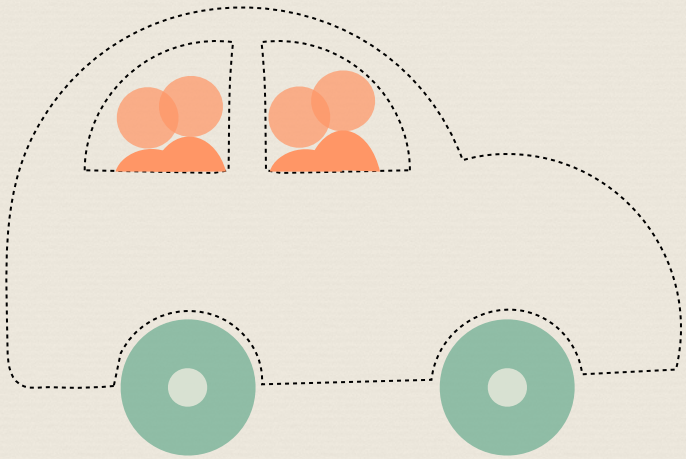
MyChe 车

CARPOOLING
FOR A BETTER WORLD



INDUSTRIAL ANALYSIS REPORT

Global Manufacturing Strategy

Tsinghua University

2015

« BY SHARING WE STAND PREPARED TO BUILD RELATIONSHIPS AND GIVE WINGS TO HUMANITY. »

KISHORE BANSAL

A GROWING MARKET

The market of carpooling is much diversified. It include the individual user who shares his car with his colleagues, the student who user carpooling to have cheap travels and the one who use it to reduce his impact on environment.

We can group these different actors in the following categories:

- **Usage for daily travels**
- **Usage for long travels**
- **Carpooling organization inside a company**
- **Business companies proposing carpooling**
- **Institutional carpooling systems**

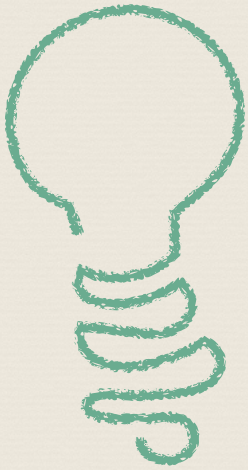
REAL IMPACTS OF THE ENVIRONMENT

Even if this is not the first motivation of carpoolers, reducing the number cars on the road will reduce the pollution.

By taking the decision to use carpooling, the users can contribute to the protection of the planet.

This awareness regarding the environment is also a motivation for the companies to propose carpooling services for its employees and encourage them to reduce the CO_2 emissions at their scale.

NEW TECHNOLOGIES



Dynamic carpooling consists on managing a continuous access to the carpooling available offers. A real time access is provided through a continuous updating of the offers and the demands

The popularization of smartphones, tablets, connected devices, free access to the Wifi, GPS, 3G, 4G, the 'in real time" became totally possible and accessible for all people.

Then the implementation of decentralized systems like Multi-Agent Systems (MAS) or Blockchain will help the market to grow. The objective of these Agents is to successfully associate the different users through an optimization process subjected to several, complex and variable constraints.

PUBLIC POLICY AND SOCIAL ASPECTS

The market is highly dependent on the public policy and the social awareness. If these two aspects could be an opportunity, some public politics are obstacles for the development of this kind of markets.

Due to the high competition in the transportation industry, some countries prefer to protect the classic market from this kind of activities.

This IAR will study the differences of Law and Culture in different countries to try to highlight the points that are going to help this market.

About Autors

Massine AKILAL

« After a preparatory class in France, I entered an engineering school specialized in Mechanics and Energy. After two years in this school and an Internship in automotive industry, I decided to take a double degree program in Tsinghua University.

For me it was an opportunity to study abroad first and then to study Industrial Engineering completing my initial background in mechanics. »

Morgane BARILLET-GENESTIER

« I am French and I have a professional bachelor in Quality Management.

After my graduation, I worked for Airbus SAS in Toulouse (France) for 1 year. I was in charge of several suppliers as Supplier Operation Manager in the Procurement team.

I finally had the opportunity to integrate the Industrial Engineering Department in Tsinghua University to do a Master degree in Management of Science and Engineering. It is a real chance for me to finalize my academic cursus and improve myself in a lot of domains. »

Santiago COELLO

« I am from Guayaquil, Ecuador. I received my Bachelor Degree in Mechanical Engineering in ESPOL university, Ecuador.

