Behavioral Theory Research in Electric Vehicle: A Literature Review in Indonesian Context

Trisna Nagris Pratiwi[1] and Budhi Haryanto[2]

1Faculty of Economics and Business, Universitas Sebelas Maret, Surakarta, Indonesia
trisnanp@gmail.com
2Faculty of Economics and Business, Universitas Sebelas Maret, Surakarta, Indonesia

Abstract: The goal of technological advancements, including the development of electric vehicles (EVs), is to address emerging social and transportation challenges while mitigating pollution levels. As the country with the fourth-highest population density globally, Indonesia has witnessed both a population surge and a corresponding annual rise in the number of vehicles. The transportation sector, especially motor vehicles, stands as the second-largest source of air pollution in Indonesia, emphasizing the importance of addressing this substantial increase in usage. This study, thus, presents a systematic literature review related to the behavioral theory applied to EV in the Indonesian context. The Scopus database is used to extract the relevant articles. First, in presenting the extracted articles, descriptive statistics shows the number of articles per year and names of published journals. Next, a qualitative approach is used to classify the articles according to the type of research and method used. A scientometric analysis is then used to visualize the bibliometric clusters. Finally, we also provide a suggestion as a future research direction in which it is recommended to conduct research using the latest reasoned action approach model applying to EV.

Keywords—behavior; electric vehicle; Indonesia; literature review

1. INTRODUCTION

Indonesia began experiencing an oil balance deficit since 2003 due to an increase in consumption (about 1.21 million barrels per day) and a decline in production (only about 1.18 million barrels per day), according to the *British Petroleum*. This shortage was amplified from year to year. If this condition continues without a proper solution, it is not impossible that one day there will be an energy crisis in Indonesia. Based on data from the 2019 Indonesian Energy Outlook, the total energy consumption (without traditional biomass) in 2018 was 114 MTOE (million tons of oil equivalent), contributed from transportation sector (about 40%), industrial sector (36%), household (16%), commercial sector (6%), and about 2% from other sectors [1]. To prevent this oil shortage, there must be efforts especially from the government to reduce oil consumption, especially in the transportation sector. This is because the transportation sector contributed about 40% from the total oil consumption (the highest among all).

Over the last decade, there has been an increase in fuel consumption of about 8.6% per year in the transportation sector [2]. According to [3], more than 17,000 liters of fuel are consumed by vehicles every minute. To reduce oil consumption in the transportation sector, an energy efficient vehicle is needed. One type of vehicle that is energy efficient and can be an alternative for reducing oil consumption is an electric vehicle (EV).

In recent years, energy scarcity and environmental pollution have greatly promoted the rapid development of EV industry [4]. Several studies reveal that EVs have been widely considered as a promising solution to the problems of environmental degradation and energy depletion [5]. If we look at it ten years ago, there were only hundreds of renewable energy vehicles worldwide and in 2021, with the total sales of 6.5 million units—according to *Inside EV*. This figure increased 108% compared to 2020 which was only 3.1 million units of sales.

Even though the market of EV is slowly starting to grow, the number of EV sales especially in Indonesia, are still relatively smaller compared to the conventional vehicles. Electric cars only account for less than 1% of the total Indonesian car market. A survey conducted by Populix entitled "Indonesian Modern Consumption" which discusses Indonesian consumer behavior in the modern era, including the use of EV, showed that only 13% of the respondents own electric motorbikes and only 2% of them own electric cars [6]. This skepticism towards EV occurs for several reasons, for example, the perception of limited range for batteries [7], the unavailability of electric charging stations, longer charging times, higher prices [8], as well as its treatment and durability which are still not widely known. In particular for a marketer, to increase sales of EV or to market EV more effectively, one way that can be taken is to know the factors that influence people's intentions to buy EV.
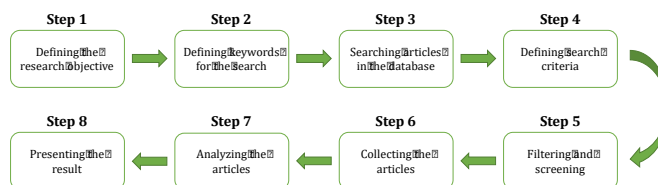

