GLOBAL BUSINESS & FINANCE REVIEW, Volume. 30 Issue. 2 (FEBRUARY 2025), 99-112
pISSN 1088-6931 / eISSN 2384-1648 | Https://doi.org/10.17549/gbfr.2025.30.2.99

GLOBAL BUSINESS & FINANCE REVIEW

www.gbfrjournal.org
for financial sustainability and people-centered global business

The Necessity of Electric School Bus: A Comparative Study of Myanmar and Vietnam

Yang-Ho Lee[a], Saeyeon Roh[b], Jin-Woong Yoo[c†]

[a]*Kyonggi University, Suwon-si, South Korea*
[b]*Plymouth Business School, University of Plymouth, Plymouth, UK*
[c]*Hertfordshire Business School, University of Hertfordshire, Hatfield, UK*

A B S T R A C T

Purpose: This research aims to ascertain key factors which influence the necessity of South Korean electric school buses in Myanmar and Vietnam. The interest in business sustainability and the demand for electric or safe school buses are increasing in Myanmar and Vietnam.
Design/methodology/approach: As quantitative research, this study relies on a non-probability sampling method to collect data sets from experts in both countries. As this research covers three steps, including 1) literature reviews, 2) preliminary analysis and 3) Consistent Fuzzy Preference Relations (CFPR) analysis, robust outcomes were found and established in this study.
Findings: Among five driving factors, including 1) safety, 2) technology, 3) industry, 4) environment and 5) policy reasons, this research demonstrated that while in Vietnam, safety and environmental reasons are the crucial driving factors, in Myanmar, safety and technical reasons are the critical driving elements towards the necessity of electric school buses.
Research limitations/implications: Even though this paper lacks an underpinning theory, as an exploratory state, both policymakers and business leaders in South Korea, Vietnam and Myanmar can refer to our findings and analysis to facilitate the necessity of electric school buses and enhance perceived safety.
Originality/value: As a first attempt covering the range from business to safety aspects, this research demonstrated that safety is the most crucial factor influencing the necessity of South Korean electric school buses in Myanmar and Vietnam.

Keywords: Electric School Bus, Myanmar, Vietnam, South Korea, Consistent Fuzzy Preference Relations (CFPR)

I. Introduction

A low-floor electric bus has normally benefited the elderly and disabled owing to easy access (Hwangbo et al., 2015). This is because automatic scaffolding for boarding and wider seats are available (D'Souza et al., 2019). Furthermore, electric buses can have zero emissions, employing electricity from lithium-ion storage batteries towards a motor. For a longer driving range, electric buses are designed with large battery packages (Perumal, Lusby & Larsen, 2022). In addition, the noise of engine vibration for a low-floor electric bus is lower than that of an ordinary bus, which can lower the tiredness for

Received: Oct. 13, 2024; Revised: Nov. 8, 2024; Accepted: Nov. 13, 2024

† Corresponding author: Jin-Woong Yoo
E-mail: j.yoo@herts.ac.uk

drivers and passengers (Munyaneza & Sohn, 2022). On the other hand, in addition to accommodating elderly and disabled people, it is worth noting that a low-floor electric school bus should be adopted for children's physical health, to strengthen perceived safety and to fulfil sustainable performance underpinned by Sustainable Development Goals (SDGs) set up by the United Nations in 2015 (e.g., Hallmark, Sperry & Mudgal, 2011; Modgil, Gupta & Bhushan, 2020). For reference, in terms of sustainable performance, Sitorus et al. (2022) implied the significance of innovation at the firm level. This is owing to links with environmental, social and economic performance. On the other hand, according to Lipu et al. (2022), adopting electric vehicles or buses can be relevant to SDG7 (i.e., affordable and clean energy) for accessing clean and affordable energy to curtail air pollution. Furthermore, this research has taken note of SDG3 (i.e., good health and well-being) for children's healthy lives and SDG4 (i.e., quality education) for children's lifelong learning opportunities (Asekomeh, Gershon & Azubuike, 2021).

In the Southeast Asia region, concerning Myanmar and Vietnam, due to the scarcity of data sets and existing literature, the relevant information on school buses is very limited. In Myanmar, owing to the lack of a traffic management system, unclear traffic signal cycle times, policies and illegal roadside parking (e.g., Thein, 2020), the demand for developed electric school buses and traffic management systems is increasing. In Vietnam, owing to the increasing interest in safety, security, innovation and business markets in the automotive industry (e.g., Nguyen & Pojani, 2023), the necessity of electric school buses can come to the fore for enhancing children's safety and technological innovation.

Concerning a low-floor electric school bus for children in South Korea, as of September 2022, a low-floor electric school bus is widely used in kindergartens, elementary schools, academies, special schools, training centres, international schools, alternative schools, early childhood education and promotion centres. In total, 16,460 facilities have adopted 29,490 low-floor electric school buses (Park, Song & Shin, 2023). Based on an act on Korea Motor Vehicle Safety Standards, safety appliances should be set up and mandatory to enhance children's safety. It is worth noting that from the 2nd of January 2024 in South Korea, to protect children's health, diesel vehicles for commuting to school (i.e., school buses) are banned (Korea Legislation Research Institute, 2024). On the other hand, owing to the government plan for a developmental strategy for the future vehicle industry: 2030 national roadmap, an electrified transit system is to be adopted across all sectors of society, particularly utilising battery or fuel cell electric buses (Kwon et al., 2020).

