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# Casual Carpooling as a Strategy to Implement Mobility-as-a-Service schemes in a Developing Country

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**Abstract:** Mobility as a Service (MaaS) goal is to offer tailored-made on-demand mobility solutions by integrating on a single service, public and private transport modes. However, the concept is still uncertain, and its current development and applicability is centered on developed countries. On the other hand, we advocate that MaaS is modular, adaptable and applicable to several realities. In developing countries where public transport is mostly inefficient and insufficient, MaaS schemes could help to “balance the scale” with private transportation offerings, such as: rides (casual carpooling). Thereby, our general objective was to identify the motivating factors of the practice of casual carpooling and propose a strategy to implement it in a MaaS scheme. The survey was applied to 307 university students in the city Lavras – Brazil. Data were analyzed using descriptive statistical techniques and Web Scraping. We assumed that the casual carpooling is sustained by solidarity; simplicity and agility; no costs to passengers; and pick-up points. As strategy to implement it, 4 pillars were identified: unified drop-off points; modal customization; remuneration for credit; and no costs for passengers. We concluded that casual carpooling may be a supplement mode on MaaS schemes in last-miles commutes or in places with inefficient public transport.

**Keywords:** Mobility as a Service; Casual carpooling; Consumer behavior.

## Highlights

- MaaS is modular, adaptative and applicable to any context;
- The act of sharing a car may be used as a transport modal in a MaaS scheme;
- MaaS can be implemented in places without an efficient public transport;
- Casual carpooling may be a solution to implement MaaS in developing countries;

## Introduction

Mobility-as-a-Service (MaaS) has the aim to offer tailored-made on-demand mobility solutions by integrating on a single service via a single user interface, public and private transport modes (Hensher, 2017). However, the concept is still surrounded by uncertainties and its current development and deployments are mainly centered in developed countries (Jittrapirom et al., 2017; Karmagianni et al., 2016). In addition, as Public Transport (PT) entails the backbone of MaaS schemes (Pangbourne et al., 2018; Sochor et al., 2017; Karlsson et al., 2016), it is understood that in order to efficiently implement MaaS services, capable offerings of PT are pivotal.

On the other hand, we advocate that MaaS is modular, adaptable and applicable to several realities. Corroborating with this, Hietanen (2019) states that MaaS is a viable

answer in most places because the modal split can be adaptable. For this, in places where PT is inefficient and mostly insufficient (e.g. developing countries), MaaS could help to “balance the scales” with private transportation offerings, for instance, by increasing private car efficiency with casual carpooling.

Casual carpooling is an informal, ad-hoc, user-run type of ridesharing that provides a high-occupancy rate on private vehicles (Shaheen, Chan & Gaynor, 2016; Chan and Shaheen, 2012). In this type of “free commute”, the passenger occupies an idle seat that would not be used by the driver on his/her daily routine from point A to B anyway (Frenken & Schor, 2017; Beroldo, 1999). In this sense, by occupying the idle capacity of a vehicle, casual carpooling is aligned with the concepts advocated by the sharing economy (Benkler, 2004; Shaheen, Chan & Gaynor, 2016).

The sharing economy provides positive environmental effects (Acquier, Daudigeos & Pinkse, 2017; Botsman & Rogers, 2011). Thus, having casual carpooling as a transport mode inserted in a MaaS scheme could help in the construction of a service in favor of eco-innovation, in a sense that such access-based business models are pivotal to foster innovation on developing countries and frontier markets (Wiprächtiger et al., 2019). Gandia et al. (2019) state that MaaS should only be characterized as an eco-innovation if private car users either replace the usage of their vehicles for other transport modes or make more efficient use of their vehicles, that is, by reducing the idle capacity.

However, several factors can influence on casual carpooling, due to its consonant aspects to the sharing economy, such as trust and reputation (Ert, Fleischer & Magen, 2016; Wu, Ma & Xie, 2017), governance in collaborative consumption (Hartl, Hofmann & Kirchler, 2016), and generational cohorts influence (Godelnik, 2017; Lasmar et al., 2018).

Given the aforementioned, the present paper sought to focus on such issues in the context a small city (Lavras) in a developing country (Brazil), since this city holds several universities and therefore many students, who – on their daily commute – routinely practice casual carpooling (whether as passengers or as drivers).

Our research problem can be summarized in the following guiding questions: Which are the motivating factors of casual carpooling? And, how can casual carpooling be implemented in a MaaS scheme? Thereby, **our general objective was to identify the motivating factors of the practice of casual carpooling and propose a strategy to implement it in a MaaS Scheme.**

This paper addresses three main contributions. First, by understanding MaaS as adaptive and modular, its business model could be conceived without having public transport as a backbone. In this sense, solutions aimed on reducing car-occupancy inefficiency while additionally complementing PT would be a feasible MaaS alternative in developing countries that struggle with public transport offerings. Given that, from the relations between casual carpooling and MaaS, our second contribution sought to analyze the possibility of this modal to be inserted in a MaaS scheme, which, to the extent of our literature review, such approach has not yet been taken into account, neither in the academia nor in real-world deployments. At last, our final contribution seeks to add to the state-of-the-art in a sense that there is a lack in studies on casual carpooling, when it comes to behavioral trends and user motivations (Shaheen, Chan & Gaynor, 2016).

## **Literature review**

### **Mobility-as-a-Service (MaaS) an overview**

The first comprehensive definition of MaaS emerged in 2014 in Finland, where Hietanen (2014) described MaaS as a mobility solution offered by a single interface of a service provider that combines different transport modes to offer tailored mobility packages.

It is noteworthy, that given its promising prospects, there is still a high degree of ambiguity surrounding the concept with multiple sources vying to offer definitions of MaaS (Jittrapirom et al., 2017). According to Callegati et al. (2016), the main idea of MaaS is to offer a unique and seamless interface to its users, aggregating heterogeneous transport options offered by different mobility providers handling the whole experience of traveling, from providing information, to travel planning, and payments.

