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Research paper

Behavioral intention to use parcel lockers in the last mile and underlying linkages with travel modal choice

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ABSTRACT

As e-commerce expands globally, using parcel lockers is becoming more and more common. Ultimately, our study contributes to a better understanding of last-mile delivery intents by providing insightful information to legislators and courier businesses seeking to encourage locker usage. After an online survey was completed in Mumbai, India, a Latent class cluster analysis and structural equation modeling were used to examine the variables influencing parcel locker users' usage. The study is unique in that it looks at three clusters: regular transit users, car owners, and those who own and use two-wheelers to explore the relationship between transportation mode choice and intention to utilize parcel lockers. According to the findings, perceived usefulness, perceived ease of use, perceived risks, and shopping preference are among the major drivers of behavioral intention to use parcel lockers. Owners of motorcycles and bicycles showed a positive correlation between all parameters and their intention to use parcel lockers, suggesting that ease of access will lead them to utilize this service. The relevance of convenience in locker accessibility was shown by the positive link between perceived usefulness and attitude among regular transit users. Contrary, car owners only indicated a positive correlation with perceived ease of use, indicating a low propensity to use parcel lockers. These results highlight the necessity for urban logistics regulations to adjust to new delivery models like parcel lockers by matching service offerings to various means of transportation and considering locker placement. In cities, these flexible regulations may increase accessibility and encourage creative last-mile solutions.

1. Introduction

The surge of e-commerce, driven by globalization and technological advancements in recent years, has resulted in a significant increase in delivered and returned parcels (Vakulenko et al., 2018a). The COVID-19 pandemic brought about restrictions and lockdowns, curbing movement in most economies, propelling digitalization in the logistics sector and moving considerable amounts of commerce online. As sales shifted online, e-commerce platforms reported a boom in their sales. Amazon reported a 220 % increase from the same time of the previous posting of $8.1 billion in profit (Weise, 2021) (Amazon's profit soars 220 percent). This surge has increased demand for faster parcel delivery, resulting in a notable swell in last-mile freight activities (Liu et al., 2023) (Liu et al., 2023). This final stage of delivery of packages between the transportation hubs and the end-consumer is called 'Last Mile' (Deutsch & Golany, 2018) (Deutsch & Golany, 2018). Since the shopping and delivery environment has evolved drastically over the last few years, the door-to-door delivery system hasn't exactly been placid, giving rise to what is referred to as the 'Last Mile Delivery Problem'. This problem comes from multiple reasons. There is always waiting time involved for customers until the courier arrives at home (Kawa, 2020) (Kawa, 2020). High population density in remote areas makes it difficult for delivery workers to find the correct addresses, especially in remote areas with lower transport access. With the recent increase in the amount and volume of parcels, there is a higher number of vehicle usage, leading to increased congestion of roads and significant pollution in addition to higher customer service costs (Moroz & Polkowski, 2016) (Moroz & Polkowski, 2016). Another problem is that goods are being delivered to

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the wrong customers or are not flexible in time and place, rendering a negative customer experience (Macioszek, 2018) (Macioszek, 2018).

Various strategies can be employed to address last-mile logistics sustainability and efficiency issues. One approach involves increasing drop densities through optimizing delivery routes, consolidating parcels, and establishing collection points such as parcel lockers (Mommens et al., 2021) (Mommens et al., 2021). These lockers offer a secure, accessible and convenient location for customers to retrieve their packages, reducing the need for individual doorstep deliveries (Deutsch & Golany, 2018) (Deutsch & Golany, 2018). Another strategy is shifting vehicle types to embrace alternative technologies such as autonomous and electric vehicles. In Europe, electric vehicles instead of traditional fuel-run vehicles are used for deliveries to promote sustainability and potentially reduce operational costs in the long term. Shifting delivery times is also a viable tactic. Delivery during off-peak hours can alleviate traffic congestion and reduce delivery lead times. This improves efficiency and contributes to smoother operations within urban areas, ultimately benefiting both logistics companies and customers. Addressing receiver behavior is another crucial aspect. Effective customer communication can help avoid delivery failures and mitigate issues associated with not-at-home situations or misplaced parcels. Encouraging customers to pick up orders from designated locations, like stores or parcel lockers, enhances convenience and reduces the likelihood of delivery disruptions.

Various simulation and optimization techniques have already been developed to determine the optimal location of parcel lockers to minimize the overall cost, reduce environmental damage, deal with the not-at-home problem, and optimize the usage of delivery vehicles. For instance (Zheng et al., 2020) (Zheng et al., 2020), have considered the instance of Shiweitang Sub-District in Guangzhou City, China, where they have developed a hybrid GIS-based AHP and Huff model for identifying a suitable location for Parcel Pickup Points (PPP) in a typical residential area. They did so by determining and evaluating the factors affecting the resident's selection of a PPP and calculating the attractiveness of the facilities to predict the number of customers at the candidate facilities. A similar study was done by Oliveira et al. (2017). It investigated the use of automated delivery lockers (stations) in Belo Horizonte, Brazil. The study employed surveys to gauge potential demand through both stated and revealed preference methods. The results showed that while home delivery remains the most preferred option, there's significant potential demand for automated lockers among online shoppers in the city. Despite the advancements in parcel locker location-allocation problems, the research on behavioral adaptation towards parcel lockers leaves much to be desired. For instance, previous research (Lachapelle et al., 2018) on pickup point users in Australia highlighted that most early adopters are car users, people on foot, and bikes. One striking finding is that very few transit users were willing to shift to alternatives involving parcel lockers, possibly due to the higher impedance levels. The possibility of combining parcel lockers with public transportation systems is covered in Keeling et al. (2021). It discovered that passengers on buses and trains, among other transit users, are drawn to lockers at transit stops. By examining Portland, Oregon's transit infrastructure, the research established a link between customer behavior and mode of transportation. It proposed that placing lockers at transit hubs enhances transit usage while mitigating traffic congestion caused by deliveries. The study emphasized accessibility and equity issues, demonstrating how patterns of locker adoption are influenced by public transportation and other alternative forms of transportation.

Iannaccone et al. (2021) examined how accessibility and travel distance influence customers' preferences for parcel lockers over home delivery. It demonstrates that accessibility by several modes of transportation, especially walking and biking, and closeness to lockers are essential considerations in consumer decision-making, focusing on younger consumers. According to the survey, there is a general high level of interest in parcel lockers, and people are eager to use them if they are conveniently located. Policymakers seeking to promote sustainable last-mile delivery options by enhancing travel mode accessibility to lockers will find this data extremely valuable.

It is required to find out how different transportation modes influence parcel locker accessibility for residents. Moreover, it is aimed to determine which factors will encourage the adoption of parcel lockers, including car ownership and mobility preferences. Lastly, it is aimed to determine how perceived risk, usability, and purchasing behavior impact consumer uptake of this last-mile solution. The current research does not go deep enough in its methodology to consider transportation behavior while formulating problems and finding solutions. Most research either examines locker adoption without taking individual-level mobility choices like commute modes into account or concentrates on accessibility without taking travel patterns into account. This study segments the consumer base according to travel mode and car ownership to close this gap using Latent Class Analysis (LCA) and Structural Equation Modeling (SEM). Then, the effect of various transportation modes, including driving, walking, and public transport, is examined on the accessibility of parcel lockers in urban areas. To answer this, we use Latent class cluster analysis in our research to segment consumers based on car ownership and transportation preferences and provide important insights into parcel locker adoption. Structural equation modeling assesses the effects of perceived risk, user-friendliness, and purchasing behavior on consumer responses.

This study focuses on the issues of last-mile delivery, which are unique to highly populated cities in the Global South, with a specific focus on Mumbai. As the world's sixth most congested city, its population density is 83,660 per square kilometer, significantly above other Indian cities (T. Homer, 2024) (Homer, 2024). Traffic bottlenecks have worsened over time, with overflow rates exceeding the basic norm by 55 %, which means that during peak periods, the 30-min drive takes nearly 50 min. It restricts the average traffic speed to 14 km/h, delaying delivery vehicles (Y. Voices, 2023) (Voices, 2023). These obstacles underline the need for novel solutions such as parcel lockers, which this paper assesses considering Mumbai's distinct transportation and logistics ecosystem.

2. Literature review

Door-to-door delivery in B2C logistics suffers from inefficiency and high costs due to frequent pauses, extended rounds, and unused truck capacity (Lagorio & Pinto, 2020) (Lagorio & Pinto, 2020). Furthermore, high delivery failure rates and empty trips are caused by the "Not-at-Home Problem," in which deliveries needing identification or signatures are unsuccessful because the recipient is not there Gevaers et al. (2014). Fuel consumption and emissions increase due to this difficulty, which is made worse by the need for quick deliveries and inefficient light goods trucks (Buldeo et al., 2019). Delivery delays and higher prices are caused by irregular logistical infrastructure in developing nations, such as Vietnam and Kenya, and a lack of geocoordinates, as in Pakistan (Abdul Rahman et al., 2022; Hai et al., 2021; Mogire et al., 2022). According to Jiang et al. (2018), China also experiences significant delivery failure rates as a result of the "Not-at-Home Problem." In contrast, Switzerland's ranking in the UNCTAD B2C E-commerce Index is enhanced by its high postal reliability, while European nations have embraced electric vehicles to promote sustainability (Planning and implementation of low; No15 UNCTAD Technical Notes on, 2020).

2.1. Behavioral intention to use parcel lockers

Numerous scholarly inquiries have scrutinized the multifaceted factors influencing customers' intentions to utilize parcel lockers, shedding light on various dimensions that shape consumer behavior in this domain (Chen et al., 2023; Li et al., 2024; Yuen et al., 2019). One pivotal factor identified in the extant literature is effort expectancy, which encapsulates customers' perceptions of the ease or difficulty of

using parcel lockers to receive packages (Yusoff et al., 2023; Zhou et al., 2020). Effort expectancy, in turn, can be intricately linked with the accessibility of parcel locker locations, encompassing factors such as the distance customers must travel to reach lockers and the time required to complete transactions (Mitrea et al., 2020).

Literature underscores various factors influencing customer intentions to use parcel lockers, ranging from effort expectancy and psychological perceptions to social influences and individual characteristics. Understanding these multifaceted determinants is imperative for policymakers and industry stakeholders seeking to enhance the adoption and utilization of parcel locker solutions within urban logistics ecosystems. For instance, psychological factors emerge as significant determinants of customer intentions to utilize parcel lockers, as Najmi et al. (2023) underscored. These psychological considerations encompass customers' perceptions of the convenience afforded by parcel lockers compared to traditional delivery methods. UTAUT proposes that technology usage is influenced by behavioral intention, shaped by performance expectancy, effort expectancy, social influence, and facilitating conditions, moderated by factors like age, gender, experience, and voluntariness of use. The Theory of Planned Behavior (TPB) is a frequently utilized behavioral model that elucidates behavioral change by assuming deliberate behavior can be predicted through planning. The perceived ease and convenience of parcel locker usage are pivotal in influencing adoption intentions, with individuals more inclined to utilize lockers if they perceive them as more efficient and user-friendly. Safety and privacy concerns also play a crucial role in shaping customer attitudes toward parcel locker adoption (An et al., 2022; Lai et al., 2022; Mitrea et al., 2020). Customers must feel assured that their packages will be securely stored and readily accessible, with trust in the reliability and security of parcel lockers as a cornerstone for adoption. Social factors also notably influence customers' intentions to use parcel lockers, as Vakulenko et al. (2018b) illustrated. Recommendations from friends or influencers can significantly sway individuals' perceptions and encourage them to try parcel lockers based on positive experiences shared by others. This social validation fosters a sense of trust and familiarity, driving adoption among potential users. In addition to psychological and social determinants, individual factors play a pivotal role in shaping intentions to use parcel lockers, as elucidated by Chen et al. (2023) and Tsai & Tiwasing (2021). Perceived utility, perceived risk, and demographic variables such as age, gender, income level, education, and occupation emerge as salient factors influencing adoption intentions. Moreover, technological barriers pose significant challenges to adoption, with concerns regarding interface complexity, technical glitches, and initial setup costs potentially deterring customers Lai et al. (2022); Tsai & Tiwasing (2021); Yuen et al. (2018).

