Carpooling: travelers’ perceptions from a big data analysis

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Abstract
Purpose – The purpose of this paper is to provide a better understanding of the reasons why people use or do not use carpooling. A further aim is to collect and analyze empirical evidence concerning the advantages and disadvantages of carpooling.

Design/methodology/approach – A large-scale text analytics study has been conducted: the collection of the peoples’ opinions have been realized on Twitter by means of a dedicated web crawler, named “Twitter4J.” After their mining, the collected data have been treated through a sentiment analysis realized by means of “SentiWordNet.”

Findings – The big data analysis identified the 12 most frequently used concepts about carpooling by Twitter’s users: seven advantages (economic efficiency, environmental efficiency, comfort, traffic, socialization, reliability, curiosity) and five disadvantages (lack of effectiveness, lack of flexibility, lack of privacy, danger, lack of trust).

Research limitations/implications – Although the sample is particularly large (10 percent of the data flow published on Twitter from all over the world in about one year), the automated collection of people’s comments has prevented a more in-depth analysis of users’ thoughts and opinions.

Practical implications – The research findings may direct entrepreneurs, managers and policy makers to understand the variables to be leveraged and the actions to be taken to take advantage of the potential benefits that carpooling offers.

Originality/value – The work has utilized skills from three different areas, i.e., business management, computing science and statistics, which have been synergistically integrated for customizing, implementing and using two IT tools capable of automatically identifying, selecting, collecting, categorizing and analyzing people’s tweets about carpooling.

Keywords Sentiment analysis, Twitter, Fuzzy logic, Big data analysis, Carpooling

Paper type Research paper

1. Introduction
Nowadays, the travel sector is the driving force of many industrialized economies, capable of contributing heavily to the development of any country (Orlikowski and Scott, 2013). However, as with other sectors, travel has suffered a crisis from the beginning of the new millennium, especially in those countries not properly ready for the technological upgrading that has penetrated all kinds of markets (Lee, 1980). In recent years, in spite of the timid economic recovery, the travel sector has become a protagonist of a new impetus due to the emergence of the recognition of the need for a massive private sector reorganization. In fact, positive data have emerged with particular emphasis on sustainable travel alternatives. These are being promoted for reasons not only related to economic aspects but also because they offer opportunities for providing concrete answers to various issues that have, for years, been affecting the entire travel sector including inter alia, traffic congestion, high accident rates, harmful emissions into the atmosphere and noise pollution (Ciasullo et al., 2017; Díaz-Méndez et al., 2017; Ferreira Rebelo et al., 2014).
These issues highlight both the ineffectiveness of previous public policies in responding to the real needs of citizens (Baccarani and Bonfanti, 2015; Baccarani and Golinelli, 2011), on the shifting focus of scholars, policy makers and entrepreneurs on the importance of making the travel sector more oriented to the concept of sustainability in its broadest sense (Douglas, 2015): in this context, from a purely environmental point of view, being sustainable means reducing air and noise pollution (McKinnon et al., 2015; Golinelli, 2012); from an energy utilization viewpoint, the objective of sustainability is to direct choices toward the use of renewable sources (Franzitta et al., 2016); economic sustainability, on the other hand, favors the use of relatively low tariffs (Lippiatt, 2000); whilst from a social perspective (Partridge, 2014), the goal is to ensure the same opportunities for mobility to anyone, including people with impaired movement such as pregnant women or disabled people.

In the light of this, especially in recent years, the policies adopted at various government levels, increasingly focused on the involvement of many actors (Mele and Polese, 2011) and on the active participation not only of service providers but also of users (Polese et al., 2017; Barile and Polese, 2010a, b; Maione et al., 2017), are gradually encouraging citizens to use mass travel services such as trains, buses, trams and so on as well as shared transport services such as bike sharing, car sharing and carpooling.

This approach aims to stimulate urban-territorial recovery and development through the implementation of sustainable and intelligent travel systems based on cutting-edge ICT (apps, web platforms, etc.) (Barile et al., 2017). This will help to improve the balance between transport supply and demand and bring significant benefits in terms of both efficacy and efficiency across the entire travel sector.

