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ORIGINAL ARTICLE

Incentivizing sustainable mobility through an impact innovation methodology

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ABSTRACT

The transport sector plays a crucial role in the social and economic development of our society. Nevertheless, it is responsible for one quarter of the global CO_2 emission worldwide. Although sustainable mobility could drastically reduce transport-related emissions, its adoption is still underdeveloped. In this paper, an impact innovation methodology has been used to generate a solution that could boost sustainable mobility development by creating an efficient offline tracking method that combines transactions and GPS data. The results suggest that incentive-based solutions could increase the adoption of sustainable mobility. This study generates the basis for the development of a sophisticated algorithms, able to track mobility and to incentivize people's sustainable habits.

Keywords: Sustainable mobility; impact innovation; reward system; payments; tracking.

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INTRODUCTION

The transport sector plays a crucial role in modern society. Main human activities, both social and economic, rely on the capacity of movement. Indeed, transport has been described as "the blood of our society" (Givoni & Banister 2010). The transport of people and goods has seen an enormous increase in the past century, clearly underlying the important economic and social benefit of transport (Rietveld & Bruinsma 1998). Mobility allows people to create and maintain social networks, to access services, such as healthcare, shopping, travel, and to have employment opportunities (Banister & Anderton & Bonilla & Givoni & Schwanen 2011). Nevertheless, transport is one of the biggest CO_2 emitter sectors worldwide, indeed one quarter of the global CO_2 emissions in 2016, around 8Gt of CO_2, has been generated by the transport sector (International Energy Agency 2018). Moreover, roadways-based transportation accounted for 72% of EU transport emission in 2016 (European Environment Agency 2018). It thus appears evident that to achieve the Paris climate goals, transport-related emissions must be drastically reduced (Transport & Environment 2016). Fortunately, sustainable mobility, such as electric vehicles, sharing platforms, public transport, walking and biking, offers a concrete opportunity to reduce the environmental impact of urban transportation systems (Heineke & Kloss & Scurtu 2019). An incentive-based solution in the mobility sector is a particular business model centred on a tracking and a reward system that involve four stakeholders: citizens, municipalities, merchants, and mobility service providers. Basically, mobility habits of citizens are monitored, through ICT technologies and the use of sustainable mobility is incentivized through a reward system generated by merchants and mobility services providers (Herrador & Carvalho & Feito 2015).

Incentive-based solutions (Herrador & Carvalho & Feito 2015) but also gamification methods (Kazhamiakin & Pistore & Marconi & Valetto 2015) have been tested to boost the development of sustainable mobility, enhance environmental awareness and reduce CO_2 emission, while stimulating urban economy.

Nevertheless, the development of an incentive-based solution needs reliable tracking systems to identify exactly the mode of transportation used and the path length travelled. A common approach is the use of GPS tracking systems, but they have some limitations such as difficulties in understanding the means of transport used.

Recently, the Payment Services Directive 2 (PSD2) (EU Directive 2015/2366) has opened new opportunities in the fintech sector for data sharing and open banking (Brodsky & Oakes 2017). Through open banking and Application Programming Interfaces (APIs), third-party services have the possibility to access payment-related data. Then, using classification algorithms, the transactions related to mobility can be further analysed and matched with GPS data. This operation could significantly improve the reliability of understanding the means of transportation used.

The aim of this study is to investigate if an incentive-based solution that uses payment data can be utilised to change mobility habits of citizens. Therefore, the feasibility of a novel incentive-based platform, that provides reliable information about user's mobility-related habits has been investigated.

THEORETICAL BACKGROUND

Systemic design and critical thinking are two innovative methodologies that could help politicians and policy makers solve problems related to the environmental consequences of the mobility sector. Systemic design is a problem-solving approach performed through the application of the scientific method (Systemic Design Toolkit Guide 2019). According to this methodology, it is important to start with a scientific observation of the problem in order to have a clear and focused direction and check for diversions. The result of this preliminary research should be the production of a clear and simple problem statement (Brown & Wyatt 2010). Once a clear understanding of the problem is acquired, the creation of relevant hypothesis leads to the design and conduction of experiments to test and learn more of the problem and its context. The experimentation follows a cyclical advancement, in which at each step the results are analysed, the assumptions are improved, and the problem knowledge is increased, in an iterative process (Camacho & Rui 2019).