Fig. 1. *Steps of conducting systematic literature review*

This paper aims to systematically review academic articles regarding articles which discussed behavioral theory applied to

EV in Indonesia. In this study, we present a clear overview of what has been done in the literature towards EV in Indonesia in accordance to the behavioral theory. More precisely, we classify the articles according to the type of research and method used. In addition, we also provide a scientometric analysis is used to visualize the bibliometric clusters. Finally, the review provides a suggestion for the future research agenda.

2. METHODOLOGY

The steps to conduct the systematic literature review are described in this section and illustrated in Figure 1. In Step 1, the research objective has to be defined well. This study systematically reviews articles regarding the behavioral theory applied to electric vehicle (EV) in Indonesian context. Step 2 is conducted to restrict the search criteria. As such, the relevant search keywords for the query process are determined. The articles which contain "electric" AND ("car" OR "vehicle*" OR "motor") AND "behavio*") AND "Indonesia" in their title, abstract or keywords are extracted.[1]

Step 3 is searching for articles in the database. To get a widespread coverage of the literature, the most extensive scientific database is selected, i.e., Scopus by Elsevier (https://www.scopus.com/), following [9], who mentioned, "Scopus includes most of the journals indexed in WoS [Web of Science]." This database provides access to scientific articles and wide-ranging journals from various fields. Several research studies also used this database to perform literature review, e.g., [10], [11], [12]. In Step 4, the authors define the search criteria. For the sake of quality assurance, the document type is restricted to peer-reviewed research article published in a journal. From a pragmatic point of view, only articles published in English are included. Using the previously mentioned inclusion criteria, the search yields 17 articles. This low yield indicates that this research area is underexplored especially in the Indonesian context.

In Step 5, the authors independently read the abstract to verify whether the extracted articles are relevant to this study's objective. The authors then perform cross-checking by comparing the verification result to minimize the subjective
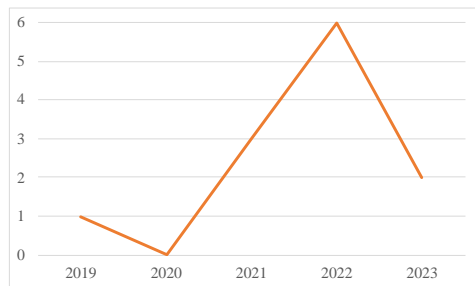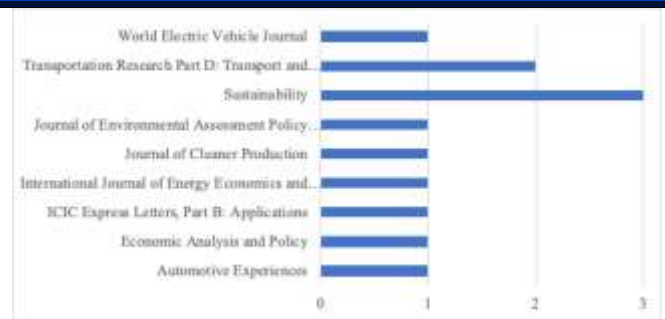
Fig. 3. *Number of published journals*

bias. Doing this way, only 12 articles are included for further analysis. In analyzing the collected articles in Step 7, the authors use qualitative approach to categorize articles according to type of research and method used.

In presenting the results (as in Step 8), descriptive statistics is presented showing the number of articles per year and names of published journals. Next, a qualitative approach is used to classify the articles according to the type of research and method used. Lastly, a scientometric analysis is used to visualize the bibliometric clusters, namely co-authorship and co-occurrence (keywords) analysis.