Despite this growing focus on travel sustainability, there are no contributions within the extant academic literature which deal with the topic utilizing a very large sample of travelers. This paper aims to fill that gap and enhance understanding of the actual reasons, as stated by travelers themselves, for their resorting to alternative travel arrangements, with particular emphasis on carpooling. To this end, the paper is structured in five sections: first, it opens with a broad discussion of the reference literature, aimed at providing a sufficiently exhaustive conceptual representation of carpooling, its evolution and various forms spread over time throughout the world; then the big data collection and analysis methodology is described; next the results of the analysis are described and the possible implications discussed under both theoretical and practical profiles; and finally the conclusions of the paper are presented along with the limitations of the study and ideas for a future research agenda.

2. Literature review: the growth of carpooling

In recent years, there has been more and more emphasis on ensuring a high quality of life for people alongside the development and subsequent diffusion of innovative technologies. This has shifted the focus from the managerial strategies aimed at pursuing the achievement and maintenance of high levels of efficacy and efficiency to those that also promote respect for the concept of sustainability (not only environmental but also energy, technological, social and economic).

In this regard, there are numerous studies, including the travel sector, highlighting a mature awareness of the benefits arising from the adoption of sustainable practices: the prevalent literature orientation emphasizes that more and more frequently every kind of material and immaterial (economic, financial, human, cognitive, temporal and so on) resources are invested in the development of strategies based on techniques, methods and tools designed to improve overall results of citizens’ choices about urban and extra-urban mobility.

In this scenario, carpooling is one of the most valid solutions to solve many of the issues of the travel sector (Ben-Akiva and Atherton, 1977). According to Dewan and
Ahmad (2007), carpooling defined as the sharing of rides in a private vehicle involving two or more individuals, represents the easiest and most common vehicle sharing arrangement. Carpooling can be seen as an alternative and relatively new method of travel where a person provides a vehicle (which he/she usually owns) and transports one or more people to their destination in exchange for a pre-agreed amount of money (tariff, rate or fee) (Chen and Hsu, 2013).

The most rudimentary form of this phenomenon dates back to the first years following the Second World War. Although, in that period, the reasons for choosing to share means of travel were mostly associated with the aftermath of war. In the 1970s, mainly because of the oil crisis, the use of carpooling was given a new lease of life (Oliphant and Amey, 2010) before falling out of favor again until the beginning of the new millennium. However, recent technological developments and, more specifically, the affirmation of the internet and the pervasive use of mobile devices (tablets and smartphones primarily), have given new impetus to carpooling, leading to a level of uptake that in some countries exceeds 10 percent of the total journeys made by motor vehicles (Chan and Shaheen, 2012). To date, the practice of sharing a car is used in the countries of Northern Europe and in the USA, where specific associations exist and the practice is also encouraged by road signs, indeed, in some USA cities, motorway lanes have been set aside specifically for cars carrying more than one person. These lanes are less congested and lead to faster journey times. It is increasingly becoming a widespread mode of travel, especially in working or university environments, where people traveling the same route at the same time spontaneously agree to travel together and so reap the benefits from such a choice. One of the main conditions to be respected in carpooling is the existence of at least two persons: the car’s owner and the passenger. This condition is fundamental in distinguishing carpooling from other similar, but different, forms of vehicle sharing. In particular, carpooling should not be mistaken, or considered synonymous, with car sharing. They are different phenomenon. Carpooling implies the sharing of a car among private individuals, whereas car sharing is a membership-based service available to all qualified drivers in a community. All members have access to a network of vehicles owned by a company that offers such a travel service. (Car Sharing Association: http://carsharing.org/what-is-car-sharing/).

Over time, carpooling has taken on several connotations, very similar to each other but different for a number of reasons, such as the type of users, the technology used, the territorial context, the sector (public or private), the number of vehicles involved, etc. (Bento et al., 2013). To date, among the most common forms of this alternative travel system, there are dynamic, informal and flexible carpooling.

