related core benefits, expected financial benefits, and user-manufacturer interaction all indicate a positive correlation with the adoption of eBECA in Malaysia, with respective values of 0.643, 0.575, 0.558, and 0.408. Additionally, the significance value for all four independent variables is 0.000. Commitment to the product field demonstrates a correlation with the adoption of eBECA in Malaysia. The eBECA, operating with solar and motor power, features a distinct appearance compared to traditional becas, as discussed by Louise-Ann Leyland et al. (2019).

Furthermore, the development of eBECA aims to assist older individuals currently working in the beca community, involving them in the development process due to their firsthand experiences. Louise-Ann Leyland et al. (2019) highlighted in their study that the adoption of e-bikes challenges age-based assumptions, showcasing that older individuals can contribute as innovators and participants in design processes. Additionally, users' characteristics are correlated with the adoption of eBECA in Malaysia. The integration of technology into becas is expected to streamline the work for the beca community. Louise-Ann Leyland et al. (2019) found that older individuals facing health challenges may find it challenging to ride a traditional bike, but an e-bike enables them to continue bicycling. The study also addresses concerns about the impact of e-bikes on safety, health, and the environment, asserting that the eBECA in Malaysia adheres to a speed limit to mitigate risks to riders and passengers. Having examined the relationship between users' adoption decisions and the adoption of eBECA technology, the users' characteristics align with the theoretical framework proposed. This supports the conclusion that the framework, along with the independent variables, correlates with the dependent variable of the research study, as evidenced by the results of the Pearson's Correlation Analysis.

The third objective of this research is to innovate the intention of users in adopting eBECA technology. The value of R square as stated in the model summary of the multiple regression analysis indicates that there are 43.5% effects of the variables towards the

adoption of eBECA in Malaysia which are considered as moderate. From the hypothesis, the commitment to the product field is accepted in this study. The characteristics of users towards the commitment of the product field regarding the eBECA can also attract more people to adopt the technology and make further improvements. Fang-Chi Lu et al. (2021) indicated the existence of innovative competition, motivating a broader audience of potential adopters to strategize future installations or undertake the technology's introduction to new locations, aiming to secure a market advantage. Besides that, innovation related core benefits are not accepted in this study. According to Abbasi et al. (2021), the Theory of Planned Behavior (TPB) is a psychological framework designed to elucidate the intricacies of human behavioral intention. Describing human behavior is a challenging and intricate endeavor, and the innovation literature suggests that individuals adopting technological innovations reveal that their preferences are shaped by the choices of others. This implies that adherence to group norms and the influence of mutual contagions play a substantial role in molding individual inclinations (Breschi et al., 2023). Additionally, the eBECA technology must align with driver comfort and adoption, as demographic data indicate that only seven respondents are from the riders.

Apart from that, expected financial benefits are also not accepted in this study. This is because the study only highlights the Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT). Meanwhile, as per a recent investigation led by Goel et al. (2023), a positive correlation has been identified between the financial characteristics and psychological traits of individuals opting for the adoption of electric vehicles (EVs). The research further affirms the efficacy of the norm activation model (NAM) in elucidating how consumers' attitudes toward environmentally conscious choices and their approaches to social responsibility influence their perspectives and intentions concerning travel decisions.

Thus, the acceptance of the variable may be impeded due to its ambiguity or a lack of clarity in how the expected financial benefit is defined or conceptualized in the study. Clearly defining and articulating the variable is crucial for ensuring its understanding and acceptance. Lastly, variables of interaction between user manufacturers are also rejected in this study. This is because there is a challenge in getting precise measurement of the variable that raises apprehensions regarding the reliability and validity of the data. Supported literature also claimed that the advantages of innovation extend beyond the final results of user inventions. Innovating consumers should derive benefits from the innovation process itself. Engaging in problem-solving throughout the development stages allows users to apply their skills and knowledge, leading to a sense of satisfaction (Arranz et al., 2020). Thus, researchers suggested that employing robust measurement methods is essential for the acceptance of the variable.

There are several recommendations and suggestions that the future research can take note of and use. Future researchers were encouraged to approach professionals in the business. The first recommendation for future study is to analyze this research further utilizing a qualitative technique to have a deeper grasp of the adoption of electric beca (eBECA). In the future, instead of distributing surveys to collect data, the researchers may conduct interviews with the respondents. This is by having the face-to-face session with the respondents, researchers can gain more information that are not stated in the survey or other

sources. This strategy might make a significant contribution since it encourages more active engagement from respondents, which could lead to fresh results and perspectives. This will aid in gaining a better grasp of adoption of eBECA.

The next recommendation for future study is that they can add more components into their research. For example, using the Norm Activation Model (NAM) explains altruistic and environmentally friendly behavior. It posits that people's engagement in environmentally responsible actions is influenced by a series of psychological processes. The NAM emphasizes the role of personal norms, perceived consequences, and moral considerations in shaping individuals' environmental behaviors, making it a valuable framework for understanding and predicting ecological decision-making.

In the context of electric beca (eBECA), through their eco-friendly features, align with and reinforce the psychological processes outlined in the NAM model. As users become aware of the positive consequences of using eBECA, they activate personal norms that prioritize environmental responsibility. This, in turn, influences their behavior, driving a preference for electric becas and contributing to the overall promotion of sustainable and environmentally friendly transportation options. The NAM model thus provides a robust framework for understanding the psychological dynamics behind the adoption of electric becas and other pro-environmental behaviors. By adding these components in the future study, the research will be more comprehensive as it covers a broad range of characteristics for the adoption of eBECA.

Acknowledgement

This publication was supported by Universiti Teknikal Malaysia Melaka (UTeM) under the Journal Publication Fee Initiative 2025. The authors would also like to acknowledge the support from the Faculty of Technology Management and Technopreneurship.

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