The growth of carpooling:
Insights from a social media investigation

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Abstract

Purpose. The work aims to highlight and analyse empirical data about the motives leading people to resort to innovative travel systems and, more in detail, carpooling, in order to foster a major awareness about the reasons of its success, such as money saving, comfort, curiosity, environmental sustainability, etc.

Methodology. The study is based on a big data analysis, performed by implementing an IT tool (Twitter Crawler) to collect in real time people's tweets about carpooling, by considering the hashtags used by them in a specified time span (four months).

Findings. The analysis shows that the main reason for which people declare to use carpooling is money saving, although there are also other important motives, such as curiosity, desire to make friends, chance to use innovative technologies, opportunity to travel with a high level of comfort, etc.

Practical implications. The work offers insights for both scholars and practitioners, suggesting deepening, on one hand, the motives leading people to resort increasingly to alternative travel systems, and, on the other, the importance to become aware about the opportunity of using smart technologies also in travel context to efficacy and timely respond to changing market needs.

Originality/value. In order to respond to the research question, skills of different areas, business management and information technology, have been synergistically combined for developing and implementing an IT tool able to identify, select, collect and categorize automatically people's tweets about carpooling.

Keywords

Smart Technology; Smart travel systems; Big data; Big data analysis; Twitter Crawler; Carpooling

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183

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1. Introduction

In the current economic context, characterized by an increasing unpredictability of global markets (Schönsleben et al., 2010), transports represent one of the sectors most affected by sudden changes (Colvile et al., 2001). Among the main factors guiding and influencing the transport sector, it is worth considering the growing attention to environmental sustainability (Richardson, 2005), the availability of increasingly performing technologies (Ciasullo et al., 2013), the change of citizens' preferences and habits (Xenias and Whitmarsh, 2013), etc. This scenario leads all levels of government in making significant efforts in trying to anticipate the needs to promote a continuous improvement of the effectiveness and efficiency of the transport sector (Yannis and Georgia, 2008). To this end, it is necessary to predispose appropriate strategic documents, containing guidelines for the adoption of competitive transport policies, adoptable by means of a careful analysis of both current criticalities of mobility system and the opportunities that could arise through the implementation of the required actions. However, to perform analysis effectively able to highlight the strengths and weaknesses of transport system, it is necessary, at least, to start from a big data analysis, which offers the advantage of favouring the intake of decisions based on what emerges from studies realized by taking into account a large amount of information (Kitchin, 2014).

In this perspective, the work, through a big data analysis, aims to highlight and analyse empirical information about the motives leading people to resort to innovative travel systems and, more in detail, carpooling, in order to foster a major awareness about the reasons of its success, such as money saving, comfort, curiosity, environmental sustainability, etc. In order to respond to the research question, the paper is structured in four sections: first, it begins with a theoretical overview about the importance of big data analysis (Mcafee e Brynjolfsson, 2012; Chaudhuri et al 2011; Turbante et al., 2008; Watson and Wixom, 2007), smart technologies in transport context (Forrester, 1969; Droege, 1997; Graham e Marvin, 2001), and the spread of carpooling as one of the most valid alternative to traditional transport systems (White, 2000); subsequently, it goes on with an explanation of the methodology used, consisting in a big data analysis performed by means of Twitter Crawler; later, the results are shown and discussed; finally, the conclusion and the theoretical and practical implications are described, the insights for future research are presented and the limits of the research are highlighted.

2. Theoretical Background

2.1 The opportunity to analyze big data

Among the factors playing a significant role in improving organizational and production processes, a major role is played by big data analysis, the interpretation of which enables both public and private managers to measure effectively value of any activity performed within organization.

Thanks to big data analysis, in fact, it is possible to transform the gathered information into knowledge able to make both decision-making and business performances more effective. The advantages resulting from big data analysis regard three different reading keys, as suggested by McAfee and Brynjolfsson (2012): the possibility to use easily a large amount of data; the opportunity to analyse data in real time; the chance to dispose of a significant variety of information. Therefore, by leveraging on the use of big data analysis, organizations could be capable of improving their business performances, increasing the probabilities to understand the real effects of the corporate policies adopted.

In turn, the possibility to achieve these advantages contributes to increase the interest in techniques, technologies, systems and practices facilitating the understanding of the strengths and weaknesses of the dynamics underlying the activities carried out (Sallam et al. 2011), favoring an overall improvement of decision-making (Chaudhuri et al 2011; Turban et al 2008; Wixom and Watson 2007).