2.1 Dynamic carpooling

Dynamic carpooling has been defined by Arnould et al. (2011) as a particular form of travel sharing aimed at offering a planning solution capable of reacting in real time to any additional driver or passenger joining or leaving the “pool” of carpoolers. This implies keeping in mind all events that could affect travel, such as traffic congestion, incidents, accidents, roadworks and so forth. Dynamic carpooling probably dates back to the early 1990s, but it has been successful only since 2012. As Friginal et al. (2014) reported, recent studies carried out in China (Xin et al., 2009) have underlined an increasing interest in dynamic carpooling solutions, highlighting financial savings and traffic reduction as its main advantages. It is characterized by the possibility of organizing specific routes suddenly in exchange for the payment of a certain amount of money, thanks to the use of a mobile device with GPS and connected to a social network (Mallus et al., 2017). Dynamic carpooling, a novel social-inspired service that offers users the chance to easily share a vehicle (Friginal et al., 2014), is also known as real-time ridesharing, on-demand ridesharing, instant ridesharing and ad hoc ridesharing (Amey et al., 2011). Its diffusion is
strongest in areas where traditional transport services (buses, trains, trams, taxis and so on) are inadequate with respect to demand. What characterizes this form of carpooling more than anything else is the tendency to resort to it only in times of urgency or emergency, since for planned or cyclic needs, it is cheaper to use alternative travel systems (Créno, 2016). In this regard, Massaro et al. (2009) reported that dynamic carpooling challenges traditional carpooling restrictions by allowing a large membership base of passengers and drivers to be matched with each other automatically in real time, allowing for on-the-spot arrangement of rides. The latest dynamic carpooling systems also provide the chance for users to travel a route using more than one vehicle. However, this mode of travel, though potentially comfortable, is not achieving the hoped-for success (Grigurević et al., 2015).

2.2 Informal carpooling
Informal carpooling (also known as casual carpooling or slugging) is a form of carpooling developed in the mid-1970s in order to meet the multiple needs of both passengers and drivers (Chan and Shaheen, 2012). Indeed, the former can benefit from the opportunity to reach a given destination for free or by paying a price lower than those charged by traditional travel systems; drivers, on the other hand, because they are carrying more people on board, have access to dedicated lanes specifically set aside by some local governments (especially in the USA and Canada) to help minimize road congestion and contribute to the reduction of atmospheric pollution (Masoud and Jayakrishnan, 2017). However, it is worth pointing out that slugging was, and remains, an alternative travel service organized and entirely operated by private individuals. The main motive inducing people to offer an informal carpooling service is the ability to save time rather than earn money. This aspect, along with the fact that they are used especially during the morning, represents the characteristic that distinguishes it from other forms of carpooling (Badger, 2011). As reported by Masoud and Jayakrishnan (2017), this form of carpooling is usually pre-arranged and occurs between people who share things in common other than the time and location of their trips. In this regard, Mote and Whitestone (2011) have pointed out that the adoption of slugging has grown due to the opportunity to fulfill the requirements of lanes on an informal basis, that is, without coordinating and arranging the requisite number of passengers on a daily basis: to begin slugging is very simple, since no registration or prior arrangements are required and people typically learn about slugging through friends and co-workers (by means of word of mouth).

2.3 Flexible carpooling
Flexible carpooling is a form of carpooling started in the early 1980s (Chan and Shaheen, 2012). It is halfway between dynamic carpooling and informal carpooling. In fact, it implies the formal definition of routes that can be taken by drivers but without specifying the departure or arrival time (Beroldo, 1990). In other words, users can benefit from this alternative form of travel by going to a given meeting point where they can offer or receive passage. Hence, the main advantage of flexible carpooling is the possibility of getting a car ride in a certain direction without having to organize it in advance (Dorinson et al., 2009). According to Minett (2009), the key feature of flexible carpooling is the absence of the need for pre-arrangement on a trip-by-trip basis: people arrive at a meeting place and fill cars in order of arrival, i.e., on a first-come-first-served basis. In the informal systems, rides are offered and taken without a pre-registration process and without money changing hands. Therefore, this form of carpooling is well-suited to the circumstances in which the need for passage is manifested at the last moment. As Minett et al. (2008) have observed, flexibility provides people with three main benefits: first, they can get into another user’s vehicle or
allow another participant to get into their car; second, they can participate as both driver and passenger, and switch at will each day between riding and driving; and third, they can arrive to use the system at different times day-to-day. However, because of this greater flexibility, it may be necessary to wait a long time at the meeting point before the user can find an available vehicle or she/he may even wait in vain for its arrival (Shaheen et al., 2016; Kelly, 2007). Therefore, flexible carpooling can be considered an emergency travel system as it is impossible to rely on it with absolute certainty (Minett et al., 2008).

