

Ride Sharing in FEUP

Catarina Ferreira
up2015066710@fe.up.pt

Gil Teixeira
up2015057350@fe.up.pt

Tiago Neves
up2015062030@fe.up.pt

March 30, 2019

1 Context

Each year, the Portuguese population spends more than 7.8 millions of tons of fuel, of those 7.8, approximately 4.7 are spent in diesel¹ and a bit more than 1 million are spent in petrol.²

In 2017 in Porto Metropolitan Area the occupancy tax of a car was 1.56 in average and 1.36 for aggregates with only one person³ and 47.3% of students spend more than 100€ per month on fuel.⁴

The focus of this project is the segment of the population that we most resemble with, students, more precisely FEUP students. Students in Porto Metropolitan Area are the second most mobile segment, the first being the working class.⁵

In this project the alternative of ride sharing will be tested in order to reduce our fuel consumption and, by consequence, our ecological footprint.

2 Problem Statement

In this project the main problem is, using ride sharing, the minimization, of:

- The amount of fuel used and therefore the emissions of CO₂ and other pollutant gases;
- Traffic Jams and by consequence the time spent;

¹Paulo Salteiro Rodrigues Direção Geral de Energia e Geologia. *Vendas de Produtos de Petróleo em Portugal 1970 - 2016*. 2018.

²*Ibid.*

³I.P Instituto Nacional de Estatística. *Mobilidade e funcionalidade do território nas Áreas Metropolitanas do Porto e de Lisboa 2017*. 2018, p. 40.

⁴*Ibid.*, p. 28.

⁵*Ibid.*, p. 26.

Commuting in a closed community with the same destination but different starting points.

3 Domain Characterization

Ride Sharing consists in an arrangement between 2 or more people to make a regular journey in a single vehicle. This practice is commonly used between people that live near each other and share a common destination.

Carpooling has many benefits for its users, such as, the reduction of fuel consumption, parking tickets, tolls and car maintenance. At a society level, it also leads to a reduction of the impact on the environment and an overall traffic reduction, as the numbers of cars in the roads decrease.

Some difficulties that prevent Ride Sharing of becoming more mainstream are finding someone with the same schedule and destination to share a ride, the loss of privacy and being dependent of others.

Since FEUP is a college with more than 8000 students and 1000 professors and researchers,⁶ it is a ideal destination for shared rides. Therefore, as the students do not have yet a source of income, share the same schedule and study at the same location they should be an excellent target audience.

In section 8.1, a report of a survey that aims to better characterize this population is presented.

4 Hypotheses

- If a greater percentage of students use ride sharing, the emissions of CO₂ will reduce;
- If more students ride share, each student will spend less money in commuting per

⁶FEUP. *FEUP em Números 2017*. 2018.

month;

- If the university implements more incentive strategies, more students will ride share;
- A person that doesn't mind who they share their car with will spend less, in the same conditions, than a person that doesn't share their car with anyone.

5 Simulation Purpose

With the results of our survey we will separate our population into different groups. We will then implement matching and scheduling policies, matching students that have a vehicle to students that need a ride, to test our Hypotheses.

We will simulate the effects that different incentive policies and different percentage of the groups that characterize the students have on:

- the amount of fuel used;
- the amount of money spent commuting;
- the amount of pollutant gases emitted;
- the matching of students.

5.1 Scenarios

We will have:

- Multiple scenarios with different percentages of the groups of students;
- Multiple scenarios with different incentive policies;
- A scenario where the population will have the same characteristics of the results we obtained in the survey;

5.2 Operation policies

In this project will be present two operation policies:

- The matching of students and scheduling to form ride sharing trips which will take in to consideration the distance and the amount of deviation of the normal path the student would take;
- The incentive policies that affect the amount of students using ride sharing, this will take in to account the different characteristics from the different groups of students.

6 Related Work

There are already several papers related to the impact of carpooling, quantifying the impact of a organization on the environment and modelling a carpooling multi-agent system in NetLogo.

For instance, a study⁷ was done by a student to measure the total ecological footprint of the Ohio State University. Three parameters were chosen to do the Ecological Footprint Analysis: Energy, transportation and waste. This paper showed that transportation was the greatest cause to the Ecological Footprint with 72 % of the total.