Doan et al. (2011) and O'Reilly (2005), furthermore, state that, thanks to the spread of the Internet, big data analysis, besides fulfilling data collection and storage, allows understanding customers' needs and increasing opportunities for new business.

The advantages coming from the use of big data analysis has progressively attracted the interest of academic and industrial world (Fan et al., 2014), paving the way to many research activities aimed at describing the evolution of consumers' expectations, preferences, behavioral intentions, etc. To this aim, considerable investments have been made in order to foster more performing and timely big data analysis (Cohen, et al., 2009). In particular, high attention has been paid to the development and subsequent implementation of smart technologies (Kitchin, 2014), able not only to collect data, but also to interpret them, providing a valuable contribution in tracking new trends and, therefore, in maximizing organizations' chances of strategic advantage (Simmhan et al., 2013).

2.2 Smart Technologies and transport systems

The widespread need to provide citizens with a better standard of living, has led scholars and managers to seek methodologies and practices capable of orienting the focus towards a stronger both environmental and social sustainability. Numerous studies (Archigram, 1994; Forrester, 1969; Castells, 1989; Droege, 1997; Gabrys, 2003; Graham and Marvin, 2001), in fact, have shown that in several big cities many programs have been proposed to ensure an effective preparation of urban development plans (Ciasullo et al., 2016). In order to arrive at an as appropriate as necessary process synchronization, in addition to an increase of resource efficiency, the attention has been paid, in particular, on the use of smart technologies. The issues have also called for a major consideration of the problems concerning transport, fostering the use of technologies capable of orienting and addressing effectively local government management.

In this regard, although some studies (Debnath et al., 2014; Haque et al., 2013; Thompson and Bonsall, 1997; Waterson et al, 2001) have highlighted that there is no certainty about the economic and travel advantages that could arise from the implementation of smart technologies, the prevailing orientation in literature (Mwasilu et al., 2014; Townsend, 2013; Eman-Hall, 2003; Hodel and Cong, 2003; Merriman, 1998; Ferguson, 2000), stresses the necessity to allocate more and more material and immaterial resources for the development of high-tech devices, able to improve greatly city liveability and citizens' transport conditions. Consistently, Hodel and Cong (2003) point out that the inclusion of smart technology in programs for urban mobility improves the efficiency of alternative transport systems (Paroutis et al., 2014), which, in recent times, are taking on an increasing importance, such as car sharing, carpooling, bike sharing, boat sharing, etc.

Such systems, in fact, in line with the advances achieved in transport activities management, thanks to the implementation of more and more performing Information and Communication Technologies (ICT), can lead to greater economic and environmental sustainability, ensuring a strong reduction of costs and time (Meijer and Bolívar, 2016; Streimikiene et al., 2013; Caragliu et al., 2011; Shapiro, 2006)

2.3 Carpooling

In the light of the aforementioned considerations, carpooling seems to represent one of the most valid solution to reduce several problems related to transportation (White, 2000), being considerable as a useful alternative to move (Wartick, 1980; Willson and Shoup, 1990).

In fact, it is a system of private car sharing among a group of people, with the main goal to reduce the costs of moving (Bento et al., 2013; Matsoukis, 2006). This alternative transport system is, together with car sharing, ride sharing, and bike sharing, one of the main levers of transport policies aimed at promoting a sustainable mobility (Dewan and Ahmad, 2007). Thanks to widespread use of smart technologies, in fact, carpooling reduces the number of cars in circulation with beneficial effects on the cost of transport, atmospheric pollution and congestion (Ferreira et al., 2009). Specifically, carpooling is based on an virtual platform (developed on a website or app) that allows users to provide or require the willingness to travel by a car directed in a certain place, encouraging the exploitation of resources (free places in car) that otherwise would be wasted (Dakroub et al., 2013). In addition, smart technologies also allows leaving feedbacks on the lived experience, reducing, doing so, the concern to travel with unknown people (Chen and Hsu, 2013).