3. Research design
A large-scale text analytics study has been conducted with the main aim of understanding the real motives pushing people to use innovative travel systems and in particular, carpooling. The collection of users’ opinions was realized via a specific social network community named “Twitter.” Twitter was chosen due to its high popularity – in 2012, more than 100 million users posted about 340 million tweets a day[1] and the service handled an average of 1.6 billion search queries per day. In order to avoid interpretative distortions of the comments posted by Twitter users, the analysis was performed over the course of a 12-month period, from the beginning of October 2016 to the end of October 2017. The reason for such a long time span is that performing a big data analysis in a short time span could see the emergence of results biased by specific factors such as the month, the season (summer, autumn, winter and spring), the weather and so forth.

3.1 Data mining
The process of data collection has been realized by means of a web crawler named Twitter4J. It allowed data to be gathered in nearly real time as background activity. It is based on the use of API, which provided access to the public accounts on the chosen virtual community (Twitter). Specifically, the data collection has been performed by establishing and then implementing specific filters in order to identify all Twitter users’ comments including the hashtag #carpooling. The hashtag can be defined as a string of characters preceded by a hash (#) character (Tsur and Rappoport, 2012) used to synthesize in a single word a concept which is described later in 280 or less characters (see Figure 1).

Specifically, the crawler has taken into account only the tweets containing #carpooling and has allowed the identification, selection, gathering and classification of lots of words, thus obtaining a classification capable of highlighting many keywords connected to the considered phenomenon, which, once analyzed, allowed understanding of the reasons why people used or did not to use carpooling. Subsequently, a further screening of the extracted words was made to avoid some of them complicating the interpretation of the results. For instance, the crawler has automatically ignored individual letters, definite and indefinite articles (a, an, the), prepositions (from, by, with and so on) and other terms that, taken individually, would not help in any way the understanding of the findings.

3.2 Data analysis
After mining, the collected data went through a sentiment analysis using software called “SentiWordNet.” This is a lexalytics text mining tool (Ohana and Tierney, 2009; Denecke, 2008) that enables the identification of people’s perceptions on a particular topic, allowing understanding of the overall polarity of a set of words (Hung and Lin, 2013; Esuli and Sebastiani, 2007). The most frequently used words identified and extracted in the previous stage were passed to the submodule responsible for the sentiment check. Specifically, for each word, the adjectives and expressions related to it were checked against a lexicon annotated with sentiment values in order to establish their potential positive, negative or objective value (Baccianella et al., 2010a, b). The submodule has returned, for each adjective/expression,
values in the (0-1) range that represent the adjective/expression’s positivity, negativity, or neutrality, whose sum total is 1. As such, for the $i$-th word, its corresponding positivity ($Sp_i$), negativity ($Sn_i$) or neutrality ($Su_i$) values have been computed as follows:

$$Sp_i = \frac{\sum_{k=1}^{K} p_k}{K}$$

$$Sn_i = \frac{\sum_{k=1}^{K} n_k}{K}$$

$$Su_i = \frac{\sum_{k=1}^{K} u_k}{K}$$

where $K$ is the total number of adjectives/expressions found and evaluated, and $p_k$, $n_k$ and $u_k$ are the $k$th positivity, negativity and neutrality value, respectively, for the $k$th adjective/expression.
Then, in order to evaluate the collective perception related to a single word, a fuzzy inference system (FIS) (Guillaume, 2001) was used to obtain the value of the CP starting from the sentiment scores \( S_{p_i}, S_{n_i}, \) and \( S_u \) of the word computed by the SDA module with the formulas previously described. Such scores represent the inputs of the FIS and their membership functions are reported in Figure 2. The FIS obtains a value for the collective perception by “defuzzifying” the output (Kasabov and Song, 2002; Jang, 1993). The CP value helps with the estimation of the community’s perception about the analyzed word and with the understanding of the benefits and disadvantages felt by people (Chang and Chang, 2006).

4. Findings
Overall, thanks to Twitter4J, about 10 percent of the data flow published on Twitter by users from all over the world was analyzed. In order to provide an answer to the research goal, only tweets containing the hashtag #carpooling were collected. This filter enabled the consideration of about one million tweets (exactly 993,778) within which about 10,000 (9,342) different words were automatically identified. Figure 3 shows a word cloud containing the terms most frequently used by Twitter users in their posts about #carpooling, without considering stopwords: the size of the words represented in the figure is directly proportional to the number of times that they have been extracted by the web crawler.

To avoid interpretive distortions, the most widely used words were grouped into categories (concepts) based on the affinity of their meanings. This action allowed the identification of 12 main concepts, as shown in Table I.

