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MOVING FREIGHT WITH THE CROWD? AN INVESTIGATION ON THE INTENTION TO ADOPT CROWDSHIPPING FOR THE LAST-MILE DELIVERY

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SOMMARIO

Lo scopo di questo studio è quello di analizzare le determinanti relative all'intenzione di adozione di una soluzione di consegna innovativa da parte dei possibili utilizzatori. La soluzione proposta e descritta è il crowdshipping, un innovativo servizio di consegna basato sulla sharing economy, dove le persone comuni possono diventare veri e propri corrieri, accettando di consegnare un pacco durante uno dei loro tragitti quotidiani, effettuando deviazioni di entità contenute in cambio di un minimo compenso. Dal punto di vista pratico il crowdshipping presenta impatti positivi nel contesto in cui viene applicato: riduzione dei veicoli in movimento e delle emissioni inquinanti all'interno delle aree urbane. D'altra parte, le indagini comportamentali sulle motivazioni che spingono gli utenti all'adozione di tale servizio sono ancora inesplorate, dimostrando la tempestività di questo studio e il suo contributo alla letteratura esistente. Lo studio applica l'Innovation Diffusion Theory per la costruzione di un modello di equazioni strutturali (SEM) basato sulle cinque determinanti fondamentali che influenzano l'intenzione di adozione dei consumatori previste dalla teoria (vantaggio relativo, compatibilità, complessità, sperimentabilità, osservabilità), con l'aggiunta di una ulteriore componente fondamentale denominata "resistenza al cambiamento". Lo studio è basato sulla somministrazione di un questionario che coinvolge gli intervistati che vivono in contesti urbani nel Sud Italia. I dati raccolti sono stati elaborati mediante tecniche statistiche e discussi.

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1. Introduction

In the last decades, an increase of the movements for freight transportation and parcel delivery was registered, especially in urban areas, around the economic and social development of cities. The phenomenon has a strict correlation with different new behaviours that completely change the daily-life of consumers. People started to make a massive use of e-commerce, and this tendency is expected to grow in the near future (World Economic Forum, 2017). As a result, logistics carriers need to manage a considerable number of small packages. This aspect generates various issues, inefficiencies, and externalities affecting the industry, particularly in the last-mile segment (Perboli *et al.*, 2014, Bertazzi *et al.*, 2019).

As such, there is a greater awareness of the need to improve transportation activities in the last-mile while making them more sustainable and competitive. Last-mile delivery was defined by Lindner (2011) as the last segment of the supply chain 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*" (page 3). From the industrial point of view, it is crucial to have efficient delivery systems to reduce costs and transportation time, as long as to increase the customer satisfaction.

The only way to face this phenomenon is by mixing traditional aspects with the emerging technologies. In fact, the need to increase the efficiency of delivery activities has inspired different contributions and new ideas into the field. Researchers and stakeholders promote the identification of new delivery options among emerging technologies, including cargo bikes (Perboli *et al*., 2016), electric vehicles (Taefi *et a*l., 2016), autonomous vehicles (Gelareh *et al.*, 2013), drones (Murray and Chu, 2015) and parcel delivery with lockers (Dell'Amico *et al*., 2011).

On the other side, the society registers another interesting and inspiring phenomenon: the spread out of the "sharing economy", which became very popular and has been applied to different services (Le *at al.*, 2019): accommodations (e.g., AirBnB, Couchsufing), finance (e.g., crowdfunding, peer-to-peer banking), information and communication technologies (e.g., cloud computing) etc.. In the transportation field, lots of new passenger and freight sharing services based on different features can be found, like bike-sharing (Miaojia *et al.*, 2019), car-sharing or car-pooling (Giglio and Palmieri, 2016), shared taxis and parking spaces for passenger mobility or van-sharing for freight mobility (Hua *et al.*, 2019, De Maio *et al*, 2018).

Considering all these aspects, the introduction of new delivery models, also based on the sharing economy concepts, could stimulate a better use of the transport capacity and favour the reduction of transportation costs and emissions (Bubner *et al.*, 2014). In this context, a very promising innovative way to improve the delivery sector in urban areas is crowd logistics. Crowdsourced goods delivery has been defined as a frontier (Wang *et al*., 2016) or a revolutionary change in city distribution (Macharis and Kin, 2017). Mehmann *et al*. (2015) defined the crowd logistics as "*the outsourcing of logistics services to a mass of actors, the coordination is supported by a technical infrastructure. The objective is to achieve benefits for all stake- and shareholders*" (page 123). In particular, one of the most popular paradigms of crowd logistics is represented by crowdshipping. There is no formal definition for this service until now. In general, crowdshipping can be defined as a system where the delivery is outsourced to occasional drivers drawn from the public of private travellers and is coordinated by an on-line platform/app-mobile to achieve benefits for the involved stakeholders (Punel *et al*., 2017). Nevertheless, the study of crowdshipping is very challenging, because the field is relatively new and affected by the lack of operational uniformed systems and availability of operational data. This emerging paradigm has the great potentiality to alter the way shipments are organized until now, and as a consequence, to change the vision related to who will be the carriers of the future, and how people expect package deliveries to be performed (Rougès and Montreuil, 2014). However, the potential of crowdshipping is not quantifiable, yet, because its success depends on the real intention of the users that could operate both on the supply-side (as shippers) and on the demand-side (as customers). The literature is relatively poor in analysing the cause-effect relationships correlated to the users' willingness to perform or adopt the service.

For these reasons, the aim of this study is to investigate users' determinants of intention toward the adoption of crowdshipping solutions for the demand-side that is considering customers' willingness to receive parcels delivered by occasional drivers. In fact, the main impacts and implications succeeding to crowdshipping adoption have been addressed in the recent literature (Deutsch and Golany, 2017; Park *et al*., 2016), but behavioural investigations about adoption determinants and antecedents are still underexplored, thus, proving the timeliness of this study and its contribution to the extant literature (Yuen *et a*l., 2018; Punel and Stathopoulos, 2017).

The specific aim of the study is the identification of the main determinants of crowdshipping acceptance among users by means of analyzing the different factors impacting directly on their decisions (control over delivery conditions, shipping and package attributes, socio-demographic features, economic reasons, user shipping experiences, safety and security etc.). Furthermore, understanding the grade of acceptance of the service is a strategical and crucial point for different reasons. From the managerial point of view, it allows companies to deeply investigate the consumer preferences and better forecasting the demand for the innovative shipping service. Moreover, understanding the behavioural insights could give a great contribution to the construction of sustainable business models and operational frameworks for managing crowdshipping, in order to make the service more appealing for users and enlarge the number of people engaged as senders/receivers. This is a major point for building the necessary critical mass in order to implement a crowdshipping delivery system with significant impacts on social benefits (Rougès and Montreuil, 2014, Punel *et al*., 2017).