2.2. Research gap and novelty

An important factor that is often ignored is the consumers' modal choice, which significantly impacts how accessible parcel lockers are. Numerous studies have confirmed the role of perceived benefits in increasing consumers' intention to adopt parcel lockers, as well as how compatibility and perceived complexity indirectly influence adoption intentions through attitudes (Wang et al., 2018). The study by Lachapelle et al. (2018) focuses primarily on automotive access and does not give much attention to other modes of transportation. Our study broadens by examining a greater range of travel behaviors (such as work, shopping, and leisure) and how these decisions affect the utilization of parcel lockers (Keeling et al., 2021). Investigates lockers for public transportation but skips over individual-level mobility habits. To provide a more nuanced view of accessibility, this paper uses Latent Class Analysis (LCA) to classify clients based on mode preferences and automobile ownership. The study by Iannaccone et al. (2021) focuses on younger consumers and is mostly conducted in a European context. To fill the gap, this paper uses structural equation modeling (SEM) to examine how modal preferences, perceived risk, and lifestyle compatibility impact locker uptake in Mumbai, a densely populated metropolis in the Global South where complicated transit patterns and high population density can make it difficult to use innovative technology like self-service lockers. Therefore, little research has been done on how transportation mode, trip chaining patterns, and post-COVID changes in consumer behavior affect the desire to utilize parcel lockers in urban settings like Mumbai. Further research is necessary to fully understand how shopping preferences, online vs in-store purchases, and parcel locker perceptions interact, particularly in light of the notable shifts in consumer behavior toward online purchasing that occurred during and after the COVID-19 epidemic.

This study examines how Mumbai, India inhabitants' mode choices and car ownership affect parcel locker accessibility and adoption to fill in these research gaps. The study accounts for the diversity in transportation choices depending on trip purpose by gathering thorough data on respondents' modes of transportation for work, shopping, and leisure. This extensive data set makes possible a more nuanced understanding of how various transportation patterns impact consumers' impressions of parcel lockers. Using Latent Class Analysis (LCA), different customer clusters with differing intentions to utilize parcel lockers were identified by segmenting the consumer base according to their mode preferences and car ownership. The study employed Structural Equation Modelling (SEM) to assess the key characteristics that impact customer behavior towards parcel lockers in each sector. These elements include perceived risk, simplicity of use, and compatibility with lifestyle. This method adds to the small amount of research on last-mile delivery options in highly populated cities in the Global South. It sheds light on the significance of modal choice in determining access to parcel lockers, especially considering the COVID-19 pandemic's effects on consumer behavior.

3. Methodology and data

A research process flow diagram for an overall overview of the study is shown in Fig. 2, which intends to analyze and evaluate the primary factors influencing customers' intention to use parcel lockers. Data from 1022 Mumbai residents were collected using an online survey among people who frequently utilize last-mile delivery services. The survey was aimed to analyze transport and attitudes toward parcel lockers, consisting of 25 questions broken down into four parts: (1) personal information (e.g., age, earnings), (2) transport usage (e.g., "How frequently do you take public transport?" "Which vehicle do you use?"), (3) parcel locker convenience (e.g., "How useful do you consider parcel lockers?"), and (4) willingness to change behavioral patterns (e.g., "Would you use parcel lockers if faster?"). however, the data collection process has limitations. The online survey format may introduce selection bias,

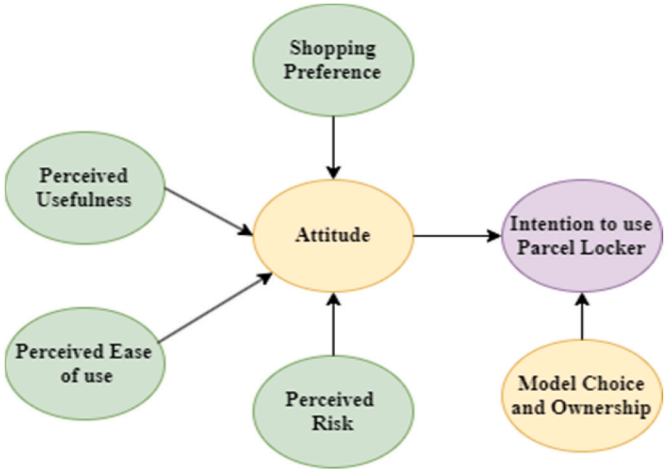


Fig. 1. Key hypotheses on customer behavior and connections.

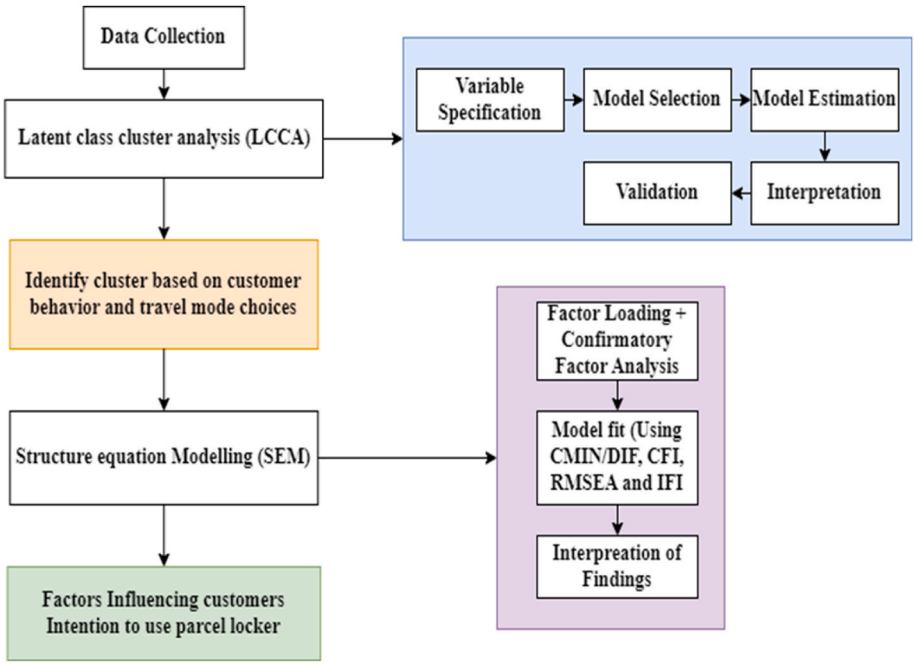


Fig. 2. Research process flow diagram.

potentially underrepresenting residents without internet access or those less tech-savvy. We have only considered Mumbai city in our study, and the sample size is limited to truly representing the Mumbai population of over 20 million. The results may not be fully generalizable to the preferences of the broader population. Additionally, self-reported data could be subject to response bias. Next, we employ a statistical technique called Latent Class Cluster Analysis to identify distinct groups of customers based on these demographics. Once we have these customer segments, we delve deeper using Confirmatory Factor Analysis to pinpoint the exact factors influencing their decision to use parcel lockers.

3.1. Hypothesis development

Five critical hypotheses are taken from the literature and presented in Fig. 1 to comprehend customer behavior and explore these connections. Through these hypotheses, this study examines the variables that affect Mumbai residents' intention to use parcel lockers.

H1. ***Positive Relationship Between Shopping Preference and Attitude:*** This hypothesis, supported by Chen et al. (2023) examines the link between online shopping preferences for delivery options and the adoption of parcel lockers for package pickup. These studies suggest that parcel lockers hold promise as a popular last-mile delivery solution for frequent online shoppers. A positive relationship between shopping preference and attitude is hypothesized. Specifically, individuals who frequently shop online will likely develop a more favourable attitude towards utilizing parcel lockers.

H2. ***Positive Relationship Between Perceived Usefulness and Attitude:*** Different Researchers (Mitrea et al., 2020; Yuen et al., 2019) investigate the connection between perceived Usefulness and attitudes towards parcel lockers. These studies emphasize the importance of understanding customer perspectives on locker adoption in the last-mile delivery landscape, particularly considering parcel lockers' relative novelty. A positive relationship between perceived Usefulness and attitude is hypothesized. Customers who perceive parcel lockers as fulfilling a need and offering valuable benefits, such as mitigating missed deliveries, streamlining package receiving, or providing a secure alternative to unattended home deliveries, will likely develop a more favourable attitude towards using them.

H3. ***Positive Relationship Between Perceived Ease of Use and Attitude:*** Building on prior research by (Tsai & Tiwasing, 2021) (Tsai & Tiwasing, 2021) that explores factors influencing the adoption of parcel lockers, this study specifically examines the relationship between perceived ease of use and attitude towards these lockers. Perceived ease of use refers to the customer's belief that parcel lockers are user-friendly and require minimal effort to learn and operate. A positive relationship between these two factors is hypothesized. In simpler terms, customers are more likely to adopt a service they find convenient and straightforward. This hypothesis suggests that if individuals perceive parcel lockers as easy to locate, navigate, and use, they will develop a more favourable overall impression of using them. This positive attitude is expected to translate into a higher likelihood of adopting parcel lockers for future deliveries.

H4. ***Positive Relationship Between Perceived Risks and Attitude:*** Oliveira et al. (2017) highlights risks associated with parcel lockers. Study reveals there's significant potential demand for automated lockers among online shoppers in the city. This could occur when individuals weigh the perceived risks AGAINST lockers' potential benefits. For instance, someone who frequently misses deliveries due to work schedules might perceive the risk of missed deliveries as more significant than the potential risk of their package being damaged in a secure locker. In such cases, the perceived risk (missed deliveries) could encourage a more positive attitude towards lockers. This hypothesis suggests that understanding these perceived risk-benefit trade-offs can provide valuable insights for promoting wider locker adoption.

H5. ***Positive Relationship Between Attitude and Intention to Use:*** Building upon prior research by Mitrea et al. (2020) that investigated user sentiment towards parcel lockers, this hypothesis delves deeper into the connection between attitude and intention to use. The studies above examined how existing users perceive factors like convenience, security, and overall experience with lockers. Leveraging these insights, a positive relationship between attitude and intention to use is hypothesized. Customers who develop a favourable attitude towards lockers, likely due to their perceived benefits outweighing potential drawbacks, are likelier to choose them for future deliveries.