Finally, the sentiment analysis enabled positive and negative concepts to be distinguished, as shown in Tables II and III.

5. Discussion
5.1 Carpooling advantages
Economic efficiency. The results show that, regardless of what the theory in the literature stated, the main reason why people resort to carpooling is the economic savings. In line with what Chen and Hsu (2013) and Yang and Huang (1999) have pointed out, carpooling is an alternative travel system that, besides lowering the tariff, also allows the minimization of a
series of other costs associated with the use of motor vehicles, such as fuel, oil, tires, tolls, parking and so forth. Therefore, the success of carpooling seems to be due to the advantage of ensuring an opportunity to save money not only to drivers but also to passengers. In this respect, the analysis showed 8,957 tweets containing comments related to the concept of “economic efficiency,” demonstrating people’s primary interest in carpooling was spending less than they needed to spend to use traditional travel systems (trains, buses, trams, taxis, private cars and so forth) (Shewmake, 2012).

Environmental efficiency. According to the findings, environmental efficiency is the second most cited reason for people to use carpooling as a healthy alternative travel system. The reading of the 8,835 comments posted by people on Twitter, in fact, emphasizes the great attention paid to environmental issues. This growing interest derives from feeling an increasingly need to counteract the dangerous effects of climate change that in recent years has caused serious ecological, e.g., the melting glaciers caused by global warming (Schipper and Pelling, 2006). This aspect, along with the inexorable depletion of traditional natural resources (among which, primarily, fossil fuels such as oil) and the unstoppable increase in demand for services by the world’s population, is increasingly emphasizing the need to define and adopt business models that are efficient not only from an economic point of view but also from a purely environmental point of view (Schaltegger and Wagner, 2017; Tate et al., 2013). In this perspective, users are well aware that a reduction in the number of cars on the roads will help to protect the environment and help to reduce air pollution. In this regard, Vlek and Steg (2007) underline that this enhanced awareness among consumers about the importance of respecting the environment is orienting market demand toward sustainable lifestyles. Consistently, Amel et al. (2009) and Arbuthnott (2009) highlight how, in current market contexts, increasingly characterized by consumerism, indiscriminate waste, and uncontrolled exploitation of natural resources, healthy alternative travel systems represent a winning strategy for achieving and maintaining a successful impact in the long run.

Comfort. This is the third place most cited reason that consumers use carpooling: comfort. Indeed, it emerges from the 7,971 tweets collected and analyzed from those that use an innovative travel system based on the use of the latest generation of mobile devices that

Figure 3.
The most used words in the tweets with the hashtag #carpooling

Source: Authors’ elaboration
Table I.
The most used concepts within tweets about #carpooling