Systemic design can be effectively applied to analyse and investigate the mobility sector. For a period, public administrations, politicians, and citizens have been debating to find a way that could implement sustainable urban mobility. Nowadays, there are multiple methods to understand the way people move inside the urban ecosystem. The infrastructure of transport in metropolitan areas and cities shape the way people behave and move. Moreover, almost every transport requires a user interaction with the transportation mode. The interactions can be recorded every time and can represent, together with the GPS sensor, a way to track origins and destinations of citizen movements. Those data have been used by researchers and public administrations to improve and implement new services for a more sustainable urban mobility (Zhang 2017).

Data infrastructure and sustainable urban policies have supported the rising of urban sharing models, such as bike and car sharing. Understanding how people behave in terms of mobility is crucial in order to develop policies able to help the transaction to a low-emissions mobility.

In literature there are examples of incentives provided by Governments to facilitate the adoption of more advanced and more environmentally-friendly vehicles and to change citizen behaviours. Public non-profit business models have been created in order to include all the stakeholders of urban economy and create a sustainable model by providing discounts or other kinds of rewards (Herrador & Carvalho & Feito 2015). Other models have been generated using blockchain technology in order to transfer the incentive directly to customers that are using a bike (Jaffe & Mata & Kamvar 2017). In addition, other solutions have been developed to support sustainable mobility. For instance, "Ciclogreen" (Ciclogreen website) provides incentives to users in order to promote their habits related to sustainable mobility (e.g., walking, cycling, using of public transportation or car sharing). However, target customers are just only employees of companies that decide to invest in the program. Another existing solution in the market is "Wecity", an app that rewards individual sustainable mobility habits (Wecity website). According to customers reviews, the ineffective tracking system and unattractive rewards are the crucial point of weakness of this solution. "Pin Bike" is another app-based solution that rewards bikers according to how many kilometres they have covered. Hence, this solution does not reward people that use sustainable transport but only bikers (Pin Bike website).

As mentioned before, some of the information that regards mobility can be extrapolated through the analysis of payment transactions. Categorization methods, based on machine learning approaches (Alpaydin, 2020), allow to associate specific payments to the related sector, such as transport, utility, etc. For instance, Saltedge provides a unified banking API hub, taking advantage of the PSD2. In addition, Saltedge offers a data enrichment platform with transaction categorization and merchant identification APIs (Saltedge website). Finally, Aland Index Solutions is a CO_2 emission calculation tool for payments based on a categorization matching (Aland Index Solutions website).

METHOD AND DATA

The impact innovation methodology used in this paper, has started from a challenge provided, active in the sector of energy supply. The challenge to be coped was related on how to make fintech platforms enablers of circular economy and sustainability. In order to address this challenge, a strict methodology has been followed.

The methodology that has been used, basically consists of four different steps: problem statement definition, brainstorming sessions to collect ideas, application of critical thinking to select and filter most effective ideas, definition and iterative validation of the solution identified. For what concerns the problem statement, the problem formulation has been stated as follows: "*people are unable to have a positive environmental impact because they are averse to put effort in changing their habits*". After an extensive research, mobility has been considered as the most impactful sector to be investigated. An ideation process

has been started through which an effective and novel solution has been generated.

The identified solution has been submitted to a severe validation process, structured as follow: analysis of the critical functions, creation of a stakeholder map and interview of main actors and experts. The effectiveness of an incentive-based solution has been further investigated through a survey, launched on 11 May 2020 with a duration of about 30 days.

The survey has been structured with some general questions, regarding profiling information (age, origin, gender, etc..), questions about environmental awareness of the impact of people habits (especially in the mobility sector) and desire of people to change their most impactful customs. Then, after the definition of the most utilised mean of transport, the survey has been divided in three categories, automobile and motorcycle drivers; pedestrians and bike riders; public transport and sharing platforms utilisers. Questions about mobility habits and the desire to change means of transportation with an economic incentive have been done to all the three categories. Finally, the level of gradience of a tracking app and the most appreciated kinds of incentives have been investigated.

The survey has been mainly conducted in Italy and has reached 686 answers, covering a representative mixed socio-demographic population. The sample has covered 47.1% male and 51.9% female. The majority of respondents (57.6%) has been between 18 and 30 years old, about a quarter (23.0%) has been between 30 and 40 years old and a smaller part (19.4%) has been over 40 years old. The 60.9% of the interviewed have declared to live in a city with more than 500,000 citizens, of which the 60% from Turin and the 31% from Milan. The 75.7% of answers have come from the north of Italy, the 13.9% from central Italy, the 6.2% from the south of Italy, and the remaining 4.2% of answers have come from countries abroad Italy. Specific insights on issues related to privacy were not obtained with this survey, but 212 respondents, on a total of 686, had no concerns to leave their personal email for receiving information related to the development of the solution proposed.