The work is organized as follows: Section 2 provides a literature review; Section 3 describes the theoretical framework and the hypotheses development; Section 4 describes the methodological approach, which is composed of a linear regression analysis considering socio-demographic variables, and the Structural Equation Modeling (SEM) with Exploratory and Confirmatory Factor Analyses (EFA and CFA, respectively) considering variables affecting the innovation diffusion dynamics; Section 5 reports the statistical results and related discussion, and Section 6 ends with conclusions.

2. Literature overview

The fast-increasing interest in crowdshipping approach generates lots of contributions in the literature, that describe and analyse the paradigm from different points of view.

Crowdshipping is defined alternatively as crowd logistics or crowdsourced delivery in different studies. From the practical point of view, a large range of real applications can be found in literature. Indeed, the relevance of business, economic and managerial implications of crowdshipping relies in the cross-sectoral nature of the sharing economy: lots of firms are disrupting the classical last-mile freight delivery market - e.g., Uber, Deliveroo, Foodora - dealing with different product categories such as books, clothing, electronics, food&beverage, flowers etc. (Le and Ukkusuri, 2019).

Savelsbergh and Van Woensel (2016) describe the case of Walmart (2013), a company that introduced the possibility to assign the orders collected online to the in-store customers, that assumed the role of occasional drivers, guaranteeing also the same-day delivery to online customers. Another practical application is described by Slabinac (2015) that analysed the DHL case. In particular, DHL implemented a mobile application in order to find users available to perform delivery services in the last-mile, on their way back home, in exchange for an incentive at the end. Also, Amazon is exploring a similar setting for crowdshipping (Bensinger 2015). Except for the major players, no companies existed in this new market until 2012. Nowadays, the situation is quite different because a series of crowdshipping companies were born all over the world (Punel and Stathopoulos, 2017). The majority of crowdshipping start-ups emerged in the US (e.g., Deliv, Kaargo, UberRush), Australia (e.g., PostRope, PPost), Colombia (Rappi), Nigeria (Max), China (Renren Kuaidi), and Europe (e.g., Nimber in UK and Norway, Trunkrs in the Netherlands, PiggyBaggy in Finland) or across countries (Parcelio, Quincus).

Nevertheless, only a small fraction of them survives into the market, reaching the critical mass of users within the system (Dablanc, 2016). This aspect underlines the critical role that the willingness of acceptance plays in the development of sustainable crowdshipping services. To the best of our knowledge, there is a lack of behavioural research work in this area, that are necessary to support the birth of sustainable operational concepts. Different studies were proposed to evaluate users' behaviour around the innovations related to goods delivery. These include, but are not limited to, the study of the potentiality for collaborative delivery (Chowdhury, 2016) and the acceptance of variance in delivery timing (de Jong *et al.*, 2016; Holguín-Veras e*t al.*, 2007; Marcucci and Gatta, 2017).

The specific literature of crowdshipping is focused on three main branches, as described by Punel and Stathopoulos (2017): crowdshipping services are analysed on the operational-side, attribute-side, socio-demographic and contextual externalities side.

From the operational point of view, lots of researchers investigate the impact of using different types of crowd-resources to complete deliveries. Wang *et al*. (2016) describe a large-scale framework for assigning citizen-workers to different last-mile delivery from pick-up stations, using real data analysis. The results were very promising because they suggest that companies can reduce costs and improve customer satisfaction. Chen and Pan (2016) try to apply a crowdshipping system to a fleet of taxis in order to match taxi-routes with shipments without decreasing service quality level. Archetti *et a*l. (2016) study a new variant of the vehicle routing problem introducing both professional and occasional drivers with the aim to satisfy the demand and minimize the cost. Other discussions related to the operative aspects can be found in Kafle *et al*. (2017), while managerial implications are described by Arslan *et al*. (2016).

From another point of view, the literature gives a short contribution considering the service attributes. Indeed, no specific inspirations to the crowdshipping service can be found, but it is possible to discuss a great parallelism with the personal transportation ridesourcing. In the ridesourcing field, users manifest great importance to travel time, flexibility, convenience, and security (Agatz *et al*., 2012) in requesting a ride. Another important aspect is related to the presence of non-professional carriers that are protagonists of the crowdshipping service. Both aspects usually generate lots of concerns in final customers. In practice, lots of companies create rating systems for each delivery, in order to ensure a good level of transparency performance and maintaining a high service quality level (Hall and Krueger, 2015) with also the effect of reassuring end users (Panda *et al*., 2015).

Finally, it is important to understand the relevant socio-demographic and contextual features of the possible "critical mass" in order to evaluate correctly the adoption intention of people. Firstly, a smart mobile device and/or a web platform is necessary to manage the service. For this reason, it attracts more the younger segment of users or high level-education people (Rayle *et al*., 2016). Other analyses in the field are related to: gender attitude (Shaheen *et al*., 2016; Anderson, 2014), security (Panda *et al*., 2015), and income level (Efthymiou *et al*., 2013); or motivations like: incentives and opportunity to make new social connections (Bellotti *et al.*, 2015), environmental impacts (McKinnon *et al.*, 2015), curiosity (Paloheimo *et al.*, 2016). From a more practical point of view, also some features of the service can affect the adoption intention: length and time of the deviation - impacting significantly also on the shipper side - (Le *et al*., 2019), shipment cost (Punel and Stathopoulos, 2017), privacy concerns of consumers (Devari *et al*. 2017).

Therefore, the goals of this paper are to provide an original theoretical contribution to the poorly-grounded extant literature on behavioral intention toward crowdshipping adoption.

3. Theoretical model and hypotheses development

In this section, the demand-side perspective of crowdshipping is analyzed. As explained before, a major gap observed in the current literature is the limited discussion of consumers' behavioural perspective and the

lack of a theoretical framework to examine the determinants influencing consumers' decision to adopt crowdshipping delivery services.

This paper builds on the literature on the topic of crowdshipping by means of applying the Innovation Diffusion Theory (IDT) (Rogers, 2003; Baskerville *et al*., 2014). Innovation Diffusion Theory identifies five determinants affecting consumers' adoption intention (or behavioral intention – BI), namely, relative advantage, compatibility, complexity, trialability, and observability. The main objective is to investigate those variables affecting the attitude of users to adopt the delivery service trough non-professional carriers.