In conjunction with the above five hypotheses, we posit an additional hypothesis concerning the unique influence of behavioral factors on the intention to utilize parcel lockers within each cluster (Lachapelle et al., 2018). highlight how mode-specific amenities like parking, bike racks, transit stops, and taxi stands surrounding parcel lockers improve their accessibility and convenience for users of various travel modes. The study emphasizes integrating such amenities with locker locations to enhance last-mile delivery efficiency. By aligning locker placement with multimodal urban transport options, the paper provides valuable insights into strategies that support different travel modes, which can be applied to better understand locker adoption and support the formulation of Hypothesis 6 in this context. Hence, H6 is articulated as follows:

H6. Modal choices and ownership exhibit a direct correlation with the intention to use parcel lockers. This hypothesis would be confirmed on the identification of distinct significant factors for each cluster through structural equation modelling.

By testing these hypotheses, valuable insights can be gained into the factors influencing Mumbai adoption of parcel lockers.

3.2. Analysis methods

This study uses Latent Class Cluster Analysis (LCCA) and Structural Equation Modeling (SEM) to investigate factors that influence customers' inclination to utilize parcel lockers. LCCA separates consumers by managing mixed data types, continuous (e.g., distance to lockers) and categorical (e.g., perceived security) outperforming classic clustering approaches like k-means by discovering hidden subgroups probabilistically (Hennig & Liao, 2013; Lezhnina & Kismihók, 2022) (Hennig & Liao, 2013; Lezhnina & Kismihók, 2022). These segments feed into SEM, which models causal relationships among variables like accessibility and convenience, leveraging its ability to manage Latent constructs and test complex hypotheses (Bakk et al., 2013). This combined approach effectively analyzes mobility behavior and locker adoption determinants, enhancing accuracy and practical insights for last-mile delivery optimization (Bakshi et al., 2024).

3.2.1. Latent Class Cluster Analysis

Latent class cluster analysis (LCA) is used in this study to investigate the association between parcel locker use for deliveries and people's travel habits. LCA doesn't force data into predetermined categories like traditional clustering techniques do. Instead, by analyzing trends in survey responses, it identifies natural groupings within the population that offer unique behavioral segments. The LCA model finds hidden categories, or Latent classes, among the responses once the research begins with collecting data on travel patterns and locker usage. Fit indices, like AIC and BIC, are used by researchers to compare different models and identify the greatest fit. cyclists who prefer lockers"), enabling a more complex understanding of the relationship between preferences for parcel lockers and modes. The model outputs allow for a more nuanced assessment of the relationship between parcel locker preferences and travel choices by revealing discrete groups of people (e.g., "frequent cyclists who prefer lockers").

3.2.2. Structural equation model

A flexible technique that lets researchers look at both observable variables and hidden components in one cohesive framework is structural equation modeling (SEM). It incorporates factor analysis and regression methods to investigate intricate correlations between variables. The first step in the process is the theoretical definition of relationships, followed by assessing how effectively observed data captures the underlying elements. After that, scientists build a structural model to show how these variables interact. AIC and RMSEA indices are used to evaluate the model fit, and modifications are made as needed. A deeper understanding of the data can be obtained by drawing inferences about the proposed correlations once an adequate fit has been established.

3.3. Study area and data

A data collection campaign was launched to evaluate Mumbai people's transportation preferences and possible openness to parcel lockers. 1022 city dwellers responded to this project's organized and targeted questionnaire. The collected information covered a wide variety of participant demographics, as indicated in Fig. 3(a) and (b), including gender, age, educational background, occupation, monthly income, and the number of automobiles, motorcycles, and bicycles each household owned. Residents were asked to select their primary method of transportation from walking, cycling, motorcycles, public transportation, Uber/Ola, and other options for work/education, shopping trips, and leisure activities to better understand their transportation patterns within the city. The poll on mobility was supplemented with questions regarding residents' internet purchasing behaviors. One of the questions in this was how frequently various categories, such as cooked dinners, supermarket deliveries, and general-purpose items, are received through online orders. A breakdown of respondents' genders indicates that 56.6 % are men and 43.4 % are women. The group with the lowest representation is those over 45 (20.3 %). The largest age group of the respondents is 25–44, accounting for 57.2 percent. The remainder (22.5 %) are in the 18–24 age range. Regarding education, the results show that individuals with a bachelor's degree have the most representation (53.2 %), followed by those with a master's degree or higher education (20.4 %). People who had completed high school comprised 18.9 % of the sample, while those who had not completed high school made up 7.5 %. The research on income distribution shows that 40.49 % are in the (2500–6250) USD income bracket, 22.65 % are in the (6250–12,500) USD bracket, 20.00 % earn less than 2500 USD, 8.33 % are in the (12,500–18,750) USD bracket 4.22 are in the (18,750–25,000) USD bracket, and 4.31 % earn more than 25,000 USD, indicating a concentration of respondents in lower to middle-income ranges.

The survey also gauged the participants' familiarity with this service to delve deeper into the potential adoption of parcel lockers. This included their perceived ease of using parcel lockers, perceived risks, and trust in utilizing this delivery method. It's important to note that the survey responses were collected through various factors using a Likert five-point scale. This scale provided participants with the following options to express their level of agreement with each statement: Strongly Disagree, Somewhat Disagree, Somewhat Agree, Neither Agree nor Disagree, Agree, and Strongly Agree. By employing this scale, a glean valuable insight into the participants' attitudes and perspectives on the topics covered in the survey.

Combining the respondents' transportation preferences, online buying habits, and demographic profiles, the survey is critical in determining their inclination to use parcel lockers. The survey gathers comprehensive information on participants' modes of transportation, including walking, cycling, public transportation, and private vehicles, for various activities such as shopping, work, and leisure. This allows for understanding how mobility patterns affect the accessibility of potential parcel locker locations. Convenient delivery solutions are in high demand, as seen by the respondents' online shopping behaviors, mainly the frequency with which they order groceries, prepared meals, and other items. We may segment the population and target groups that are more likely to use parcel lockers, such as younger, higher-income individuals who frequently purchase online, based on demographic data like age, gender, income, and education level. We can determine which regions or customer types might benefit most from parcel lockers by comparing the frequency of online buying with the modes of transportation. For example, individuals who rely on public transportation or walk may prefer lockers close to residential areas or transit hubs. Insights into the financial and geographical accessibility of locker locations are also provided by the survey's breakdown of income and car ownership, ensuring that lockers are positioned in places that

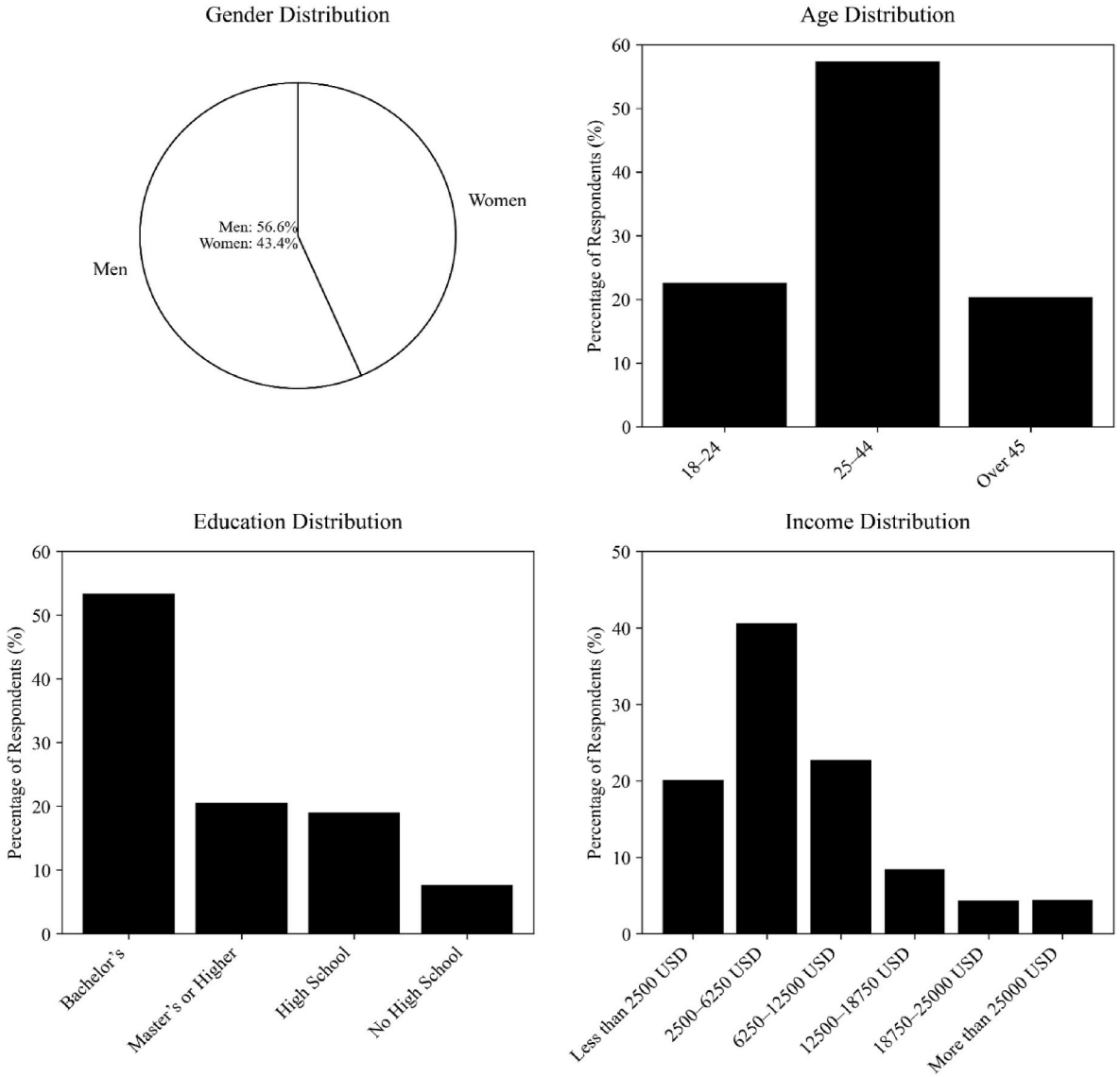


Fig. 3(a). Demographic description.