From the South Korean firm's perspective, electric bus markets in both Myanmar and Vietnam are quite attractive for enhancing their business or sustainable performance. Due to locational reasons and the policy of foreign direct investment, many international firms from South Korea have carved out their business in the Southeastern Asian region (Park & Kim, 2007). Among Cambodia, Laos, Myanmar and Vietnam, where the population account for around 25% of the Association of Southeast Asian Nations (ASEAN) population, Vietnam accounted for the highest Gross Domestic Product (GDP) in 2019; the GDP was 261.92 billion US dollars. Subsequently, Myanmar accounted for 76.08 billion US dollars in 2019 (Law et al., 2022). Despite the lack of investment in human resource development, it is expected that the reform of the economic structure can boost the rapid growth of businesses and foreign investments for sustainable business performance when considering the GDP growth rate from 1990 to 2018 (Hlaing, Oh & Park, 2021; Law et al., 2022). Particularly, the demand for electric vehicles, including buses, is increasing in Vietnam and Myanmar for transportation safety and sustainability (Kim Tran & Ngoc Hoang Yen, 2018; Le, Posada & Yang, 2022). Compared to Vietnam, only 40% of the population in Myanmar can access electricity (Pandyaswargo et al., 2020); thus, understanding the advanced system of school buses, such as the case of South Korea, can be more demanded. This study focuses on the necessity of adopting South Korean electric school buses in both

Myanmar and Vietnam.

To ascertain crucial factors for the necessity of electric school buses in Myanmar and Vietnam, the question arises: what is the most vital element for the necessity of South Korean electric school buses? Based on the extant literature and policy papers, 1) safety, 2) technology, 3) industrial, 4) environmental and 5) policy aspects are covered in this study (e.g., Kim et al., 2022; Park, Song & Shin, 2023). The Consistent Fuzzy Preference Relations (CFPR) method is employed to identify crucial factors or reasons influencing the necessity of South Korean electric school buses. Compared to other quantitative methods, CFPR can help reinforce the consistency of decision-making as it features a fuzzy approach that can reduce the vagueness of data sets and analysis, particularly in social science (Chen & Chao, 2012). Moreover, for practical insights by considering both criteria and alternatives, policymakers prefer to use CFPR at the initial stage focusing on practical implications rather than using Ordinary Least Square, which estimates the parameters between variables (Raad & Rajendran, 2024). According to Roh, Shin and Seo (2018, 299), 'fuzzy set theory attempts to select, prioritise, and rank a finite number of courses of action by evaluating a group of predetermined criteria'. Structurally, CFPR is based on pairwise comparisons in line with the additive transitivity property (Bernal et al., 2024).

In summary, to ascertain the crucial factors influencing the necessity of South Korean electric school buses for children both in Myanmar and Vietnam, the CFPR method is employed in this research. For children's safety and relevant business industries, both countries have shown interest in South Korean electric buses and their systems.

II. Literature Review - Driving Factors of the Necessity of South Korean Electric School Bus

Based on the extant literature and policy papers, different reasons or determinants can be discussed to grasp the necessity of the South Korean electric school bus in both nations. This study mainly covers 1) safety, 2) technological, 3) industrial, 4) environmental and 5) policy reasons, based on the existing literature and policy studies.

Concerning safety, understanding the mandatory installation of devices for enhancing children's safety can improve a safe commute for children in both Myanmar and Vietnam; safety for a safe commute can be a major factor influencing the necessity of South Korean electric buses (e.g., Park, Song & Shin, 2023). Technological aspects can be highlighted to improve electric vehicle technologies in Myanmar and Vietnam, such as the use of Information and Communications Technology (ICT). Particularly in Vietnam, the production, assembling and import of electric vehicles will be promoted by 2030. From 2031 to 2040, the use of fossil fuels will be gradually limited, which can impact the use of motorcycles (Korea Institute for International Economic Policy, 2023).

Moreover, adopting South Korean electric school buses may enhance relevant business industries in Myanmar and Vietnam, such as batteries and after-service centres. While it is explicit that adopting electric school buses can curtail the amount of greenhouse gases contributing to environmental aspects (e.g., Lipu et al., 2022), adopting South Korean electric school buses could also improve transport and traffic policies for passengers in both countries. South Korea has constantly developed transport programs and safety management policies (e.g., the mandatory installation of safety devices) to prevent child traffic accidents (Choi & Choi, 2016).

A. Safety Reason

As a determinant of the necessity of South Korean electric school buses in two different countries, safety facets can be discussed. In this research, safe commute for school children is mainly highlighted to elucidate 'safety reason'. When considering parents' perceptions, it is implied that to strengthen safe commutes, South Korean electric school buses should be adopted (Park, Song & Shin, 2023). Notably, as parents' safety perceptions can influence children's solo commuting to school, the new electric school buses imported from South Korea can improve both children's and parents' safety perceptions in both Myanmar and Vietnam.

As South Korean electric school buses feature 1) a precise schedule management system, 2) infrastructure at bus stops, 3) travel information and 4) guidance for the safety behaviours of drivers, perceived safety about commutes can be reinforced (Farmer et al.,2024; Herrador-Colmenero, Villa-González & Chillón, 2017; Jomnonkwao et al., 2022). Moreover, when considering accessibility to a low-floor electric bus for young children, the adoption of South Korean electric school buses can likewise enhance both teachers' and drivers' safety perceptions.

In summary, for safe commutes for children, both Myanmar and Vietnam can demand the adoption of South Korean electronic school buses.

B. Technical Reason

In terms of the technological facet, this research focuses on the adoption of ICT, which is very predominant in South Korea (Farmer et al., 2024). ICT covers all communication technologies such as mobiles, wireless networks, etc. In addition to improving tailored seats for children and emergency escape devices in both nations, the adoption of South Korean electric school buses can strengthen the efficiency of driving record technologies (Korea Transportation Safety Authority, 2021). For instance, since 2021, Digital Tacho Graph (DTG) has been mandatory for school buses in South Korea. By adopting DTG, bus travel time can be prompt (e.g., Mustafa, Hwang & Cho, 2024). Moreover, driver's driving behaviours can be analysed (e.g., Jeong et al., 2022), which in turn increases the perceived safety of parents and staff in school (Jomnonkwao et al., 2022).