Also, Matyas and Kamargianni (2017) point out that MaaS is a user-centric, intelligent mobility distribution model in which all mobility service providers' offerings are aggregated by a sole mobility provider (the MaaS provider) and supplied to users through a single digital platform. According to Mulley (2017, p. 248-249), there are three main concepts of MaaS;

- 1) **Transport on-demand:** to meet a customer's needs, a MaaS service provider arranges the most suitable transport means, be it public transport, taxi or car rental, or even ride-, car- or bike-sharing;

- 2) **Subscription service:** users have no need to buy travel tickets or sign up for separate transport accounts since a MaaS account provides the freedom to choose the mobility you need, for an agreed period or pay-as-you-go subscription and;
- 3) **Potential to create new markets:** for transport providers, MaaS can offer new sales channels, access to untapped customer demand, simplified user account, and payment management, as well as richer data on travel demand patterns and dynamics.

Thus, by this multiple definitions, Jittrapirom et al. (2017, p.14) affirms that MaaS can be thought as “a concept (a new idea for conceiving mobility), a phenomenon (occurring with the emergence of new behaviors and technologies) or as a new transport solution (which merges the different available transport modes and mobility services)”. In an effort to reduce that uncertainty, the authors also carried out a critical literature review to identify, among others, the core characteristics of MaaS (Table 1).

**Table 1:** Description of MaaS’ core characteristics

<b>Core Characteristic</b>	<b>Description</b>
1. Integration of transport modes	Brings together multi-modal transportation allowing the users to choose and facilitating them in their intermodal trips. Transport modes that may be included: public transport, taxi, car-sharing, ride-sharing, bike-sharing, car-rental, on-demand bus services.
2. Tariff option	Offers users two types of tariffs in accessing its mobility services: 1) mobility package (bundles of various transport modes and includes a certain amount of km/minutes/points that can be utilized in exchange for a monthly payment); 2) “pay-as-you-go” (charges users according to the effective use of the service).
3. One platform	Relies on a digital platform (mobile app or web page) through which the end-users can access to all the necessary services for their trips: trip planning, booking, ticketing, payment, and real-time information.
4. Multiple actors	An Ecosystem is built on interactions between different groups of actors via a digital platform: demanders of mobility (private customer or business customer), a supplier of transport services (public or private) and platform owners (e.g. third party, PT provider, authority). Other actors (e.g. local authorities, payment clearing, telecommunication and data management companies) can also cooperate to enable the functioning of the service and improve its efficiency:
5. Use of technologies	Combines different technologies: devices, such as computers and smartphones; reliable mobile internet network (WiFi, 3G, 4G, LTE); GPS; e-ticketing and e-payment system; database management system and integrated infrastructure of technologies (i.e. IoT).
6. Demand orientation	Seeks to offer a transport solution that is best from the customer’s perspective to be made via multimodal trip planning feature and inclusion of demand-responsive services.
7. Registration	End-user is required to join the platform to access available services. The

requirement	subscription not only facilitates the use of the services but also enables the service personalization.
8. Personalization	Ensures end-users' requirements and expectations are met more effectively and efficiently by considering the uniqueness of each customer. The system provides specific recommendations and tailor-made solutions on the basis of users' profiles, expressed preferences, and past behaviors (e.g. travel history). Additionally, they may connect their social network profiles with their MaaS account.
9. Customization	Enables end-users to modify the offered service option according to their preferences. This can increase MaaS' attractiveness among travelers and its customers' satisfaction and loyalty.

Source: Adapted from Jittrapirom et al., (2017).

Besides these multiple definitions, it is possible to observe that the main idea behind MaaS is to combine multiples products and services (integrating transportation modes) in a unique platform customized for passengers to fulfill their needs.

Utriainen & Pöllänen (2018) states that the transport modes analyzed in most MaaS studies are restricted to cars (privately owned vehicles, car-sharing, car rental, and taxis), public transport, and cycling. However, we understand that the possibilities for MaaS are wider and other kinds of transport modes could be used in a MaaS scheme, such as casual carpooling.

### **Casual carpooling and sharing**

Casual carpooling, also known as “slugging”, consists in the act of informal carpools for purposes of commuting and can be understood as a variation of hitchhiking for urban areas (Shaheen, Chan & Gaynor, 2016; Maltzman & Beroldo, 1987; Chan & Shaheen, 2012).

The concept was born in communities north and east of San Francisco (USA) and spread to other states in America (Shaheen, Chan & Gaynor, 2016). The essential idea is to provide a free ride for a passenger in order to complete idles seats in the car. By doing this, the driver gets access to benefits provided for high-occupancy vehicles (HOV) such as access to dedicated lanes and discount in tolls.

According to Chan & Shaheen (2012), for casual carpooling to be successful - in the context of USA – it should present the following features: (1) time savings incentive for drivers; (2) monetary savings for passengers; (3) pick-up locations near freeways, residences, parking, or public transit stops; (4) a common drop-off location; (5) convenient public transit for the evening commute; and (6) an high occupancy vehicle

requirement of three or more persons to ease personal safety concerns (Beroldo, 1990; Reno et al., 1989 apud Chan & Shaheen, 2012).

Casual carpooling can also occur by solidarity, that is, without time and costs benefits, just for the act of sharing. In fact, Belk (2014) states that it is necessary to move from the old wisdom mindset of “you are what you own” towards “you are what you can access”.

Over the past years, several different business models have emerged with similar characteristics related to the act of sharing (Acquier, Daudigeos & Pinkse, 2017; Cohen & Kietzmann, 2014; Botsman & Rogers, 2011). Despite the fact that sharing economy or collaborative consumption is a recent phenomenon – boosted by the widespread popularization of the internet (Casprini, Di Minin & Paraboschi, 2019), the act of “sharing is as old as humankind and has been essential for our survival” (Belk, 2017 p. 249).