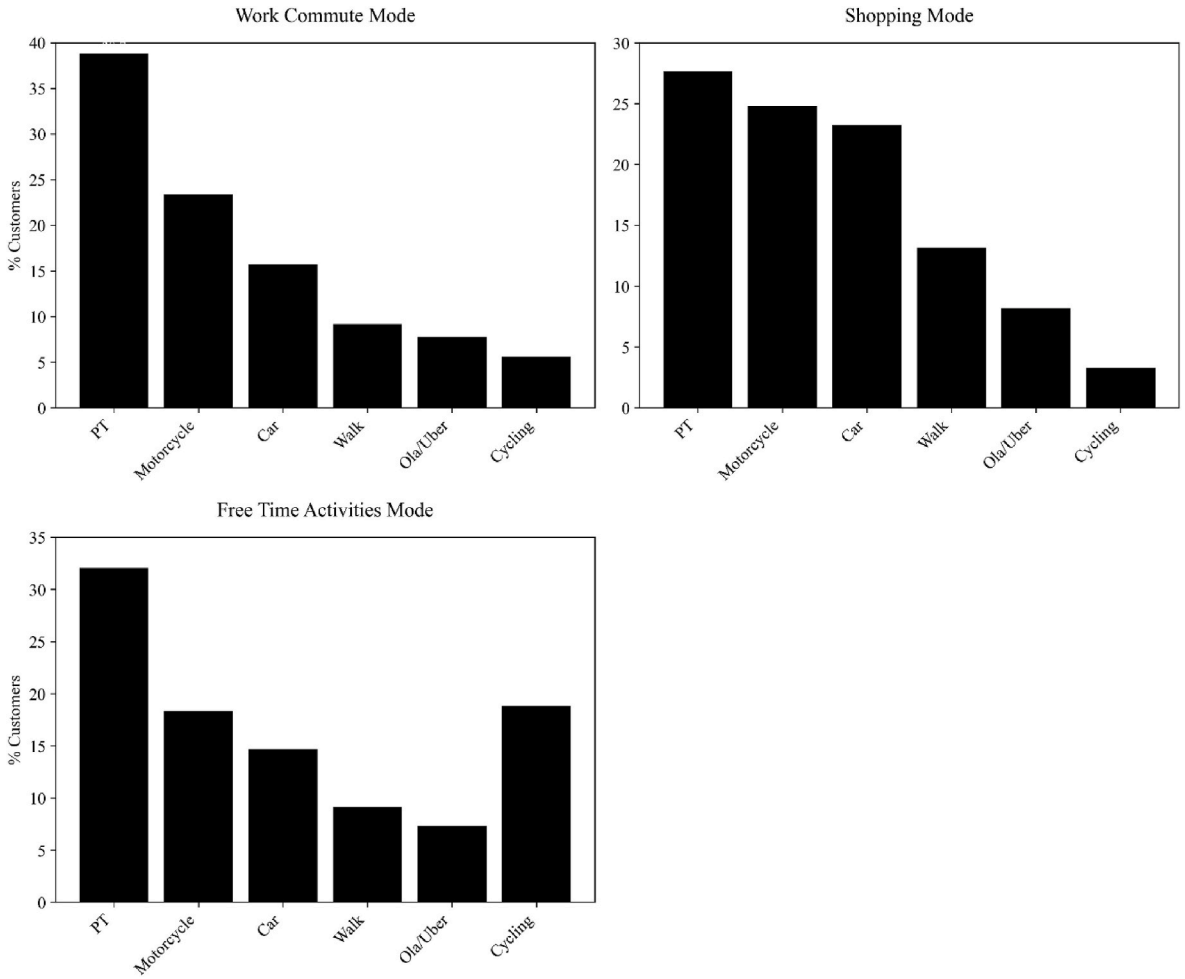


Fig. 3(b). Mobility behavior Description.

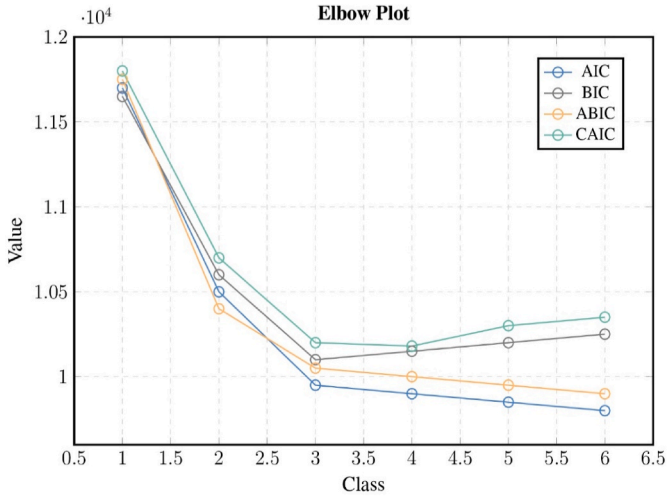


Fig. 4. Elbow plot of the cluster.

correspond with people's daily travel routes and delivery demands.

The data-driven approach makes it possible to identify the elements influencing the intention to use parcel lockers. It provides information for making strategic decisions regarding the location of lockers, accessibility, and marketing initiatives to increase adoption.

4. Results and discussions

4.1. Identifying mode choice segments

To organize and understand the responses from the survey data, a Latent class clustering algorithm is used considering the type of vehicle

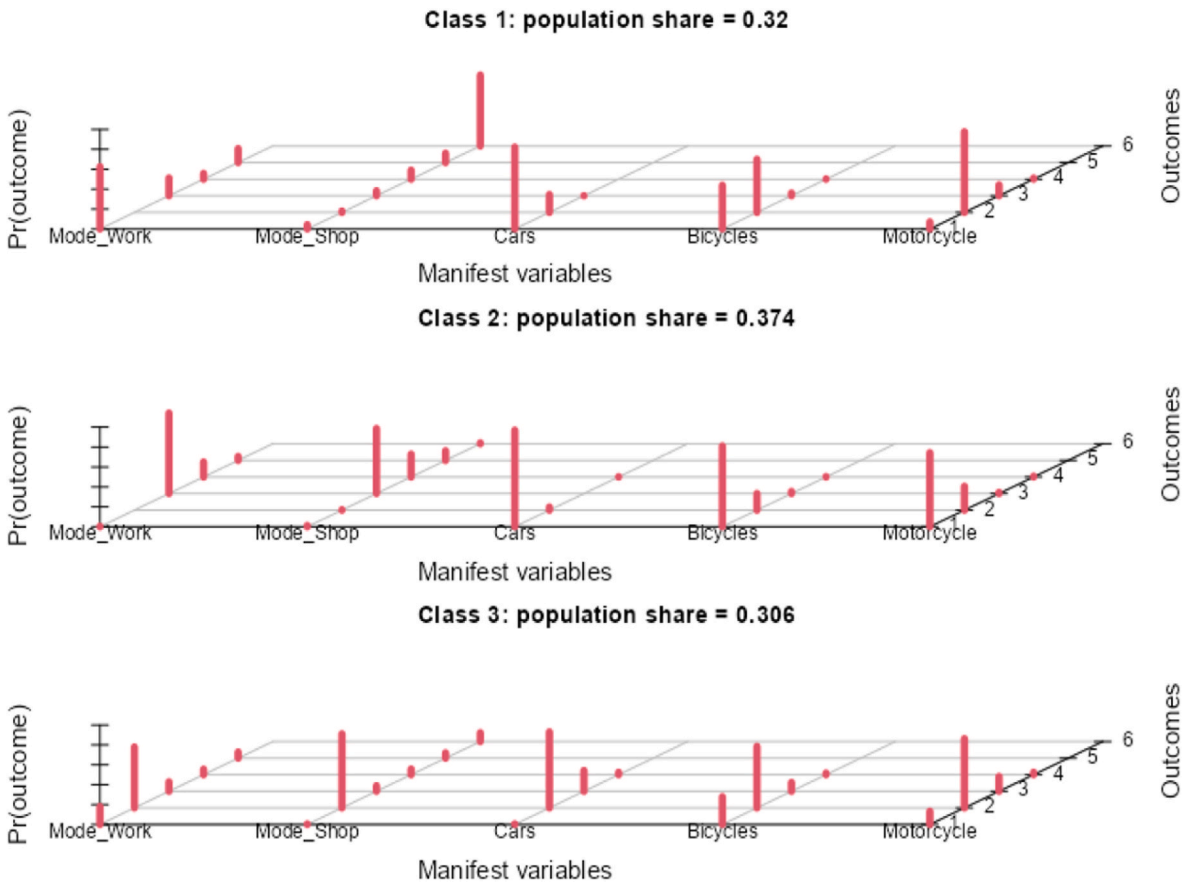


Fig. 5. LCA plot.

one holds and how many of each type, the mode of transport one uses to go to work, and the mode taken to go shopping. This clustering has been done using Jamovi 2.3.28 (Jamovi desktop, 2024) (jamovi desktop). The legend of the encoding for the Latent class clustering is given in Appendix Table A1.

The next step after encoding is to analyze the clusters formed to determine how many clusters are to be considered. The elbow plot (Fig. 4) shows a bend at the third cluster for a six-class LCA plot. On assigning a specific class membership (assuming there are six classes), it is seen in Fig. 5 that the Bayesian Information Criterion (BIC) value decreases till the 3rd Latent class and then again increases. The BIC determines how many classes are taken while using LCA. The BIC values further strengthen the Elbow plot, and thus, the data should be clustered into three clusters to classify the data.

From Fig. 4, three clusters need to be formed. It is seen in the LCA plot (Fig. 5) that the clusters, though almost equally sized, still take up different fractions of the population share. The three clusters formed can be represented as:

a. **Motorcycle Shoppers + Bicycle Workers** – Those respondents who own and use two-wheelers like a cycle or a motorbike. From the topmost portion of this figure, it can be observed that most people are taking the work mode as a cycle corresponding to the encoding above 1, representing the bicycle. They are using Motorcycles (encoded as 6 in Figure A) for shopping. Further, they also own a zero number of cars (as LCA 1 is encoded as zero). Thus, they correspond to the Motorcycle Shoppers + Bicycle Workers cluster. From Fig. 5, a total of 0.320 fractions belong to cluster 1.

b. **Regular Transit Users** – Those respondents who own almost no vehicle and commute using public transportation or cab services or prefer walking. The analysis figure for the second cluster shows that the number of cars, bicycles or motorbikes owned by most people in this set corresponds to zero (encoded as 1 for LCA). This cluster thus represents the set of people who have to use other modes of transportation (walking, public transportation or cab services encoded as 3,4 and 5) for work and shopping. It comprises a 0.374 fraction of the respondents, making it the most significant cluster in the LCA plot (Fig. 5).

c. **Car Owners** – Those respondents who own and frequently use cars as their mode of transport for work and shopping. The third cluster shows that the number of cars, bicycles, and motorbikes most people own is one or more than 1 (1 vehicle, two vehicles, and more than two vehicles are encoded as 2,3 and 4). So, this cluster has relatively more ownership of all vehicles (cars, bicycles and motorbikes). But

Table 1
Factor loading for different clusters.

Factors/Cluster	Shopping Preference								Perceived Usefulness					Perceived Ease of Use		Perceived Risks					Attitude		Intention to Use	
	1	2	3	4	5	6	7	8	1	2	3	4	5	1	2	1	2	3	4	5	1	2	1	2
Cluster 1	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Cluster 2	✔			✔			✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Cluster 3		✔	✔							✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔

most people prefer using their cars for work and shopping (since two correspond to the personal car as mode of work and mode of shop in the LCA plot). This set of people takes up 0.306 fraction of the total and forms the smallest cluster, as shown in Fig. 5.

4.2. Modelling behavioral intention to use parcel lockers

The classification output produces three clusters, with structural equation modeling performed on each in the following steps.