For school buses, an electronic or digital pathway can be recorded or analysed to reinforce children's and drivers' safety by employing ICT (i.e., devices and applications of DTG) (Raad, Deriche & Sheltami, 2021). On the other hand, for buses in South Korea, according to the UN (2019, 18), 'a digital tachograph is installed inside them to record bus operations, such as driving trajectories, in-real time, allowing for bus operation information to be transmitted to an electronic tachograph analysis system'.

In summary, to develop ICT for school buses, both Myanmar and Vietnam can demand the adoption of South Korean electronic school buses.

C. Industrial Reason

Pertaining to industrial reasons for the necessity of South Korean electric school buses, this study accentuates the improvement of business industries in both countries, such as batteries. In terms of the battery industry in Vietnam, the International Market Analysis Research and Consulting Group (IMARC Group) (2024) indicates that the market growth rate from 2024 to 2032 can be 6.12%; this is owing to 1) expansion of electric vehicles, 2) technology, 3) policies and 4) business sector demands including transportation and construction. Notably, the rapid shift to electric vehicles attributed to renewable energy systems in Vietnam demands business or technological innovations such as batteries. As customers in Vietnam can borrow the battery every month instead of buying it, the vehicle market in Vietnam is expected to grow significantly, including school buses, which are rarely discussed in academic research yet (Le, Posada & Yang, 2022). Moreover, by adopting Korean electric school buses, firms in Vietnam can enhance

customer satisfaction; innovative technologies for faster charging and charging stations can be introduced by South Korean firms, which in turn increases customer satisfaction (Kwon, Son & Jang, 2020). On the other hand, in the case of Myanmar, owing to the degrowth in the automobile market in Myanmar and the lack of supportive government policies, battery industries in Myanmar are less active than in Vietnam (Noudeng, Quan & Xuan, 2022). However, there is the potential growth of lithium-ion batteries in the electric vehicle market; Myanmar has a hydropower potential of 100,000 MW (Pode, 2015).

In summary, to facilitate business industries such as batteries, both Myanmar and Vietnam can demand the adoption of South Korean electronic school buses.

D. Environmental Reason

As both Myanmar and Vietnam put efforts towards a greener future, the environmental facet can be a vital determinant. To reduce carbon emissions that stem from the burning of fossil fuels, Vietnam plans to facilitate electric motorbikes (Nguyen-Phuoc et al., 2023). Moreover, Myanmar started the production of hybrid electric vehicles in 2022 in earnest. On top of that, it is implied that the adoption of electric school buses can contribute to sustainability performance in both countries (Lipu et al., 2022).

According to Minh, Le Quang & Pham (2021), the types of electric vehicles are hybrid, fuel-cell, extended-range, plug-in hybrid and battery electric vehicles. For reference, while plug-in hybrid vehicles can be charged through an external power source, hybrid vehicles cover either petrol or diesel engines along with an electric motor (Peng et al., 2015). For charging services of electric vehicles, Vehicle-to-Grid (V2G), Vehicle-to-Building (V2B) and Vehicle-to-Vehicle (V2V) are utilised. Moreover, electric vehicles can be deemed as Environmental and Social Sustainability (ESS) facilitated in South Korea (Korea Institute for International Economic Policy, 2023). This is because when the electricity cost is lower, electronic vehicles can buy electricity, which can be provided to the grid, buildings (e.g., homes) and other vehicles.

In summary, to curtail carbon emissions, both Myanmar and Vietnam can seek the adoption of South Korean electronic school buses.

E. Policy Reason

Owing to the demand for policy developments for children and safe transportation systems, both Myanmar and Vietnam can adopt the South Korean electric school bus and its policy. This research focuses on traffic safety environment acts for underpinning a policy reason (i.e., safety environment policies). When operating electronic school buses in South Korea, where school zones exist with speed limit signs within 300 meters of a school, it can increase perceived safety. South Korea has developed road safety policies. For instance, in the school zone, drivers can pay double fines and have penalty points under the Road Traffic Act when violating the rules. Moreover, under the Child Welfare Act, children in kindergartens and elementary schools should receive safety education at least 10 hours a year and once every two months. Regarding the operation of school buses for young children, all buses are registered at the local police station (Sul, 2018).

In addition, as both Myanmar and Vietnam strive to develop safety policies for school buses, Article 48 of the Act of the rules on the performance and standards of automobiles and automobile parts in South Korea can be referred to. For instance, '1. The red lights must automatically flash when the main door opens; 2. When the door closes for departure, the yellow or amber lights must automatically flash again; 3. The red and yellow lights or amber lights shall not flash at the same time when the other types of lights are flashing' (Farmer et al. 2024, 5). On the other hand, it is suggested that the school bus itself can construct a safety zone on the road by using enhanced lighting systems such as projected text on the left side (temporarily stop) and on the right side (no overtaking) (Farmer et al., 2024).

Table 1. Driving factors of the necessity of electric school bus (step 1)

Determinants/reasons	Feature	In South Korea	Relevant sources
Safety (C1)	Safe commutes for children	Tailored seats, emergency devices, IT, ADAS and around view	Park, Song and Shin (2023)
Technology (C2)	ICT developments	Digital Tacho Graph (DTG)	Jeong et al. (2022); Korea Transportation Safety Authority (2021); Mustafa, Hwang and Cho (2024)
Industry (C3)	Battery industry	Faster charging and charging stations	IMARC Group (2024); Kwon, Son and Jang (2020); Noudeng, Quan and Xuan (2022)
Environment (C4)	Curtailing carbon emissions	As part of Environmental and Social Sustainability (ESS)	Korea Institute for International Economic Policy (2023); Nguyen-Phuoc et al. (2023)
Policy (C5)	To reflect/adopt South Korean safety environment policies	Act of the rules on the performance and standards of automobiles and automobile parts	Farmer et al. 2024

The element C1-C5 will be presented in the finding section.

