An investigation of customers' intention to use self-collection services for last-mile delivery

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An Investigation of Customers' Intention to Use Self-Collection Services for Last-Mile Delivery

Anchored on Innovation Diffusion Theory (IDT), this paper analyses customers' intention to use self-collection as a last-mile delivery method. Characteristics of innovation were hypothesised to be key factors influencing customers' intention to use self-collection services. Demographic characteristics were also tested. Survey data were collected from 164 consumers located in Singapore and analysed using hierarchical regression analysis. The results show that among the five key characteristics of innovation, relative advantage, compatibility and trialability positively influence customers' intention to use self-collection services. It is also found that the pre-eminent step to improve customers' intention is to integrate self-collection into consumers' lifestyle, values and needs. In addition, self-collection services should be marketed in a manner that confers a clear advantage over other last-mile delivery methods. This paper enriches the literature on IDT as well as the management and design of self-collection services for last-mile delivery.

Keywords: last-mile delivery, self-collection, e-commerce, adoption behaviour, innovation diffusion theory

1. Introduction

Last-mile delivery is defined as the last segment of a delivery process which "involves a series of activities and processes that are necessary for the delivery process from the last transit point to the final drop point of the delivery chain" (Lindner, 2011). Parcel deliveries made directly to the doorsteps of customers have been the most popular mode for last mile delivery. However, in recent years, there has been an emergence of self-collection delivery as an alternative to home delivery. Self-collection delivery involves the provision of a network of service points where operators pool and deliver their consignees' parcels, and consignees pay, collect or return their parcels (Piplani and Saraswat, 2012). Such service points could be stationary (e.g. collection at locker points or convenience stores), mobile (e.g. collection at locker-fitted vehicles), attended (e.g. collection aided by a service attendant), or unattended (e.g. collection aided by fully-automated systems) (McKinnon and Tallam, 2003).

There are numerous benefits associated with adopting self-collection delivery services over home deliveries. Firstly, from the operators' perspectives, self-collection delivery services improve order fulfilment by minimising failed deliveries that are commonly associated with home deliveries. This could translate to substantial cost-savings for the operators. It is estimated that £850 million could be saved if all home deliveries in London were successful at first attempts (Francke and Visser, 2015). Secondly, from the societal and environmental perspective, self-collection delivery services allow consolidated shipments which reduce the number of road trips that are generated to serve customers. This reduces road congestions, demand for curb-side parking, emissions of greenhouse gases, and improves urban liveability (Chen et al., 2017; Van Duin et al., 2016). According to Edwards et al. (2010), up to 83% reduction of carbon emission could be achieved if consumers collect their parcels from self-

collection facilities. Finally, from the consumers' perspective, self-collection delivery services eliminate inefficiencies associated with consumers waiting at home for their deliveries (Agatz et al., 2011). Home deliveries are often made within a two-hour timeslot and consumers need to wait at home for the deliveries. For self-collection deliveries, notifications are often sent to consumers when their parcels are delivered to the service points. Consumers can then choose to pick up their parcels at their own convenience within a certain time window. This reduces consumers' opportunity costs that are associated with waiting.

However, despite the various advantages that self-collection services possess over home deliveries, it is noted that home delivery remains as the more popular mode of last-mile delivery amongst consumers in some countries. According to a recent survey conducted by Tan (2016), 80% of the surveyed consumers in Singapore prefer home deliveries over self-collection services. In addition, Choo (2016) reported that only 5.5% of all last-mile deliveries in Singapore are made to self-collection points. Similarly, according to Morganti et al. (2014), only 10% of online shoppers in France chose self-collection services over home deliveries. Their findings clearly reveal a strong inertia in consumers' acceptance of new modes of last-mile delivery.

The existing literature has primarily focused on optimising the self-collection network as well as discussing the trade-offs involving the various modes of last-mile deliveries (Deutsch and Golany, 2017; Park et al., 2016). There are currently very few theoretical studies that explore factors influencing consumers' behaviour i.e. their selection or adoption of last-mile deliveries. To bridge the gap in the literature, this study examines these factors through the theoretical lens of innovation diffusion theory (IDT). It describes how an innovation, idea, practice or objective become accepted and spread through societies large or small (Rogers, 2003). IDT is an appropriate theoretical

lens for this study because it involves examining a relatively new, last-mile logistics practice i.e. self-collection services, which can be considered as an innovation. According to the theory, there are five factors that influence the consumers' acceptance of an innovation (Baskerville et al., 2014). They are relative advantage, compatibility, complexity, trialability, and observability.