4.2.1. Factor loading and confirmatory factor analysis

In the initial step, finding the factor loading for all the six desired parameters is required after encoding the survey responses from a scale of 1–5 on IBM SPSS Statistics 21. On this scale, 1 depicts the least likely, and 5 illustrates the most likely contribution to the intention of using a parcel locker. Some factors were seen to impact the usage behavior negatively; these were encoded in reverse so that they have a positive relationship with the intention to use parcel lockers. The factors and their variable ames are shown in Appendix Table A2 (Pani et al., 2020). The symbols in Appendix Table A3 are used to load the factors.

As per the procedure to perform confirmatory factor analysis, all the parameters where the factor loading (taking only the standardized estimates) is less than 0.5 are removed, and all others are taken for the next stage of model fit. The factors that have loaded less than 0.5 are those that are not contributing to the construct and, thus, are removed. Table 1 below shows the factors taken for different clusters. It can be seen from the table that the shopping preferences of clusters 1, 1–4 and 7–8 are chosen. However, 5–6 are not chosen. For cluster 2, only parameters 2,3 and 6 of shopping preference and 1 of perceived Usefulness are not chosen. For cluster 3, shopping preferences 2 and 3 are selected while leaving out shopping preferences 1 and 4–8, perceived usefulness 1, and perceived risk 4. The chosen factors are shown in Table 6 for cluster 1. Cluster 2 and Cluster 3 chosen factors are shown in Appendix Table A4.

Interestingly, each cluster has a different set of factors in the factor loading shown in Table 1, contributing to its analysis. This proves that modality styles make a difference in the contribution to a customer's behavior using a parcel locker. Thus, each cluster is further taken through model fitting and structural equation modeling separately using IBM SPSS AMOS 23.

4.2.2. Step 2: model fit evaluation for modal choice clusters

The next step is to find the correlation between the different parameters to fit the model to a suitable value of CMIN/DF, CFI, RMSEA and IFI. For cluster 1, the error terms e2 – e4 and e7-e10 have correlations drawn to make the model fit better. For Cluster 2 and 3, no such correlation requirements are needed as the model is already a good fit.

CMIN/DF is the chi-square minimum discrepancy. CMIN is the chi-square statistic, and DF is the degrees of freedom. A lower CMIN/DF value indicates a better fit of the model to the data. The appropriate cut-off value for CMIN/DF may vary depending on the specific research question and the sample size. (Marsh & Hocevar, 1985) (Marsh & Hocevar, 1985) recommends a ratio of <5 as acceptable. RMSEA (Root Mean Square Error of Approximation), another common goodness-of-fit index, offers a slightly more straightforward interpretation. A value of 0.05 or lower is considered excellent, indicating a very close fit between the model and the data (Schumacker & Lomax, 2004) (Schumacker & Lomax, 2004; Goretzko et al., 2024) suggest values between 0.05 and 0.08 are still acceptable, while (Hu & Bentler, 1999) [56] suggest a cut-off of 0.06 for good fit.

A perfect cut-off value must be found for the Comparative Fit Index (CFI). However, researchers have proposed different guidelines to help us make sense of this index. Researchers (Hu & Bentler, 1999) suggest a CFI above 0.95 indicates a good fit, while values between 0.90 and 0.95 are still acceptable. IFI, which stands for Incremental Fit Index (also known as Bollen's IFI), is another goodness-of-fit index used in confirmatory factor analysis (CFA) to assess how well a hypothesized model fits the data compared to a baseline model. Generally, higher IFI values indicate a better fit of the model to the data. Common cut-off values for IFI are >0.9 suggested by Bollen (1989) The results are shown in Tables 2 and 3 and prove to be a good fit for all the clusters.

Table 2
Model Fit for different clusters.

Model Fit/Cluster	CMIN/DF	CFI	RMSEA	IFI
Cluster 1	2.46	0.918	0.069	0.919
Cluster 2	2.386	0.937	0.060	0.937
Cluster 3	2.473	0.954	0.067	0.955

4.2.3. Step 3: Analysis of Significant Factors Across Transport Modes

The next step is to test hypotheses to determine whether each factor significantly contributes to the intention to use a parcel locker. If the p-value of a hypothesis is less than 0.05, then it is considered statistically significant. Regression Weights in Table 5 for cluster 1 shows that most of the indicators have a significant P value smaller than 0.05 (mark *** indicates figures much smaller than 0.05). For Cluster 2 and Cluster 3, refer to Appendix Tables A5 and A6 respectively. Structural Equation Modeling (SEM) further examined factors influencing parcel locker uptake across these clusters, focusing on Shopping Preference, Perceived Usefulness, Perceived Ease of Use, Perceived Risk, and Attitude. Key findings reveal distinct behavioral patterns. For Motorcycle Shoppers + Bicycle Workers, Attitude toward lockers was significantly shaped by Perceived Ease of Use ($\beta = 0.570$, SE = 0.163, $p < 0.005$, 95 % CI [0.251, 0.889]) and Perceived Risk ($\beta = 0.423$, SE = 0.104, $p < 0.005$, 95 % CI [0.219, 0.627]), driving higher Intention to Use ($\beta = 0.838$, SE = 0.161, $p < 0.005$, 95 % CI [0.522, 1.154]). Regular Transit Users (Class 2) showed a significant Attitude-to-Intention link ($\beta = 0.699$, SE = 0.199, $p < 0.005$, 95 % CI [0.309, 1.089]), with Perceived Ease of Use as a key driver ($\beta = 0.711$, SE = 0.128, $p < 0.005$, 95 % CI [0.460, 0.962]). Car Owners (Class 3) exhibited a weaker Attitude-to-Intention relationship ($\beta = 0.630$, SE = 0.373, $p = 0.091$, 95 % CI [−0.101, 1.361]), with only Perceived Ease of Use significantly shaping Attitude ($\beta = 0.972$, SE = 0.221, $p < 0.00$, 95 % CI [0.539, 1.405]), indicating less parcel locker adoption due to vehicle dependence. Shopping Preference and Perceived Usefulness showed no consistent significance across clusters (e.g., $p > 0.05$), underscoring mode-specific influences. These findings, supported by p-values and confidence intervals, highlight distinct transport-mediated preferences for last-mile solutions. Thus, only those hypotheses whose p-value indicates significance will be considered a contributing factor, as shown in Table 6 for Cluster 1. For Cluster 2 and Cluster 3 refer to Appendix Table A7. The five hypotheses are as follows:

a. There is a positive relationship between Shopping preference and attitude to lockers (H1)
b. There is a positive relationship between Perceived Usefulness and attitude to lockers (H2)
c. There is a positive relationship between Perceived ease of use and attitude to lockers (H3)
d. There is a positive relationship between Perceived risks and attitude to lockers (H4)
e. There is a positive relationship between Attitude and Intention to Use (H5)

For Cluster 1, H1, H3, H4, and H5 are valid, i.e., Shopping Preference, Perceived Usefulness, Perceived Risks, and Attitude are all positively related to the intention to use a parcel locker. This portrays that motorcycle and bicycle owners and users are more likely to adopt parcel lockers since they can easily travel to the lockers and collect their parcels. However, since their mode of transport is smaller and has less storage space, they are also likely to avoid frequently going to the store. For Cluster 2, H3 and H5 are true. This depicts that a person who is a transit user would only use a parcel locker when one has easy access to

Table 3
Model Fit diagram through AMOS.

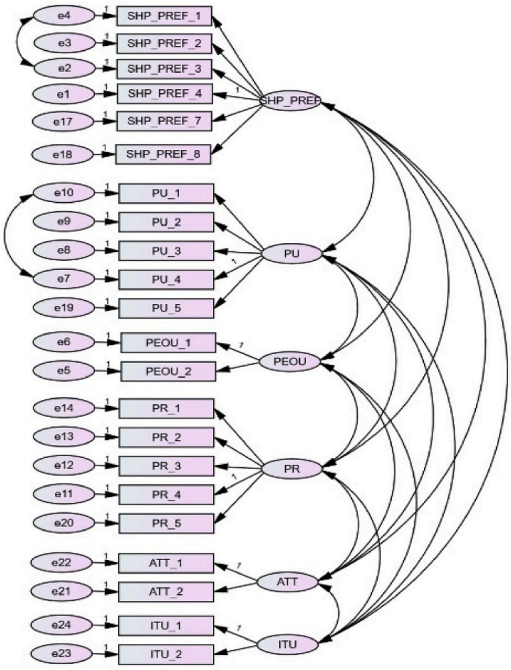
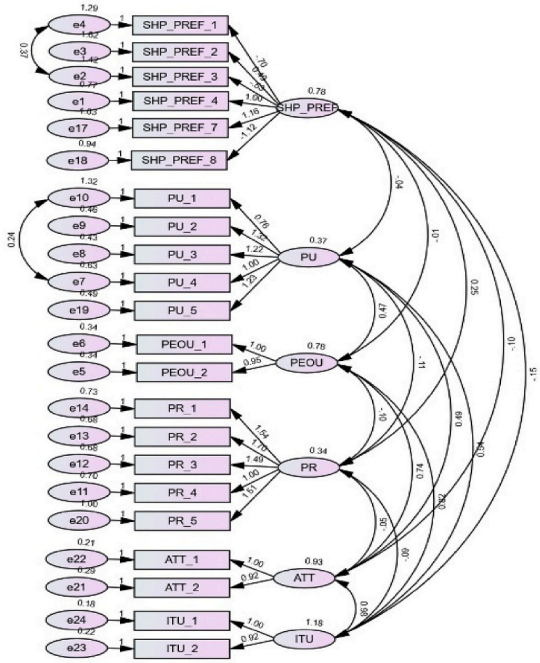
Cluster	Model Fit	Model Fit with standardized weights
Cluster 1		

Table 4
Significant factors for various transport modes.

Factors/Cluster	Hypothesis 1	Hypothesis 2	Hypothesis 3	Hypothesis 4	Hypothesis 5	Remarks
	Shopping Preference → Attitude	Perceived Usefulness– > Attitude	Perceived Ease of Use– > Attitude	Perceived Risks– > Attitude	Attitude → Intention to Use	
Cluster 1 MTW/ Bicycle	✔	–	✔	✔	✔	–
Cluster 2 Transit	–	–	✔	–	✔	–
Cluster 3 Car	–	–	✔	–	–	–

the locker. They are less likely than the first cluster to adopt parcel lockers but have a positive intention to use them if there is an ease of using the locker, which is probably having a locker at a small distance away or in the path of their transit. For Cluster 3, only H3 is true. This shows that these people are least likely or almost impossible to use self-delivery lockers. These car owners and users prefer going to the store to buy or choose a home delivery service since it is always challenging to take the car out to collect a parcel (especially in cities with more minor roads). They travel between their destinations and do not transit from any nearby post offices, metro stations, or bus stands where the locker may be placed for easy access. It is seen that the ease of using a parcel does not directly translate to using a parcel locker. All those who agree to its Usefulness may not have the intention to use it because they want to maintain the comfort of home deliveries.

Additionally, the results underline and confirm the H6 hypothesis. For instance, the significant factors observed for each cluster are distinct and logically interpretable, as shown in Table 4. H1, H3, H4, and H5 are valid for Cluster 1, H3, and H5 for Cluster 2, and H3 for Cluster 3. These results show the discernible direct linkages between modal choice, vehicle ownership, and the intention to use parcel lockers.