Overall, to develop safety environment policies, both Myanmar and Vietnam can cooperate with South Korea by adopting their electronic school buses. On the other hand, in Table 1, an overview of five driving factors is presented.

III. Methods

A. Sample and Process

Prior to analysing CFPR as step three, this research consists of other steps such as exploring key determinants in literature review and policy papers as step one and preliminary analysis as step two. As part of data collection for the South Korean government research project, by visiting Myanmar and Vietnam from August to September 2023, the request for initial screening was made in both nations (See Table 2). Following this, surveys were distributed and completed in schools, institutions and government agencies in both nations (See Table 3). A non-probability sampling method was applied to both steps two and three in this research. All participants are involved in electric vehicles and school policies (i.e., experts) as introduced by local institutions dealing with automobile policies.

In step two, for preliminary analysis, to determine if all five factors are relevant to the necessity of electric school buses, the request for initial screening was made to two public officers in the Department of Trade in Myanmar and two public officers in the National Traffic Safety Committee in Vietnam. Thus, all five determinants in this study were checked and utilised for CFPR analysis as step three. In addition, experts were also asked in both countries if cooperation with South Korea is either important or necessary through the 7 Likert Scale; in Myanmar, 6.5 of the mean value was found, while in Vietnam, 5.3 of the mean value was captured. As these values are higher than 3.5 in both countries, cooperation with South Korea has been captured for the necessity of electric school buses (e.g., Yoo et al., 2024).

B. Consistent Fuzzy Preference Relation

As one of the Multi-Criteria Decision Making (MCDM) methods, CFPR based on additive transitivity was employed as step three in this paper. CFPR features the establishment of the decision matrices of pairwise comparison (Herrera-Viedma et al., 2004; Panwar, Tripathi & Jha, 2019). Notably, fuzzy preference relations can form values for a set of

Table 2. Respondent characteristics (step 2)

Experts	Job grade	Age	National
Expert 1	Deputy commissioner	50s	Myanmar
Expert 2	Secretary	40s	
Expert3	Secretary General	50s	Vietnam
Expert4	Secretary	40s	

Table 3. Respondent characteristics (step 3)

	Category	Frequency (Number)	Percent (%)
Myanmar	Myan Trade	2	9.5
	International School	4	19
	Private School	4	19
	High School	3	14.5
	Fire Fighting Authority	2	9.5
	Municipal Authority	2	9.5
	Department of Trade	2	9.5
	Department of Consumer's Affair	2	9.5
	Total	21	100
Vietnam	National Traffic Safety Committee	2	13.3
	Ministry of Transport	2	13.3
	University	3	20
	International School	3	20
	Private School	3	20
	Vietnam Register	2	13.3
	Total	15	100

criteria; the value here concerns the level of preference for the first criteria over the second criteria.

This research relied on two major sorts of preference relations comprised of 1) multiplicative preference relations (e.g., Saaty, 1980) and 2) fuzzy preference relations (e.g., Bernal et al., 2024; Chiclana, Herrera & Herrera-Viedma, 1998).

1) In the case of multiplicative preference relations: A multiplicative preference relation R concerning a set of alternatives A is illustrated by a matrix $R \subseteq A \times A$, $R = (r_{ij})$, where r_{ij} refers to the preference ratio of alternative a_i to a_j. It is recommended to measure r_{ij} utilising a ratio scale, and the defined 1 - 9 scale. For reference, $r_{ij} = 1$ denotes the absence of a difference between a_i and a_j. On the other hand, $r_{ij} =$ 9 indicates that a_i is maximally better than a_j. Here, the preference relation R can be deemed as a multiplicative reciprocal, $a_{ij} \cdot a_{ji} = 1 \ \forall i, j \in \{1, \cdots, n\}$.
2) In the case of fuzzy preference relations: A fuzzy preference relation P on a set of alternatives A refers to a fuzzy set on the product set $A \times A$ with membership function $\mu_p : A \times A \rightarrow [0, 1]$. The preference relation can be understood by the $n \times n$ matrix $P = (p_{ij})$, where $p_{ij} = \mu_p (a_i \cdot a_j) \ \forall i, j \in \{1, \cdots, n\}$. For reference, p_{ij} means the preference ratio of alternative a_i to a_j; $p_{ij} = 1/2$ indicates that there is no difference between a_i and a_j; $p_{ij} = 1$ shows that a_j is way better than a_j; and $p_{ij} > 1/2$ denotes that a_i is better than a_j. The preference

matrix P can be assumed to be an additive reciprocal, $p_{ij} + p_{ji} = 1,\ \forall i, j \in \{1, \cdots, n\}$.

This study refers to CFPR calculations addressed by Herrera-Viedma et al., (2004); these are presented as follows:

Proposition 1) Contemplate a set of alternatives, $X = \{x_1, \cdots, x_n\}$, related to a reciprocal multiplicative preference relation $A = (a_{ij})$ for $a_{ij} \in [1/9, 9]$. Subsequently, the corresponding reciprocal fuzzy preference relation, $P = (p_{ij})$ with $p_{ij} \in [0, 1]$ linked to A is provided as $p_{ij} = g(a_{ij}) = \frac{1}{2}(1 + \log_9 a_{ij})$. $\log_9 a_{ij}$ is contemplated. This is because a_{ij} is between $\frac{1}{9}$ and 9. If a_{ij} is placed between $\frac{1}{7}$ and 7, then $\log_7 a_{ij}$ is employed.