3. RESULT

3.1 Descriptive Statistics

Figure 2 illustrates the number of articles per year, in which in 2019 there was one article published, three articles were published in 2021, six articles were published in 2022, two articles were published in 2023, and no article was published in 2020. The collected articles are spread across 9 different journals, see Figure 3. Sustainability by MDPI ranks first (published 3 articles), followed by Transportation Research, Part D: Transport and Environment by Elsevier which published 2 articles.

3.2 Classification of the articles

Each article is classified according to type of research and method used. Classifying extracted articles from the literature review allows readers to validate what has been studied and

Table 1: Type of research and method used

Article	Type of research	Method
Guerra (2019) [14]	Predictive	Mixed logit model
Alamsjah et al. (2021) [15]	Analytical	Chi-square test of independence
Rizki et al. (2021) [16]	Predictive	Multinomial logit model

Fig. 2. *Number of articles per year*

---

[1] The asterisk sign (*) is used to find a root word plus all the words made by adding letters to the end (or beginning) of it.

Article	Type of research	Method
Febransyah (2021) [17]	Predictive	Analytic network process
Gunawan et al. (2022) [18]	Analytical	Structural equation modelling
Rahmawati et al. (2022) [19]	Analytical	Structural equation modelling
Sunitiyoso et al. (2022) [20]	Predictive	Mixed logit model
Murtiningrum et al. (2022) [21]	Analytical	Structural equation modelling
Waluyo et al. (2022) [22]	Predictive	Ordered logit model
Choi et al. (2022) [23]	Predictive	Mixed logit model
Putra et al. (2023) [24]	Analytical	Structural equation modelling
Haryadi et al. (2023) [25]	Exploratory	Exploratory factor analysis

also can provide the possibility to find gaps in this research domain. Table 1 shows the classification of extracted articles based on type of research and method used.

Based on the type of research, the articles are classified into four categories: exploratory, descriptive, analytical, and predictive [13]. An exploratory study is performed into a research problem with very little information or no earlier studies. The purpose is to search for patterns and ideas and obtain better familiarity with the research area to conduct a more rigorous investigation at a later phase. Only one exploratory research which is identified from the extracted articles, i.e., [25]. This study aimed to understand the characteristics of electric charging stations and (ECS) electric vehicle charging stations (EVCS) users in Indonesia in order to identify determinant factors for ECS and EVCS utilization. Using an exploratory factor analysis, the study found that potential EVCS users are adults from upper-middle-class backgrounds, with four family members, who own a motorcycle and live in suburban areas. Furthermore, a wide social network, knowledge of technology, and ease of access, convenience, and price were identified as key factors for choosing ECS/EVCS.

Descriptive research is performed to describe phenomena—and for this—that typically produces a problem's profile, subject, event or issue to be investigated. It aims to recognize and find information about the features of an issue or a problem. It goes further in investigating a problem than previous exploratory research. In this review, there is no descriptive research which is identified.

Analytical (or explanatory) research analyzes and explains why the phenomenon or the problem or issue or event being investigated is happening. Therefore, the research aims to understand the phenomenon by discovering and/or measuring the causal relationship. It tests hypotheses or uses theories to describe the reasons that cause the investigated phenomenon [26]. From the extracted articles, there are 5 analytical research studies; one of them is the study of [18]. This study aims to provide an overview of the factors that drive interest in adopting electric vehicles in Indonesia using data from 526 respondents in various cities located in Indonesia.

Finally, the predictive research goes further by forecasting the likelihood of a similar situation occurring elsewhere. It aims to generalize the analysis by predicting certain phenomena based on hypothesized or general relationships. There are 6 predictive research studies in this study, one of them is the study of [14], which presented the results of a choice experiment to evaluate the extent to which electric motorcycles are a potential replacement for gasoline-powered motorcycles in Solo, Indonesia. To estimate the probability of selecting different motorcycle types, the survey data are fit with a mixed logit model with random coefficients.