The IDT is a general theory that describes how innovations or technologies spread through societies, as such, the individual process to adopt an innovation, new service, or product. The process is featured by different consequentially stages, defined by Wijaya (2015) as knowledge, persuasion, decision, implementation and confirmation. The knowledge stage refers to the initial moment of the process, in which the user firstly keeps in contact with the innovation and starts the knowledge acquisition about it. The persuasion stage considers the phase in which the user searches information about the innovation and evaluates the credibility of the sources and the referents' attitudes. Thirdly, the decision stage leads on the acceptance or rejection in the innovation adoption. After, the implementation phase, performed only if the decision phase results positive, consists in involving the individual in the actual innovation use, with possible positive or negative experiences. Finally, the confirmation stage may result in the decision of continuing the usage of the new technology. As already introduced, IDT suggests that the specific attributes of an innovation influence consumers' adoption decision. These attributes are relative advantage, compatibility, complexity, trialability, and observability. They are analysed in details in the following:

1) **Relative advantage (RA)**: it is "*the degree to which an innovation is perceived as being better than the idea it supersedes*" (Rogers, 2003, page 213). It substantially depends on the possibility that the individual perceives advantages in adopting the innovation (Hashem and Tann, 2007). In general, advantage is measured as economic profitability, status giving, social-prestige factors, convenience and satisfaction. In our context, the user could consider the crowdshipping delivery service more advantageous than the traditional deliveries for different reasons: economic value (e.g., lower opportunity costs associated with the delivery), convenience (e.g., great facility to use crowdshipping delivery), satisfaction (e.g., better experiences in using the service comparing with traditional deliveries), fastness (e.g., possibility to receive the package in a smaller time), flexibility (e.g., major opportunity to receive package after work-time without overcharge in price). When such an advantage is realised by consumers, it positively impacts on the intention to use crowdshipping service. For this reason, the following hypothesis is proposed: "*H1. Relative advantage has a positive effect on consumers' intention to use crowdshipping services*".

2) **Compatibility (CT):** it is the degree "*to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. An idea that is more compatible is less uncertain to the potential adopter*" (Rogers, 2003, page 223). An innovation can be compatible with personal and social beliefs and values, introduced ideas, lifestyle, past experiences and needs. In the context of crowdshipping, for example, individuals that possess safe-environmental attitudes could manifest a greater tendency to accept deliveries played by people that are already in movement, in order to shorter traffic and pollution. Be greener is a good alternative aligned with their value to protect the environment. For this reason, the following hypothesis is proposed: "*H2. Compatibility has a positive effect on consumers' intention to use crowdshipping services*".

3) **Complexity (CX)**: it is the degree the individual perceives the innovation as difficult to be understood and used (Rogers, 2010). It was observed that innovations requiring particular new technologies or skills and implying extra efforts to be understood (Palmieri and Giglio, 2015a; Palmieri and Giglio, 2015b) will be adopted slower compared with less complex-ones. For crowdshipping, complexity arises when users interact with the mobile app or web platform in order to use the system for charging the delivery requests, paying and checking-out the request after receiving the package. Therefore, the

following hypothesis is proposed: "*H3. Complexity has a negative effect on consumers' intention to use crowdshipping services".*

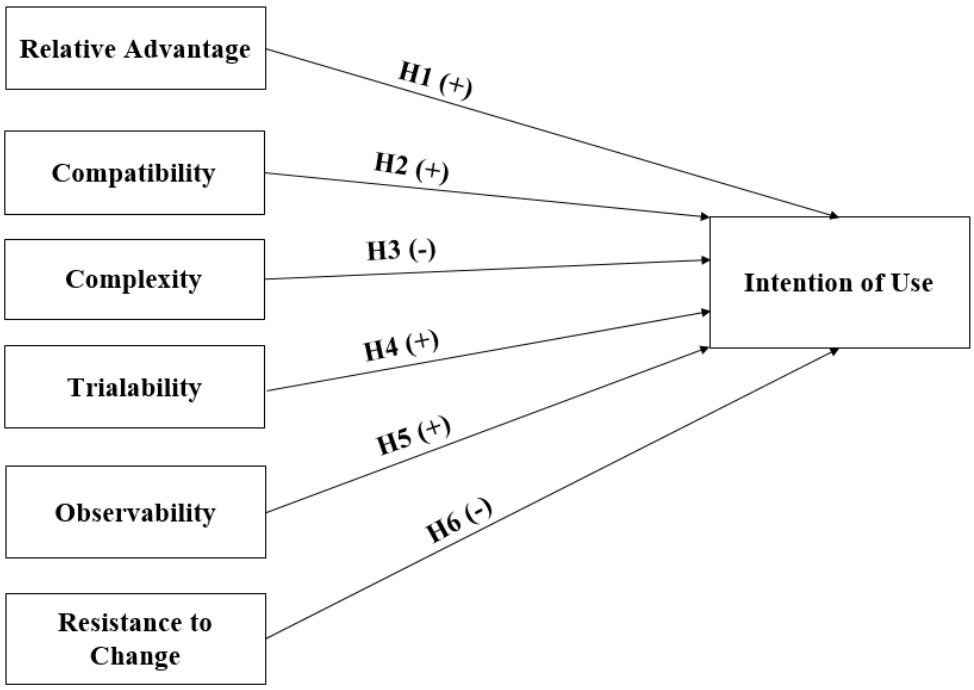
4) **Trialability (TR):** it is "*the degree to which an innovation may be experimented with on a limited basis*" (Rogers, 2003, page 231). In this case, there is low apprehension or uncertainty in adopting the innovation because the individual is able of trying it out. The user perceives a safe environment for experimenting with the novelty and satisfying his/her curiosity about it (Strömberg *et al*., 2016). It is expected that users who consider crowdshipping easy to be tested will view the usage of such service with less uncertainties. For this reason, the following hypothesis is proposed:" *H4. Trialability has a positive effect on consumers' intention to use crowdshipping services".*

5) **Observability (OB):** it refers to the visibility of the benefit of the adopted innovation (Pannell *et al.*, 2006). If the results are very visible and positive, the users are more inclined to adopt the innovation. In the crowdshipping context, if the procedures of the service are easy to be learned, observed and explained to other users, consumers have a greater intention of adoption. Therefore, the following hypothesis is proposed: "*H5. Observability has a positive effect on consumers' intention to use crowdshipping service".*

In addition to the five main attributes of the IDT, we introduce another important feature related to the users' adoption intention, namely Resistance to Change (RC). It aims to consider an important aspect that is activated when starting an innovation process that is the inertia of users. In general, it is defined as the attitude to prefer maintaining the *status quo* and contrasting the pressure of alter own habits and comfort zone (Zaltman and Wallendorf, 1983). Several theories in psychology (Watson, 1971; Sheth, 1981) explicitly suggest resistance can be considered a normal response of consumers when confronted with innovation. The cause-effect relationship is analysed in the crowdshipping case in order to understand how resistance to change weighs on adoption intention. For these reasons, the last hypothesis considered is the following: "*H6. Resistance to change has a negative effect on consumers' intention to use crowdshipping service".*

As a result of the above discussion, we propose the following model in Figure 1.