The remaining parts of the paper are organised as follows. First, a review of the contemporary literature on self-service deliveries and IDT was conducted. Thereafter, hypotheses were formulated. Subsequently, surveys were designed and conducted for the purpose of data collection. Next, the data were analysed and hypotheses were tested using hierarchical regression analysis. The results were then presented and discussed. Finally, conclusions are drawn based on the results.

2. Literature Review

2.1 Self-Collection Services

As early as 2001, Lee and Whang (2001) recognised the importance of e-fulfilment strategies in helping organisations to emerge victorious in the last-mile of e-commerce. Using two core concepts on information utilisation and resource leverage to complete last-mile delivery, they pinpointed five e-fulfilment strategies that organisations can adopt, namely "Logistics postponement", "Dematerialisation", "Resource exchange", "Leveraged shipments" and "Clicks-and-mortar". Two of the strategies are most relevant to this study. "Leveraged shipments" is a strategy that can maximise e-tailers' delivery-value density. It is a measure that can determine if it is economical to deliver goods to a neighbourhood in a single trip by aggregating orders. It can also be done by engaging localised home delivery service providers known as "dealers", with each dealer making deliveries to customers of their assigned zones. For the "Clicks-and-

Mortar" model, it involves engaging customers' cooperation in the last-mile delivery. This can be done by tapping onto the bricks-and-mortar stores of e-tailers or a local store for customers to pick up their parcels. These strategies have materialised and are being applied in today's context in the form of self-collection points, a concept where aggregated customers' orders are delivered and customers self-collect their parcels.

Before the birth of the self-collection concept, e-grocery was used as basis for last-mile delivery research. Reception box and delivery box concepts were discussed by Punakivi et al. (2001) and these concepts are deemed to be feasible approaches of unattended delivery. Reception box is a "refrigerated, customer-specific reception box installed at the customer's garage or home yard" whereas delivery box is an "insulated secured box equipped with a docking mechanism". These approaches however, mainly revolve around only one customer at a time. Punakivi and Tanskanen (2002) further discussed how shared reception boxes concept can increase the cost-efficiency of last-mile delivery. Although this delivery method requires customers to pick up their parcel within the specified pick-up time window, the operation efficiency ratio of such deliveries per hour is the highest. Moreover, 55% to 66% of cost savings can be achieved subjecting to an operational efficiency that is 2.8 times higher than home deliveries. Time is saved using this method as customers are not required to specially travel to a store, and parcel collection can be planned and included as part of their daily travelling activities. Although the demand for such services is unpredictable at the time of study, the researchers saw its potential and suggested future research to be directed towards its feasibility and the acceptance of self-collection services.

Moving forward to today's environment, researchers begin to steer their course towards the study of self-collection points resulting in an influx of studies on alternative parcel delivery services.

Morganti et al. (2014) focused on self-collection networks in Europe and analysed how the operators arranged the self-collection networks, giving insights on the spatial patterns. Their findings showed that the self-collection networks reduce the operational cost of last-mile logistics delivery. It also improves parcel consolidation while reducing the possibility of failed deliveries. However, the conceptual framework proposed in the article only identifies the main considerations and limitations that may affect the design of a self-collection network and was based on an operator's perspective. In addition, the framework also presents a new perspective to designing self-collection network. For example, centres and nodes in cities, which originally represents parameters related to end-customers' mobility and accessibility to socio-economic activities can be converted into a self-collection network to encourage customers to use self-collection services.

From a behavioural perspective, Collins (2015) investigated the environmental footprint of last-mile parcel delivery. It was found that adjusting factors such as price, quality, location of self-collection points and delivery offering can influence customers to switch to more environmental friendly modes of picking up from the self-collection points or to integrate their pickup into an existing trip. This not only illustrates how changing certain characteristics of self-collection points and home delivery can influence customers' choice of transportation mode, it also shows how customers' choice and subsequent behaviour can be influenced by certain factors that they perceived to be important. This opens up the possibility of studying such behavioural influence on different areas, such as comparison between home delivery and alternative delivery methods.

McLeod et al. (2006) investigated the transport impact of local self-collection points. By comparing the existing home delivery and self-collection point method,

McLeod et al. (2006) found that self-collection points are more favourable when (1) the carrier's depot is inconveniently located and is distant from the collection area, making it hard for trips to be combined, (2) a substantial number of people walk to their local self-collection points, or (3) when there is a high number of first-time home delivery failures. Additionally, having more self-collection point locations is also constructive to customers as they can travel shorter distances. However, this might potentially be detrimental to carriers as they have to deliver parcels to more locations.