Based on method used, the predictive research use either logit model (i.e., mixed logit, ordered logit, and multinomial logit) or analytic network process (ANP). The logit model is used to estimate the probability of selecting different choices. The ANP is a multi-criteria decision model that can be used to rank decision alternatives. Most of the analytical research used structural equation modelling (SEM) to test and evaluate multivariate causal relationships. Lastly, the exploratory factor analysis (EFA) is used to discover the factor structure of a measure and to examine its internal reliability. EFA is often recommended when researchers have no hypotheses about the nature of the underlying factor structure of their measure.

3.3 Scientometrics Analysis

Scientometric analysis as a tool for performing science mapping is conducted in this review, namely, co-authorship and co-occurrence. Science mapping is a quantitative approach that utilizes visualization techniques as well as statistics to analyze bibliographic networks (e.g., keywords, authors, journals, citations, institutions, and countries) in a specific area.

We use VOSviewer software [27] to conduct the analysis. Fractional counting is used, in which each article has only one unit that it is fractioned according to the number of co-authors. It is used to normalize the influence of articles with multiple authors. When fractional counting is used, the strength of a co-authorship link between two authors is determined not only by the number of articles co-authored by the authors, but also by the number of authors of each co-authored article.
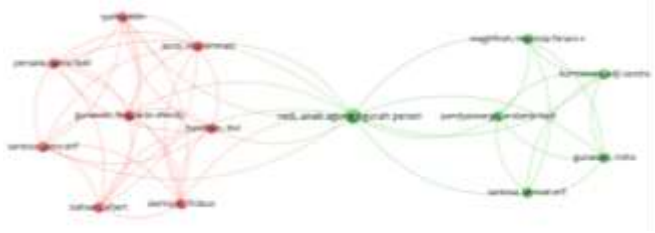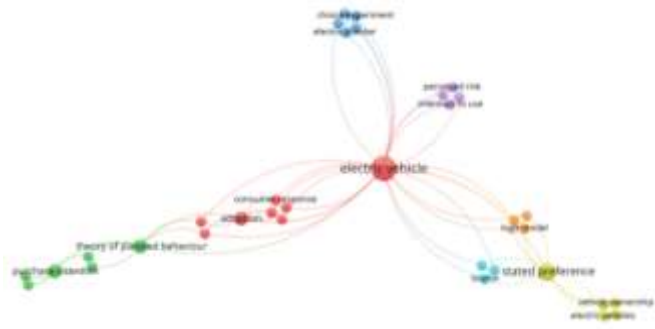
Fig. 4. *Co-authorship network*

Fig. 5. *Keywords and co-occurrence networks*

Co-authorship has been operationalized as a proxy for research collaboration. It is an interesting issue due to formalized shift in the policy-for-science paradigm from funding individual investigators to funding groups. This is because presumably, the more experts are working together on a particular problem, the better the chances for effectiveness, innovativeness, and/or productivity. Accordingly, many public research investments are made in organized research units with different types of expertise from different economic sectors and/or from different disciplines. Figure 4 illustrates the co-authorship network. In this network, nodes represent authors, which are connected when they share the authorship of an article.

Keywords co-occurrence analysis aims to map the co-occurred keywords and group them into several research clusters. It is performed to explain the structure and internal composition of the research domain as well as to reveal the frontier, see [28]. The map can be used to elucidate the knowledge structure of the research theme and it might help to identify the potential research opportunities in the future. Keywords co-occurrence network is shown in Figure 5. The most frequent keyword is "electric vehicle" which appeared six times, followed by "stated preference" (three times).

4. FUTURE RESEARCH DIRECTION

In the behavioral theory research, the reasoned action approach (RAA) [29] is considered the latest and updated model. The RAA is a more comprehensive version of its precursors, the theory of reasoned action (TRA) [30] and the theory of planned behavior (TPB) [31], [32].