I am a candidate master student in Management Science and Engineering, Chinese Program, at Industrial Engineering

Department in Tsinghua University, focused in logistic and supply chain area."

Introduction

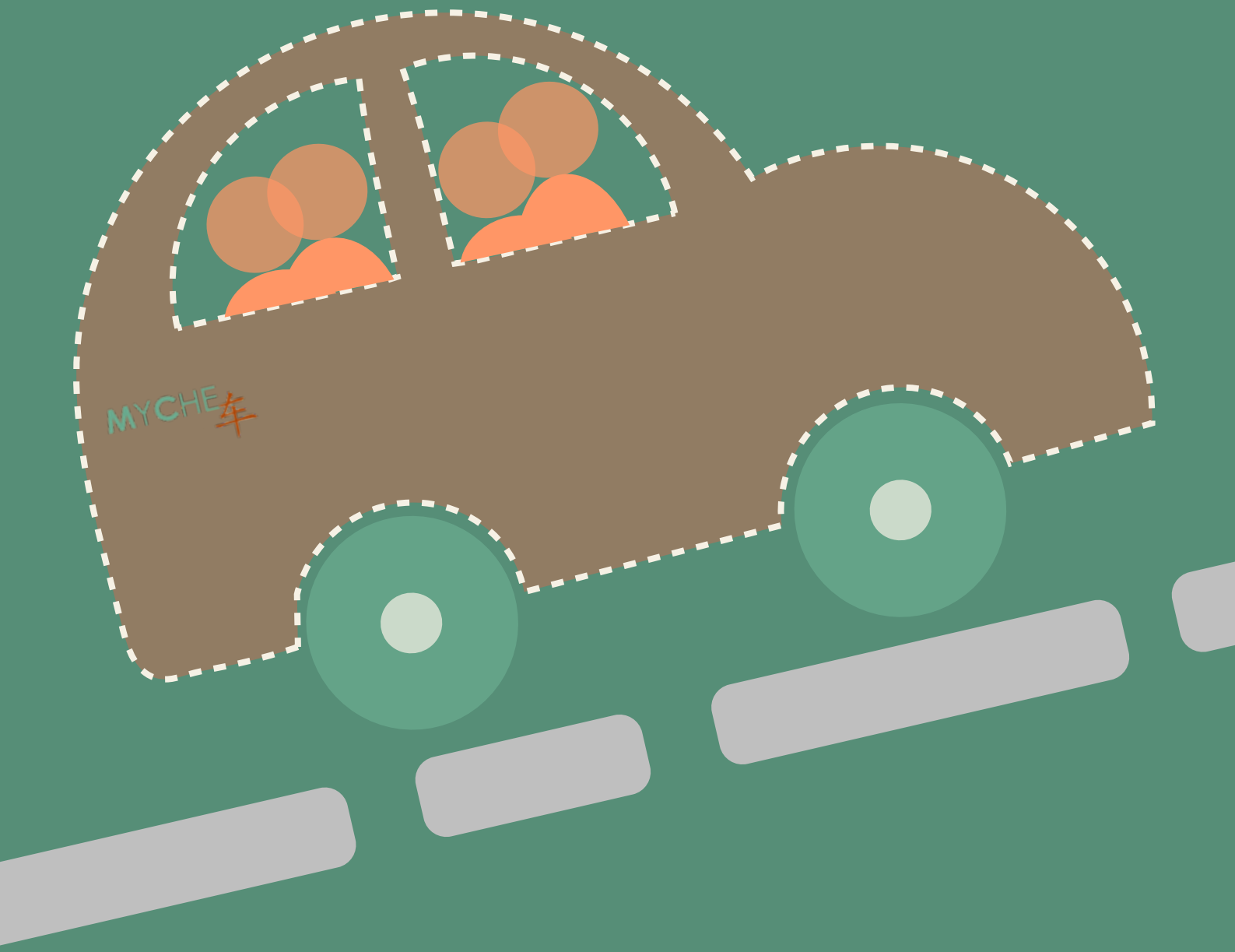
MyChe车 is a group consisting of 3 graduate international students at Tsinghua University. They come from two different countries : France and Ecuador.
This report was written as a part of « Global Manufacturing Strategy' course by the Industrial Engineering Department during the Spring Semester 2015.

Objective

This report aims to provide a general overview to the current state of the carpooling service through the world to a general audience.