<table>
<thead>
<tr>
<th>Word</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saving (3,189)</td>
<td>Economic efficiency (8,957)</td>
</tr>
<tr>
<td>Money (2,122)</td>
<td></td>
</tr>
<tr>
<td>Moneysaving (2,110)</td>
<td></td>
</tr>
<tr>
<td>Savings (188)</td>
<td></td>
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<tr>
<td>Efficiency (825)</td>
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<tr>
<td>Efficient (523)</td>
<td></td>
</tr>
<tr>
<td>Sustainability (3,128)</td>
<td>Environmental efficiency (8,835)</td>
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<tr>
<td>Air pollution (2,110)</td>
<td></td>
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<tr>
<td>Smog (1,100)</td>
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<tr>
<td>Health (1,099)</td>
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<tr>
<td>Nosmog (1,053)</td>
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<tr>
<td>Environmentalism (345)</td>
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<tr>
<td>Comfort (2,316)</td>
<td>Comfort (7,971)</td>
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<tr>
<td>Comfortable (2,080)</td>
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<tr>
<td>Coziness (1501)</td>
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<td>Cozy (1,275)</td>
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<td>Comforting (589)</td>
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<td>Cosiest (210)</td>
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<tr>
<td>Cosy (158)</td>
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<tr>
<td>Traffic (2,214)</td>
<td>Traffic (4,108)</td>
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<tr>
<td>Congestion (1,894)</td>
<td>Socialization (2,909)</td>
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<tr>
<td>Socialize (958)</td>
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<tr>
<td>Relationships (714)</td>
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<td>Socialization (658)</td>
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<tr>
<td>Friendship (579)</td>
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<tr>
<td>Effectiveness (879)</td>
<td>Effectiveness (1,614)</td>
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<td>Effective (522)</td>
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<td>Efficacy (111)</td>
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<td>Efficacious (102)</td>
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<tr>
<td>Flexibility (588)</td>
<td>Flexibility (1,119)</td>
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<td>Flexible (215)</td>
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<td>Supleness (197)</td>
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<tr>
<td>Elasticity (119)</td>
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<tr>
<td>Reliability (451)</td>
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<tr>
<td>Reliable (422)</td>
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<tr>
<td>Dependable (202)</td>
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<tr>
<td>Privacy (1,038)</td>
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<tr>
<td>Danger (521)</td>
<td>Danger (767)</td>
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<tr>
<td>Dangerous (122)</td>
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<tr>
<td>Risk (69)</td>
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<td>Risky (55)</td>
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<tr>
<td>Curious (320)</td>
<td>Curiosity (589)</td>
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<tr>
<td>Curiosity (225)</td>
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<tr>
<td>Inquisitiveness (44)</td>
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<tr>
<td>Trust (321)</td>
<td>Trust (582)</td>
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<tr>
<td>Confidence (115)</td>
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<td>Confident (102)</td>
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<tr>
<td>Trustful (44)</td>
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carpooling makes the travel experience much less stressful and easier. In this regard, numerous contributions can be found in the extant literature (Balcombe et al., 2009; Spake et al., 2003) reporting the importance of comfort in influencing consumers’ buying behavior. The influence of comfort on consumer choices seems to be even greater in the travel sector, where people prefer to be transported in comfort (Southward, 2015; Neumann et al., 1978).
Traffic. According to the big data analysis carried out, carpooling is one of the most effective travel systems for reducing urban and extra-urban traffic, since the availability of more seats (typically from two to seven) in the same car positively affects the number of vehicles in circulation and contributes to a reduction in road congestion (Matsoukis, 2006). Several studies (Ma et al., 2016; Patriksson, 2015; Sonnenberg et al., 2013; Buchanan, 2015; Bryant et al., 2004) underline the importance of traffic as a variable capable of influencing public opinion (especially those of daily commuters) on a particular travel system.

Socialization. As predicted (Baslington, 2008; Shim et al., 2005), socialization is among the most important factors for stimulating carpooling. Socialization happens because the sharing of the same means of travel allows the establishment of social relationships between unknown people, stimulating the start-up and development of processes that are linked to the framework of the sharing economy (Matos et al., 2014; Haustein et al., 2009). In this regard, as stated in the tweets, socialization seems to be fostered by the opportunity for passengers to share time with strangers randomly and, if desired, by the possibility to choose from various available alternatives, the driver who theoretically, has more features more compatible with their own personality. To this end, as pointed out by Selker and Saphir (2010), many carpooling platforms are based on special algorithms able to suggest users with whom there could be greater character compatibility in order to make the travel experience more enjoyable. In this case, socialization is stimulated by the use of special technologies, which, based on a series of personal information (such as gender, age, work, hobbies, musical tastes, religion, literary interests, sports and so on) promote the birth of relationships between people who use carpooling.

Technological reliability. Although it cannot be identified as one of the most important reasons cited by people for using carpooling, the reliability of this travel system is still an element that can contribute decisively to its popularity. In fact, in many of the 1,614 tweets collected and analyzed, it is clear that users are quite satisfied with the technology underlying the service, considering it to be sufficiently reliable, albeit, improvable. In fact, lots of positive comments reveal a high level of users’ satisfaction, which, through the technological devices owned by anyone (such as smartphones, tablets, laptops, etc.) can effectively and efficiently take advantage of the travel service. Technology reliability,

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Concepts</th>
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<tbody>
<tr>
<td>1st</td>
<td>Economic efficiency (8,957)</td>
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<td>2nd</td>
<td>Environmental efficiency (8,835)</td>
</tr>
<tr>
<td>3rd</td>
<td>Comfort (7,971)</td>
</tr>
<tr>
<td>4th</td>
<td>Traffic (4,108)</td>
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<tr>
<td>5th</td>
<td>Socialization (2,909)</td>
</tr>
<tr>
<td>6th</td>
<td>Reliability (1,075)</td>
</tr>
<tr>
<td>7th</td>
<td>Curiosity (589)</td>
</tr>
</tbody>
</table>