Proposition 2) For a reciprocal fuzzy preference relation $P = (p_{ij})$, the statements below are the same:

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2},\ \forall i, j, k. \tag{2.1}$$

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2},\ \forall i < j < k. \tag{2.2}$$

Proposition 3) For a reciprocal fuzzy preference relation $P = (p_{ij})$, the statements below are the same:

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2},\ \forall i < j < k. \tag{3.1}$$

$$p_{i(i+1)} + p_{(i+1)(i+2)} + \cdots + p_{(i+k-1)(i+k)} + p_{(i+k)i} = \frac{k+1}{2},\ \forall i < j. \tag{3.2}$$

By referring to the statements above, particularly 3.1 and 3.2, CFPR can be implemented from the set of n - 1 values $\{p_{12}, p_{12}, \cdots, p_{(n-1)n}\}$. Moreover, a decision matrix is formed with entries which are not in the interval [0,1]. It should be described as the interval $[-k, 1 + k]$, $k > 0$, which can be determined by transforming the obtained values employing a transformation function. Here, the transformation function maintains reciprocity and additive consistency. The function $f : [-k, 1 + k] \rightarrow [0, 1]$, $f(x) = (x + k) / (1 + 2k)$ can be referred to in this case.

IV. Results

The proposed CFPR method was applied to identify factors for the necessity of South Korean electric school buses in Vietnam and Myanmar. This study addressed some vital elements from the aforementioned literature and validated them through preliminary analysis.

For the analysis of CFPR, 36 experts in total participated in step 3 (e.g., 15 experts from Vietnam and 21 experts from Myanmar). The entire procedure for the construction of the decision matrix is illustrated as follows:

1) Collecting the questionnaires which are designed as linguistic variables.
2) Converting linguistic variables and computing the average score for each pairwise comparison. Table 4 shows the computed initial values for the criteria.
3) Forming the initial criteria decision matrix. Table 5 demonstrates the initial value of the fuzzy preference. The diagonal values are all 0.5 and are computed according to Proposition 1). The "x" in Table 4 is going to be identified in the following stage.
4) Computing the rest of each factor within the decision matrix employing Eq. (3.2) in Proposition 3). If some fuzzy preference ratios are not in the interval [0, 1], to preserve reciprocity and additive consistency, a transformation function can be utilised to have the transformation. Last but not least, it is vital to calculate the priority of the weight, w, which can be computed as follows:

$$W_i = (\Sigma_{j=1}^{n} p_{ij}) \,/\, \Sigma_{i=1}^{n} (\Sigma_{j=1}^{n} p_{ij})$$

Table 4. The initial score of the pairwise comparison

Vietnam					
	C1	C2	C3	C4	C5
C1	1	3.52			
C2		1	1.27		
C3			1	0.35	
C4				1	2.76
C5					1
Myanmar					
	C1	C2	C3	C4	C5
C1	1	4.53			
C2		1	1.89		
C3			1	0.97	
C4				1	1.36
C5					1

Table 5. The initial decision matrix

Vietnam					
	C1	C2	C3	C4	C5
C1	0.50	0.79	x	x	x
C2	x	0.50	0.55	x	x
C3	x	x	0.50	0.26	x
C4	x	x	x	0.50	0.73
C5	x	x	x	x	0.50
Myanmar					
	C1	C2	C3	C4	C5
C1	0.50	0.84	x	x	x
C2	x	0.50	0.64	x	x
C3	x	x	0.50	0.49	x
C4	x	x	x	0.50	0.57
C5	x	x	x	x	0.50

The priority and the ranking are shown in Table 6.

When referring to the outcomes of Table 6, in both Vietnam and Myanmar, safety reason is the most crucial one affecting the necessity of South Korean electric school buses. In Vietnam, while environmental reason is the second influencing factor, technical reason is the third crucial determinant. Subsequently, policy and industrial reasons are captured. In the case of Myanmar, technical reason is the second influencing element while environmental reason is ranked as the third one. Moreover, the industrial reason is placed as the fourth factor and policy is the less vital factor for the necessity of South Korean electric school buses.

Table 6. The complete decision matrix

(Vietnam) Criteria	Weight	Rank
Safety C_1	0.26	1
Technical C_2	0.18	3
Industrial C_3	0.16	5
Environmental C_4	0.23	2
Policy C_5	0.16	4
(Myanmar) Criteria	Weight	Rank
Safety C_1	0.34	1
Technical C_2	0.21	2
Industrial C_3	0.16	4
Environmental C_4	0.16	3
Policy C_5	0.14	5

V. Discussion

A. Theoretical Implication

As safety is the main reason for the necessity of South Korean electric school buses in Myanmar and Vietnam, it is expected that this research can contribute to the importance of safety literature when addressing electric vehicles (e.g., Park, Song & Shin, 2023). As this study newly underlines safe commute for children as a main concept, this study has taken note of perceived safety and its implications in this study, which was rarely discussed in the safety or business policy literature (Herrador-Colmenero, Villa-González & Chillón, 2017). Thus, the literature review and implications of this paper contribute to the safety literature.

B. Practical Implication

First, to reinforce the necessity of South Korean electric school buses in Myanmar and Vietnam, business leaders or policymakers in South Korea can refer to our findings to establish a strategic business plan. The safety or safe commute of children is the priority in both nations. Thus, surveys before/after adopting electric school buses can be utilised to see the differences in perceived safety from both parents and children (Farmer et al., 2024). In addition to highlighting the safety facet in both countries, the survey results of perceived safety can be utilised further for their business or marketing plans in diverse countries or regions where the demand for electric school buses can be found (Jomnonkwao et al., 2022).

Second, policymakers in the automotive industry, particularly in South Korea, Vietnam and Myanmar, can enhance their cooperation strategies by referring to our findings; in addition to safety reasons, both environmental and technical facets were found to be significant driving factors for the necessity of South Korean electric school buses in Myanmar and Vietnam. Both Myanmar and Vietnam have tried to curtail carbon emissions as part of their sustainability initiatives (Aung, Saboori & Rasoulinezhad, 2017; Nguyen-Phuoc et al., 2023). However, as Myanmar lacks electronic vehicle policies (Schröder, Iwasaki & Kobayashi 2021), government officers in Myanmar can be required to cooperate with South Korean firms to enhance sustainable performance for their automotive industry. In the case of Vietnam, although ICT has become popular, an understanding of ICT and its applications (e.g., DTG) from South Korea may be required to accurately predict safe pathways and drivers' driving patterns, which in turn increases perceived safety (Jeong et al., 2022).