The contents of this report deals with different elements : history of carpooling, market and technology analysis, law and public policy and social awareness.

Based on this, this report propose a discussion about the future of carpooling.



EXECUTIVE SUMMARY

INTRODUCTION

Concept of Carpooling

Carpooling over the years

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Introduction

Concept of Carpooling

Carpooling is an option whether or not own or drive a car. If someone know that travel the same route as a neighbor or co-worker, consider arranging to carpool or ride-share. Carpooling is seen as a more environmentally friendly and sustainable way to travel as sharing journeys reduces carbon emissions, traffic congestion on the roads, and the need for parking spaces. Authorities often encourage carpooling, especially during high pollution periods.

Carpool commuting is more popular for people who work in places with more jobs nearby, and who live in places with higher residential densities. Is significantly correlated with transport operating costs, including gas prices and commute length, and with measures of social capital, such as time spent with others, time spent eating and drinking, and being unmarried. Is significantly less likely among people who spend more time at work, older workers, and homeowners.

Carpooling - Wikipedia

Carpooling over the years

1. World War II car sharing clubs (1942-1945)
2. Energy crises (1970-1980)
3. Early organized ride sharing schemes (1980-1997)
4. Reliable ride sharing systems (1999-2004)
5. Technology-enabled ride matching (2004-today)

1942-1945

World War II car-sharing clubs

Propaganda for Carpooling during the Second World War. Sources: Oregon State Archives, US Archives and Records Administration

Ridesharing began during World War II through "car clubs" or "car-sharingclubs". In 1942 US government regulation required that ridesharing arrangements to workplaces be made when no other alternative transportation means were available. The objective was share a ride in one car to conserve rubber and fuel for the war effort. It also created a ridesharing programme called the Car sharing Club Exchange and Self-Dispatching System. Factories and companies were responsible for forming these car-sharing clubs. Even churches, homemakers, and parent–teacher associations were responsible for forming carpools to and from various functions.

1970-1980

Major responses to the energy

Ridesharing reappeared in the late 1960s and grew significantly in the 1970s in response to the energy crisis and the Arab oil embargo of 1973 to 1974. During phase two, strategies to facilitate ridesharing included: employer-sponsored commuter ridematching programmes, vanpooling, HOV lanes, casual carpooling, and park-and-ride facilities.

These programmes were created relatively simply—each company collected employee data, hand-matched those who were neighbors (this eventually became computerized), and distributed personalized matches. This straightforward method proved highly successful; when coupled with priority parking privileges, several companies were able to double vehicle occupancies and reduce parking lot strain. Beginning in 1973, the Arab oil embargo shifted ridesharing's focus from constrained parking supply concerns to energy conservation. Employer-sponsored commuter ridematching programmes caught the attention of US federal agencies as an aggressive tool to achieve energy conservation goals. The Federal Highway Administration (FHWA) began cataloguing successful employer ridematching programmes to publish guidebooks on carpooling and vanpooling. FHWA conducted a nationwide survey of ridematching programmes, many of which began during the energy crisis. The study found an increase of 29 to 400 commuters in carpools and a reduction of 23% of vehicle-miles travelled (VMT) among 197 000 employees

Early organized ride sharing schemes

1980-1997

As energy conservation efforts waned in the 1980s and 1990s, transportation demand management shifted focus to improving congestion and air quality issues. Advances in computerized ridematching during this period also marked a move towards more dynamic ridesharing applications in the form of telephoneand Internet-based ridematching programmes. However, as gasoline prices returned to lower levels during this time, ridesharing lost much of its competitiveness. Many of the early schemes, with developing and imperfect technology, never gained much use but formed the basis for many of today's ridesharing services.

Reliable ride sharing systems

1999-2004

With most dynamic ridematching applications of the 1980s and 90s failing to overcome the "critical mass" barrier (i.e. providing enough users to consistently create a successful instant ridesharing match), most North American ridesharing systems between 1999 and 2004 focused on systems to encourage ridesharing among commuters who had the most reliable trip schedules. This included online ridematching and traveller information services.

With the proliferation of the Internet, many ridesharing systems took online forms, known as online ridematching. Fullfledged, online ridematching services began around 1999. Before then, websites were either simple pages listing agency contact information, online forms for users to e-mail the agency to receive a matchlist, or online notice boards for users to manually post or search carpool listings. Since 1999, private software companies began developing ridematching "platforms", providing their suite of services to clients for a monthly fee. Carpools formed through online ridematching tended to be more static and inflexible and required prearrangement. While it was easier to find ridematches in a larger online database, these carpools still suffered from the same drawbacks as traditional carpools; namely, regular commuters lost the flexibility that private auto travel offered.