Figure 1 – The theoretical model adopted to investigate crowdshipping adoption intention



4. Research methodology

4.1 Scale development and survey design

This study is based on a survey questionnaire, whose development involved the review of the literature on customers' preferences and IDT theory. All the background and basic concepts associated with the IDT are englobed and contextualized into the survey (relative advantage, compatibility, complexity, trialability, observability, resistance to change) in order to test if the hypothesized constructs were significant determinants of users' preferences.

The survey was preceded by a description of crowdshipping in order to briefly and neutrally explain what it is and how prospective users may be involved in the implementation of this innovative service. In the following, Table 1 below shows the demographic characteristics of the respondents.

Table 1 – Demographic characteristics of respondents

Attribute	*Number (N=229)*	*Percentage (%)*
Gender		
Male	123	53.71%
Female	106	46.29%
Age		
18-*29*	119	51.96%
30-39	82	35.80%
40-50	9	3.9%
>50	19	8.29%
Education Level		
Medium School	3	1.31%
High School	66	28.82%
Bachelor/Master Degree	113	49.34%
PhD, MBA, etc…	47	20.52%
Annual Income		
<5,000 €	92	40.17%
5,000-10,000 €	93	40.61%
10,000-25,000 €	28	12.23%
25,000-50,000 €	9	3.93%
>50,000 €	7	3.05%
Components of family		
1	29	12.66%
2	40	17.46%
3	31	13.54%
4	84	36.68%
>4	45	19.65%
Children		
0	190	82.96%
1	13	5.67%
2	20	8.73%
More	6	2.6%

The survey presents a pool of items for each construct (Table 3). The respondents were asked to answer the questions with a mark related to their level of comprehension of the crowdshipping service. The rating

scale is divided in 7 points, with 1 and 7 being the two extremes (e.g., 1 as "strongly disagree" and 7 as "strongly agree"), and 4 to represent neutrality. Multi-item measurement scales are adopted for all variables in order to adequately catch on to the domain constructs (Churchill, 1979; Nunnally, 1978). Three reverse-scaled items are used in the operationalisation of "complexity" (item CX1 in Table 3) and "resistance to change" (items RC1 and RC2 in Table 3) to ensure data quality and avoid the response set. Respondents answering incoherently are excluded from the dataset (Perri and Corvello, 2015). The final section of the questionnaire is devoted to capture demographic information about the respondents': age, level of education, annual income, profession, components of the family and presence of children.

Initially a pilot survey was first conducted in order to test the viability of the study. In this phase, elicitation interviews were conducted with a quota sample representing the population in terms of demographic variables (Perri and Corvello, 2015). After this first step, different questions were improved in order to figure out more comprehensible for people. Finally, a formal on-line survey was conducted and 291 survey responses were collected. After removing incomplete or invalid questionnaires, 229 valid responses were used for data analyses, with a valid response rate of 78,69%.

The survey was submitted to a group of people resident in a university city of Southern Italy, namely, Cosenza, where the potential users represent a great variety in terms of income, cultural level, origin (many people move from the hinterland or the region to the city for study or work). The choice is justified by the fact that we are investigating a completely scalable system, considering the territorial dimension (i.e., regional) of applicability. If the crowdshipping service will be attractive for this context, it is plausible to think that transposing it in other regional contexts - where the infrastructures and services are even more advanced - would require lower start-up costs.

As expected, the analysed set of respondents is made up of around 87% of people under 40 years old, with a high level of education (more than 69%) and with an average annual income lower than € 25,000 (more than the 92% of respondents).

4.2 Data analysis

The data analysis has been split into two parts. The main part of this study is represented by a full SEM analysis conducted on the model described in Section 3. Nevertheless, it was preceded by a linear regression analysis performed on socio-demographic variables.

Consumers' intention to adopt crowdshipping was regressed on socio-demographic predictors in order to identify possible relationships between age, education level, annual income, number of family members and number of children, on the one hand, and behavioural intention, on the other hand. Each independent socio-demographic variable was measured by means of a single item, thus, not being possible to respect the minimum number of items required to include them into the SEM analysis. This analysis was realized by using IBM® SPSS® Statistics version 25.0.

Afterwards, the model detailed in Section 3 was tested by means of a full SEM analysis with EFA and CFA. The exploratory factor analysis was realized by using IBM® SPSS® Statistics version 25.0 in order to verify whether the measured variables related to the crowdshipping adoption intention had been designed and answered in the proper way. The reliability tests and the validity checks were performed in accordance with reference literature (Anderson and Gerbing, 1988; Hair *et al.*, 2006). Bartlett's test and Kaiser-Meyer-Olkin (KMO) goodness-of-fit tests were conducted. The Maximum Likelihood was used together with Promax method for the factor rotation. After EFA, the Structural Equation Modeling analysis was performed by using LISREL 8.80 to test the hypotheses in Section 3. In particular, the CFA was conducted before testing the full SEM model -whilst path analysis is mainly appropriate when more complex models including many (final) dependent variables are considered (Streiner, 2005), that is not our case. In detail, CFA is adopted in order to test whether items/variables clustered by each construct fit the theoretical model or not. The full SEM model is more complete than merely applying path analysis, since SEM provides also the opportunity to test and, possibly, draw relationships between a number of latent independent/dependent

variables simultaneously (Streiner, 2006; Klein, 1998), capturing also possible mediating or moderating variables (Hair *et al.*, 1998). All latent variables in the model are associated with three or more items (except for "trialability", which has two after scale dropping during EFA): in any case, the minimum requirement for the number of items per variable is satisfied.