RESULTS

An effective solution to the identified problem statement has been generated through the innovation method described above. In particular, in order to boost the sustainable mobility development and to empower people to have an affordable way to change their mobility-related habits, an incentive-based solution is proposed.

The solution proposed herein is to create a robust tool that allows the offline tracking of individual mobility, matching the data deriving from GPS tracking and the data obtained through the analysis of financial transactions related to mobility. GPS tracking data are available thanks to the several API service providers, for example, by Google Maps Platform. Payments tracking and categorization is facilitated by PSD2 and API services. Combining these two tracking approaches it is possible, for example, to understand if the user is using a sharing service or public transport. Then, it is possible to calculate the path length. Having the information about the mean of transportation and the path length, CO_2 emissions can be precisely estimated. In addition, avoided CO_2 emissions by using sustainable means of transport, in respect to a reference (traditional car), can be calculated. Therefore, this solution could be effectively used to create a solid reward system that incentivize people to move toward sustainable mobility.

In order to validate the solution proposed, firstly, an analysis of the current state of the mobility sector, mainly in Italy, has been performed. From the data generated with the survey that has been carried out, the definition of the following statement has been possible: (i) 98.7% of people interviewed believe that they can actively contribute to reduce the environmental impact of society, (ii) 96% of people interviewed are willing to change their habits in order to reduce the environmental impact of our society and (iii) 65% of the interviewed state that they are willing to change their transport-related habits. From this data, it appears evident that most people want to act personally, in order to reduce the environmental impact of society.

However, the 43.5% of the respondents agree that a collective action is needed to have an effective impact in carbon emissions reduction. The data from the survey shows that the actual trend on the mobility sector, mainly in Italy, is the following: 38.6% of people use automobile and motorcycle, 27.6% of people use public transport and the 15.6% and 16% of people use biking and walking, respectively. Finally, only the 2.2% of people actually use sharing platforms, in Italy (Fig. 1). From the analysis of this data, it is possible to state that 61.4% of interviewed already use sustainable means of transportation (public transport, biking, walking and sharing platform) while there is a consistent portion of the population (38.6%) that is still using unsustainable vehicles, such as traditional automobile and motorcycle. Considering that the 34.3% of automobile and motorcycle drivers have declared to do less than 10 kilometres per day, there is a big portion of people that could move from car and motorcycle toward sustainable means of transportation. Consequently, taking into consideration that 208 grams of CO_2 are emitted on average by a traditional car per kilometres (travelandmobility. tech 2019), a relevant CO_2 reduction could be achieved if drivers, that travel less than 10 kilometres per day, move toward sustainable mobility. In addition, sharing platforms have revealed to be the least used mean of transportation, underlying the urgent need of its empowerment.

Moreover, from the survey, it has been possible to understand that 48.4% of the respondents believe that

they are completely aware of the environmental impact of the mobility sector. Nevertheless, only the 30.5% can precisely determine the real impact of mobility, in terms of CO_2 emission, while the 46.2% and the 23.3% underestimate and overestimate their impact, respectively. Thus, it appears evident that a solution, that not only incentivize sustainable mobility, but also provide reliable information on the environmental impact of our transportations, is needed to increase the awareness of citizens.

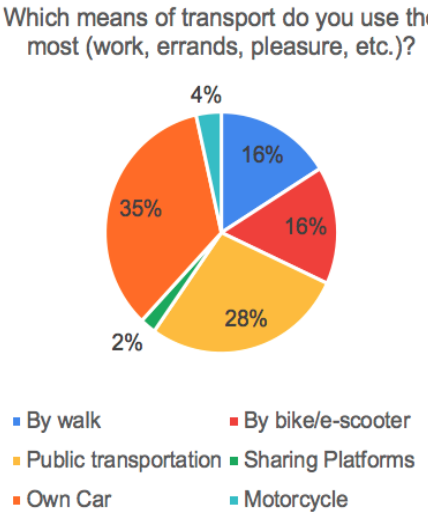

Fig. 1. Actual trend of mobility distribution in Italy, data generated from the survey (686 answers).