Xu and Hong (2013) examined the factors influencing customers' intention to use self-collection services. Among the four main facets of personal characteristics, parcel characteristics, environmental characteristics and service evaluation of traditional home delivery, "convenience perception of home delivery", "online shopping age", "frequency of online shopping in a specified period" and "parcel values" are discovered to be significant variables affecting customers' willingness to choose self-collection services. Following which, the authors proposed that customer segmentation can be implemented to better suit the needs of customers. An intriguing finding is that customers' satisfaction of home delivery service is not a significant factor influencing customers' willingness to use self-collection services. This implies that service quality will not motivate customers to choose new delivery alternatives.

According to Joerss et al. (2016), self-collection services are not well-received by most consumers despite the benefit of picking up their parcels at their convenient time. This corroborates recent studies reporting that only five to ten percent of last-mile deliveries in countries such as France and Singapore were being performed through self-collection services (Choo, 2016; Morganti et al., 2014). These figures are considerably lower than consumers' stated-intention to use self-collection services which was reported to be about 20 percent (Tan, 2016). Joerss et al. (2016) noted that

about 50 percent of the consumers are willing to switch to self-collection services only when home deliveries cost $3 more than self-collection services.

The findings discussed in the preceding paragraph suggests that a majority of the consumers have strong preference for home deliveries. However, a major gap observed in the current literature is the limited discussion of consumers' inertia to switch to self-collection services, and the lack of a theoretical framework to examine the factors influencing consumers' decision to adopt self-collection services.

2.2 Innovation Diffusion Theory (IDT)

The current study distinguishes itself by examining the factors influencing consumers' decision to use self-collection services through the theoretical lens of IDT. The theory describes how innovations or technologies become accepted and spread through societies large or small (Rogers, 2003). It is a decision process whereby individuals decide whether to adopt an innovation, new service, or product.

The decision process consists of five stages that occur sequentially. Accordingly, they are "knowledge", "persuasion", "decision", "implementation", and "confirmation" stages (Talke and Heidenreich, 2014; Wijaya, 2015). First, an individual begins the process by gaining knowledge about the innovation simply by being aware of its existence or exploring its functions. Second, the individual then sources for information regarding the innovation, assesses the credibility of the sources, and evaluates significant referents' attitudes toward the innovation. Third, the individual decides whether to accept or reject adopting the innovation. Such adoption is often performed in an incremental manner before receiving full commitment by the individual. Fourth, should the individual decide to use the innovation, he or she will begin the implementation stage which involves the actual use of the innovation. Positive or negative experiences may manifest from the use of the innovation. Finally, the

individual looks for support regarding his or her decision for the continual usage of the technology. In the event when there are too much information or experiences that are incongruent with the action, the individual might discontinue using the innovation and revert to using services that the individual is familiar with. On the contrary, the individual may continue to use the service if it has received positive experiences or information from using the innovation.

Apart from the learning phases described above, IDT also suggests that the specific attributes of an innovation influence consumers' decision to use an innovation. These attributes are relative advantage, compatibility, complexity, trialability, and observability.

2.2.1 Relative Advantage

Relative advantage is the extent to which "an innovation is perceived as better than the idea it supersedes" and it is dependent on whether an individual views the innovation as being advantageous (Hashem and Tann, 2007). The comparison between both ideas can be measured in economic terms, social-prestige factors, convenience and satisfaction.

In the context of this study, consumers may perceive self-collection services to be more advantageous than home deliveries for their economic value (e.g. lower opportunity costs associated with waiting for home delivery), social-prestige (e.g. conformance with significant referents such as families and peers who prefer using self-collection services), convenience (e.g. easier to use self-collection services than home delivery), and satisfaction (e.g. better experiences from previous usage of self-collection compared to home delivery). When such advantage over home delivery is present and realised by consumers (Cheng and Tseng, 2016), they will have stronger intentions to use self-collection service. Therefore, the following hypothesis is proposed.

H_1: Relative advantage has a positive effect on consumers' intention to use self-collection services

2.2.2 Compatibility

Compatibility is the degree to which the individual perceives the innovation as being aligned with his or her lifestyle, values, past experiences, and needs (Lu and Su, 2009).

In this context, compatibility is to be distinguished from relative advantage. Relative advantage involves the comparison of self-collection services and home deliveries based on their cost and benefit. For instance, an individual may perceive self-collection services to be superior than home deliveries if he or she finds that using self-collection services are more convenient than home deliveries. On the other hand, compatibility accounts for the degree of congruency that self-collection services have with an individual's lifestyle, values, past experiences, and needs.