According to Belk (2007, p. 126), “sharing is the act and process of distributing what is ours to others for their use as well as the act and process of receiving something from others for our use.” Historically, the concept of sharing was restricted to people from the same social circle, making it a tendency not to share with strangers (Frenken & Schor, 2017). However, the emergence of peer-to-peer digital platforms has facilitated the exchange of underutilized assets by strangers (Böcker & Meelen 2017) in such a way that such platforms facilitate building trust (Frenken & Schor, 2017; Ballús-Armet et al., 2014; Botsman and Rogers, 2011).

However, Belk (2010) states that are imprecise lines between sharing and two other acquisition and distribution mechanisms: 1) gift exchange and, 2) commodity exchange. According to the author, gift exchange aims at a desire for connection, often imposed by the need for reciprocity, while the economic exchange is characterized by calculability. Nevertheless, sharing tends to be a communal act that links us to other people. Sharing is linked to ideas about ownership and self, which are learned during childhood in the sense that sharing options refer to individual choices subject to individual and cultural differences (Belk, 2010).

Still, according to Belk (2010), sharing may have interesting social and theoretical implications when analyzed outside of the immediate family circle. Thereby the author brings the definitions of “sharing in” and “sharing out”. The former expands the sphere of the extended-self and the domain of common property. It is closer to the archetype of sharing within the family, because it involves ownership as common so

that others are included in the extended self. The latter, however, deals with dividing a resource between different interests. It preserves the self / other boundary and does not involve expanding the aggregate sphere of the extended self by expanding the domain of common property. It involves giving others outside the boundaries that separate self and the other and is closer to the gift and commodity exchange (Belk, 2010).

In this way, sharing a car with family, friends or acquaintances would be closer to the concept of “sharing in”, while large P2P sharing services may be more related to “sharing out” (Belk, 2010). However, in between these two, other means of sharing (such as casual carpooling) could be inserted.

### Methodological approach

This study is characterized as quantitative of exploratory and descriptive nature. The survey was applied to 307 university students in the city of Lavras - Brazil enrolled from the second academic semester of 2018. The research design is depicted in Figure 1.

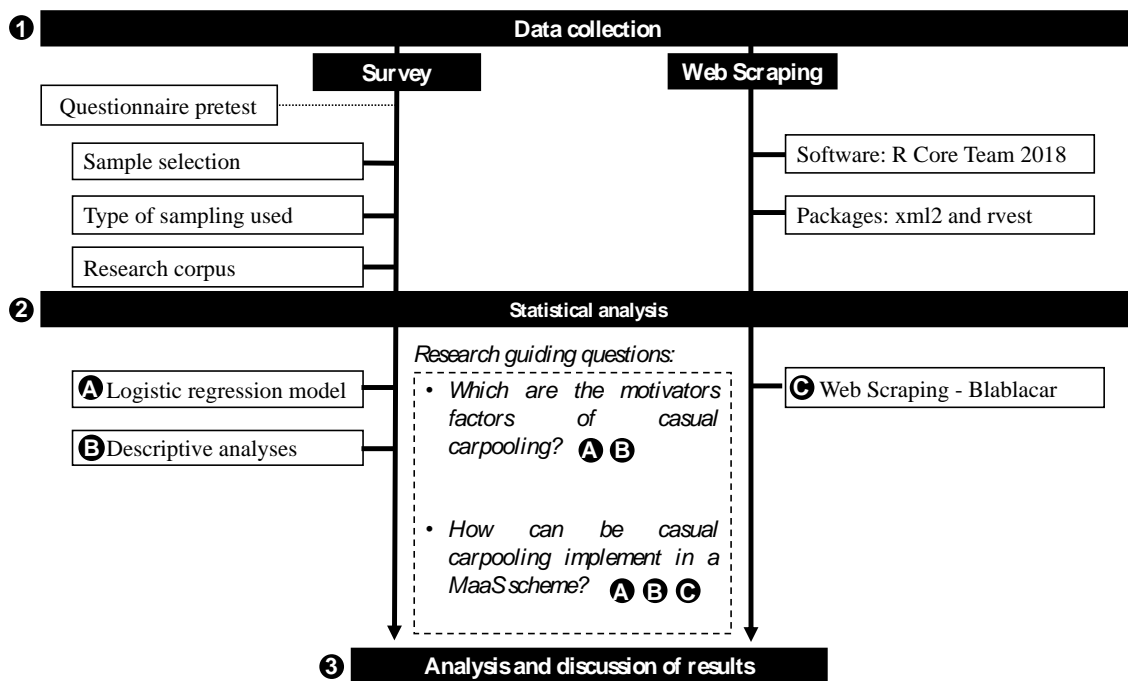


Fig. 1. Research design

Step 1 referred to data collection. Data collection was carried out in two distinctive ways. The first one was done by a cross-sectional study (survey) with 307 students of the four Higher Education Institutions (HEI) of the city. The selection of participants was done by non-probabilistic sampling (Aaker, Kumar & Day, 2001; Hair,



2005; Malhotra, 2001). The second stage on data collection was done via web scraping. For this, we used software R version 3.5.1 (R Core Team, 2018) and the packages `xml2` (Wickham; Hester; Ooms, 2018) e `rvest` (Wickham, 2016).

Step 2 consisted of statistical analyses. Our paper aimed to answer two main research problems. In order to answer our first research problem (Which are the motivating factors of casual carpooling?) survey data were analyzed using logistic regression models (A) fitted via software R. Also, descriptive statistical techniques (B) as a way of understanding the socioeconomic factors associated with the habit of offering and picking up rides (casual carpooling) were used.

After data pre-processing, logistic models were fitted separately for the groups of drivers ( $n_c = 78$ ) and non-drivers ( $n_{nc} = 204$ ), considering as response variable the habit of offering or taking a ride ( $Y = 1$ , for the answers “yes” or “occasionally”, and  $Y=0$  for the answer “no”). At first, full models were fitted considering the predictors age, sex, income, marital status, type of institution (public or private), day/night shift, and distance to the institution. The best models were then selected by stepwise based on AIC values. The final models are presented for each of the groups and interpreted in terms of odds ratios.