As housing and employment centres became more dispersed, giving even less incentive to rideshare, online ridematching had difficulty gaining more users than its related employer-sponsored commuter ridematching programmes of the late 1960s.

Technology-enabled ride matching

2004-today

Focus on reducing climate change. Financial incentives for "green trips" through sponsors. Growing dependence on foreign oil and traffic congestion. Partnerships between ride matching software companies and regions and large employers. Internet, mobile phones, and social networking platforms. Real time ride sharing services.

Ridesharing statistics in some

Company	BLABLACAR	SIDECAR	DIDA PINCHE	UBER	OLA	LIFT	DIDI DACHE	KUAIDI DACHE
Origin	France	United States	China	United States	India	United States	China	China
Launch year	2006	2002	2014	2011	2010	2012	2012	2012
Ridesharing/Taxi service		X		X	X	X	X	X
Carpooling	X	X	X	X		X		
Approximately Value (millions USD)	**1,000`**	NI	NI	**60.000`**	**2,000`**	**2,500`**	**6,000`**	
Funding Received (millions USD)	**110`**	**35`**	**130`**	**5,900`**	**676`**	**1,000`**	**817`**	**950`**
Users	20`000.000	NI	4`000.000	8`000.000	NI	NI	200`000.000	100`000.000
Drivers	NI	NI	NI	160 000	100 000	NI	NI	1`000.000
Countries presence	19	1	1	58	1	1	1	1
Cities presence	NI	NI	13	290	67	65	300	300

Part 1

Market Analysis

Part 1: Market Analysis

In 2010, 1 000 millions cars passed

In 2004, 87 millions cars were produced

This period encompasses the fifth ride sharing phase, called: "technology-enabled ride matching". In this period is most notable for the widespread integration of the Internet, mobile phones, and social networking (i.e. an online community where individuals connect and interact) into ride sharing services. At present, the majority of North American ride matching services use online websites as their chief technology medium. Many of them are based on a ridesharing software platform purchased from a private company. As of July 2011, there were approximately 12 such companies in North America that offer this software. (E.g. Ecology and Environment, Inc. offers Green Ridew, and Pathway Intelligence Inc. provides Jack Bell Ride-Share). While the abundance of online ridesharing systems is promising, it has resulted in disparate, non-standardized databases that leave many programs with a lack of critical mass.

There are approximately 638 ride matching programs in North America.

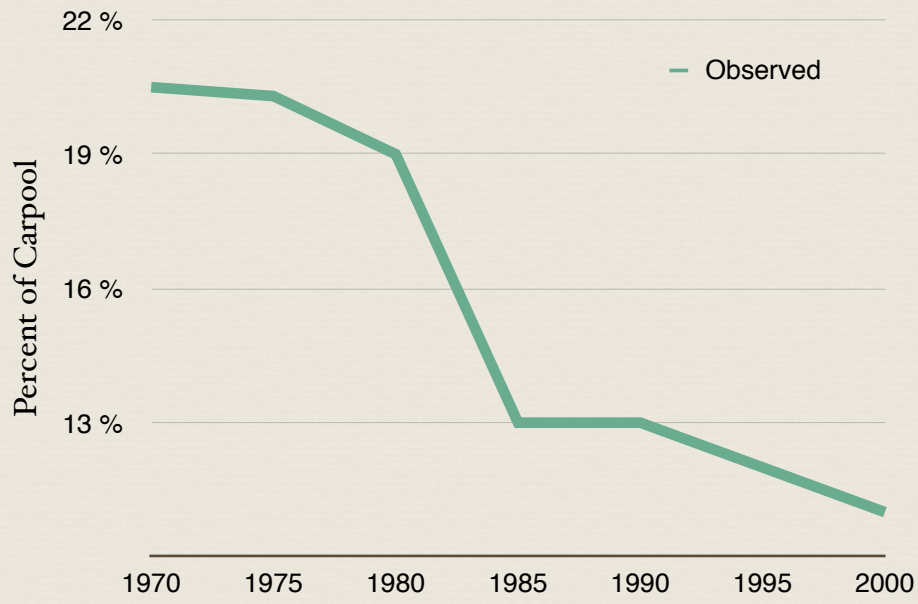
As of July 2011, the authors estimated that there were 638 ride matching services in North America, based on an extensive Internet search. This tally includes both online (most have an Internet-based component) and offline carpooling and vanpooling programs. Those located in sparsely populated rural areas, which appeared to have very low use, were excluded. Institutions that have their own ride matching website but employ a common platform were each counted separately. Of the total, 401 are located in the USA, and 261 are in Canada (24 programs span both countries). Carpooling attracts the largest focus, with 612 programs offering ride matching, and 153 providing vanpool ride matching; 127 offer both.