Third, by referring to our findings and analysis, policymakers in both Myanmar and Vietnam can consider how to reinforce the safety quality of school buses. For instance, the adoption of different functions from South Korean electric school buses can help school buses in Myanmar and Vietnam improve 1) seats tailored to children's bodies, 2) emergency escape devices, 3) around view, 4) the utilisation of Information Technology (IT) and 5) Advanced Driver Assistance System (ADAS) (Korea Transportation Safety Authority, 2021). For reference, ADAS concerns technologies which can help drivers reinforce safety, such as active safety information, assistance with parking and driving interventions through car or bus interface (Kang et al., 2023; Park, Choi & Park, 2021).

C. Limitations and Future Research

Although this paper features an exploratory state, some limitations can be seen in this research. First, as this study is based on the MCDM technique for identifying key factors for the necessity of electric school buses, future studies can develop a conceptual model along with an underpinned theory (e.g., Ojuola, Mostafa & Mohamed 2020). Second, rather than a cross-sectional design, a longitudinal study can be contemplated to detect any changes or trends of factors in both countries. Third, other MCDM techniques, such as the Decision-making trial and evaluation laboratory, can be used to validate the results of the findings (e.g., Gharedaghi & Omidvari, 2017; Omidi, Karimi & Moradi, 2023; Yoo et al., 2024). Fourth, in addition to the quantitative approach, using a qualitative approach, such as focus group interviews and Delphi, can be contemplated to gain in-depth knowledge of each driving factor (Stojčić et al., 2019). Fifth, albeit the number of 35 experts is well enough for the MCDM technique (e.g., Prakash & Srivastava, 2019), more data sets or participants (i.e., experts) can be included for robust outcomes. Sixth, although both Myanmar and Vietnam can be classified in the Asian context, subtle discrepancies in business cultures can be contemplated to design driving factors for the necessity of electric school buses by referring to the features of national business culture (Oh, Fei & Andrews, 2024). Last but not least, by referring to this study, researchers can further underscore safety theories, such as the social safety theory, when discussing electric school buses in both countries.

As safety reasons can be the priority, factors for social bonds to facilitate perceived safety can be discussed (e.g., Slavich et al., 2023).

VI. Conclusion

As key factors for the necessity of electric school buses in Myanmar and Vietnam remain unknown, the question arises: what is the most vital element for the necessity of South Korean electric school buses? This research has newly discovered and underlined safety for children (i.e., safe commutes) as a priority in both countries. Through three steps, including literature reviews, preliminary analysis and the implementation of CFPR, this paper has empirically demonstrated that in Vietnam, the order of importance is 1) safety, 2) environment, 3) technology, 4) policy and 5) industrial facets. In Myanmar, the order of importance is 1) safety, 2) technology, 3) environment, 4) industrial and 5) policy facets. To the best of our knowledge, this research is the first attempt academic paper stressing safety as a core driving factor for the necessity of electric school buses in Myanmar and Vietnam. Albeit this study is an exploratory state, this study contributes to safety literature. Moreover, researchers can further underline safety theories, such as the social safety theory to address diverse safety factors for facilitating the necessity of South Korean electric school buses in both countries.

Funding Statement

This work is supported by the Korea Agency for Infrastructure Technology Advancement (KAIA) grant, which is funded by the Ministry of Land, Infrastructure and Transport (RS-2022-00143581), Republic of Korea.

Conflicts of Interest

No conflicts of interest are involved.

Author Contributions

Yang-Ho Lee PhD, is an Assistant Professor at Kyonggi University, South Korea. His research interests include industrial management engineering and international business. He has investigated and completed several industry-university research projects such as technical development for the safety improvement of electric buses and system research of automobile parts.

Saeyeon Roh PhD, is a Lecturer in International Logistics at Plymouth Business School, UK. His research interests include Humanitarian Logistics, Logistics Management and Supply Chain Management. He has published several articles in Supply Chain Management: An International Journal, The Asian Journal of Shipping and Logistics, International Journal of Supply Chain Management and Maritime Policy & Management.

Jin-Woong Yoo PhD, is a Lecturer in HRM at Hertfordshire Business School, University of Hertfordshire, UK. He has a PhD from the University of Plymouth, UK. He has previously worked with Nottingham Trent University. His research interests focus on HRM and OB studies within the public sector.

References

Asekomeh, A., Gershon, O., & Azubuike, S. I. (2021). Optimally clocking the low carbon energy mile to achieve the sustainable development goals: Evidence from Dundee's electric vehicle strategy. *Energies, 14*(4), 842.

Aung, T. S., Saboori, B., & Rasoulinezhad, E. (2017). Economic

growth and environmental pollution in Myanmar: An analysis of environmental Kuznets curve. *Environmental Science and Pollution Research, 24*, 20487-20501.

Bernal, M. L., Krivoshapkina, M., Tsymzhitov, S., & Yeo, G. T. (2024). Prioritizing key factors for improving logistics of Sakha Republic using CFPR. *The Asian Journal of Shipping and Logistics, 40*(3), 133-138.

Chen, Y. H., & Chao, R. J. (2012). Supplier selection using consistent fuzzy preference relations. *Expert Systems with Applications, 39*(3), 3233-3240.

Chiclana, F., Herrera, F., & Herrera-Viedma, E. (1998). Integrating three representation models in fuzzy multipurpose decision making based on fuzzy preference relations. *Fuzzy Sets and Systems, 97*(1), 33-48.

Choi, H. J., & Choi, K. (2016). A comparative study on the safety management policy of children school bus of the United States, Britain, and Japan: Some community safety perspectives. *The Journal of Korean Association of Security and Safety, 11*(1), 66-81.