Intention is a central construct of the RAA. It reflects the extent to which individuals are motivated to perform a given behavior and is conceptualized as the most proximal antecedent of behavior. Intentions are a function of three sets of belief-based constructs, i.e., attitude, subjective norms, and perceived behavioral control (PBC). Attitudes are an individual's overall positive or negative evaluation of a behavior. Subjective norms reflect the individual's beliefs that significant others want them to participate in the behavior. It comprises injunctive and descriptive sub-components, e.g., [33], which describe social pressures to perform the behavior and beliefs in the extent to which the behavior is typical or normal, respectively. PBC reflects the extent to which the behavior is under the individual's control. PBC is differentiated into autonomy and capacity sub-components, e.g., [34], which reflect perceptions of control over doing the behavior and perceived confidence in doing it, respectively.

We again conduct a search in the Scopus database using the search query: "reasoned action approach" AND "Indonesia". Only English peer-reviewed research article published in journals are included. Only two articles are extracted. The first article is [35] which aims to explore psychosocial factors that contribute to breast self-examination (BSE), which is an alternative to prevent breast cancer. Focus group discussions with 62 women aged 18-55 years were conducted to explore these psychosocial factors. The second article is [36], continuation research of [35], which aims to confirm the psychosocial factors of intention to carry out BSE. The respondents were 204 women aged 18-65 years and had never been diagnosed with breast cancer. This research combines RAA and the health belief model (HBM).

To find out similar research in a worldwide context, a search is carried out again in the Scopus database using the search query: (("electric" AND ("car" OR "vehicle" OR "motor") AND ("reasoned action approach")). Again, only English peer-reviewed research article published in journals are included. The result shows that there is only one article, i.e., [37], which examines the low adoption of EVs in Denmark. The study showed that Danish car owners' intention to purchase EVs increases with their attitudes towards EVs and the presence of a moral obligation to purchase environmentally friendly cars; and decreased as perceived difficulty in using EVs and feelings of uncertainty about EVs increased.

The visual of the previous searches is shown in Figure 6. According to these searches, it is recommended to conduct research using the latest RAA model applying to EV as there is no research conducted in the Indonesian context and only limited research conducted worldwide.

5. CONCLUSION

This study systematically reviews relevant articles from the Scopus database about the behavioral theory applied to EV in Indonesian context. It represents a unique opportunity
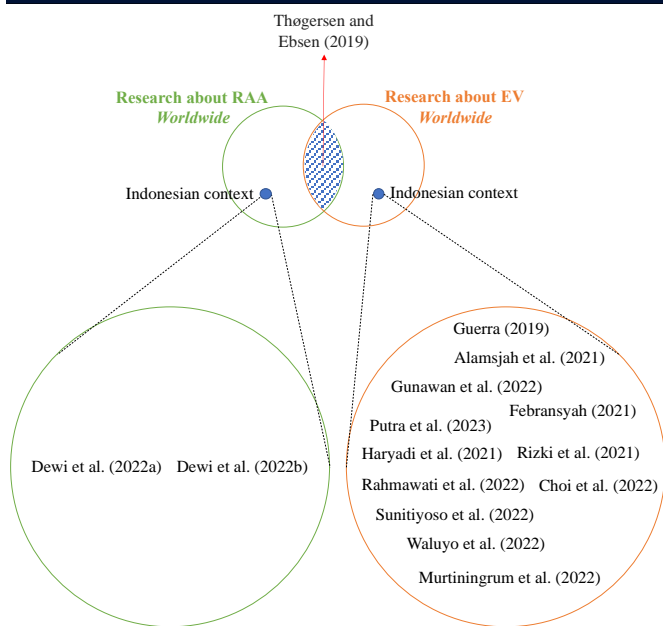
Fig. 6. *Summary of the search*

to contribute to the literature by mapping articles systematically in this research domain. Through the review, 12 articles published in 9 different journals are thoroughly analyzed. This study classifies the articles according to type of research and method used. The finding shows that there is one exploratory research, five analytical research, and six predictive research. This research also shows the co-authorship and keywords co-occurrence networks. Finally, we also provide a suggestion as a future research direction in which it is recommended to conduct research using the latest RAA model applying to EV.