For what concerns car and motorcycle drivers, the 73.2% are willing to change their means of transportation, if incentivized, to reduce their environmental impact and of these, the 48.4% would leave cars for moving by bikes. This data confirms that most of traditional drivers, if rewarded, would abandon their cars and motorcycles, and use sustainable mobility. Surprisingly, if this data is scaled up to the Italian population (60.36 million) and assuming the following hypothesis, based on survey results: (i) the 38.6% of Italians are drivers, (ii) the 73.2% of these leave their cars, (iii) the average distance travelled each day is 10 kilometres and (iv) a traditional car emits about 208 grams of CO_2 per kilometres (travelandmobility.tech 2019); about 35 thousand tons of CO_2 could be avoided every day by sustainable mobility, only in Italy.

Moreover, the 71.4% of people moving by bike or by foot would like to be rewarded for their sustainable ways of travel and interestingly, the 42.6% of these would completely avoid car usage, if properly rewarded. This is a clear evidence that an incentive-based solution could further boost the utilisation of sustainable means of transportation also in those people that already use mostly sustainable mobility.

Additionally, the 81.4% of people using public transport and sharing platform (bike and e-scooter), would like to receive an economic recognition for their sustainable mobility habits. Moreover, the 58.8% of public transport and sharing platform utilisers would move by bike, if incentivized, clearly demonstrating the possibility to decongest the public transport system by incentivizing bike utilisation.

Overall, the most relevant result obtained by the survey is that 75.1% of the interviewed are willing to move toward sustainable mobility, thanks to an incentive (Fig. 2); in particular 73.2% of automobile drivers would leave the automobile to move toward more sustainable mobility, if rewarded. Additionally, the 59% of the interviewed declare that they would like the utilisation of an app that offline tracks their good behaviours on mobility, demonstrating that the solution proposed could have a good level of appreciation. Finally, the kind of reward that could be more-likely appreciated, has been investigated. Surprisingly, the most appreciated reward has been discounts in electricity and gas bills, followed by discounts in sustainable products stores, discounts in bike stores and rewards in cash.

Therefore, from the survey performed in this study it is clear that most of people interviewed would move towards more sustainable means of transportation if properly rewarded. Interestingly, from the survey it is also evident that most of people interviewed will not have concerns to have their transport-related habits monitored.

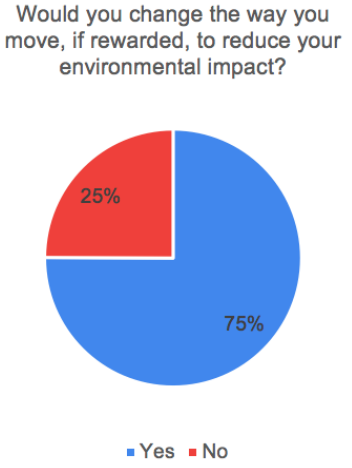

Fig. 2. People that would change their mobility habits, if rewarded. Generated from the survey (686 answers).

DISCUSSION AND CONCLUSIONS

The mobility sector is of crucial importance for the social and economic development of our society. Nevertheless, many empirical data underlines that the transport sector is one of the biggest responsible of CO_2 emissions worldwide. In order to manage this environmental and social problem, the development of

sustainable mobility could bring effective advantages, but its diffusion is still weak and slow.

Incentive-based solutions, that rewards individual sustainable mobility, could boost the development and the diffusion of more eco-friendly means of transportation. In addition, the combined use of payment and GPS data could allow the development of an effective method for the tracking of individual sustainable mobility.

To validate this solution, a survey has been performed. The results of the survey let us speculate that people need an economic incentive to move toward sustainable mobility. The analysed data underlines the crescent wish in reducing the environmental impact of society, but nonetheless the need of increasing citizens' awareness on the impact of the mobility sector. Furthermore, the performed survey has confirmed that a significant portion of the population could potentially change their mobility-related habits. The results suggest that incentive-based tracking systems could be an impactful solution to boost the development of the urban sustainable mobility. Finally, some of the more appreciated incentives have been identified.

Nevertheless, the results are limited to a relatively small fraction of the Italian population and would need further validation with a bigger portion of the worldwide population. Moreover, the economic feasibility and the business model of the solution proposed in this paper, would need further validation and accurate research.

In order to further develop the solution proposed in this paper, an intensive mathematical study is needed to generate an efficient algorithm for data collection and analysis. Moreover, the research performed in this study, could represent the starting point for the development of a digital application, able to track and reward citizens' sustainable habits related to mobility.

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