In order to understand the second research problem (How can casual carpooling be implemented in a MaaS scheme?) we also carried out a web scraping on the platform Blablacar from 9<sup>th</sup> to 27<sup>th</sup> March 2019. 290 users were analyzed on 298 trips, of which 97 were interstate journeys. Descriptive statistics were obtained for these data.

Web scraping consists of scraping data from internet sites to turn it into a simpler format to be analyzed. The Blablacar platform was chosen because it offers a service with characteristics close to what a MaaS model can be (since MaaS does not exist yet in the context in which this work was done). Although we are aware that distinctions between a MaaS model and Blablacar exists, both models have similar characteristics (such as one online platform, customization, personalization, registration requirement, and use of technologies). At last, step 3 consisted of the analysis and discussion of results.

## **Research context**

The city of Lavras-MG with a population of around 100.000 inhabitants is located in the south of the state of Minas Gerais, 425 km from Rio de Janeiro, 380 km

from São Paulo and 240 km from Belo Horizonte. The city holds four higher education institutions, being one public (Federal University of Lavras - UFLA) and 3 privates (Unilavras, Fagammon, and Fadminas).

UFLA currently holds 31 undergraduate courses and 33 lato-sensu and stricto-sensu graduate programs, totaling more than 16,000 people among students, faculty, and staff. Due to its extension and peripheral location regarding the city of Lavras, the campus counts with five stops for casual carpooling, which all have different destinations in the city. Today, the practice of casual carpooling is already institutionalized in the local culture. In addition, the university provides a free internal articulated shuttle which is intermittent at peak times and periodic during weekdays.

As for the private institutions, although significantly smaller than UFLA, they also represent a significant portion of the academic population of Lavras. Together, they hold 10 lato-sensu graduate programs and 17 undergraduate courses. However, unlike UFLA, they do not have physical stops for casual carpool (mainly due to the fact that they are all located within the city and not in the vicinities as UFLA).

## Analyzes and results

Results are displayed in 3 steps. Initially the results from the logistic models are presented, followed by their descriptive analyzes and. At last, the results obtained by web scraping in the Blablacar platform are shown.

### Logistic regression model

In order to understand the habit of casual carpooling, the first analysis we carried out was the logistic regression model (Table 2).

**Table 2:** Estimates and Wald tests for the effects in logistic regressions, odds ratios estimates and confidence intervals.

Group	Effect	Estimate	s.e.	p-value	$\widehat{OR}$	$IC_{95\%}(OR)$
Drivers	Intercept	-1.192	1.451	0.411	-	-
	Age	0.071	0.056	0.203	1.074	[0.977; 1.221]
	<b>Institution=Public</b>	<b>1.501</b>	<b>0.609</b>	<b>0.014</b>	<b>4.486</b>	<b>[1.427; 16.129]</b>
Non-Drivers	Intercept	0.688	0.457	0.132	-	-
	Institution=Public	0.601	0.334	0.072	1.824	[0.944; 3.513]
	Distance = 500m and 1km	0.125	0.551	0.820	1.134	[0.376; 3.339]
	Distance = 1km and 2km	-0.201	0.540	0.709	0.818	[0.276; 2.334]

Distance = 2km and 3km	-0.751	0.549	0.172	0.472	[0.156; 1.364]
<b>Distance = 3km and 4km</b>	<b>-1.756</b>	<b>0.685</b>	<b>0.010</b>	<b>0.173</b>	<b>[0.042; 0.631]</b>
<b>Distance = 4km</b>	<b>-1.320</b>	<b>0.549</b>	<b>0.016</b>	<b>0.267</b>	<b>[0.087; 0.763]</b>

For drivers, a significant effect was found regarding the type of institution they belong to. When belonging to the public institution, the estimated chances of him/her offering a ride are approximately 5 times higher than those of students from private institutions ( $\widehat{OR} = 4.486$ ). This result was already expected due to the strong and structured sharing culture in the public university studied.

For non-drivers, we observed that the type of institution is also an important variable in the model, but not significant at a 5% significance level. For this group, we noticed a significant effect of the distance that the student lives from the institution. If this distance is greater than 3 km, the odds of the student to seek for a ride are reduced ( $\widehat{OR} = 0.173$  and  $\widehat{OR} = 0.267$ ) compared to students who live within a walking distance of (up to 500m) from the institution.

### **Descriptive analyses**

Based on the logistic regression model, the only predictor variable that had an effect on the question "do you offer a ride?" was a type of institution (public or private). In this way, stratified analyses were performed in relation to the nature of the institution (public and private). Analyses were done separately for drivers and passengers.

Table 3 presents the predisposition and offer of casual carpooling stratified by type of institution. In general, we observed that there is a greater predisposition to offer a casual carpooling in the public institution over private ones (62.3% and 26.7%, respectively). The number of users who offers rides to strangers is also much higher in the public institution (45.9%). On the other hand, in the private institution, the largest offer leans towards family, friends, and acquaintances (62.1%).

**Table 3:** Predisposition for casual carpooling by institution type.

<b>Do you offer a ride?</b>	<b>Higher Education Institutions</b>	
	<b>Public</b>	<b>Private</b>
Yes	62,3%	26,7%
No	11,6%	35,6%
Occasionally	26,1%	37,8%
<b>Usually, for who do you offer a ride?</b>		
Family	3,3%	24,1%
Family or friends	16,4%	3,4%
Family, friends or acquaintances	34,4%	62,1%
Anyone	45,9%	10,3%

For those drivers who do not offer rides, they were asked why they did not do so and what could make them change their minds (Table 4). While the greatest concern among respondents from the public institution was the loss of freedom (50%), in the private institution the fear of robbery was the biggest cause (43.8%). We observed that 48.8% of drivers would offer a ride to anyone if they were paid financially, but in the private institution, for most respondents, no sort of reward would make them change their minds (54.8%).