6. REFERENCES

[1] Sekretariat Jenderal Dewan Energi Nasional (2019). *Outlook Energi Indonesia 2019*.

[2] Akhmad, A., & Amir, A. (2018). Study of fuel oil supply and consumption in Indonesia. International Journal of Energy Economics and Policy, 8(4), 13.

[3] PwC (2019). Oil and Gas in Indonesia. Taxation Guide. Jakarta. Available online: https://www.pwc.com/id/en/energy-utilities-mining/assets/oil-and-gas/oil-gas-guide-2019.pdf (accessed on November 13, 2023).

[4] Weiller, C., & Neely, A. (2014). Using electric vehicles for energy services: industry perspectives, Energy, 77, 194–200.

[5] Muneer, T., Milligan, R., Smith, I., Doyle, A., Pozuelo, M., & Knez, M. (2015). Energetic, environmental and economic performance of electric vehicles: Experimental evaluation. Transportation Research Part D: Transport and Environment, 35, 40-61.

[6] Republika (2022). Survei Sebut Permintaan Mobil Listrik di Indonesia akan Naik Signifikan. Available online: https://sindikasi.republika.co.id/berita/r87fq2368/survei-sebut-permintaan-mobil-listrik-di-indonesia-akan-naik-signifikan (accessed on November 13, 2023).

[7] Ajanovic, A., & Haas, R. (2018). Electric vehicles: solution or new problem?. Environment, Development and Sustainability, 20(1), 7-22.

[8] Subekti, R. A., Sudibyo, H., Susanti, V., Saputra, H. M., & Hartanto, A. (2014). Peluang dan Tantangan Pengembangan Mobil Listrik Nasional. LIPI Press, Jakarta.

[9] Mongeon, P. and Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. Scientometrics, 106(1), 213-228.

[10] Herrera-Franco, G., Montalván-Burbano, N., Carrión-Mero, P., Apolo-Masache, B., and Jaya-Montalvo, M. (2020). Research trends in geotourism: a bibliometric analysis using the scopus database. Geosciences, 10(10), 379.

[11] Mishra, M., Sudarsan, D., Santos, C.A.G., Mishra, S.K., Kar, D., Baral, K. and Pattnaik, N. (2021). An overview of research on natural resources and indigenous communities: a bibliometric analysis based on Scopus database (1979-2020). Environmental Monitoring and Assessment, 193(2), 1-17.

[12] Oliveira, A.S., de Barros, M.D., de Carvalho Pereira, F., Gomes, C.F.S. and da Costa, H.G. (2018). Prospective scenarios: a literature review on the Scopus database. Futures, 100, 20-33.

[13] Collis, J. and Hussey, R. (2013), Business Research: A Practical Guide for Undergraduate and Postgraduate Students, 4th ed., Palgrave Macmillan, New York City.

[14] Guerra, E. (2019). Electric vehicles, air pollution, and the motorcycle city: A stated preference survey of consumers' willingness to adopt electric motorcycles in Solo, Indonesia. Transportation Research Part D: Transport and Environment, 68, 52-64.

[15] Alamsjah, F., Siahaan, A., Santoso, Y. A., Syahruddin, Handoko, D., Gunawan, F. E., Asrol, M., Redi, A. A. N. P., and Persada, S. F. (2021). Potential factors affecting adoption of electric vehicle by Indonesia market. ICIC Express Letters Part B: Applications, 12(11), 1081-1090.

[16] Rizki, M., Syahputri, J., Belgiawan, P. F., & Irawan, M. Z. (2021). Electrifying tourist mobility in bali, indonesia: Setting the target and estimating the co2 reduction based on stated choice experiment. Sustainability, 13(21), 11656.

[17] Febransyah, A. (2021). Predicting purchase intention towards battery electric vehicles: A case of indonesian market. World Electric Vehicle Journal, 12(4), 240.