Table II. Ranking of the positive concepts expressed with regard to #carpooling

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Concepts</th>
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<tbody>
<tr>
<td>1st</td>
<td>Effectiveness (1,614)</td>
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<tr>
<td>2nd</td>
<td>Flexibility (1,119)</td>
</tr>
<tr>
<td>3rd</td>
<td>Privacy (1,038)</td>
</tr>
<tr>
<td>4th</td>
<td>Danger (767)</td>
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<tr>
<td>5th</td>
<td>Trust (582)</td>
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</table>

Table III. Ranking of the negative concepts expressed with regard to #carpooling
though it is only ranked sixth (after economic efficiency, environmental efficiency, comfort, traffic and socialization) can be understood as the main benefit without which the other advantages of carpooling would not exist (Fink et al., 2015; Cioppi, 2013).

Curiosity. Curiosity is ranked last of the motives triggering the success of carpooling. However, this data are not consistent with the results from other studies (Park et al., 2015; Foulds, 2014; Hill and McGinnis, 2007) where it is reported to be one of the main factors for stimulating and orientating consumer behavior and choices. However, a plausible explanation for this disagreement may be represented by the consumer’s tendency to express judgment on a specific service only after having been used it, and by then any curiosity might be already largely fulfilled and, therefore, no longer particularly considered by users.

5.2 Carpooling disadvantages

Effectiveness. Among the most negative feelings about carpooling, ineffectiveness of the travel service as a whole was the most cited: in many countries, the decision of local governments to allocate preferential lanes for vehicles adhering to carpooling, although bringing benefits to the users of this alternative travel system (Manzini and Pareschi, 2012), it also restricts the space available to other vehicles. This caused problems such as the risk of a more congestion, higher fuel consumption and the worsening of air pollution (Calvo et al., 2004).

Flexibility. Although, from its conception, carpooling has been acknowledged as a highly flexible travel system, in practice results from the big data analysis have shown high levels of dissatisfaction due to people being unable to make the service fit their needs and expectations. Indeed, regardless of the technology implemented to facilitate the operation characterizing the service as a whole, carpooling involves the necessary users’ availability to be flexible, since it encourages them to come to an agreement with an unknown person to establish timing, route and fare (Li et al., 2007). This limit is less evident in “flexible carpooling,” so called precisely because it does not require the prior specification of the starting or arrival time, but only of the routes run by each vehicle (Dorinson et al., 2009).

Privacy. Like many other multiuser services, carpooling also implies the need for users to sign up to the web platform, enabling their identification, the electronic traceability of their information and leave feedback after using the alternative travel experience. However, this inevitable action, while allowing minimal information about the actors involved in the delivery and enjoyment of the service, on the other, entails privacy concerns (Kladeftiras and Antoniou, 2015). In fact, as in any form of resource sharing, the private sphere of people mixes with that one of other users, who, for example, can easily find themselves in the position of listening to a phone call received or made by another passenger or by the driver (Aïvodji et al., 2015; Friginal et al., 2014).

Danger. Danger, closely related to privacy, is another highly discussed issue about carpooling. In fact, 767 tweets have made comments that show the existence of concerns by individuals about their own safety in the enjoyment of service shared with strangers. However, such data needs to be analyzed more deeply, because at least until now, crimes linked to the carpooling phenomenon are rare and, in any case, no more numerous than those occurring with the traditional travel services (taxis, buses, trains and so on) (Minett et al., 2008).

Trust. Trust is among the top five reasons why people say they do not resort to carpooling. As noted in the 582 comments posted by Twitter users, though all those who intend to use the platform have to preventively sign up and the transactions made through the platform are automatically traced, this is in any case a service shared with and between unknown people, whom carpooling users voluntarily choose to spend a varying amount of time with depending on the route.
6. Theoretical implications

This paper might be considered useful to academics, since it attempts to foster a greater awareness about the benefits and disadvantages arising from the use of one of the most widespread alternative travel systems, carpooling.

From a purely theoretical viewpoint, the work offers some insights into the importance of big data analysis for understanding what people really think about a given phenomenon. Specifically, the paper tries to overcome the limiting feature of many contributions dedicated to carpooling, that of a rather small sample of subjects. Indeed, big data analysis allows for a more complete view of the phenomenon under study (Sagiroglu and Sinanc, 2013) highlighting not only its advantages but also its disadvantages: analyzing a large amount of data means additional information can be extracted not normally obtainable from a small sample, thus ensuring greater reliability and better generalization of the results.