**Table 4:** Reasons to not offer rides and possible incentives.

<b>Why do you not offer a ride?</b>	<b>Higher Education Institutions</b>	
	<b>Public</b>	<b>Private</b>
Loosing my freedom	50,0%	12,5%
Fear of theft	25,0%	43,8%
Routes without riders	0,0%	37,5%
Other	25,0%	6,3%
<b>What type of reward would make you offer rides to strangers?</b>		
Tax exemption	2,4%	4,8%
Crypto-coins	7,3%	2,4%
Rewards program	4,9%	4,8%
Paid rides	48,8%	26,2%
Nothing	34,1%	54,8%
Would offer without reward	2,4%	7,1%

Given that the celebration of casual carpooling should be mutual and have acceptance of both drivers and passengers, we also sought to understand the habits of casual carpooling among non-drivers (Table 5). It was noticed that the acceptance was

greater in the public institution in which 62.6% of the respondents say they are carpooling fans, while in private the number was 44.4%.

Still distinguishing between UFLA and private institutions, when comparing the proportion of respondents who are willing to take rides with strangers, we also found a greater predisposition among UFLA's students (81.2%) while for the private universities this number drops to only 12.5%.

**Table 5:** Casual carpooling habits among non-drivers

Do you get a ride?	Higher Education Institutions	
	Public	Private
Yes	62,6%	44,4%
No	37,4%	55,6%
<b>Usually, from who do you get a ride?</b>		
Family	2,6%	15,3%
Family or friends	2,6%	26,8%
Family, friends or acquaintances	13,7%	44,6%
Anyone	81,2%	12,5%

The analyses were also made under the MaaS perspective (Table 6). Considering that MaaS is a fairly recent concept (Hietanem, 2014); most of the respondents might not have been familiar with it. Thus, in order to analyze the results we presented a compilation of MaaS central features as a single statement to the respondents.

Overall, 53.2% of those who answered "yes" to the question regarding MaaS have already offer carpool rides. This number rises to 65.9% from the standpoint of UFLA's respondents and drops to 38.2% among the private schools' respondents.

**Table 6:** Willingness to offer rides within a MaaS context

Adept at MaaS	Do you offer a ride?								
	General			Public			Private		
	Yes	No	Occasionally	Yes	No	Occasionally	Yes	No	Occasionally
Yes	29,1%	16,5%	53,2%	27,3%	6,8%	65,9%	32,4%	29,4%	38,2%
No	20,0%	28,6%	51,4%	24,0%	20,0%	56,0%	10,0%	50,0%	40,0%

### Web scraping Blablacar

The results obtained with the application of the web scraping technique on BlaBlaCar are presented in the sequence. As elucidated by Casprini, Di Minin and

Paraboschi (2019), Blablacar is an online market platform whose business model is to offer peer-to-peer intercity shared mobility. According to the authors, today, the company operates in 22 countries, has over 600 employees, over 35 million members and an estimated value of over 1.5 billion USD.

Out of 290 users, 18.34% are female, while 81.66% are men. The ages range from 18 to 72 with averages of 30. Regarding users' profiles Blablacar offers the possibility (for both drivers and passengers) to express preferences for their trips (such as willingness to chat, listen to music, smoke, and carry pets). By subscribing to the platform, the user may (non-mandatory) tick one of three options related to each of these topics, the percentage of drivers who expressed preferences regarding these items is presented in Table 7.

Chattiness had the highest incidence of responses (39.34%), followed by smoking (22.58%). The highest percentage of responses from chattiness is neutral compared to openness to conversations (27.24%), indicating that the conversations may occur according to people's state of mind (mood). About 20% of drivers do not allow smoking. About the same percentage as to listen to music during the trip (19.53%). When it comes to the transport of pets, there is a duality between being welcome or not, and there is no neutrality.

**Table 7:** Carpooling preferences among users on Blablacar.

Carpooling preferences	Reponses	Total	Carpooling preferences	Reponses	Total	
<b>Chattiness</b>	I'm the quiet type	0,96%	<b>Smoking</b>	No smoking in the car please	20,22%	
	I'm chatty when I feel like it	27,24%		Smoking in the car is OK sometimes	0,00%	<b>22,28%</b>
	I love to chat!	11,14%		Smoking in the car doesn't bother me	2,06%	
<b>Pets</b>	No pets in the car	10,04%	<b>Music</b>	Silence is golden	0,83%	
	Depends on the animal	0,00%		I listen to music if I fancy it	0,00%	<b>20,36%</b>
	Pets are fine. Woof!	7,98%		It's all about the playlist!	19,53%	

In order to analyze the relationship between price and distance traveled, we also analyzed the most frequent origins for the city of Lavras on the platform (Table 8). For each of these routes, it is highlighted the average prices practiced in the platform, the

standard deviation, as well as maximum and minimum values. For comparison, we also present the prices usually practiced by road transport companies for these same routes and a price/km ratio traveled regarding both Blablacar and road transport companies.

**Table 8:** Relation price/km from 10 most frequently departures to Lavras in Blablacar.

Leaving from	Distance(km)	Frequence	Average prices	SD	Min – Max	Road transport (coach)	Price/Km Blablacar	Price/Km Road transport
Belo Horizonte	240	73	€ 9,78	± 6,84	35 - 63	€ 17,99	€ 0,04	€ 0,07
São Paulo*	378	48	€ 14,13	± 9,65	56 - 97	€ 19,84	€ 0,04	€ 0,05
S. J. Del Rey	94	25	€ 3,96	± 2,75	14 - 20	€ 7,70	€ 0,04	€ 0,08
Barbacena	149	15	€ 6,25	± 4,89	22 – 35	€ 11,40	€ 0,04	€ 0,08
Varginha	107	10	€ 5,27	± 3,77	15 - 28	€ 9,49	€ 0,05	€ 0,09
Pouso Alegre	186	9	€ 6,94	± 3,49	28 - 37	€ 14,44	€ 0,04	€ 0,08
Juiz de Fora	244	8	€ 10,58	± 7,37	35 - 55	€ 17,99	€ 0,04	€ 0,07
Piracicaba*	484	8	€ 16,19	± 4,82	68 - 80	€ 22,19	€ 0,03	€ 0,05
Três Corações	87	7	€ 3,40	± 3,55	10 - 20	€ 7,47	€ 0,04	€ 0,09
Uberlândia	531	7	€ 22,54	± 10,69	80 - 110	€ 40,56	€ 0,04	€ 0,08

\* Interstate routes

In general, we observe that the prices on the platform are approximately 50% lower when compared to the road transport companies, in this way, we realize that passengers are price sensitive (interstate transports showed a slightly lower difference). It is worth mentioning that the prices of these companies are also subject to changes, through high demand.