Another project,⁸ conducted by researchers of the Texas Tech University, aims to find the environmental consequences of ride sharing in the United States of America. Carpooling can help reduce the number of cars on roads and consequently relieve traffic congestion. It also focus on determining the variables that would increase the carpooling rate. For example, a increase of the gas price and a higher number of persons per household cause the rate to be higher, on the other hand people more educated and with higher income have more intention to drive alone.

In an article⁹ published by a team of researchers from the University of Vigo was pre-

⁷Jaclyn Janis. "Quantifying the Ecological Footprint of the Ohio State University". In: (June 2007).

⁸Roxana Javid, Ali Nejat, and Mahmoud Salari. "The Environmental Impacts of Carpooling in the United States". In: Aug. 2016.

⁹Marcelo Armendáriz et al. "Carpooling: A Multi-Agent Simulation In Netlogo". In: ECMS. 2011.

sented an enhanced model that simulates urban traffic by adding carpooling functionalities. The objective of this project was to evaluate the benefit of carpooling using different scenarios with several parameters. With this simulations it was concluded that carpooling can have a bigger impact in highly populated cities than in the smaller ones and that is essential that the amount of drivers must be several times greater than the number of users waiting to be served. Also, the integration of the public transports services could strongly benefit carpooling system since many routes cannot be frequently covered by the drivers belonging to the carpooling system alone.

7 Work Plan

- Data Collection:
 - Create survey
 - Send survey
 - Clean responses to the survey
- Model conceptualization
- Model Translation
 - Study the Traffic Grid Goal model in NetLogo
 - Adapt the Traffic Grid Goal model to represent our model
- Verification
- Validation and Calibration
- Experimental Design
- Production and Analysis
- Create final report with the simulation results

Full Gantt chart in Section 9 Fig.4

8 Preliminary Work

8.1 Survey

In this section will be presented the main sections of our survey.

In the Figure 1 we have questions to obtain some characteristics of the vehicles that will be important to calculate the emissions of pollutant gases and the occupancy of the vehicles.

With the data from Figure 2 we know the distance each student is from FEUP, the number of trips that each student makes, on average, per week and the money spent commuting per month. This data is useful to calculate the emissions of pollutant gases and will also be useful for the matching of students.

The section described in Figure 3 will be used to characterize the population in terms of knowledge about and openness to the concept of ride sharing and also the different incentive policies that will be simulated in our project.

After collecting the responses to the survey the data will have to be modified so that it can be used in the model. This will be made by running a factor analysis process over the data collected and then a clustering algorithm, so that we can separate the population into groups with the same characteristics to later be used in the model.

9 Appendix

Detalhes do veículo

Tens: *

☐ Carro

☐ Mota

☐ Bicicleta

☐ Other:

O teu veículo é: *

☐ A gasolina

☐ A gasóleo

☐ Híbrido

☐ Elétrico

☐ Other:

O teu veículo tem quantos lugares disponíveis habitualmente? *

☐ 0

☐ 1

☐ 4

☐ Other: _____

Figure 1: *Vehicle Characteristics*

Estilo de Viagem

Para te deslocares até à faculdade, utilizas transporte privado ou transporte público? *

☐ Transporte Privado

☐ Transporte Público

☐ A pé/bicicleta

Aproximadamente quantos km é o teu trajeto até à faculdade? *

Se não sabes podes estimar usando o Google Maps com destino na FEUP: <https://goo.gl/AfGiz6>. (Não temos acesso aos dados introduzidos no Google Maps)

Your answer _____

Vives dentro ou fora do Porto?(Concelho do Porto) *

☐ Dentro

☐ Fora

Aproximadamente quanto dinheiro gastas em combustível por mês? *

☐ 0€

☐ 0€ a 20€

☐ 20€ a 40€

☐ 40€ a 60€

☐ 80€ a 100€

☐ 100€ a 120€

☐ 120€ a 140€

☐ 140€ a 160€

☐ 160€+

☐ Não sei

Aproximadamente quanto dinheiro gastas em Transportes Públicos por mês? *

☐ 0€

☐ 0€ a 15€

☐ 15€ a 30€

☐ 30€ a 45€

☐ 45€ a 60€

☐ 60€ a 75€

☐ 75€+

☐ Não sei

Quantas viagens fazes por semana em média para te deslocares para a FEUP e de volta? *

percurso casa-FEUP-casa implicará duas viagens. Paragens intermédias são desconsideradas.