5. Results

After ensuring that data were cleaned up in order to avoid missing values and incoherent answers to the reverse-scaled items, the two analyses (i. e. regression and SEM) were performed as described in the following subsections.

5.1 Linear Regression Analysis

Behavioural intention towards crowdshipping adoption is the dependent variable in the linear regression analysis, whereas socio-demographic variables - i. e. age, education level, annual income, number of family members and number of children - are the independent ones, coherently with extant literature (Yuen *et al.*, 2018). In detail, the analysis has been performed on the whole sample and, then, split by gender. The results of the linear regression analysis in these three scenarios are reported in Table 2.

Table 2 – Linear Regression Analysis

Variables	*Mean*	*Pearson correlation with BI*	*Sig.*	b_i	*Sig.*
Total sample					
Age	1.6856	-0.286*	0.000	-0.265*	0.000
Education level	2.8908	0.082	0.109	0.061	0.371
Annual income	2.4148	-0.114*	0.043	-0.040	0.576
Numebr of family members	3.2795	0.034	0.305	-0.009	0.897
Number of children	0.3100	-0.079	0.118	-0.011	0.876
Men					
Age	1.6226	-0.327*	0.000	-0.330*	0.007
Education level	2.9151	0.147	0.067	0.070	0.499
Annual income	2.3962	-0.016	0.434	0.037	0.713
Numebr of family members	3.3679	0.149	0.063	0.077	0.463
Number of children	0.1981	-0.065	0.255	0.061	0.590
Women					
Age	1.7398	-0.260*	0.002	-0.206*	0.041
Education level	2.8699	0.032	0.361	0.054	0.557
Annual income	2.4309	-0.180*	0.023	-0.166	0.141
Numebr of family members	3.2033	-0.059	0.260	-0.139	0.198
Number of children	0.4065	-0.094	0.150	-0.024	0.806

*=Significant (p-value<0.05).

The regression model shown in Table 2 is significant in all of the three scenarios analyzed that is the total sample (F=4.189, Sig.=0.001, R^2=0.086, N=229), the model restricted to men (F=2.864, Sig.=0.019, R^2=0.125, N=106), and the one restricted to women (F=2.472, Sig.=0.036, R^2=0.096, N=123).

However, most of the socio-demographic variables proved to be non-significant, thus, not affecting the adoption intention. Only "Age" was found to be significant and to impact negatively on adoption intention.

The results show that younger people are more inclined to adopt crowdshipping solutions, in accordance with reference literature about other innovative logistics services (Rayle *et al*., 2016). Unexpectedly, other variables proved to have no significant effects compared to other studies in literature: Rayle *et al.* (2016) found people with a higher education tend to be more inclined to adopt mobility systems based on sharing economy; Efthymiou *et al*., (2013) affirmed that a lower annual income plays a significant role towards the adoption of cheap sharing economy systems. More precisely, in our study, it comes out that the annual income is correlated with the adoption intention only for women, but still not significant according to the linear regression analysis. As a general remark, the differences among the men and women sub-samples are sometimes barely perceivable (i. e. BI-annual income correlation) and, however, not significant. This shows that the overall perception of crowdshipping service features is substantially overlapping for men and women.

In conclusion, the results in Table 2 suggest that most of the socio-demographic variables do not adequately explain consumers' intention towards crowdshipping adoption, thus, pushing our research into searching for other stronger predictor, not linked to socio-demographic attributes.

5.2 Reliability Analysis and Exploratory Factor Analysis (EFA)

Internal consistency of items and their corresponding reliability were verified through Cronbach's alpha (α) values, α-if-Item-Deleted (AID) and Item-to-Total Correlation (ITC) (Nunnally, 1978). Cronbach's alpha may fall between 0 and 1, with a minimum acceptance threshold of no less than 0.6 and an optimal one from 0.7 on: in our case, which is an exploratory study on crowdshipping adoption intention, concentration between variables is acceptable from 0.6 on (De Vellis, 1991). Cronbach's alphas of some variables (CT, RA, TR, RC) were improved by removing some items (CT1, RA5, RA6, TR1, RC1) from the specific constructs, coherently with AID and ITC values. The results of the reliability analysis for each construct are reported in Table 3.

EFA was conducted in order to test unidimensionality of the measurement constructs and to assess the validity of the data for factor analysis. EFA was conducted through Maximum Likelihood (ML). This way, it was possible to estimate factor loadings in order to explain the common variance separately from the error variance. Alternative methods - e.g., Principal Component Analysis and Parallel Analysis - have not been chosen, since they calculate factor loadings not making any distinction between common and error variances or they impose a fixed-factor extraction. As a further prove of the methodological validity of this choice, results obtained with ML did not lead to lose significant information, provided a reliable estimation of factor loadings, and a cleaner pattern matrix, if compared to the mentioned alternative approaches. Promax method was used for factor rotation, which makes it easier to visualize and understand the relationships between variables and extracted factors, if compared to Varimax rotation. Promax rotation clearly proved that two variables, namely CT and RA, had high overlapping of loading values. This result suggested that a merge between the underlying constructs should be considered and analysed, since the theory of the Innovation Diffusion model is in support of it (Rogers, 2003). In fact, despite Griliches (1957) believes that in the long-term the sociological dimension is not significant for the innovation diffusion, since variables of (economic) relative advantage remain the only significant ones, Rogers (2003) states that "*to argue that economic factors are the sole predictors of rate of adoption is ridiculous*" (page 215), since "*not surprisingly, rather strong evidence refuting Griliches' assertion has been brought to bear on the controversy*" (Rogers, 2003, page 215). Subsequent studies by Dixon (1980) "*led to the general conclusion that profitability* [pertaining to the relative advantage] *and compatibility are complements, not substitutes, in explaining the rate of adoption. So the original controversy seems to have died now to a close approximation of consensus*" (Rogers, 2003, page 215). In fact, Rogers (2003) considers also "*compatibility to be of relatively less importance in predicting rate of adoption than other attributes, such as relative advantage. This result may be in part an artifact of difficulties in measuring perceived compatibility. In most of the studies […], compatibility was found to be positively related to rate of adoption, even though the correlation was often not significant when the effects of other attributes were removed statistically*" (page 226). Moreover, he

states that "*one dimension of compatibility is the degree to which an innovation is perceived as meeting the needs of the client system*" (Rogers, 2003, pages 225-226). Therefore, based on Rogers's interpretation of the relationships among compatibility (CT) and relative advantage (RA), we reframe and merge the corresponding hypotheses (H1 and H2) into the H1/H2 hypothesis, which states that compatibility towards users' needs and preferences can be considered either as part of or closely related to the relative advantage construct and, then, merged with it. Therefore, we propose the merged hypothesis: "*H1/H2. Relative advantage and compatibility have a positive effect on consumers' intention to use crowdshipping services*".