D'Souza, C., Paquet, V. L., Lenker, J. A., & Steinfeld, E. (2019). Self-reported difficulty and preferences of wheeled mobility device users for simulated low-floor bus boarding, interior circulation and disembarking. *Disability and Rehabilitation: Assistive Technology, 14*(2), 109-121.

Farmer, D., Song, Y., Shin, P., Kim, H., Tandan, S., & Lee, J. (2024). School bus lighting effectiveness and improvements: Results from a driving experiment. *Sustainability, 16*(2), 501.

Gharedaghi, G., & Omidvari, M. (2017, January). A contractor selection model for gas and oil industries in safety approach using ANP-DEMATEL in grey environment. In *Safety and Reliability* (Vol. 37, No. 1, pp. 25-47). Taylor & Francis.

Hallmark, S., Sperry, B., & Mudgal, A. (2011). In-use fuel economy of hybrid-electric school buses in Iowa. *Journal of the Air & Waste Management Association, 61*(5), 504-510.

Herrador-Colmenero, M., Villa-González, E., & Chillón, P. (2017). Children who commute to school unaccompanied have greater autonomy and perceptions of safety. *Acta Paediatrica, 106*(12), 2042-2047.

Herrera-Viedma, E., Herrera, F., Chiclana, F., & Luque, M. (2004). Some issues on consistency of fuzzy preference relations. *European Journal of Operational Research, 154*(1), 98-109.

Hlaing, Y., Oh, J., & Park, K. (2021). Determinants of Myanmar's trade pattern and policy implications for effective financing. *Global Business & Finance Review (GBFR), 26*(3), 100-110.

Hwangbo, H., Kim, J., Kim, S., & Ji, Y. G. (2015). Toward universal design in public transportation systems: An analysis of low-floor bus passenger behavior with video observations. *Human Factors and Ergonomics in Manufacturing & Service Industries, 25*(2), 183-197.

IMARC Group. (2024). Vietnam battery market report by battery technology (lead-acid battery, lithium-ion battery, and others), application (automotive data centers, telecommunication, energy storage, and others), and region 2024-2032. https://www.imarcgroup.com/vietnam-battery-market

Jeong, H., Park, W., Lee, J., Park, S., & Yun, I. (2022). Influence of public bus driver's driving behaviors on passenger fall incidents: An analysis using digital tachograph data. *Journal of Advanced Transportation, 2022*(1), 2941327.

Jomnonkwao, S., Banyong, C., Nanthawong, S., Janhuaton, T., Ratanavaraha, V., Champahom, T., & Jongkol, P. (2022). Perceptions of parents of the quality of the public transport services used by children to commute to school. *Sustainability, 14*(20), 13005.

Kang, H., Lee, Y., Jeong, H., Park, G., & Yun, I. (2023). Applying the operational design domain concept to vehicles equipped with advanced driver assistance systems for enhanced safety. *Journal of Advanced Transportation, 2023*(1), 4640069.

Kim Tran, S., & Ngoc Hoang Yen, L. (2018). Viettire's Dilemma: the expansion strategy in Myanmar. *Emerald Emerging Markets Case Studies, 8*(3), 1-29.

Kim, N., Yoon, J., Park, J. S., & Song, T. J. (2022). Development of evaluation system of driving safety for school bus. *Journal of Korean Society of Transportation, 40*(5), 613-630.

Korea Institute for International Economic Policy. (2023). Recent sales trend in the automobile market in Vietnam. https://www.kiep.go.kr/aif/businessDetail.es?brdctsNo=350263&mid=a30400000000&systemcode=03

Korea Legislation Research Institute. (2024). Special act on the improvement of air quality in air control zones. https://elaw.klri.re.kr/eng_mobile/viewer.do?hseq=56249&type=part&key=39

Korea Transportation Safety Authority. (2021). Planning on the development of the safety improvement technology for school buses in Korea. https://scienceon.kisti.re.kr/srch/selectPORSrchReport.do?cn=TRKO202300002887

Kwon, Y., Kim, S., Kim, H., & Byun, J. (2020). What attributes do passengers value in electrified buses? *Energies, 13*(10), 2646.

Kwon, Y., Son, S., & Jang, K. (2020). User satisfaction with battery electric vehicles in South Korea. *Transportation Research Part D: Transport and Environment, 82*, 102306.

Law, C. C., Zhang, Y., Gow, J., & Vu, X. B. (2022). Dynamic relationship between air transport, economic growth and inbound tourism in Cambodia, Laos, Myanmar and Vietnam. *Journal of Air Transport Management, 98*, 102161.

Le, H., Posada, F., & Yang, Z. (2022). *Electric two-wheeler market growth in Vietnam: An overview.* Washington, DC, USA: International Council on Clean Transportation.

Lipu, M. S. H., Mamun, A. A., Ansari, S., Miah, M. S., Hasan, K., Meraj, S. T., ... Tan, N. M. (2022). Battery management, key technologies, methods, issues, and future trends of electric vehicles: A pathway toward achieving sustainable development goals. *Batteries, 8*(9), 119.

Minh, P. V., Le Quang, S., & Pham, M. H. (2021). Technical economic analysis of photovoltaic-powered electric vehicle charging stations under different solar irradiation conditions in Vietnam. *Sustainability, 13*(6), 3528.

Modgil, S., Gupta, S., & Bhushan, B. (2020). Building a living economy through modern information decision support systems and UN sustainable development goals. *Production Planning & Control, 31*(11-12), 967-987.

Munyaneza, O., & Sohn, J. W. (2022). Modeling and control of hybrid MR seat damper and whole body vibration evaluation for bus drivers. *Journal of Low Frequency Noise, Vibration and Active Control, 41*(2), 659-675.

Mustafa, G., Hwang, Y., & Cho, S. J. (2024). Predicting bus travel rime in Cheonan city through deep learning utilizing digital tachograph data. *Electronics, 13*(9), 1771.