Over the years, several scholars have tried to identify the socio-demographic determinants of carpooling, in order to understand the real reasons for which people tend to resort to it. In this regard, for example, in some studies (Kurth and Hood, 1977; Teal, 1987; Brownstone and Golob, 1992), it emerges that the main variable effectively capable of conditioning people's willingness to use carpooling systems is income condition. According to Selker and Saphir (2010), instead, in considering the chance to resort to carpooling, people take into account some conditions linked to their workplace, such as unavailability of parking. This factor, in fact, seems to play a crucial role in inducing people to look for alternative transport systems (Ben-Akiva and Atherton, 1977), since it highly increases people's desire to move comfortably (Kostyniuk, 1982; Brownstone and Golob, 1992). Accordingly, besides several alternatives of available transport systems and some workplace conditions, Hunt and McMillan (1997) point out other two factors possibly influencing the choice of resorting to carpooling: users' family conditions and users' personal conditions.

In any case, regardless of the number of variables potentially able to affect people's willingness to use carpooling, this high focus placed on the topic suggests the importance arising from a right interpretation about its advantages according to its users, especially in terms of better understanding and management of transport systems.

3. Methodology

The study has been conducted by means of a big data analysis, developed in three consecutive stages. Firstly, taking into account the research goals, among different available alternatives, the authors have identified the IT tool considered most appropriate to the automated collection of the opinions expressed by the members of a preselected online community (Twitter); the choice to automate the data collection phase has not been accidental but dictated by the belief that it appears to be the most efficient way to get the highest possible number of feedbacks in a limited time span. Subsequently, the selected tool has been implemented within the chosen online community for four continuous months. Finally, the authors have appropriately analysed the summary sheet provided by the IT tool, interpreting results in an effort to define a kind of ranking of the reasons for which people resort to carpooling.

Specifically, the proposed framework is based on a Twitter Crawler, which allows collecting Twitter data in nearly real time as background activity. It is realized by means of

Twitter's API, which has provided access to Twitter public accounts' information. After crawling, tweets have been analysed in order to extract features and enrich their content, by exploiting external resources disambiguating (i.e., Wikipedia). In particular, the authors have implemented a tweet's content wikification, that is the practice of representing a sentence with a set of Wikipedia concepts (i.e., entries) (Mihalcea and Csomai, 2007). Sentence wikification has been already exploited for text summarization (Hu et al., 2009; De Maio et al., 2016, 2017) and has revealed to be not compromised by the short nature of the sentence. Tweet's content wikification has allowed determining the meaning of the tweet, performing Wikipedia concepts indexing and identifying Wikipedia categories that group together the extracted topics. Collected information has been saved on a full text-indexing engine Apache Lucene in an enterprise search engine Apache Solr. Such an information has been provided through a friendly user interface, which has supported multi-facets visualization and faceted search. The latter is a technique of semantic search, which simplifies the user experience by presenting information categorized according to different perspectives. It enables users to narrow down search results by applying multiple filters, called facets tailored on specific application domain (e.g., e-commerce, biomedicine). The number of items indexed with different facets' values allows carrying out a kind of semantic analytic service.

With regard to the research goals, in order to verify which reasons push people to use carpooling, the authors have performed an analysis during a period ranging from the beginning of September to the end of December 2016. Specifically, in four months, about 10% of information flow published from all over the world on Twitter has been automatically analyzed. To make the analysis replicable and ensure a potential international audience to the paper, the English language filter has been used. Finally, it is worth highlighting that, rather than using all text words, the authors have chosen to consider only hashtags, consisting in a string of characters preceded by an hash (#) character (Tsur and Rappoport, 2012). Typically, hashtags represent the synthesis in a single word of the concept which is described later in 140 or less characters.

4. Results

The analysis shows that respondents, though representative of a very heterogeneous sample in terms of education, age, profession and socio-economic situation, declare that they often resort to carpooling.

In fact, considering only the hashtags most commonly associated with the term carpooling, the work has allowed identifying, selecting, collecting and classifying about 673912 tweets, obtaining a classification capable of highlight the various reasons pushing people to use carpooling.

More specifically, the used research technique has allowed classifying, on the basis of their semantic meaning, all the terms identified in the analysis. In fact, the IT tool used has been able to immediately recognize terms with similar meaning, combining them into a single category. In order to gain an effective data re-elaboration, the supervision role played by the authors has been anyway necessary in order to avoid that possible biases regarding the automation of the data collection process could, in some way, affect the result emerging from the analysis.