Table 3 – Measurement scales: reliability analysis

Factor/Item	*Corrected Item-to-Total Correlation*	*Cronbach's Alpha-if-Item- Deleted*
Compatibility - CT (α=0.859)		
Previous experiences (CT1)[a]	-	-
Lifestyle/Daily routine (CT2)	0.700	0.835
Needs (flexibility, privacy, safety&security etc.) (CT3)	0.773	0.766
Personal preferences (CT4)	0.730	0.806
Relative advantage (RA) (α=0.846)		
Easier to receive parcels (RA1)	0.689	0.803
Faster to receive parcels (RA2)	0.783	0.759
Economically more convenient (RA3)	0.669	0.811
Higher environmental sustainability (RA4)	0.598	0.840
More reliable for high-value products (RA5) [a]	-	-
More reliable for fragile products (RA6) [a]	-	-
Complexity (CX) (α=0.736)		
Ease to use (CX1)[r]	0.646	0.554
Difficulty to understand how to use (CX2)	0.581	0.624
Information/Competences required (CX3)	0.466	0.769
Trialability (TR) (α=0.811)		
Ease to try out (TR1) [a]	-	-
Previous long-term utilization (TR2)	0.686	-
Used by friends/family (TR3)	0.686	-
Observability (OB) (α=0.945)		
Learning after observation (OB1)	0.831	0.960
Explaining to others after observation (OB2)	0.948	0.807
Telling others whether is beneficial (OB3)	0.879	0.924
Resistance to change (RC) (α=0.889)		
Trusting non-professional shippers (RC1)[a,r]	-	-
Tendency to test new products (RC2)[r]	0.799	0.833
Tendency to maintain own habits (RC3)	0.791	0.837
Tendency to use well-known products (RC4)	0.767	0.856
Behavioural Intention (BI) (α=0.853)		
Adoption possibility upon availability (BI1)	0.757	-
Urge to adopt (BI2)	0.757	-

α = Cronbach's alpha

[a] Item dropped during scale purification

[r] Reverse-scaled items in the administered questionnaire

However, in order to ensure the respect of Rogers' (2003) theoretical and empirical findings in support of merging RA and CT into a unique RACT variable, the reliability tests and validity checks (EFA) were run, again. The corresponding results are reported in Table 4 for the new reliability analysis conducted limited to the merged items and variables (RA and CT). Table 4 reports very good results for the reliability analysis of the new RACT variable, which are even improved if compared to the previous reliability analyses conducted on RA and CT constructs separately. This result clearly supports the merge of these constructs and the reframing of the corresponding hypotheses into the H1/H2 one. The validity checks through EFA assessed the measurement model showing that the items considered were valid and consistent, thus, the model was well-defined and did not need any item deletion. In fact, Bartlett's test of sphericity value is 3,320.575 (sig.=0.000, df=190) and Kaiser-Meyer-Olkin measure of sampling adequacy is 0.832. Such values demonstrate the significance of variable correlation and a high goodness-of-fit. Finally, as an overall remark, EFA proved that concentration of the measured variables is good. In fact, almost all of the loadings were higher than 0.5 and properly grouped. This result did not improve after running EFA with alternative methods and/or rotations (Horn, 1965; Keeling, 2000; Lautenschlager *et al.* 1989) and proved to be coherent with Kaiser's Rule - i. e. Eingenvalue >1 - and Scree Plot results. In conclusion, the data collected from the sample are suitable for factor analysis (Huh, 2001).

Table 4 – Measurement scales: reliability analysis after merging RA and CT into RACT variable

Factor/Item	*Corrected Item-to-Total Correlation*	*Cronbach's Alpha-if-Item- Deleted*
RACT (α=0.892)		
Lifestyle/Daily routine (CT2)	0.678	0.878
Needs (flexibility, privacy, safety&security etc.) (CT3)	0.700	0.875
Personal preferences (CT4)	0.739	0.871
Easier to receive parcels (RA1)	0.750	0.869
Faster to receive parcels (RA2)	0.747	0.870
Economically more convenient (RA3)	0.606	0.886
Higher environmental sustainability (RA4)	0.608	0.886

5.3 Confirmatory Factor Analysis (CFA)

CFA is used in order to verify whether the dataset fits well the hypothesized model or not. After conducting EFA, CFA is needed in order to model the factor structure underlying the analysed constructs and, possibly, delete/reframe non-consistent/non-valid variables (Kim, 2008). In particular, ML was utilized, again, in order to check unidimensionality, reliability and construct validity for the hypothesized model.

The fit indices of the measurement model meet the constraints on the recommended parameters (χ^2⁄degrees of freedom=3.87461; Root Mean Squared Error of Approximation (RMSEA)=0.110; p-value Test of Close Fit=0.000; Standardized Root Mean Square Residual (Std RMR)=0.0788; Normed Fit Index (NFI)=0.904; Confirmatory Fit Index (CFI)=0.927; Tucker-Lewis Index (TLI)≙Non-Normed Fit Index (NNFI)=0.910) as suggested by (Hair *et al.*, 2006). The χ^2⁄degrees of freedom is acceptable. RMSEA is barely not acceptable and its p-value does not support the goodness-of-fit of the model. However, RMSEA is not the most adequate fit index to look at in this specific context, since it is a bad performing index for relatively low-size (N) samples. As a further proof, Std RMR - which is considered one of the most sensible measures detecting non-fitting models - falls well within the acceptance threshold. Also, all remaining indices show a good fit of the model - i.e. NFI, NNFI, and CFI. In support of these results, |Std Residuals| < 3, and Qplot of Std Residuals fits the bisector very well. Finally, we can conclude that CFA confirms the good fit of our model.