With regard to lifestyle, working professionals who are not at home for most of the time or individuals who favour privacy at home may favour the use of self-collection services. As for values, individuals who possess pro-environmental attitudes may have greater tendency to use self-collection services as they are known to be the greener alternative to home deliveries, and using the services align with their values of environmental protection. Similarly, individuals would also prefer or favour self-collection services if their prior usage of the services are positive or if such services suit their individual needs (e.g. the proximity of self-collection points from the locations of an individual's core daily activities). Therefore, the following hypothesis is proposed.

H_2: Compatibility has a positive effect on consumers' intention to use self-collection services

2.2.3 Complexity

Complexity is the degree to which the individual views the innovation as being "difficult to understand and use" (Rogers, 2010). It was found that innovations that require adopter to develop new skills and understanding will be adopted at a slower rate compared to innovations that are less complex.

For self-collection, complexity arises when users interact with the self-collection system for parcel retrieval. To ensure security, various stages of identity check are designed into the system by scanning barcode, keying in password and parcel series numbers, which adds to the complexity of parcel retrieval. While some consumers may perceive the extra efforts as only marginal, others may feel it burdensome and thus form unfavourable attitude toward the self-collection system.

In this context, consumers who perceive the use of self-collection systems to be complex are likely to be more resistant or sceptical of the system and are expected to have weaker intention to use self-collection services. Therefore, the following hypothesis is proposed.

H_3: Complexity has a negative effect on consumers' intention to use self-collection services

2.2.4 Trialability

Trialability refers to how easily an innovation may be tried out or tested given a limited basis (Lee et al., 2011). Higher trialability means that there is decreased apprehension or uncertainty on the individuals when deciding whether to adopt the innovation as they can learn by trying it out.

Trials provide a free and safe environment for experimenting with the new innovation and the consumers can sample the innovation that they are curious about (Strömberg et al., 2016). The unanticipated trial experiences may lead to positive

surprises that contribute to the formation of favourable intentions toward the adoption. It is expected that consumers who perceive self-collection services to be easily tried and tested will view the usage of such services with less uncertainties. As a result, they will tend to form greater intentions to use the service. Therefore, the following hypothesis is proposed.

H_4: Trialability has a positive effect on consumers' intention to use self-collection services

2.2.5 Observability

Observability refers to how visible the results of innovation are to others, and the visibility of the net benefit when such innovation is adopted (Pannell et al., 2006). When it is easier for individuals to see the results of an innovation, there is a higher likelihood for them to adopt the innovation.

In this context, when the procedures of performing self-collection can be easily learned from observing other users, explained to other users, or when the benefits of performing self-collection are bought-in by consumers, it is expected that consumers will form greater intentions to use the self-collection service. Therefore, the following hypothesis is proposed.

H_5: Observability has a positive effect on consumers' intention to use self-collection services

3. Methodology

3.1 Scale Development

The development of survey questionnaire involved the review of the literature on customers' preference and IDT theory. As discussed previously, "relative advantage",

"compatibility", 'complexity", "trialability" and "observability" are characteristics of innovation and they were included in the questionnaire to test if they were significant determinants of customers' preference.

A pool of items was selected to represent each characteristic (See Table 1) and respondents were asked to rate them based on their understanding of using self-collection system. A 7-point rating was used in this survey, with 1 and 7 being the two extremes (namely 1 as "strongly disagree" and 7 as "strongly agree), and 4 to represent neutrality. A reverse-scaled item (c1) is used in the operationalisation of "complexity" to ensure data quality. Responses that are scored high (or low) on the item, and high (or low) on its equivalent item (c2) are considered invalid and voided.

"Intention" towards self-collection method was another area of focus for this questionnaire; three types of responses were included for "Intention", and respondents have to rate each response using a 7-point scale (1 as "strongly disagree" and 7 as "strongly agree"),.

<Insert Table 1 Here>

Questions were also included to capture information on respondents' online shopping frequency, product characteristics and demographic characteristics. Product characteristics include product type, product value, parcel size and weight. Demographic characteristics include information on the respondent's age, gender, occupation, type of housing and number of members in his/her household.

3.2 Survey Design and Administration

A pilot survey was first conducted at the second author's university in Singapore on 1st August 2016 to test the viability of the study and 80 responses were received. It revealed areas that can be improved for the questionnaire, such as the interviewees not being able to comprehend "self-collection". Improvements for latter surveys were

identified, such as specifically defining "self-collection" and illustrating it in the subsequent survey.

After revising the survey questionnaire, a formal, street-intercept survey at three locations in Singapore was conducted on 18th October 2016, and between 24 October 2016 to 6th November 2016. In total, 190 survey responses were collected. After removing incomplete or invalid questionnaires, 164 valid responses were used for data analyses.