Following this screening and after some marginal change made by the authors, seven keyword categories have been identified, by considering the words expressed by Twitter's users along with the hashtag #carpooling, as showed in descending order in Table 1:

Table 1. The most used hashtags along with #carpooling

RANKING	WORDS CATEGORY	HASHTAG	NUMBER OF TWEETS
1st	MONEY (1915 hashtags)	#MONEY SAVING	887
		#MONEY	544
		#SAVINGS	391
		#SAVING	93
2nd	SUSTAINABILITY (1519 hashtags)	#SUSTAINABILITY	497
		#AIR POLLUTION	354
		#SMOG	299
		#HEALTH	173
		#NOSMOG	172
		#ENVIRONMENTALISM	17
		#ENVIRONMENTALLY FRIENDLY	7
3rd	TRAFFIC (1286 hashtags)	#TRAFFIC	767
		#TRAFFIC CONGESTION	486
		#CONGESTION	33
4th	SHARING (683 hashtags)	#SHARING	397
		#SOCIALIZATION	188
		#RESOURCE SHARING	76
		#FRIENDSHIP	22
5th	TECHNOLOGY (511 hashtags)	#TECHNOLOGY	245
		#SMART CITY	142
		#SMART TECHNOLOGIES	124
6th	COMFORT (147 hashtags)	#COMFORT	125
		#COZINESS	22
7th	CURIOSITY (57 hashtags)	#CURIOSITY	45
		#INQUISITIVENESS	12

Source: Authors' elaboration

5. Discussion

Table 1 shows that, in line with the arguments proposed by Chen and Hsu (2013) and Yang and Huang (1999), one of the main drivers driving people to use carpooling is to chance to save money. Consistently, in fact, in many tweets people write that the only reason that drives them to resort to carpooling is linkable to possibility to move around by spending much less money than those they should would spend by using traditional modes of transportation. In this regard, it is not a coincidence that one of the most associated hashtags with #carpooling is the term #moneysaving, capable of highlighting the importance of the economic aspect for all carpooling's users (Shewmake, 2012). These considerations are in line with those ones of other studies (Becker, 2013; Hansen et al., 2013; Yang et al., 2013), which in different contexts emphasize the role played by price in influencing consumer behaviour.

Besides price, a further variable that can influence the choices of carpoolers is #sustainability, which shows how people are particularly sensitive to environmental issues. In

this regard, McKenzie-Mohr (2013) and Vlek and Steg (2007) state that an high awareness of the need to ensure respect for environment and public health is increasingly orienting the market demand towards sustainable lifestyles. In fact, Osbaldiston and Schott (2011) highlight the radical change of many consumers, who, in addition to being oriented towards individual well-being, seem to be also interested in pursuing collective goals (Arbuthnott, 2009; McKenzie -Mohr, 2000) concerning mainly public and environmental health (Amel et al., 2009; Glasgow et al., 2004).

A significant role for twitter's users seems to be played also by #traffic. Several scholars (Ma et al., 2016; Patriksson, 2015; Sonnenberg et al., 2013; Buchanan, 2015; Bryant et al., 2004) emphasize this topic as particularly felt by public opinion and, in particular, by the daily commuters. In this regard, carpooling represents a possible solution to reduce urban traffic (Bento et al., 2013; Dakroub et al., 2013), allowing more people directed in the same direction to limit the use of more cars (Matsoukis, 2006).

In line with the considerations of Matos et al. (2014) and Selker and Saphir (2010), the opportunity of #sharing time with other people also drives many people to use an alternative transport system, such as carpooling, capable not only of reducing the number of cars on the road or fostering money saving, but also of offering the opportunity to experience time with others (Selker and Saphir, 2010).

An important part for carpoolers is also done by #technology, which is recipient of great importance attached by consumers in many service contexts, not just with regard to the transport sector (Bazzan and (Troia et al., 2016), but also to energy (Tang and Tan, 2013), education (Loia et al., 2016) work (Troisi et al., 2016).

After the variables so far described, #comfort represents another important reason for which people state to resort to carpooling. Consistently, in literature several scholars (Hes, 2007, Holcombe, 1986) recognize importance to comfort as a variable often taken into account by travellers. However, the finding emerging from the analysis seem to attach greater importance to other variables (specifically: money; sustainability; traffic; time sharing; and technology), probably because carpoolers are representative of a youth population, not particularly interested in comfort.