For each item, completely standardized loading values and t-values are reported in Table 5, together with Cronbach's alphas for each construct. All factor loadings exceeded the minimum value of 0.40, and the |t-values| of the indicators exceed by far 1.96 - i. e. p-value is lower than 0.05 -, in support of convergent validity and unidimensionality (Anderson and Gerbing, 1988). CFA confirmed also that both discriminant and convergent validity are respected (Table 6). In fact, for all constructs, Composite Reliability (CR) and Average Variance Extracted (AVE) are higher than the 0.70 and 0.50 threshold, respectively, thus, in support of convergent validity (Bagozzi and Yi, 1988). Also, for each couple of latent variables, their corresponding AVEs are higher than the coefficient of determination - i.e. the square of their correlation coefficient -, proving the discriminant validity of the model (Fornell and Larcker, 1981). The maximum value of Variance Inflation Factor (VIF) is 1.380, thus, proving that there is no multi-collinearity between variables.

Table 5 – Measurement scales: CFA analysis

Factor/Item	*Completely Std loading value*	*t-value*
RACT (α=0.892)		
Lifestyle/Daily routine (CT2)[a]	0.718	-
Needs (flexibility, privacy, safety&security etc.) (CT3)	0.769	11.131
Personal preferences (CT4)	0.793	11.486
Easier to receive parcels (RA1)	0.806	11.669
Faster to receive parcels (RA2)	0.787	11.398
Economically more convenient (RA3)	0.643	9.302
Higher environmental sustainability (RA4)	0.637	9.227
Complexity (CX) (α=0.736)		
Ease to use (CX1)[a]	0.996	-
Difficulty to understand how to use (CX2)	0.628	8.553
Information/Competences required (CX3)	0.460	6.549
Trialability (TR) (α=0.811)		
Previous long-term utilization (TR2)[a]	0.509	-
Used by friends/family (TR3)	0.900	1.964
Observability (OB) (α=0.945)		
Learning after observation (OB1)[a]	0.862	-
Explaining to others after observation (OB2)	0.996	24.004
Telling others whether is beneficial (OB3)	0.926	21.064
Resistance to change (RC) (α=0.889)		
Tendency to test new products (RC2)[a]	0.911	-
Tendency to maintain own habits (RC3)	0.841	16.286
Tendency to use well-known products (RC4)	0.804	15.207
Behavioural Intention (BI) (α=0.853)		
Adoption possibility upon availability (BI1)[a]	*0.907*	-
Urge to adopt (BI2)	*0.834*	*15.674*

α = Cronbach's alpha;

[a] Item with corresponding lambda imposed equal to 1

Table 6 – Construct Summary Statistics: Correlations, Construct Reliability and AVE.

	RACT	CX	TR	OB	RC	BI	AVE
RACT	1						0.5462
CX	-0.376	1					0.53284
TR	0.146	-0.163	1				0.69054
OB	0.601	-0.454	0.084	1			0.86489
RC	-0.306	0.410	-0.135	-0.278	1		0.72772
BI	0.720	-0.534	0.167	0.539	-0.651	1	0.77895
Mean	4.6900	3.1106	1.5895	5.2838	3.3916	4.6725	
SD	1.3206	1.2610	1.0615	1.5871	1.5764	1.4889	
CR	0.8931	0.7561	0.7876	0.95034	0.88885	0.87572	

RACT = Relative Advantage and Compatibility; CX = Complexity; TR = Trialability; OB = Observability; RC = Resistance to Change; BI = Behavioural Intention; SD=Std Deviation; CR=Composite Reliability; AVE=Average Variance Extracted.

5.4 Structural Model, Hypotheses Testing and Full SEM Analysis

The model has been implemented with the full Structural Equation Model - i. e. structural and measurement models have been tested simultaneously. The model presents very good statistics of fit indices (χ^2 = 600.565; df = 155; p-value = 0.000; χ^2 / df = 3.87487; RMSEA = 0.110; p-value Test of Close Fit = 0.000; Std RMR = 0.0788; Normed Fit Index (NFI) = 0.904; Comparative Fit Index (CFI) = 0.927; Tucker-Lewis Index (TLI) ≙ Non-Normed Fit Index (NNFI) = 0.910) (Hair *et al*. 2006). Furthermore, the results for |Std Residual| is generally less than 3: in this case the goodness of the model is confirmed, again, because the analysis does not show the formation of blocks of residuals. Indeed, the Qplot of Std Residuals fits the bisector very well. The |t-values| of the indicators exceed by far 1.96 - i. e. p-value is lower than 0.05.

Table 7 describes in details the results of all the hypotheses tested. The estimates of standardized coefficients show that the hypothesized linkages between variables were all significant. Considering the results obtained, we can affirm that the hypotheses H1/H2, H3, H4, H5, and H6 were all supported. Indeed, a positive and significant influence of the compatibility and relative advantage (RACT), trialability (TR), and observability (OB) is registered on the adoption intention (BI), while the complexity (CX) and the resistance to change (RC) influence in a negative way the attitude of users on the behavioral intention.

Table 7 - Hypotheses Testing.

Paths	Coefficients	Hypotheses/Added Paths
RACT → BI	*0,504*	*H1/H2: supported*
CX → BI	*-0,147*	*H3: supported*
TR → BI	*0,008*	*H4: supported*
OB →BI	*0,052*	*H5: supported*
RC → BI	*-0,421*	*H6: supported*

The analysis of the hypotheses indicated that consumers' intention towards adoption of both the crowdshipping solutions for deliveries and the corresponding technology are positively associated with users' evaluation of the adoption consequences. Users perceived that the adoption could generate a relative advantage in terms of flexibility, fastness and costs. Furthermore, users are reassured from the trialability and observability of the phenomenon and from the compatibility with their own values.

Finally, all these attributes counteract complexity over the barriers for the adoption of smart technologies, on the one side, and resistance to change and attitude to evolve to new service, on the other side. All the described findings are coherent not only with the consolidated theoretical foundations of Innovation Diffusion Theory (Rogers, 2003), but they are also further validated by the full SEM analysis – which ensures a high goodness-of-fit of the model.

It is expectable to notice that relative advantage and compatibility are significant factors influencing positively customers' adoption intention. In fact, only when customers perceive that the crowdshipping service is better or as good as the traditional delivery, they are pushed to try the innovation. The same reflection can be done considering the perception that crowdshipping is compatible with their needs, values, past experiences and lifestyle. At this point, it is important to consider the advantageous areas for customers, because possessing knowledge about the basic benefits of each delivery method is not enough. It is important to deeply understand the main factors perceived as a relative advantage by consumers. For compatibility, it is crucial to clearly define the context of analysis, because this perception may differ significantly among individuals, cultures, and countries.