☐ 2 - 4

☐ 6 - 8

☐ 10 - 12

☐ 14 - 16

☐ 18 - 20

☐ 22+

Figure 2: *Commuting Characteristics*

Ride Sharing

Sabes o que é "Ride Sharing"? *

- ☐ Sim
- ☐ Não

Sobre ride sharing: *

Caso não saibas, de forma simplificada é "o uso partilhado de um automóvel particular por duas ou mais pessoas, para viajar juntos durante o percurso para o trabalho ou a escola. (...) contribuindo à redução do congestionamento e diminuindo a poluição do ar"

pt.wikipedia.org/wiki/Carona_solid%C3%A1ria

- ☐ Utilizo
- ☐ Não utilizo

Estarias disposto/a a utilizar ride sharing: *

	1	2	3	4	5	
Não/Nunca	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sim/Sempre

Partilhavas a tua viagem para a FEUP com: *

	1 (Não/Nunca)	2	3	4	5 (Sim/Sempre)
Amigos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Colegas do teu ano	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Colegas de curso	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Outros estudantes da FEUP	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Incentivos

Abaixo temos algumas ideias para incentivar à prática de ride sharing pelos alunos da FEUP. Classifica cada uma delas de acordo com o quão te incentivariam a praticar ride sharing.

Se ainda não é um hábito teu praticar ride sharing, o que te incentivaria?

	1 (Não interessado)	2	3	4	5 (Muito interessado)
Crédito para o sistema de impressões	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crédito para as máquinas de café	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crédito na cantina	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crédito na loja FEUP (fe.up.pt/loja)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Desconto nas propinas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Estacionamento Prioritário para quem oferece boleia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Que outros incentivos achas que seriam interessantes?

Your answer

Figure 3: Ride Sharing Questions

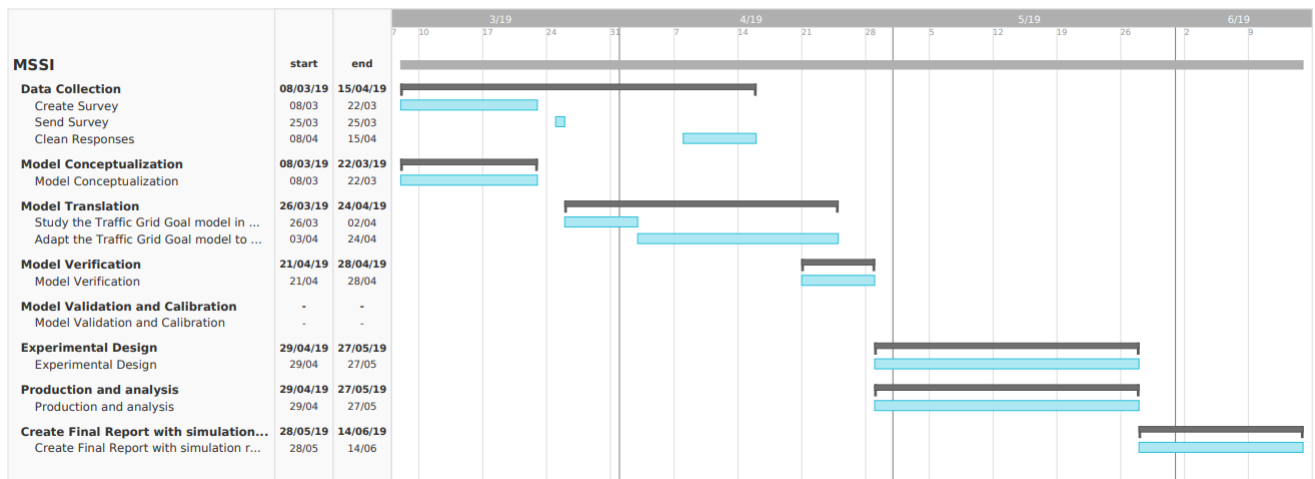


Figure 4: Gantt Chart