3.3 Demographics of Respondents and Product Characteristics

Table 2 below shows the demographic characteristics of the respondents as well as the characteristics of their most frequently purchased products.

<Insert Table 2 Here>

4. Results and Discussion

4.1 Confirmatory Factor Analysis

Since this study involves analysing latent variables, a confirmatory factor analysis was first conducted to examine the reliability and validity of the measurement items. The results of the confirmatory factor analysis are presented in Tables 3 and 4. Table 3 shows the model fit indices, standardised factor loadings (λ), average variance extracted (AVE), and reliabilities (CR and α) of each measurement item. Table 4 shows a matrix consisting of the AVE, correlations, and squared correlations of the latent constructs.

As shown at the bottom of Table 3, the model fit statistics are within the cut-off criteria recommended by Hu and Bentler (1999). This indicates adequate fit between the observed and implied covariance matrix of the manifest variables. Cronbach alpha (α) of each construct is above the general guideline of 0.70 which indicates a high level of

reliability or internal consistency in the measurement items (Nunnally, 1994). The AVE for each construct is above the cut-off point of 0.50 which suggests convergent validity (Hair et al., 2010). In addition, as presented in Table 4, the squared correlation between a pair of constructs is less than the AVE of each construct. Therefore, discriminant validity was also supported (Fornell and Larcker, 1981).

<Insert Tables 3 and 4 Here>

In general, the results indicate that the measurement model possesses adequate fit, and its associated measurement items are valid and reliable. Therefore, the study can proceed with the formal testing of its hypotheses.

4.2 Hierarchical Regression Analysis

Consumers' intention to use self-collection service was regressed on the predictors in a sequential manner with all control variables being analysed followed by the characteristics of innovation. Table 5 presents the results from hierarchical regression analysis using SPSS 21. The results of Model 1 are first discussed and subsequently, Model 2.

<Insert Table 5 here>

As shown in Model 1, consumers' intention to use self-collection service was regressed on the control variables, "age", "gender", "type of housing", "household "size", and "employment status". The regression model is not significant ($F=1.518$, $p > 0.05$). Furthermore, all the control variables were found to have no significant effects ($p > 0.05$) on consumers' intention to use self-collection service. Some of the results are unexpected. For instance, it is expected that the younger age group will favour the use of self-collection services because they are more tech-savvy, and active. On the contrary, the older age group might be less willing to travel to self-collection points to retrieve their parcels due to restricted mobility. Similarly, it is also unexpected that

employment status has no significant effect on consumers' intention to use self-collection services. Consumers who are working full-time would favour self-collection services since they have less time at home to wait for their deliveries. Nonetheless, the insignificant results suggest that demographic variables do not adequately explain consumers' intention to use self-collection services, and there are stronger predictors such as the five innovation characteristics presented in Model 2. l

Model 2 is an extension of Model 1 with the inclusion of the five innovation characteristics which are compatibility, relative advantage, complexity, trialability, and observability. The inclusion of the five variables is significant ($\Delta F = 19.799$, $p < 0.05$). In addition, the R^2 of Model 2 is 0.421. Compared to Model 1, an increase of 0.375 in the explanatory power of the model is recorded. The acceptance of Model 2 as a better model compared to Model 1 supports the utility of IDT in explaining consumers' intention to use self-collection services. Prior to interpreting the results of Model 2, a multicollinearity test was conducted. The variance inflation factor of the independent variables ranges from 1.053 to 1.683. This suggests that multicollinearity is not a major concern in this study.

However, it is noted that not all innovation characteristics have significant effects on consumers' intention to use self-collection services. Among the five characteristics, compatibility ($b = 0.32$, $p < 0.05$), relative advantage ($b = 0.36$, $p < 0.05$), and trialability ($b = 0.19$, $p < 0.05$) have significant, positive effects on consumers' intention to use self-collection services. Therefore, as depicted in Table 5, only H_1, H_2, and H_4 are accepted. On the other hand, H_3 and H_5 are rejected.

It is also observed that the five characteristics do not exert equal effects on customers' intention. In other words, the magnitude and sign of their influences differ. However, it can be observed that the mean values of most variables hover within the

range of 4 to 5 points, suggesting that customers hold a rather neutral to slightly positive view towards self-collection.