Another interesting and useful theoretical insight for scholars is the application of fuzzy logic to sentiment analysis. This approach to understanding peoples’ opinions, though not much used in management studies, actually offers many benefits, since it allows for a more weighted and valid view of the topic being studied. In fact, the FIS, by means of “If-Then” language rules, allows better understanding not only whether a concept expressed by a person is positive, neutral, or negative, but also the degree of positivity or negativity. In order to answer the research question, skills from three different areas, business management, computing science and statistics, have been synergistically integrated for customizing, implementing and using two IT tools (“Twitter4J” and “SetiWordNet”) capable of identifying, selecting, collecting, categorizing and analyzing automatically people’s tweets about carpooling. This way of working could suggest to scholars, not only interested in management but also in any other scientific discipline, the importance of conducting research by following a multidisciplinary approach to the study of a phenomenon, especially whether it is relatively recent or completely new (Loia et al., 2017).

7. Practical implications

From a practical standpoint, this paper offers insights that might prove useful to the various actors involved in business dynamics. In particular, the paper might encourage entrepreneurs, managers and policy makers to reflect on actions to be taken to take advantage of all the potential benefits that carpooling offers. In this regard, the work highlights the 12 mostly considered variables, ranking them in order of occurrences, allowing those who have invested or intend to invest in carpooling to know which aspects to pay most attention. For example, based on the feedback provided by Twitter’s users, it is useful to point out that the first variable to be considered in managing an alternative travel service is almost certainly economic efficiency: it is not possible to think of investing in this innovative and complex system without taking into account the considerable sensitivity of potential and current users to the opportunity for saving money.

However, although saving money is the main reason for inducing people to use carpooling (Bento et al., 2013), there are several other aspects that are important, such as environmental efficiency, comfort, traffic, socialization, reliability of the travel system and curiosity. This is an interesting result, especially given the current period of deep global financial crisis, in which, very often, the only variable impacting consumers’ buying decisions is financial and whether or not they will save money. This trend is confirmed in the context of urban travel, where frequently the choices between different travel alternatives appear to be influenced mainly by the amount of money it will save consumers if they change (De Grange et al., 2013).

However, the deep commitment of practitioners is necessary to promote the spread of carpooling: there are still many perplexities and doubts about the effectiveness and flexibility of this travel system. In addition, in order to induce people to rely on carpooling
services, it seems necessary to be able to minimize the issues related to privacy protection and the perception of the danger of traveling with strangers. In other words, it is necessary to overcome the initial mistrust of carpooling before users (both drivers and passengers) can develop full confidence in it.

In fact, as highlighted by (Minett et al., 2008; Minett, 2009), the question of safety is important and of great interest to people when they first hear about carpooling. Mote and Whitestone (2011) have also pointed out that getting up the courage to use carpooling for the first time is often mentioned by carpoolers as the most difficult part of the travel system, but once that is accomplished, they gradually acquire greater information about the best way to use it.

To this end, the intervention of public institutions could be useful (Polese et al., 2016; Brennan and Douglas, 2002, 1998), if they adopted policies aimed at giving concrete support to the spread of carpooling (e.g. through promotional and advertising campaigns, road feasibility studies, test projects, etc.). Such policies may help to persuade people to increase their trust in this alternative travel system (Dewan and Ahmad, 2007).

Finally, as discussed above, it is worth pointing out that worries about the risks linked to the use of carpooling are not properly and completely justifiable, since, at least until now, crimes linked to the carpooling phenomenon are rare and indeed no more frequent than crimes occurring on traditional travel services (taxis, buses, trains and so on). Indeed, no reports of rapes or assaults associated with casual carpooling exist (Minett et al., 2008).

8. Concluding remarks
The results of the work provide empirical evidence about the existence of at least seven good reasons why people resort to carpooling and five motives pushing them to do not use it. However, beyond what has emerged from the survey, it is worth pointing out that the analysis has a limit that could make the findings questionable. In fact, although the sample was particularly large (10 percent of the data flow published on Twitter from all over the world in about one year), the automated collection of people’s comments has prevented from going deeper in the analysis of users’ complete thought. Such a weakness could induce to perform a further analysis about the same topic to compare the results emerged from this study with the findings that could arise by using a qualitative approach (such as in-depth interviews).

Note

References


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**Further reading**


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