[18] Gunawan, I., Redi, A. A. N. P., Santosa, A. A., Maghfiroh, M. F. N., Pandyaswargo, A. H., & Kurniawan, A. C. (2022). Determinants of customer

intentions to use electric vehicle in Indonesia: An integrated model analysis. Sustainability, 14(4), 1972.

[19] Rahmawati, T. S., Yuniaristanto, Y., Sutopo, W., & Hisjam, M. (2022). Development of a model of intention to adopt electric motorcycles in Indonesia. Automotive Experiences, 5(3), 494-506.

[20] Sunitiyoso, Y., Belgiawan, P. F., & Rizki, M. (2022). Public acceptance and the environmental impact of electric bus services. Transportation Research Part D: Transport and Environment, 109, 103358.

[21] Murtiningrum, A. D., Darmawan, A., & Wong, H. (2022). The adoption of electric motorcycles: A survey of public perception in Indonesia. Journal of Cleaner Production, 379, 134737.

[22] Waluyo, T. A., Irawan, M. Z., & Dewanti. (2022). Adopting Electric Motorcycles for Ride-Hailing Services: Influential Factors from Driver's Perspective. Sustainability, 14(19), 11891.

[23] Choi, S., Kwak, K., Yang, S., Lim, S., & Woo, J. (2022). Effects of policy instruments on electric scooter adoption in Jakarta, Indonesia: A discrete choice experiment approach. Economic Analysis and Policy, 76, 373-384.

[24] Putra, S. W., Noer, L. R., Handriana, T., & Mardhiyah, D. (2023). Does Domestic and Global Environmental Events can Stimulated Purchase Intention E-Motorcycle?. Journal of Environmental Assessment Policy and Management, 25(01), 2350003.

[25] Haryadi, F. N., Simaremare, A. A., Ajija, S. R., Hakam, D. F., & Mangunkusumo, K. G. H. (2023). Investigating the Impact of Key Factors on Electric/Electric-Vehicle Charging Station Adoption in Indonesia. International Journal of Energy Economics and Policy, 13(3), 434-442.

[26] Cooper, D. and Schindler, P. (2013), Business Research Methods, 12th ed., McGraw-Hill Higher Education, New York City.

[27] van Eck, N. J. and Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics, 84(2), 523-538.

[28] Hu, W., Dong, J., Hwang, B., Ren, R. and Chen, Z. (2019). A scientometrics review on city logistics literature: research trends, advanced theory and practice. Sustainability, 11, 2724.

[29] Fishbein, M., & Ajzen, I. (2010). Predicting and Changing Behavior: The Reasoned Action Approach. Psychology Press.

[30] Ajzen, I., and Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice Hall.

[31] Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes. 50(2), 179–211.

[32] Ajzen, I. (2005). Attitudes, personality, and behavior. 2nd ed. Maidenhead, UK: Open University Press.

[33] Sheeran, P., & Orbell, S. (1999). Augmenting the theory of planned behavior: roles for anticipated regret and descriptive norms 1. Journal of Applied Social Psychology, 29(10), 2107-2142.

[34] Terry, D. J., & O'Leary, J. E. (1995). The theory of planned behaviour: The effects of perceived behavioural control and self-efficacy. British journal of social psychology, 34(2), 199-220.

[35] Dewi, T. K., Ruiter, R. A., Ardi, R., & Massar, K. (2022a). The role of psychosocial variables in breast self-examination practice: Results from focus group discussions in Surabaya, Indonesia. Psycho-Oncology, 31(7), 1169-1177.

[36] Dewi, T. K., Ruiter, R. A., Diering, M., Ardi, R., & Massar, K. (2022b). Breast self-examination as a route to early detection in a lower-middle-income country: assessing psychosocial determinants among women in Surabaya, Indonesia. BMC Women's Health, 22(1), 179.

[37] Thøgersen, J., & Ebsen, J. V. (2019). Perceptual and motivational reasons for the low adoption of electric cars in Denmark. Transportation Research Part F: Traffic Psychology and Behaviour, 65, 89-106.