It is not surprising to see that relative advantage and compatibility are significant factors that can exert positive influence on customers' intention to a relatively large extent. Only when customers perceive self-collection services as a better idea than home delivery, or when the use of self-collection is compatible with their values, past experiences and needs, then they will choose self-collection services. However, with a mean score of 4.77 for relative advantage, it indicates that customers view self-collection method as being only slightly more advantageous than home delivery The same applies to compatibility (mean of 4.49). Self-collection is being seen to be slightly compatible with customers' lifestyle, values, experience, and needs. This can be attributed to the fact that self-collection method is relatively new. As a result, customers are at the "early minority" or "late majority" stage. As they are still being rather neutral about the service offering, the rate of adoption for self-collection is slow. A key consideration here is not only to identify areas that are being considered as advantageous by the operator but those deemed to be advantageous by customers. In this regard, possessing knowledge about the basic benefits of each delivery method is not enough. It is important to delve deeper into the core of the customer's decision blackbox and identify the factors that are deemed as a relative advantage for him or her. For compatibility, it is important to set the right context as perception of compatibility can differ among individuals, cultures, and countries.

Though trialability has a relatively lower significance level compared to relative advantage and compatibility, it is worthwhile to discuss its impact on customers' intention. Given that it is easier to try out or be tested at a limited basis, there will be greater opportunity for learning and reduced uncertainty for customers when deciding

whether to use self-collection services. This explains the positive effect trialability has on customers' intention.

Complexity has a negative influence on customers' intention, whereby if the customers view self-collection as being difficult to understand and use, they will not choose this method of delivery. However, its effect is not significant. This could be due the inherent lack of complexity involved in self-collection services as compared to other forms of innovation or technology. For unattended self-collection services, there is often only one layer of interface, which involves customers looking at the touch screen of the locker and choosing the right option, followed by opening the locker to collect their parcel. For attended self-collection services, it only involves approaching the employee in the store to collect their parcel. In other words, the procedures for self-collection is relatively simple, rendering complexity to hold less importance on influencing customers' intention to adopt self-collection services.

The findings relating to the effect of observability on customers' intention is unexpected and not in line with IDT theory. Based on the theory, should the results of self-collection be visible to others, there is higher likelihood for them to adopt the innovation. The peculiarity of this factor may be attributed to the fact that it is difficult for customers to envisage the benefits of self-collection. Customers have to use the service to truly understand the benefit that it can offer. For example, it is hard for customers to see how self-collection can bring convenience to them unless they try it themselves as such benefits are intangible and hence, difficult to measure The benefits of self-collection are not easily visible, leading to low adoption rate.; Therefore, this renders observability to be insignificant. Another explanation concerns privacy as consumers may not wish to be observed by others about the items they are retrieving from the self-collection points.

5. Conclusion

Given that most of the identified innovation characteristics are significant determinants of customers' intention, they can be areas of improvement for current self-collection services. Moreover, Choo (2016) seems to suggest that the receptiveness of customers and their attitude towards self-collection services is equally or even more important than optimising the self-collection networks and the cost of logistics operators, which have been the primarily focus of the existing literature.

The current paper has contributed to both theory and the management of self-collection services. From the theoretical perspective, the paper enriches the literature by introducing the IDT framework to analyse the factors influencing consumers' intention to use self-collection services. The results imply that IDT is a suitable theoretical lens for this context and provides a better understanding towards consumers' behaviour and decision-making process concerning the selection of last-mile logistics services. Perhaps, the most significant contribution of this study is that the dimensions of IDT have explained approximately 42% of consumers' intention to use self-collection services. This contribution is considered sizeable in modelling consumers' behaviour.

According to Holguín-Veras et al. (2017), good urban freight policies require a sound understanding of how the targets of a policy, who in this case refers to consumers, react to it. The current paper addresses the authors' call for greater integration between policymaking and behavioural research. From the managerial perspective, the findings of this research have important implications for both transport policymakers and last-mile logistics service providers, which have different agendas. Based on the discussion provided below, transport policymakers can promote the use of self-collection services to reduce negative externalities associated with home deliveries,

while logistics service providers can seek to reduce their operating costs by encouraging consumers to use self-collection services.

Firstly, to increase the rate of adoption for self-collection systems, relevant stakeholders i.e. policymakers or logistics service providers can first focus on building up the two main characteristics of innovation, namely, relative advantage and compatibility. As per the findings, the pivotal step is to identify areas that the customers view self-collection services as being advantageous. However, the pre-condition is to have knowledge of the competitive scene of last-mile delivery. At the current moment, although home delivery is the main competitor, it is difficult to predict whether other competitors such as drone or autonomous ground vehicle delivery will gain popularity considering the rapid technological advancement. In addition, the factors that customers perceive self-collection services to be advantageous might be very subjective and vary between individuals due to different needs. Hence, a possible method that the stakeholders can use is to educate, communicate, and market the benefits to customers via various media channels. For example, the marketing of self-collection services can focus on highlighting the reduced environmental and societal impacts, and improved flexibility to collect parcels. The stakeholders could also influence consumers' behaviour by providing discount incentives or subsidisation for the use of self-collection services. Alternatively, a price mark-up on home delivery services can also be implemented to account for the added negative externalities. This would cause consumers to switch to self-collection services due to lower opportunity cost.