Finally, #curiosity is positioned at the last position. This result is inconsistent with the considerations of many scholars (Park et al., 2015; Foulds, 2014; Hill and McGinnis, 2007; Bennett, 2002; Güneri, 2014;), which consider it as a very decisive variable in the process of forming consumers' intentions. However, a plausible explanation of this discordance may be represented by the consumer's tendency to express judgment on a specific service only after having been used it, that is later having used the service, stage during which curiosity might be a feeling already largely fulfilled and, therefore, no longer particularly considered by users.

6. Conclusion and implications

As previously indicated, starting from the acknowledgment of the high importance attached to big data analysis and smart technologies, the work attempts to foster the acquisition of a full awareness about the real advantages arising from innovative travel systems. Precisely, the paper aims to highlight and analyse empirical data about the motives leading people to resort to carpooling.

In order to respond to the research question, skills of different areas, business management and information technology, have been synergistically combined for developing and implementing an IT tool able to identify, select, and categorize automatically people's tweets about carpooling. Specifically, the study has been conducted by means of Twitter Crawler, which has allowed automatically collecting data about carpooling by considering the hashtags

posted by users on Twitter during a period ranging from the beginning of September to the end of December 2016.

The analysis has shown seven main reasons pushing people to use #carpooling: #money (1915 hashtags), #sustainability (1519 hashtags), #traffic (1286 hashtags), #sharing (683 hashtags), #technology (511 hashtags), #comfort (147 hashtags), and #curiosity (57 hashtags). Hence, in accordance with the emerged findings, it seems that, although money keeps on representing the main motive leading people to resort to carpooling (Bento et al., 2013), they are attentive also to others aspects of this innovative travel systems (Dakroub, et al., 2013; Le et al., 2001).

This is an appreciable result, especially considering the current period of deep global crisis, in which, very often, the only variable taken into consideration by consumers seems to be money saving. This trend is also confirmed in the context of urban transport, where it frequently occurs that, in the choices of different travel alternatives, consumers appear to be influenced mainly by the cost to support to move (De Grange et al., 2013).

In this respect, the work tries to get involved in studies aimed at deepening the logic underlying the concept of sharing economy, in an attempt to highlight the benefits for both companies and users of several services. Sharing economy propose itself as a new economic model, considerable as an approach capable of challenging the traditional relationship between economy and society, by focusing on the timely interception of the real consumers' needs and aimed at promoting more conscious forms of consumption, based on reuse rather than on purchase and on access rather than on property. Troisi et al. (2016) consider sharing economy as based on a complex business model engaging a multiplicity of actors not properly considerable as inert service users or providers, but, rather, as actors capable of actively participating in the whole production process.

In particular, in sharing economy, professionals, consumers and ordinary citizens make available their skills, time, assets and knowledge to create virtuous ties based on the use of technology in a relational way: use, reuse, exchange and sharing of tangible and intangible resources are the goals that market demand and supply are increasingly pursuing in the hope of achieving a defensible competitive advantage over time and guaranteeing collective satisfaction beyond the purely personal interest.

In doing so, it is possible to promote a lifestyle that facilitates money saving or redistribution, fostering socialization, encouraging environmental protection and stimulating technological progress. These goals are achievable with regard not only to transport (for example, car sharing, jet sharing, sail sharing, camper sharing, etc.) but to many other services (such as house sharing, food sharing, social shopping, co-working, crowdfunding, etc.).

Consistently to what above stated with regard to sharing economy, on the basis of the findings arising from the big data analysis, carpooling also seems to respond to multiple travel needs, taking shape as one of the most valid alternative to traditional way of travelling, in an era increasingly voted to a widespread use of technology. In such a perspective, the paper could be understood as a useful tool for both scholars (researchers, students, etc.) and practitioners (entrepreneurs, managers, travel agencies, etc.), since it seeks to help to become aware, on one hand, about the motives leading people to resort increasingly to alternative travel systems, and, on the other, about the opportunity of using smart technologies also in travel context to efficacy and timely respond to changing market needs.

However, the research presents two main limits: first, the analysis has been conducted by gathering feedbacks in a limited time span (only four months); moreover, in order to use a particularly large sample, the authors have used an automated collection of Twitter people's opinions, but this has prevented from going deeper in the analysis of consumers' thinking. Therefore, it could be interesting, in future researches, to compare the results emerged from

this study with the findings that could arise by using a qualitative approach (such as in depth interview) in data collection.

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