## Discussion

### Motivating factors of casual carpooling practices

The linear regression model showed that the type of institution (public or private) was the only influential variable in offering casual carpooling. It is worth mentioning that other variables such as sex, age and income were not representative to explain differences in the habit of offering rides.

We observe that this happens due to a culture established in the city, especially by UFLA, which encourages the habit of casual carpooling. In this sense lessons thought by the institutional theory can be used, mainly regarding the role of normative isomorphism (Dimaggio & Powell, 2005). As pointed out by Assis (2010), normative isomorphism occurs when there is a demarcation of conditions, methods and practices common to the exercise of an activity, defined through a sharing of norms and knowledge with other individuals, generating a similarity among them.

We verified that UFLA has institutionalized the practice of casual carpooling by installing physical pick-up points in avenues within the campus (Figure 2). The pick-up points indicate the region where the riders in the queue wish as a final destination.



**Fig. 2.** Casual Carpool Pick-up point at Federal University of Lavras

Although there are no explicit signboards outside UFLA’s campus indicating pick-up points, there are "informal" sites scattered throughout the city that lead to UFLA. These sites are generally close to public transportation bus-stops (Figure 3), similar to those observed in metropolitan areas in the USA (Shaheen, Chan & Gaynor, 2016).





**Fig. 3.** Informal Casual Carpool Pickup point in the city of Lavras, near to a bus stop

In the USA, there are policies put in place to stimulate the practice of casual carpooling. Several types of incentives are offered to drivers, such as access to dedicated lanes and discount in tolls (Shaheen, Chan & Gaynor, 2016). However, contrary to one of the factors of success of the casual North American carpooling; "time-saving incentives for drivers" (Chan & Shaheen, 2012), there is no municipal or institutional incentive for drivers to offer these rides in the city of Lavras. In addition, rides have no cost to passengers as well. In this way, 91.1% of the drivers do it out of benevolence and solidarity.

We believe that one of the factors that encourage this solidarity is the simplicity and agility in offering rides in Lavras. Passengers make a self-organized queue without any outside intervention. In this queue, whenever a car stops, visual communication or few words are enough to consummate the act of the ride. The driver indicates how many passengers can enter the car, while the queue order is generally respected. It is worth noting that eventually, whenever a driver sees someone, he/she knows in the queue, he/she stop a little ahead of the pick-up point and that given person in the queue (regardless of their position) goes to the car.

Differently, in the case of private universities, there are no carpooling pick-up points on their campuses nor in the city. Such a fact may explain the discrepancy

between the percentage of rides to strangers offered by drivers from UFLA compared to drivers from private institutions (45.9% and 10.3%). Such a lack of “physical infrastructure” can act as a motivator to not offer a ride.

We observed that levels of trust are greater in the public institution than in the private ones (e.g., not offering a ride for fear of theft or robbery: respectively 25% and 43.8%). In addition, in private institutions, 37.5% of drivers claimed that they do not offer rides, because they usually do not encounter riders on their way to university, which may be explained due to the lack of "carpool pick-up points" aimed towards those institutions.

Thereby, we understand that the casual carpooling in Lavras is mainly sustained by the following motivating factors:

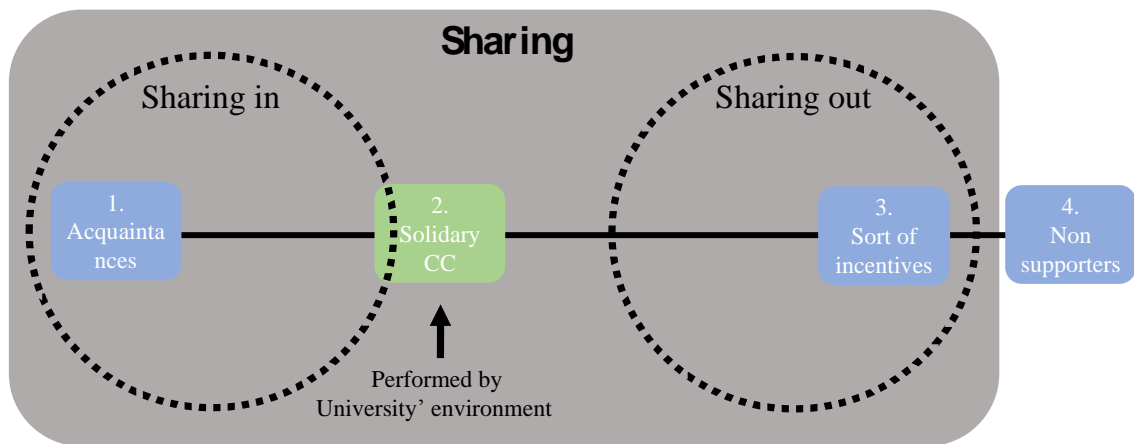
- **Solidarity:** drivers do not have financial rewards or municipal incentives to offer a ride;
- **Simplicity and agility:** casual carpooling is simple and intuitive with the pick-up points at the public university - drivers do not gain, but also do not waste time;
- **No costs to passengers:** riders accept and trust to carpool with unknown drivers;
- **Pick-up points:** bring legitimacy and practicality to casual carpooling.