Secondly, in terms of compatibility, the location of self-collection service offering is often the main area of consideration for customers. This is supported by the fact that highest usage delivery points are often located within shopping centres that are connected to transport networks (Choo, 2016), which intersect with the core daily

activities of most customers. Existing network of bus or train stations, and convenience stores are ideal locations to position the self-collection points. Stakeholders can thus constantly review the locations of the self-collection points and shift the unpopular points to a more strategic location to improve utilisation. Another aspect of compatibility is on the product itself i.e. whether the self-collection service is suitable to store the products that the customers ordered. This can be linked to the type of housing customers stayed in. Most houses have mailboxes which allow the delivery of pocket-size parcels, making it redundant for such individuals to choose self-collection service. However, one drawback of the mailboxes is that they can only fit small parcels. Therefore, stakeholders can position locker points not merely as a system of lockers but a network of lockers that can accommodate large-sized parcels. Rather than directly competing with home delivery locker points can act as a complement by accommodating bigger parcels which mailboxes are unable to accommodate.

Following which, trialability is the next area of improvement for self-collection services. Self-collection systems can be made more interactive by adding more experimentation features, such as trivia games (Chang et al., 2006; Egenfeldt-Nielsen, 2010). Upon completion of the game, points earned can be subsequently redeemed for prizes such as discount voucher for online shopping or free self-collection service. Such points benefits can potentially attract new users to experiment with the self-collection system. Additionally, such improved trialability improve existing users' familiarity with the system. This strategy can also help to improve observability. Through experimenting with the self-collection system, users can have the opportunity and are in a better position to evaluate the benefits of self-collection. This could potentially influence their intention to use self-collection services.

Despite the contributions of the study, there are two limitations, with the first being the sample size. A larger sample size might be more beneficial to achieve a better grasp of the population. The second limitation is the scope of study, in which the five main characteristics of innovation and several demographic characteristics were used as control variables. It is undeniable that there are other factors that can influence customers' intention but they are not within the scope of this study.

Future research can consider applying other behavioural theories such as perceived value theory (Cheng and Tseng, 2016) or theory of planned behaviour (Yuen et al., 2017) to enhance the explanatory power of the research model developed in this study. There is also room for research on potential competitors of self-collection, such as drones, crowd-sourcing or other disruptive technologies. The in-depth analysis of various competition allows a better positioning of self-collection system as a delivery method in this competitive last-mile logistics environment.

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TABLES

Table 1. Scale Development

Construct	Item	Source
a. Compatibility	*I feel receiving parcels by using self-collection system would be compatible with*: a1. my lifestyle a2. my needs a3. the way I like to receive my parcel a4. my current situation	Moore and Benbasat (1991) Meuter et al. (2005)
b. Relative advantage	*I feel receiving parcels by self-collection would be better than by home delivery, because using self-collection:* b1. improves my overall parcel reception experience b2. makes it easier to receive my parcel b3. enables me to receive my parcel more quickly b4. is advantageous b5. is the best way to receive my parcel	Moore and Benbasat (1991) Meuter et al. (2005)
c. Complexity	*I feel self-collection system:* c1. is easy to use* c2. is difficult to use c3. is difficult to learn how to use c4. is frustrating to use c5. is cumbersome to use c6. requires a lot of effort to use	Moore and Benbasat (1991) Meuter et al. (2005)
d. Trialability	*I feel I am able try out the self-collection system (to familiarise myself with various functions it offers) because:* d1. it is easy to try it out d2. I know where I can try it out d3. I am permitted to try it out for long enough period d4. I am able to experiment with it when necessary d5. I can access it adequately	Moore and Benbasat (1991) Meuter et al. (2005)
e. Observability	*By observing how others use self-collection system to receive parcels, I feel:* e1. I can learn how to self-collect the parcels e2. I can explain to others how to self-collect the parcels e3. I can tell whether using self-collection is beneficial e4. self-collection process is clear to me	Moore and Benbasat (1991) Meuter et al. (2005)
f. Intention to use self-collection services	*My intention to use self-collection to receive parcels for the next online purchase is:* f1. unlikely (1) / likely (7) f2. impossible (1) / possible (7) f3. Not probable (1) / probable (7)	E. Collier et al. (2014) Yuen et al. (2016)