Although, trialability and observability maintain a positive impact on the adoption intention, it is less significant if compared to relative advantage and compatibility. It is easy to understand that the possibility to try out or test the service reduces the uncertainty related to the adoption decision, transmitting a major sense of security in changing own habits. Furthermore, it is easy for users to envisage the benefits of crowdshipping through observation. These facts explain the positive effects of trialability and observability on customers' intention.

Complexity has a negative influence on customers' adoption intention. Indeed, if customers perceive crowdshipping as difficult to understand or use, they present low propulsion to adopt the service. However, its effect is not very significant, probably because the complexity involved in crowdshipping services is limited to the use of a mobile app or a web platform with an integrated on-line payment system. These components are very diffused nowadays and they are relatively easy to be used compared to other forms of innovation.

Finally, the resistance to change presents a deep effect on the adoption intention, quite similar, but opposite to the positive effect related to compatibility and relative advantage. In general, this behaviour is very common in the process of innovation adoption, because a great part of potential users is influenced by the inertia to adapt to something new. Indeed, the adaptation implies switching costs for setting to the new service. This aspect can be related to distrust, laziness, or poor perceived advantage over the proposed

innovation, and it is typical of the "late majority" and "laggards", while it is balanced by compatibility and relative advantage in the "early majority" adopters, thus, coherently with Rogers' (2003) Innovation Diffusion Theory.

Finally, all the aspects described before can be more significant if we consider the starting context: the survey was submitted in a medium-size city, featured by the presence of a university. This aspect leaves space to consider that territories/regions with a "younger" population are more suitable for designing, implementing and experimenting this innovative logistics service. As affirmed by Rayle *et al*. (2016), both millennial generation and higher-level education people have a good approach in adopting sharing systems. Our regression analysis supports the findings in literature that younger people are more inclined to adopt crowdshipping, but rejects a significant relationship with education level. The positive approach of younger people is probably related to their perception of not so high entry-barriers or switching costs when considering technology-based innovation and social sharing, and to a major attention to the environmental issues.

Lots of university cities with the same features characterize European and Italian regions and territories, hence, the managerial conclusion of this study can be considered general and scalable to other regions, upon very limited context-dependent adaptations that is taking mainly into account the cultural differences that can affect compatibility across different countries or regions.

As such, relevant managerial and institutional implications prove to come out from the findings of this study. In fact, as regards those private firms operating in the logistics industry and interested in designing and putting at work crowdshipping services, their managers could have now a clearer picture of what and how may influence consumer's adoption intention. Moreover, as regards those national, regional or local governments and institutions interested in relieving the environment of pollution and reducing traffic costs and time, the corresponding policy-makers have now more information at their disposal in order to support and incentivize crowdshipping for the sake of the regional community, firstly, and of the global society, secondly.

6. Conclusion

This paper has contributed to both the theory and the management of crowdshipping services. From the theoretical perspective, the paper enlarges the literature that applied the IDT framework – e.g., by merging relative advantage and compatibility variables. Furthermore, we consider another important factor that influences the customer's intention of crowdshipping adoption, namely, the resistance to change. The results underline that IDT is a suitable theory for this context and provides a deep and complete picture of the decision-making process concerning the selection of last-mile logistics services. Furthermore, the introduction of the sixth attribute (resistance to change) greatly enriched the theory and enlarged the perspective of analysis related to the crowdshipping adoption intention.

From the managerial perspective, the results of this study are very interesting and present important implications for last-mile logistics service providers, that can evaluate a good reduction of their operating costs by encouraging consumers to use the crowdshipping paradigm. Understanding the determinants in adoption decision is a good starting point to build a user-friendly, advantageous, secure, appealing and attractive service, in order to build the economical sustainability by reaching the critical mass of adopters. Indeed, logistics service providers can focus on the two main determinants of the innovation adoption process that are relative advantage and compatibility. Another important point is the competitive scenario related to the last-mile services: traditional home delivery performed with professional carriers is the most diffused paradigm and it is largely considered satisfactory and reliable. So, a possible way of acting could be to improve the communication with customers, in order to underline the benefits and advantages of crowdshipping, also focusing on all the aspects related to the reduction of the environmental impact,

flexibility and possibility to save money. This way, the high significance and impact of relative advantage on adoption intention could be further leveraged on.

Another important point is related to the trialability and observability of the services. Despite these attributes do not have a high impact on the adoption intention, they can be improved in order to produce an effect that can balance, in part, the resistance to change. Usually, the possibility to try an innovation without the constriction to keep on using it or the possibility to observe other people during the utilization, underline the innovation benefits better than the theory. If the potential user is able to experiment the service and the related advantages, he/she could be captured by a greater level of curiosity or conviction that changing is necessary. Crowdshipping services can be made more interactive by adding more experimentation like trivia games, as already suggested by Yuen *et al.* (2018) for the self-collection systems.

Despite the contributions of the study, there are some limitations that could be improved in the future through further researches. First, collecting data from a larger number of respondents would make it possible to identify a better grasp of the population. Second, despite the IDT represents a consolidated theoretical foundation for this kind of study, still other factors may be missing and would need other items and latent variables to be integrated in subsequent studies. Thirdly, other theoretical model could be adopted like the Perceived Value Theory (Cheng and Tseng, 2016) or the Theory of Planned Behaviour (Yuen *et al.*, 2017) in order to make a comparison with this study and further increase the understanding of the determinants of crowdshipping adoption. Fourthly, evaluating also the supply-side of crowdshipping adoption, that is the willingness of people to act as crowdshippers, would square the circle on the overall service adoption and diffusion.

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ABSTRACT

The purpose of this study is to analyze the determinants related to the adoption intention of an innovative delivery system by the potential users. The solution proposed and described is crowdshipping, an innovative delivery service based on the sharing economy, where ordinary people can become real carriers, accepting to deliver a package during their own trip, making a small-entity deviation in exchange for an incentive. From a practical point of view, crowdshipping has positive impacts in the context in which it is applied: reduction of moving vehicles and polluting emissions in urban areas. On the other hand, behavioral investigations on the motivations that lead users to adopt this service are still unexplored, demonstrating the timeliness of this study and its contribution to the existing literature. The study consists of a model of structural equations based on the five fundamental determinants proposed by the Innovation Diffusion Theory that influence the intention of consumer adoption (relative advantage, compatibility, complexity, trialability, observability), with the addition of a further fundamental component called "resistance to change". The study is based on a survey that involves the interviewees who live in urban contexts in Southern Italy. The data collected were processed using statistical techniques and discussed.