5. Conclusions, implications and limitations

5.1. Conclusions

This study provides valuable insights into the factors shaping consumer attitudes and intentions toward parcel locker adoption in Mumbai. We identified distinct consumer segments with unique preferences and behaviors using Latent class cluster analysis and structural equation modeling. Motorcycle Shoppers and Bicycle Workers demonstrated a solid intention to use parcel lockers, driven by factors such as shopping preference, perceived ease of use, and attitude. Their willingness to adopt reflects the convenience of locker accessibility along their commuting routes despite potential constraints on storage capacity and frequency of store visits. While less inclined toward parcel locker adoption, regular Transit Users exhibit a positive attitude when perceived ease of use is high. This highlights the importance of strategic locker placement along transit routes to capitalize on commuters' convenience-seeking behavior. Conversely, Car Owners displayed the lowest intention to use parcel lockers, preferring traditional delivery methods due to convenience concerns. Their reluctance underscores the need for customized delivery solutions tailored to their lifestyle preferences, such as flexible delivery options or premium services.

Table 5
Regression weights (cluster 1).

			Estimate	Std. Error	z-value	p-value	Parameter
Attitude	<—	Shopping Preference	−0.218	0.059	−3.673	***	par_25
Attitude	<—	Perceived Usefulness	0.720	0.248	2.906	0.004	par_26
Attitude	<—	Perceived Ease of Use	0.570	0.163	3.499	***	par_27
Attitude	<—	Perceived Risk	0.423	0.104	4.078	***	par_28
Intention To Use	<—	Shopping Preference	−0.083	0.067	−1.253	0.210	par_29
Intention to Use	<—	Perceived Usefulness	0.039	0.245	0.158	0.874	par_30
Intention to Use	<—	Perceived Ease of Use	0.232	0.171	1.354	0.176	par_31
Intention to Use	<—	Perceived Risk	−0.010	0.118	−0.082	0.934	par_32
Intention to Use	<—	Attitude	0.838	0.161	5.187	***	par_33
SHP_PREF_4	<—	Shopping Preference	1.000				
SHP_PREF_3	<—	Shopping Preference	−0.527	0.095	−5.517	***	par_1
SHP_PREF_2	<—	Shopping Preference	0.487	0.099	4.916	***	par_2
SHP_PREF_1	<—	Shopping Preference	−0.702	0.097	−7.208	***	par_3
PEOU_2	<—	Perceived Ease of Use	0.955	0.059	16.211	***	par_4
PEOU_1	<—	Perceived Ease of Use	1.000				
PU_4	<—	Perceived Usefulness	1.000				
PU_3	<—	Perceived Usefulness	1.221	0.119	10.264	***	par_5
PU_2	<—	Perceived Usefulness	1.322	0.127	10.411	***	par_6
PU_1	<—	Perceived Usefulness	0.764	0.115	6.627	***	par_7
PR_4	<—	Perceived Risk	1.000				
PR_3	<—	Perceived Risk	1.488	0.166	8.982	***	par_8
PR_2	<—	Perceived Risk	1.700	0.184	9.258	***	par_9
PR_1	<—	Perceived Risk	1.535	0.171	8.959	***	par_10
SHP_PREF_7	<—	Shopping Preference	1.163	0.116	10.054	***	par_11
SHP_PREF_8	<—	Shopping Preference	−1.122	0.111	−10.093	***	par_12
PU_5	<—	Perceived Usefulness	1.231	0.122	10.083	***	par_13
PR_5	<—	Perceived Risk	1.509	0.178	8.482	***	par_14
ATT_2	<—	Attitude	0.921	0.044	21.091	***	par_15
ATT_1	<—	Attitude	1.000				
ITU_2	<—	Intention To Use	0.924	0.036	26.020	***	par_16
ITU_1	<—	Intention To Use	1.000				

5.2. Managerial implications

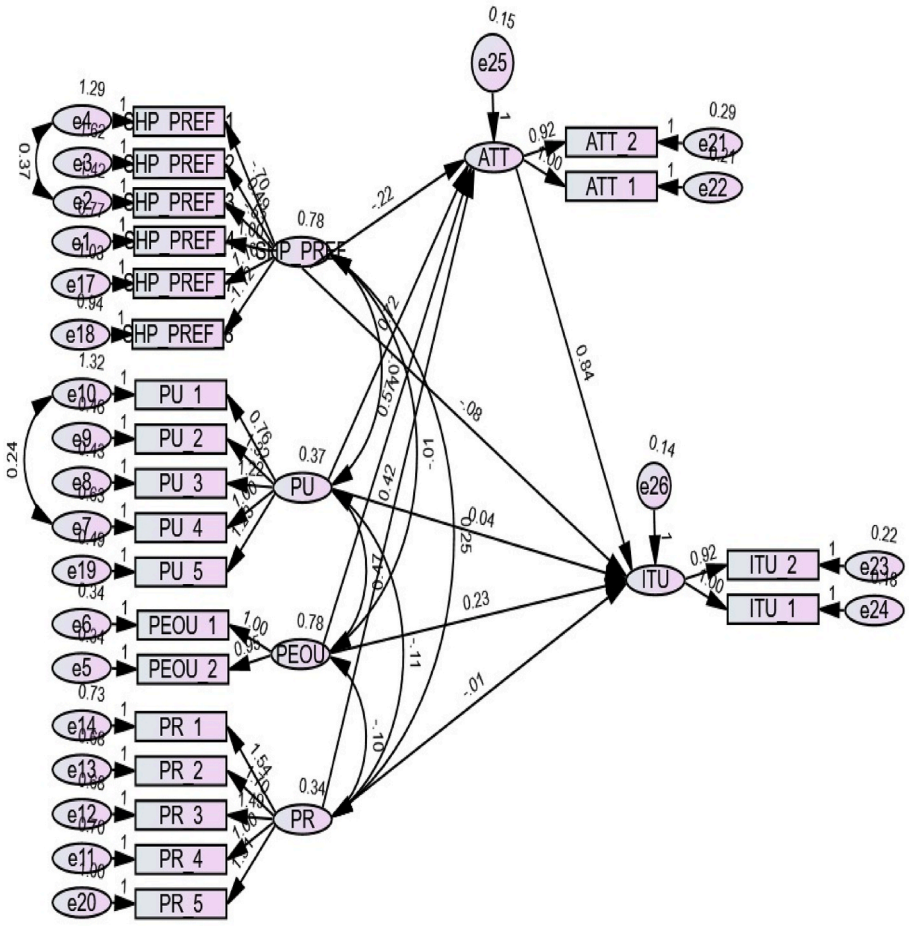
This study explores the complex aspects that affect Mumbai consumers' adoption of parcel lockers in various consumer segments, offering helpful information to legislators, e-commerce companies, and logistics suppliers. Strategies must be customized to these clusters' particular requirements and behaviors to ensure effective adoption. Given the substantial differences in consumer attitudes and intentions among groups, cluster-specific techniques are essential. For example, Cluster 1, which is made up of Bicycle Workers and Motorcyclists, shows a greater propensity to use parcel lockers if they are available on their commute routes. Targeted marketing campaigns should highlight the accessibility, speed, and convenience of lockers close to well-traveled routes to take advantage of this. Partnering with nearby companies and transportation hubs to provide lockers at key locations, such as bike racks or busy intersections, would increase the use of lockers among this demographic. Promoting parcel lockers in Cluster 2, composed of Regular Transit Users, necessitates incorporating locker locations into public transportation networks. To facilitate smooth integration into daily routines, e-commerce platforms, and logistics suppliers should collaborate closely with transit authorities to build lockers at important bus and train stations. Transit providers could also offer lower rates and incentives to passengers who combine their journey with locker pickups to encourage regular use. Car Owners who make Cluster 3 pose a particular issue because they are less likely to intend to utilize parcel lockers, probably because they are more convenient. Two strategies must be implemented to solve this: first, locker convenience should be increased by placing them in car-owner-friendly areas like shopping centers or apartment buildings with plenty of parking; second, other delivery alternatives should be provided. Premium home delivery services with adjustable time slots or same-day delivery alternatives may be able to meet the special needs of automobile owners who value flexibility in delivery, hence bridging the gap between convenience and locker utilization.

The study shows a significant, positive correlation between the intention to utilize parcel lockers and perceived ease of use across all clusters. This implies that the user experience greatly influences the adoption process. E-commerce platforms need to invest to increase the usability of both digital and physical interfaces to get past obstacles. Simple mobile apps, user-friendly locker designs, and efficient customer service procedures are essential for lowering frustration and raising satisfaction. It's also critical to address worries about perceived dangers, such as package security, dependability, or potential technical malfunctions. Building trust can be facilitated by putting strong security measures, such as round-the-clock monitoring, secure access codes, and real-time tracking updates. Consumer confidence will be bolstered by transparent communication mechanisms that ensure consumers are swiftly aware of any concerns and guarantees about package safety. Ultimately, every strategic plan needs to consider the urban spatial context. Accessibility for various transport modes, such as walking, cycling, and public transportation, should be prioritized in spatial positioning plans in a densely populated and complicated metropolis like Mumbai, where traffic patterns and congestion vary dramatically among neighborhoods. A wider audience will find the locker system more appealing if city planners work together to incorporate lockers into strategic locations, such as those next to parking lots, taxi stands, and transit terminals. Mumbai's population has a variety of needs, and this integration can meet those needs by increasing ease and promoting adoption across various means of transportation.

5.3. Limitations

While this study provides valuable insights into the factors influencing parcel locker adoption in Mumbai, several limitations should be acknowledged. The findings are specific to the context of Mumbai and may not be directly applicable to other cities or regions with different socio-economic dynamics, infrastructure, and consumer behaviors. The sample size of 1022 respondents may not fully represent the diverse population of Mumbai, potentially introducing bias into the analysis. Future research could benefit from a more prominent and representative

Table 6
Analysis of significant factors across transport modes.

Cluster	Model with weights
Cluster 1	

sample to ensure robustness and generalizability. While Latent class cluster analysis and structural equation modeling offer valuable analytical tools, the interpretation of results may be subject to researcher bias and assumptions. Sensitivity analyses and alternative modeling approaches could enhance the validity and reliability of findings. Consumer attitudes and behaviors towards parcel lockers may evolve due to technological advancements, regulatory changes, or shifts in market dynamics. Longitudinal studies tracking adoption trends and consumer preferences are needed to capture these temporal dynamics effectively. The study did not consider external factors such as competitive offerings, pricing strategies, or marketing campaigns by e-commerce platforms and logistics providers, which could influence consumer perceptions and adoption behavior. Despite these limitations, the study provides valuable insights for policymakers, e-commerce platforms, and logistics providers seeking to promote the adoption of parcel lockers in Mumbai and similar urban contexts. Future research endeavors should address these limitations and further elucidate the complex dynamics shaping consumer behavior in the e-commerce ecosystem.