Note: *c1 is a reverse-scaled item used to access the quality of the survey responses

Table 2. Demographic Characteristics of Respondents and their Most Frequently Purchased Products

Demographic or product characteristics	Number of respondents (n = 164)	Percentage (%)
Gender		
Male	73	44.5
Female	91	55.5
Age		
≤ 19 Years	32	19.5
20-29 Years	90	54.9
30-39 Years	23	14.0
40-49 Years	9	5.5
≥ 50 Years	10	6.1
Employment Status		
Employed	65	39.8
Unemployed	99	60.2
Type of Housing		
Flats	124	75.6
Condominium	21	12.8
Landed Property	10	6.1
Others	9	5.5
Product Type		
Clothing	94	57.2
Electronics	22	13.2
Others	49	29.6
Product Value (S$)		
Below 50	77	47.2
50 – 99	38	23.3
100 – 199	30	18.4
200 – 299	8	5.0
≥ 300	10	6.1
Product Size		
Small (e.g. laptop size)	117	71.1
Medium	43	26.4
Large (e.g. luggage size)	4	2.5
Product Weight		
Light (<1kg)	102	62.0
Normal	58	35.6
Heavy (>5kg)	4	2.4

Table 3. Confirmatory factor analysis and scale reliability.

Construct	Item	λ	t-value	α	AVE	CR
Compatibility (A)	a1	0.79	-	0.873	0.664	0.880
	a2	0.89	12.47			
	a3	0.70	9.30			
	a4	0.83	11.51			
Relative advantage (B)	b1	0.82	-	0.92	0.703	0.922
	b2	0.87	13.31			
	b3	0.80	11.79			
	b4	0.88	13.67			
	b5	0.82	12.35			
Complexity (C)	c2	0.74	-	0.894	0.634	0.896
	c3	0.71	9.01			
	c4	0.94	11.96			
	c5	0.82	10.95			
	c6	0.75	9.62			
Trialability (D)	d1	0.71	-	0.898	0.652	0.903
	d2	0.82	9.54			
	d3	0.82	9.52			
	d4	0.85	9.82			
	d5	0.83	9.69			
Observability (E)	e1	0.89	-	0.896	0.687	0.898
	e2	0.80	12.99			
	e3	0.76	11.89			
	e4	0.86	14.71			
Intention to use (F)	f1	0.89	-	0.937	0.836	0.939
	f2	0.87	16.32			
	f3	0.98	21.17			

Note: Model fit statistics: χ^2= 508.51, df= 284, χ^2/df= 1.79, p< 0.01; CFI= 0.93, TLI= 0.94, SRMR= 0.077, RMSEA= 0.070, 0.060 < RMSEA < 0.079 at 90% confidence interval.

Table 4. Average variance extracted, correlations, and squared correlations of constructs.

	A	B	C	D	E	F
A	**0.66**[a]	0.44[c]	0.12	0.26	0.40	0.24
B	0.66[b]	**0.70**	0.16	0.22	0.24	0.41
C	-0.35	-0.40	**0.63**	0.07	0.24	0.12
D	0.51	0.47	-0.26	**0.65**	0.28	0.16
E	0.63	0.49	-0.49	0.53	**0.69**	0.10
F	0.49	0.64	-0.35	0.40	0.31	**0.84**

Note: [a] average variance extracted values are along the main diagonal, [b] correlations between constructs are below the main diagonal, [c] squared correlations between constructs are above the main diagonal.

Table 5. Hierarchical Regression Analysis

	mean	Model 1 Controls		Model 2 Innovation Characteristics		Hypothesis
Variables (i)		b_i	Sig.	b_i	Sig.	
Control Variables						
Age	0.33	0.06	0.441	-0.20	0.263	
Gender	0.55	0.10	0.192	0.03	0.840	
Type of housing	0.24	0.10	0.207	0.36	0.056	
Household size	0.36	-0.11	0.179	0.10	0.548	
Employment status	0.53	-0.14	0.079	-0.22	0.182	
Innovation Characteristics						
Compatibility	4.49			0.32	0.001	H_1 accepted
Relative advantage	4.77			0.36	<0.001	H_2 accepted
Complexity	3.17			-0.12	0.182	H_3 rejected
Trialability	5.04			0.19	0.034	H_4 accepted
Observability	4.84			-0.20	0.052	H_5 rejected
Model's Summary statistics						
n		164		164		
ΔF		1.518		19.799		
Sig. of ΔF		0.187		< 0.001		
R^2		0.046		0.421		
ΔR^2		0.046		0.375		