A relevant factor to be highlighted is the role of solidarity as a fundamental pillar of the practices of casual carpooling. We observed that this solidarity rides are inherent to the public institution, due to the instituted normative isomorphism (Assis, 2010; Dimaggio & Powell, 2005) in the university due to the several carpool pickup points as well as due to the institutionalized culture. Thus, we consider that the act of casual carpooling in the public institution – by not seeking repayment in exchange (e.g., Belk, 2010 p. 721 "Money is irrelevant") – does indeed present features of “sharing”.

However, the act of providing shared rides is not suited for everyone. Thereby, it is important to outline the user groups identified in our sample: 1) supporters of casual carpooling for acquaintances; 2) supporters of solidary casual carpooling for anyone; 3) supporters of casual carpooling for anyone given some sort of incentives are provided; and 4) non casual carpooling supporters.

Being a relation that mitigates interpersonal boundaries posed by materialism and possession (by private car sharing), we believe that within the “sharing in – sharing out” spectrum proposed by Belk (2010), the practice of group 2 (supporters of solidary

casual carpooling for everybody) is closer to the concept of “sharing in”. Figure X demonstrates the identified groups plotted in Belk’s (2010) spectrum of sharing in-out.



**Fig. 4.** Conceptual framework for casual carpooling supporters under Belk’s (2010) sharing archetypes.

By analyzing Figure 4, we advocate that group 1 should be placed on left-end of the spectrum, within the sharing in concept as proposed by Belk (2010). Group 2, suggests a level of openness which enables the self-extension (Belk, 2010). In contrast, group 3 is placed in opposite right-end of the spectrum.

Carpooling enabled by incentives resembles the rental of a vehicle by a car-sharing company, as suggested by Belk (2010). The distinction is that, in the case of the carpool, the activity is not configured as a business.

The presence of group 2 in the spectrum is only possible due to the peculiar institutional environment of the analyzed context. However, this does not mean that such group cannot exist in other contexts, or even be stimulated. In addition, as we advocate towards a context-adaptive MaaS, this group can and should be used as a carpool catalyst in the insertion of a MaaS business model.

The group of non-casual carpooling supporters (4) is outside of the sharing spectrum. For this group motivating rewards would hardly be accepted. Also, due to their resistance to sharing, this group would have a certain aversion to MaaS. According to Hietanen (2019), MaaS is not meant to serve all, there will always be a demand that will not be fulfilled. However, for the other groups (1, 2, and 3) certain stimuli can make drivers to give rides to other passengers besides acquaintances.

## **Strategies to implement casual carpooling in a MaaS Scheme**

Although we consider public transport to be a key actor for MaaS schemes, it cannot be generalized as MaaS backbone. That being true, MaaS could not be adaptable to places in which public transport is inefficient (and that desperately need mobility solutions). Thus, in an analysis prior to the context in which this study was conducted, we observed that casual carpooling practices may be a viable alternative for the implementation of MaaS.

We observed that in general drivers predisposed to use MaaS offer rides in most cases (82.3%). This number rises to 93.2% when stratified for the public institution. In this way, we suggest that possible users of a MaaS model in the context of this study are already somewhat familiar with the casual carpooling and can make use of it as a modal.

However, it is still necessary to find a way to implement casual carpooling in a MaaS model, considering that the literature has not yet addressed this possibility. Our first thought is that casual carpooling should not be made available to all MaaS' users. This strategy is based in the customization option offered by the service provider. In a MaaS scheme, transport options are offered to the users based on their personal preferences. For instance, a user who is not open for physical exercise may not have bike-sharing among his/her transportation options. Likewise, MaaS users should only have the option of accessing casual carpooling as a transport if they are part of specific interest groups (e.g., universities or enterprises).

That is, the customization offered by the MaaS platform could provide casual carpooling as a transport mode for users of the same company or university. For instance, users (e.g. a student, professor, administrative staff, so on) from the same institution would have access to the casual carpooling among their MaaS transport modes, whereas this option would not be available to other users who are not part of this given university.

Also, based in logistic features, universities and big companies are places that have common drop-off locations (Chan & Shaheen, 2012). In addition, the institution as a unit can encourage the act of sharing due to the safety and the possible inherent social links established among its members (Belk, 2010).

Although the solidarity profile exists, we observed that some reward would motivate a greater commitment to casual carpooling for anyone (48.8%). However,

casual carpooling is a user-organized system (Shaheen, Chan & Gaynor, 2016). In this way, establishing prices per ride/trips to be practiced among passengers and drivers would be quite complex due to a lack of governance structures and mechanisms. In addition, stipulating prices per ride/trips could cause rebound effects (Manzini & Vezzoli, 2003) and transform casual carpooling into a business, such as Uber.

In this way, we propose that the financial rewards should be converted into credits into the drivers' MaaS accounts. A similar proposal to obtain credit is pointed out by Datson (2016). Thus, the driver (consumer) becomes the service provider and user of the MaaS platform. For instance, the consumer can offer, as a driver, the casual carpooling (service provider), however eventually it can choose to use public transport, a bike-sharing service or even casual carpooling but as a passenger (user).

Users and service provider perspectives are similar to those perceived on the Blablacar platform. However, unlike the platform that focuses on intermunicipal trips with medium/long length and planning, casual carpooling has an urban environment target with a short length and unplanned trips. Thus, some customizations preferences from Blablacar that we found in the web scraping technique, either do not apply to casual carpooling (transport of pets) or are likely to have lower adherence (music or smoking).

On the other hand, chattiness, seems to have applicability as customization for short length trips. This preference was the one that pointed out the greatest number of interventions in Blablacar platform (39.34%) and could contribute to the "loss of freedom", indicated by 50% of the drivers as inhibiting ride factor. In this way, from the customization, users can delineate their profile and show a willingness to converse or not and even expand to topics of interest, hobbies, among others. Thus, drivers who do not want to have their freedom compromised can choose passengers who do not want to talk for example.