The future is the share economy

3 000 million people have access to internet

Market size and growth

Observed carpool trend in the United States 1970-2000



Source: The rise and fall of the American carpool: 1970–1990, Erik T. Ferguson & Associates, P.O. Box 888729, Dunwoody,

International comparison of work trip modes shares.

International Comparison of Work Trip Mode Share

Nation	Personal Vehicle, Driver	Personal Vehicle, Passenger	Public Transit	Walked	Cycled	Other	Carpool & Public Transit
United States	78.2%	12.6%	4.7%	3.0%	0.4%	1.0%	17.3%
Canada	73.8%	6.9%	10.5%	6.6%	1.2%	1.0%	17.4%
UK	62.0%	8.0%	14.0%	11.0%	4.0%	1.0%	22.0%
Australia*	71.0%	7.6%	8.5%	4.7%	1.2%	7.1%	16.0%

Sources: US Census, 2000 Journey to Work, StastCan, 2001 Commuting Patterns of Canadians, UK DfT, 1999 National Travel Survey, ABS, 2001 Census of Population & Housing

North American Ride matching Services (July 2011).

612 Carpooling

143 Vanpooling

Sources: ITS Berkeley, Transportation Sustainability Research Center

Ride matching platform partnerships

From 2004 to the present, a new generation of ride matching platforms has been developed for regions and employers to use. Moreover, there has been significant growth and overall success with this strategy. Partnerships between ride matching software companies and its large-scale clients take advantage of existing common destinations and large numbers of potential members. These firms sell their ride matching software "platforms" to public agencies and employers, which are sometimes used as standalone websites for each group. While this partnership strategy has gained more users than previous ridesharing phases, it is most suited for commuters with regular schedules.

« Green trip » sponsored incentives

Many public agencies and companies promote ridesharing by providing its members with incentives. One example is NuRide —an online ridesharing club with over 63 000 members in seven US metropolitan areas (NuRide, 2011). NuRide rewards points when members carpool, vanpool, take public transit, bike, walk, or telecommute for both work and personal trips. These points can be used for restaurant coupons, shopping discounts, and attraction tickets. NuRide partners with public agencies, employers, and businesses to sponsor the incentives. Similarly, RideSpring works with employer commute programmes and participating employees can enter monthly drawings for prizes from over 100 retailers (RideSpring, 2010).

Social networking platforms

The rise of social networking platforms, such as Facebook, has enabled ridesharing companies to use this interface to match potential rides between friends or acquaintances more easily. These companies hope that social networking will build trust among participants, addressing safety considerations.

One example is Zimride, which has partnered with 86 US and Canadian colleges, universities, and companies that each has their own "network" of members (Zimride, 2011). In addition to each network's website, Zimride also uses the Facebook platform to attract public users.

Another service is PickupPal (2011), with over 156 000 members in 120 countries. It allows members to create their own groups based on common area, company, school, and shared interests. However, social networking may limit itself by relying on more isolated groups and excluding less tech-savvy users.

At present, there are four major North American ridesharing programmes focused on social networking: GoLocoTM, Gtrot, PickupPal, and Zimride.

Real-time ridesharing services

Real-time ridesharing uses Internet-enabled "smartphones" and automated ridematching software to organize rides in real time. This enables participants to be organized either minutes before the trip takes place or while the trip is occurring, with passengers picked up and dropped off along the way.

These programmes attempt to address the inconvenience of traditional carpooling and vanpooling.

All this models for ride matching added to the differents periods of ridesharing apps, made that until 2011, just in North America were 638 ridematching services.

Therefore, it resulted in disparate, non-standardized databases that leave many programmes with a lack of critical mass and safety.