CRediT authorship contribution statement

Eshwar Dayal: Software, Methodology, Formal analysis, Conceptualization. **Lisa Khuntia:** Writing – original draft, Formal analysis, Data curation, Conceptualization. **Lakshay Lakshay:** Writing – review & editing, Visualization, Software, Conceptualization. **Heleen Buldeo Rai:** Writing – review & editing, Visualization, Conceptualization. **Agnivesh Pani:** Writing – review & editing, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Appendix Table A1
Encoding for LCA

Column Name	Encoding	Decoded as
Mode to Work	1	Cycling
	2	Personal Car
	3	Public Transport (Bus)
	4	Walking
	5	Cab Services (Uber/Ola)
	6	Motorcycle
Mode to Shopping	1	Cycling
	2	Personal Car
	3	Public Transport (Bus)
	4	Walking
	5	Cab Services (Uber/Ola)
	6	Motorcycle
Number of Bicycles owned	1	0
	2	1
	3	2
	4	>2
	5	-
	6	-
Number of motorcycles owned	1	0
	2	1
	3	2
	4	>2
	5	-
	6	-
Number of Cars owned	1	0
	2	1
	3	2
	4	>2
	5	-
	6	-

Appendix Table A2
The relationship between the intention and the encoding for all factors is shown below:

Factors		Relation	Encoding/Responses				
			1	2	3	4	5
Shopping Preference	I like not having to leave home to go shopping (SHP_PREF1)	+	Not at all like me	Somewhat not like me	Neutral	Somewhat like me	Exactly like me
	I use internet shopping mainly because of the COVID-19 outbreak (SHP_PREF2)	–	Exactly like me	Somewhat like me	Neutral	Somewhat not like me	Not at all like me
	I like that a car is not necessary in the case of Internet shopping (SHP_PREF3)	+	Not at all like me	Somewhat not like me	Neutral	Somewhat like me	Exactly like me
	I find it hard to judge merchandise quality on the Internet (SHP_PREF4)	–	Exactly like me	Somewhat like me	Neutral	Somewhat not like me	Not at all like me
	I like the helpfulness available at local stores (SHP_PREF5)	–	Exactly like me	Somewhat like me	Neutral	Somewhat not like me	Not at all like me
	I like having merchandise delivered to me at home (SHP_PREF6)	+	Not at all like me	Somewhat not like me	Neutral	Somewhat like me	Exactly like me
	I don't trust internet payment mechanisms used for online shopping (SHP_PREF7)	–	Exactly like me	Somewhat like me	Neutral	Somewhat not like me	Not at all like me
	I think Internet buying has delivery problems (SHP_PREF8)	–	Exactly like me	Somewhat like me	Neutral	Somewhat not like me	Not at all like me
Perceived Usefulness	Delivery lockers can provide contactless delivery in the context of COVID-19 (PU_1)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	Delivery lockers can help provide faster deliveries (PU_2)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	Delivery lockers can provide greater flexibility in delivery hours (PU_3)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	Delivery lockers can reduce the delivery cost by eliminating the human component in the process (PU_4)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	Delivery lockers can have external benefits such as reduction of truck traffic in urban areas and associated air pollution (PU_5)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Perceived Ease of Use	I will find it easy to receive packages from delivery lockers (PEOU_1)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	I can use delivery lockers and receive packages if someone shows me or gives instructions how to do it first (PEOU_2)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

(*continued on next page*)

Appendix Table A2 (*continued*)

Factors		Relation	Encoding/Responses				
			1	2	3	4	5
Perceived Risks	I am concerned about package loss and potential mismatch in delivery lockers (PR_1)	–	Strongly Agree	Somewhat Agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
	I am concerned that computer systems of delivery lockers can be hacked (PR_2)	–	Strongly Agree	Somewhat Agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
	I am concerned that delivery lockers may stop free home deliveries and make it expensive to deliver at home (PR_3)	–	Strongly Agree	Somewhat Agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
	I am concerned that delivery lockers are yet to be proven as a successful technology in big cities (PR_4)	–	Strongly Agree	Somewhat Agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
	I am concerned that the adoption of delivery lockers would result in job losses and affect the livelihood of several workers (PR_5)	–	Strongly Agree	Somewhat Agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Attitude	Self-service delivery lockers are reliable (ATT_1)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	Overall, I can trust Self-service delivery lockers (ATT_2)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Intention To Use	I plan to use Self-service delivery lockers for my internet orders in the future (ITU_1)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	I will prefer Self-service delivery lockers for my orders whenever the option is available (ITU_2)	+	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

Appendix Table A3
Variables and their meanings is shown below:

Factors		Variable name
Shopping Preference	I like not having to leave home to go shopping	SHP_PREF1
	I use internet shopping mainly because of the COVID-19 outbreak	SHP_PREF2
	I like that a car is not necessary in the case of Internet shopping	SHP_PREF3
	I find it hard to judge merchandise quality on the Internet	SHP_PREF4
	I like the helpfulness available at local stores	SHP_PREF5
	I like having merchandise delivered to me at home	SHP_PREF6
	I don't trust internet payment mechanisms used for online shopping	SHP_PREF7
	I think Internet buying has delivery problems	SHP_PREF8
Perceived Usefulness	Delivery lockers can provide contactless delivery in the context of COVID-19.	PU1
	Delivery lockers can help provide faster deliveries	PU2
	Delivery lockers can provide greater flexibility in delivery hours	PU3
	Delivery lockers can reduce the delivery cost by eliminating the human component in the process.	PU4
	Delivery lockers can have external benefits, such as a reduction of truck traffic in urban areas and associated air pollution.	PU5
Perceived Ease of Use	I will find it easy to receive packages from delivery lockers	PEOU1
	I can use delivery lockers and receive packages if someone shows me or gives instructions how to do it first.	PEOU2
Perceived Risks	I am concerned about package loss and potential mismatch in delivery lockers.	PR1
	I am concerned that computer systems of delivery lockers can be hacked	PR2
	I am concerned that delivery lockers may stop free home deliveries and make it expensive to deliver at home.	PR3
	I am concerned that delivery lockers are yet to be proven successful in big cities.	PR4
	I am concerned that adopting delivery lockers would result in job losses and affect the livelihood of several workers.	PR5
Attitude	Self-service delivery lockers are reliable	ATT1
	Overall, I can trust Self-service delivery lockers	ATT2
Intention To Use	I plan to use Self-service delivery lockers for my internet orders in the future.	ITU1
	I prefer Self-service delivery lockers for my orders whenever the option is available.	ITU2

Appendix Table A4
Symbols used in AMOS is shown below:

Symbols used in AMOS	Indicators	Description
	Latent Variables	Latent variables are deduced from the collected data from respondents, and then observed variables are categorized under these latent variables since their direct prediction is unfeasible.
	Factors or Observed Variables	The response data is encoded into these variables. These variables are directly measured from the collected data.

(*continued on next page*)

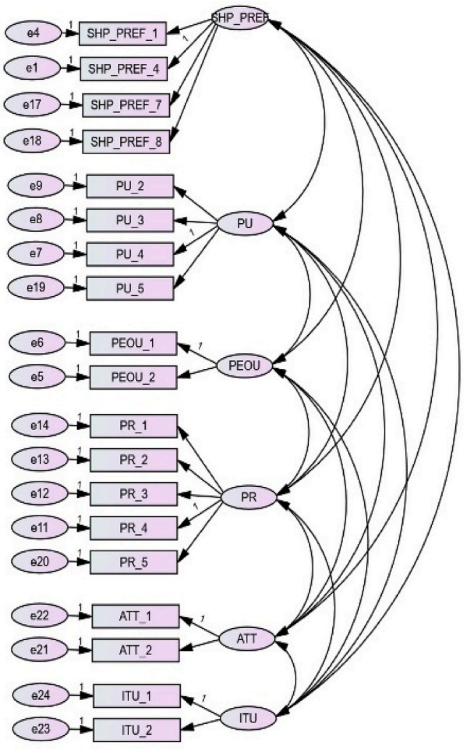
Appendix Table A4 (*continued*)

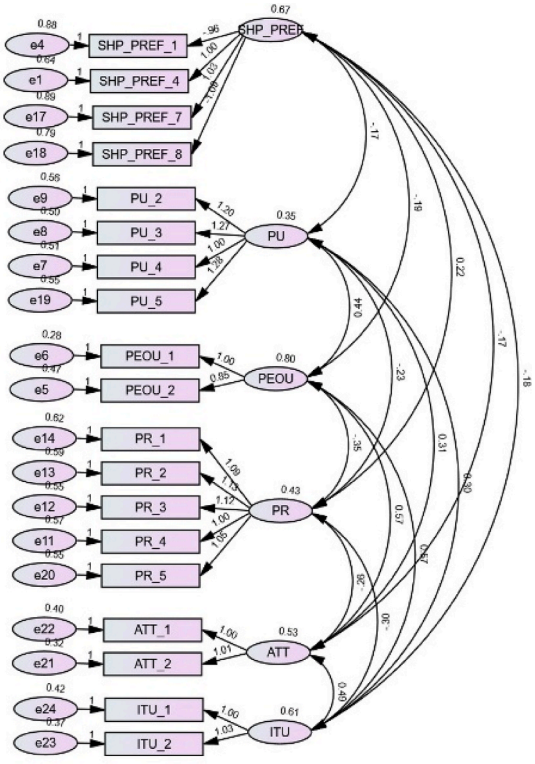
Symbols used in AMOS	Indicators	Description
	Measurement Error Variables	Error variables portray the deviation in the measurement of the observed variables.
	Random measurement error	Maps the error to its factor.
	Factor Loading	Maps the latent variable to the observed variables that influence it.
	Covariance	Correlates two latent variables, i.e. maps the covariance between two factors.