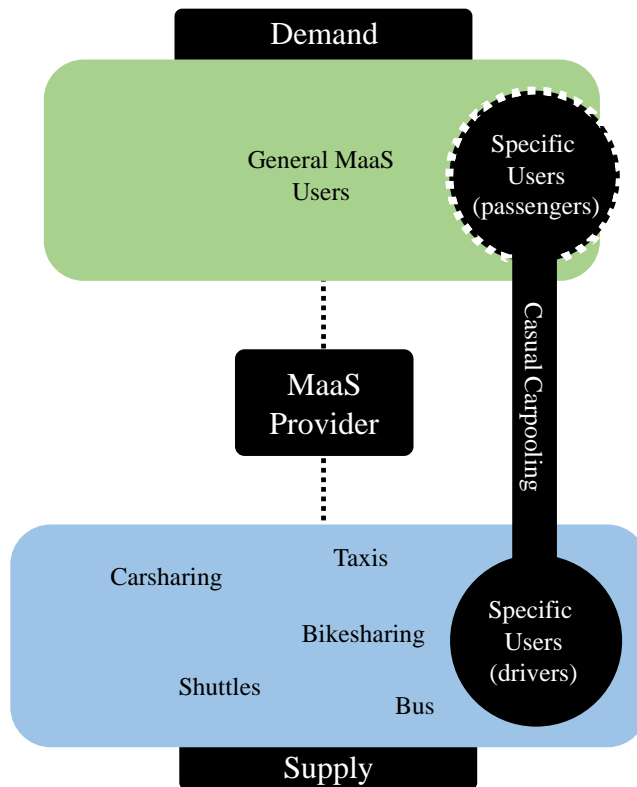
Furthermore, when it comes to passengers, the web scraping analysis illustrated a price sensitivity. The prices charged by the Blablacar platform are generally 50% lower than those charged by road transport companies (see Table 8). Also, the simple fact that casual carpooling is free already indicates this sensitivity to the price. Thus, we suggest that the casual carpooling in a MaaS scheme should be also offered for free to passengers.

This is justified because this modal does not need governance, on the contrary, it must remain user-run and act only as support for MaaS implementation (Figure 5). In

addition, the destinations served by casual carpooling are specific to certain regions. Also, we observed in our sample that casual carpooling is better suited to fulfill the last-mile issue given that the passengers who live near to the final destinations are more willing to get a ride (see Table 2). For this, casual carpooling users are most likely to need transport connections to complement their transportation needs in order to commute to other locations.

Thus, a strategy for implementing a casual carpooling in a MaaS scheme is based on 4 pillars:

1. **Unified drop-off points:** with universities or enterprises as compelling alternatives due to their large number of commuters. Also, such commuters are likely to present similar social circles, which may contribute to the act of sharing (Belk, 2010).
2. **Modal customization:** casual carpooling will not be for every MaaS user. This modal will be only available for users who are inserted in certain environments (e.g., unified drop-off points) that allow the creation of supply and demand.
3. **Remuneration for credit in MaaS:** it would feedback the system, making providers of casual carpooling to be included in MaaS as users as well.
4. **No additional costs for passengers.**



### **Fig. 5** Theoretical model of casual carpooling in a MaaS scheme

The strategy of implementing casual carpooling expands the possibilities for MaaS users who are part of specific institutions. Thus, casual carpooling is a positive strategy for the urban mobility scenario, as the incentives offered to drivers are expected to expand the offer of drivers willing to offer a ride, while still meeting demand (the maintenance of this free mode). Thereby, casual carpooling as a transport mode within MaaS will remain simple, free of charge for passengers, encouraging drivers with incentives and rewards and targeted at specific audiences.

### **Concluding remarks**

Most studies on MaaS are being carried out in developed countries with efficient public transportation systems. This study aimed to contribute to initial discussions about MaaS schemes in developing countries through more efficient private vehicles' usage.

Considering MaaS as modular and adaptable, the context in which this model will be inserted should be analyzed. Thus, we observed that the practice of casual carpooling, can be a viable proposal in the reality of this study.

In order to propose a strategy to implement the modal ride in a MaaS scheme, it was necessary to understand the motivating factors of this practice. Thus, we identified four main motivators factors for casual carpooling; (1) driver's solidarity, (2) simplicity and agility, (3) no costs to passengers, and (4) positive influence of pick-up points.

The act of drivers sharing their vehicles with strangers without expected rewards, in a certain way, mitigates the personal boundaries imposed by materialism. This fact, places casual carpooling for drivers closer to the concept of "sharing in" (Belk, 2010). In this sense, we understand that casual carpooling may be more efficient (even without rewards) in places which some social unified contact exists, such as universities and enterprises.

Nevertheless, we noted that the consumers' acceptance of casual carpooling can be also further stimulated and improve the lack of sharing culture and/or solidarity. For this, as a strategy to implement casual carpooling in a MaaS scheme, we identified four pillars: (1) Unified drop-off points; (2) Modal customization; (3) Remuneration for credit in MaaS; and (4) No cost for passengers. The unified drop-off points and modal customization are needed to stimulate sharing in (Belk, 2010) and keep the act of casual

carpooling simple. The remuneration for credit in MaaS scheme seeks to avoid rebound effects (Manzini & Vezzoli, 2003) that financial rewards may be responsible and transform the service provider into “another” Uber. At last, the lack of costs to passengers seeks not to configure casual carpooling, even inserted in MaaS, as a service but still as a form of sharing.

In this way, casual carpooling may prove to be a feasible transport as a supplement mode on MaaS schemes in last-miles commutes or in places where public transport is not efficient. However, we also infer that the city’s infrastructure (pick-up points) and local culture stimulate casual carpooling practices. Although this study needs more in-depth analysis, we have brought initial thoughts about casual carpooling in a MaaS scheme, which as far as we know, has not yet been addressed in the literature. As a future agenda, we propose to expand our sample to other countries, in places where there are MaaS schemes already running, such as Finland and Sweden.

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