Nguyen, M. H., & Pojani, D. (2023). Can electric buses entice more public transport use? Empirical evidence from Vietnam. *Case Studies on Transport Policy, 13*, 101040.

Nguyen-Phuoc, D. Q., Nguyen, N. A. N., Tran, P. T. K., Pham, H. G., & Oviedo-Trespalacios, O. (2023). The influence of environmental concerns and psychosocial factors on electric motorbike switching intention in the global south. *Journal of Transport Geography, 113*, 103705.

Noudeng, V., Quan, N. V., & Xuan, T. D. (2022). A future perspective on waste management of lithium-ion batteries for electric vehicles in Lao PDR: Current status and challenges. *International Journal of Environmental Research and Public Health, 19*(23), 16169.

Oh, I., Fei, L., & Andrews, T. G. (2024). Understanding the dynamics of national business culture: A stationarity analysis for the case of South Korea. *Asia Pacific Business Review*, 1-27. doi:10.1080/13602381.2024.2389259

Ojuola, J., Mostafa, S., & Mohamed, S. (2020, April). Investigating the role of leadership in safety outcomes within oil and gas organisations. In *Safety and reliability* (Vol. 39, No. 2, pp. 121-133). Taylor & Francis.

Omidi, L., Karimi, H., & Moradi, G. (2023, October). Assessment of emergency risk management and resilience engineering at management levels of a high hazard industry. In *Safety and reliability* (Vol. 42, No. 4, pp. 191-213). Taylor & Francis.

Pak, B., Song, H., & Shin, K. (2023). Development of an evaluation framework for school bus operation service. *Journal of Auto-vehicle Safety Association, 15*(4), 79-87.

Pandyaswargo, A. H., Ruan, M., Htwe, E., Hiratsuka, M., Wibowo, A. D., Nagai, Y., & Onoda, H. (2020). Estimating the energy demand and growth in off-grid villages: Case studies from Myanmar, Indonesia, and Laos. *Energies, 13*(20), 5313.

Panwar, A., Tripathi, K. K., & Jha, K. N. (2019). A qualitative framework for selection of optimization algorithm for multi-objective trade-off problem in construction projects. *Engineering, Construction and Architectural Management, 26*(9), 1924-1945.

Park, H., & Kim, G. S. (2007). A comparative analysis of market entry mode of South Korean firms in China and Vietnam. *Global Business & Finance Review, 12*(1), 23-35.

Park, J., Choi, Y., & Park, J. (2021). Analysis for traffic accident of the bus with advanced driver assistance system (ADAS). *Journal of Auto-vehicle Safety Association, 13*(3), 78-85.

Peng, J., Fan, H., He, H., & Pan, D. (2015). A rule-based energy management strategy for a plug-in hybrid school bus based on a controller area network bus. *Energies, 8*(6), 5122-5142.

Perumal, S. S., Lusby, R. M., & Larsen, J. (2022). Electric bus planning & scheduling: A review of related problems and methodologies. *European Journal of Operational Research, 301*(2), 395-413.

Pode, R. (2015). Battery charging stations for home lighting in Mekong region countries. Renewable and Sustainable *Energy Reviews, 44*, 543-560.

Prakash, G., & Srivastava, S. (2019). Developing a care coordination model using a Hybrid DEMATEL and PLS-SEM approach. *IIM Kozhikode Society & Management Review, 8*(1), 34-49.

Raad, M. W., Deriche, M., & Sheltami, T. (2021). An IoT-based school bus and vehicle tracking system using RFID technology and mobile data networks. *Arabian Journal for Science and Engineering, 46*(11), 3087-3097.

Raad, N. G., & Rajendran, S. (2024). A hybrid robust SBM-DEA, multiple regression, and MCDM-GIS model for airport site selection: Case study of Sistan and Baluchestan Province, Iran. *Transportation Engineering, 16*, 100235.

Roh, S. Y., Shin, Y. R., & Seo, Y. J. (2018). The Pre-positioned warehouse location selection for international humanitarian relief logistics. *The Asian Journal of Shipping and Logistics, 34*(4), 297-307.

Saaty, T. L. (1980). The analytic hierarchy process (AHP). *The Journal of the Operational Research Society, 41*(11), 1073-1076.

Schröder, M., Iwasaki, F., & Kobayashi, H. (2021). Current situation of electric vehicles in ASEAN. Promotion of electromobility in ASEAN: States, carmakers, and international production networks. *ERIA Research Project Report FY2021, 3*, 1-32.

Sitorus, C., So, I. G., Furinto, A., & Kosasih, W. (2022). Exploring the influence of digital model business innovation factors on the courier service company's sustainability innovation performance. *Global Business & Finance Review, 27*(3), 98-113.

Slavich, G. M., Roos, L. G., Mengelkoch, S., Webb, C. A., Shattuck, E. C., Moriarity, D. P., & Alley, J. C. (2023). Social safety theory: Conceptual foundation, underlying mechanisms, and future directions. *Health Psychology Teview, 17*(1), 5-59.

Stojčić, M., Zavadskas, E. K., Pamučar, D., Stević, Ž., & Mardani, A. (2019). Application of MCDM methods in sustainability engineering: A literature review 2008-2018. *Symmetry, 11*(3), 350.

Sul, J. (2018). Korea's 96% reduction in child traffic fatalities.

In *18th International Conference Road Safety on Five Continents (RS5C 2018)*, Jeju Island, South Korea, May 16-18, 2018.

Thein, S. (2020). *Sustainable Urban Transport Index (SUTI) for Yangon City, Myanmar*. ESCAP.

United Nations. (2019). Using smart transport technologies to mitigate greenhouse gas emissions from the transport sector in Asia. https://hdl.handle.net/20.500.12870/344

Yoo, J. W., Roh, S., Tripathi, S., & Jang, H. (2024). Digital leadership within large South Korean firms. *Asia Pacific Business Review*, 1-23. doi:10.1080/13602381.2024.2332734