Appendix Table A5

Model Fit diagram through AMOS for cluster 2 and cluster 3 is shown below:

Cluster 2





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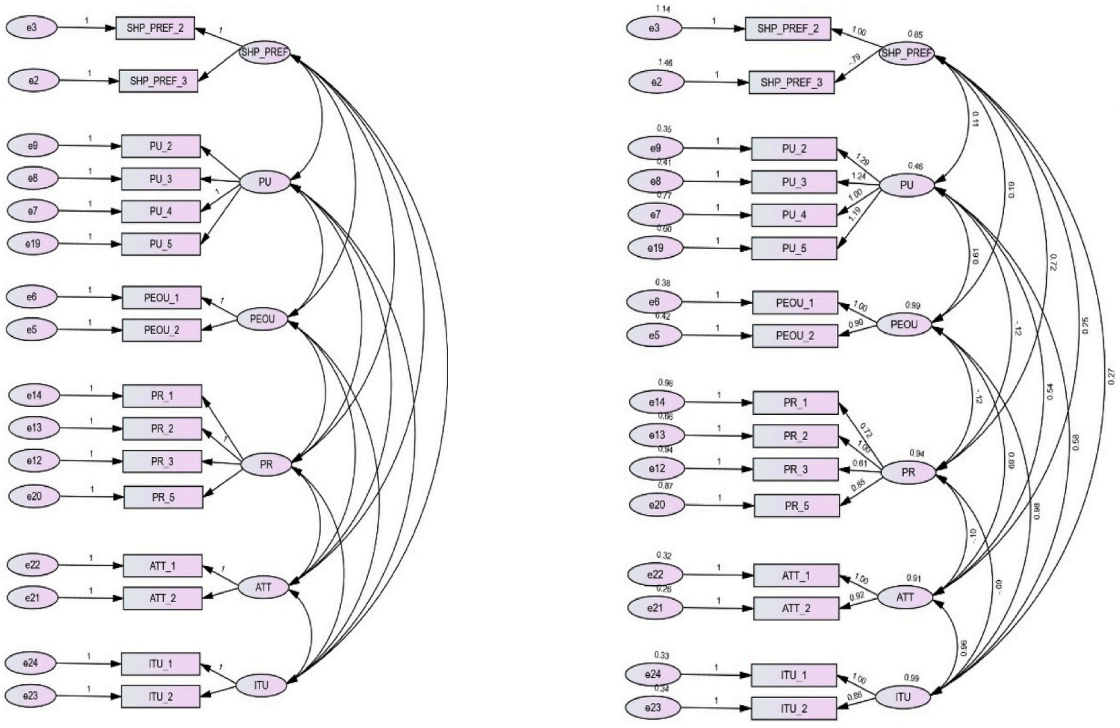
Appendix Table A5 (*continued*)

Cluster 3



Appendix Table A6
Regression Weights (Cluster 2)

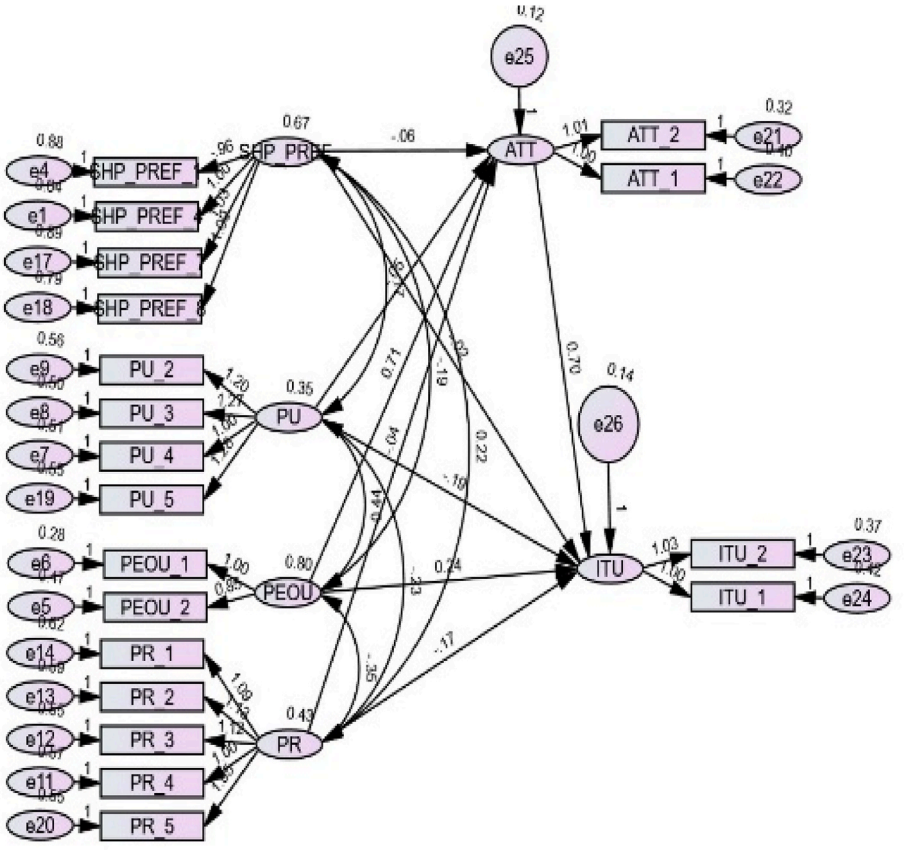
			Estimate	Std. Error	z-value	p-value	Parameter
Attitude	<—	Shopping Preference	−0.060	0.053	−1.123	0.261	par_20
Attitude	<—	Perceived Usefulness	−0.052	0.179	−0.292	0.771	par_21
Attitude	<—	Perceived Ease of Use	0.711	0.128	5.570	***	par_22
Attitude	<—	Perceived Risk	−0.038	0.082	−0.465	0.642	par_23
Intention To Use	<—	Perceived Usefulness	−0.195	0.174	−1.119	0.263	par_24
Intention To Use	<—	Perceived Ease of Use	0.235	0.200	1.175	0.240	par_25
Intention To Use	<—	Perceived Risk	−0.170	0.085	−2.014	0.044	par_26
Intention To Use	<—	Shopping Preference	−0.019	0.057	−0.341	0.733	par_27
Intention To Use	<—	Attitude	0.699	0.199	3.503	***	par_28
SHP_PREF_4	<—	Shopping Preference	1.000				
SHP_PREF_1	<—	Shopping Preference	−0.962	0.092	−10.422	***	par_1
PEOU_2	<—	Perceived Ease of Use	0.845	0.054	15.793	***	par_2
PEOU_1	<—	Perceived Ease of Use	1.000				
PU_4	<—	Perceived Usefulness	1.000				
PU_3	<—	Perceived Usefulness	1.265	0.112	11.254	***	par_3
PU_2	<—	Perceived Usefulness	1.197	0.111	10.819	***	par_4
PR_4	<—	Perceived Risk	1.000				
PR_3	<—	Perceived Risk	1.120	0.099	11.263	***	par_5
PR_2	<—	Perceived Risk	1.130	0.101	11.144	***	par_6
PR_1	<—	Perceived Risk	1.094	0.101	10.871	***	par_7
SHP_PREF_7	<—	Shopping Preference	1.031	0.096	10.713	***	par_8
SHP_PREF_8	<—	Shopping Preference	−1.091	0.098	−11.177	***	par_9
PU_5	<—	Perceived Usefulness	1.277	0.115	11.113	***	par_10
PR_5	<—	Perceived Risk	1.053	0.096	10.976	***	par_11
ATT_2	<—	Attitude	1.010	0.069	14.618	***	par_12
ATT_1	<—	Attitude	1.000				
ITU_2	<—	Intention to Use	1.027	0.072	14.304	***	par_13
ITU_1	<—	Intention to Use	1.000				

Appendix Table A7
Regression Weights (Cluster3)

			Estimate	Std. Error	z-value	p-value	Parameter
Attitude	<—	Shopping Preference	0.393	0.304	1.292	0.196	par_17
Attitude	<—	Perceived Usefulness	−0.301	0.371	−0.812	0.417	par_18
Attitude	<—	Perceived Ease of Use	0.972	0.221	4.390	***	par_19
Attitude	<—	Perceived Risk	−0.330	0.271	−1.220	0.222	par_20
Intention to Use	<—	Shopping Preference	0.099	0.271	0.364	0.716	par_21
Intention to Use	<—	Perceived Usefulness	−0.247	0.314	−0.786	0.432	par_22
Intention to Use	<—	perceived Ease of Use	0.544	0.453	1.201	0.230	par_23
Intention to Use	<—	Perceived Risk	−0.064	0.238	−0.271	0.787	par_24
Intention to Use	<—	Attitude	0.630	0.373	1.689	0.091	par_25
SHP_PREF_3	<—	Shopping Preference	−0.787	0.116	−6.805	***	par_1
SHP_PREF_2	<—	Shopping Preference	1.000				
PEOU_2	<—	perceived Ease of Use	0.899	0.050	17.933	***	par_2
PEOU_1	<—	perceived Ease of Use	1.000				
PU_4	<—	perceived Usefulness	1.000				
PU_3	<—	perceived Usefulness	1.237	0.110	11.207	***	par_3
PU_2	<—	perceived Usefulness	1.289	0.113	11.432	***	par_4
PR_3	<—	Perceived Risk	0.607	0.078	7.782	***	par_5
PR_2	<—	Perceived Risk	1.000				
PR_1	<—	Perceived Risk	0.718	0.085	8.428	***	par_6
PU_5	<—	perceived Usefulness	1.190	0.113	10.524	***	par_7
PR_5	<—	Perceived Risk	0.846	0.083	10.161	***	par_8
ATT_2	<—	Attitude	0.923	0.045	20.536	***	par_9
ATT_1	<—	Attitude	1.000				
ITU_2	<—	Intention to Use	0.857	0.044	19.587	***	par_10
ITU_1	<—	Intention to Use	1.000				

Appendix Table A8
Analysis of Significant Factors Across Transport Modes (Cluster 2 and Cluster 3) as shown below:

Cluster 2



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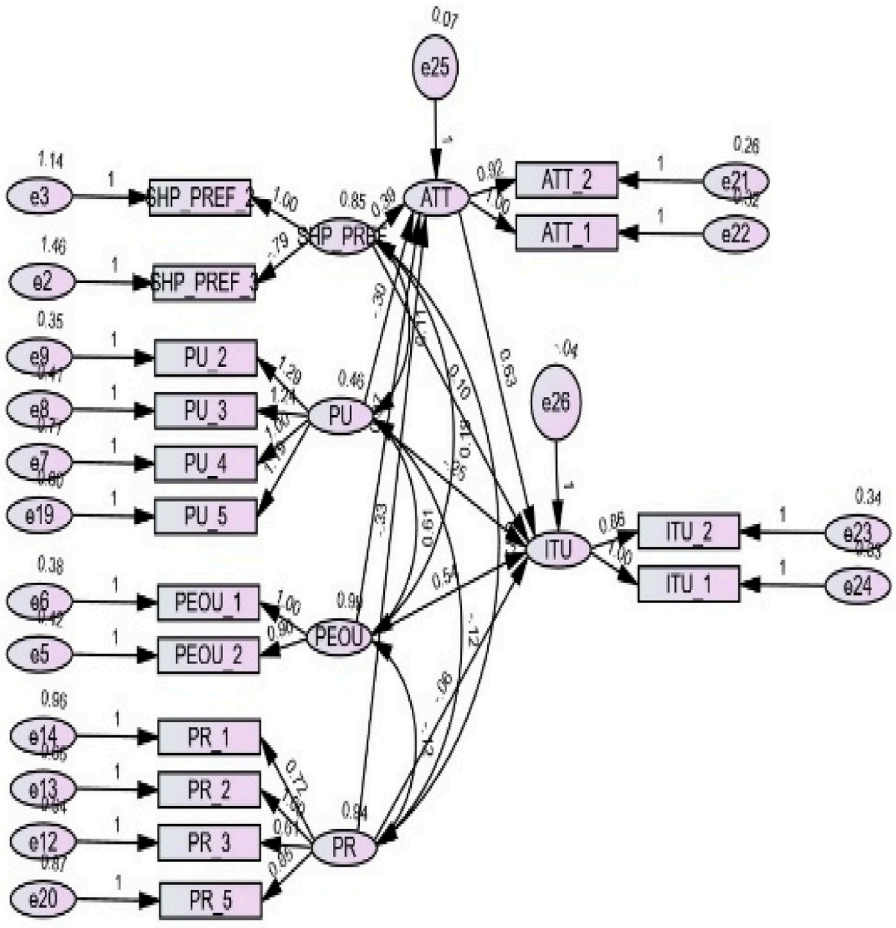
Appendix Table A8 (*continued*)

Cluster 3



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