The latest movements and strategies on market across the world

During the last years what the market has experimented the rise of some start-ups around the world related to ridesharing and carpooling smartphone applications and web services, using the technology like google maps to have real time ridesharing services and the implementation of new economy business have resulted in some interesting movements and strategys in the global market . We can see it in the Table 1, the recolecting founding those company have had, give the impression that is a lot of interest from investment companies in this market. Also some of those have taken the strategy to spread their services around the world, buying other local companies or even their competitors.

We are in front of a new and fast growing market, which one have aroused the interest of those were partner before, to nowaday become ferocious competitors. Nowadays have become a race, everyone is working with each other and working against each other, what make the market push forward technological and size advances.

Some companies

UBBER

Uber, is an USA company, headquartered in San Francisco, California. As of May 28, 2015, the service was available in 58 countries and 300 cities worldwide

Since Uber's launch, several other companies have emulated its business model. Uber have the rideharing and also pooling app. The ridesharing app consistis in a platform which connects passengers to drivers for hire car services, allowing consumers to request for a trip, an specific driver, car, etc. In the position of the driver, let to a normal person to serve like a taxi, and be himself his own boss. The mobile app sends an electronic hail for a car based on the person location. The service guarantee a ride and the transactions are automatically billed to the passenger on the credit car by Uber.

The end users are upper class, business class, urban middle class and the suppliers are individual middle class drivers and companies that provide transportation services, like limousine companies. Those companies and drivers are required by contract to have all the requisite licenses, registrations and insurances. The value proposition for end users is secure, trustworthy and guaranteed ride with shorter waiting, and for the drivers, busier and efficient days.

Uber, that is a USA company is leading the funding received, having in total 5.9 billions USD collected, being one of the youngest companies in the market, just founded in 2011.Nowadays Uber value is more than $50 billion. (the Wall Street Journal reports), what would make it the highest-valued private startup of all time.

One of their biggest strategy for success is because they push the innovative idea, have recolected big amounts of founds what let them to have an agaressive marketing campaign, which include free ride for customers, or bonus for drivers who achieve a certain amounts of rides. For example for new users they give $30 USD free for the first ride. And for drivers, to attack their competitors, they offer $500 USD for when you achieve your 20th trip and if you were on another ridesharing platform before. All this strategies make of Uber very popular between consumers and drivers.

Uber also faces an ever-growing cast of adversaries that includes dubious regulators, litigious drivers, hostile members of the press, and some well-funded rivals. But the most significant threat to the app-based transportation company may be much closer to home, from one of its biggest investors, Google. Google Ventures, the search giant's venture capital arm, invested $258 million in Uber in August 2013, and it was Google Ventures' largest investment deal ever, and the company put more money into Uber's next funding round less than a year later.Now there are signs that the companies are more likely to be ferocious competitors than allies. Google is preparing to offer its own ride-hailing service, most likely in conjunction with its long-in-development driverless car project.

BLABLA CAR

BlaBlaCar is the world's largest long-distance ridesharing community.Conceived in December 2003 by Frédéric Mazzella, and founded in 2006, BlaBlaCar connects drivers and passengers willing to travel together between cities and share the cost of the journey. BlaBlaCar has more than 20 million members across 19 countries across Europe, Russia, Turkey, Mexico and India.

The site and free mobile apps provide a range of features to create a secure, trust-based community and easy connections between drivers and passengers.

BlaBlaCar is based in Paris with offices in London, Madrid, Milan, Hamburg, Budapest, Warsaw, Moscow, Istanbul, Munich, Mexico City and New Delhi. Just in July 2014, in their third founding round, received 100 millions USD from different investors, which has allowed to make some acquisitions of locals companies to enter into new markets or even buying their competitors, like was just recently in april 2015, with carpooling.com, their biggest competitor, a ride sharing network in Europe, funded in Germany. Aventoners.com from Mexico, Postoinauto.it from Italy and Podorozhniki.com, Smart ridesharing networks with presence in Russia and Ukraine are among recent purchases of Blabacar.

LYFT

Lyft is a privately held, San Francisco–based American transportation network company. The company's mobile-phone application facilitates peer-to-peer ridesharing by connecting passengers who need a ride to drivers who have a car. Lyft's tagline is "your friend with a car". Lyft operates in about 65 U.S. cities, including San Francisco, Los Angeles, and New York City, with plans to expand domestically and internationally.

The case of Lyft is very particular, due its founder John Zimmer originally founded Zimride, a ridesharing company focused on ridesharing for longer trips, often between cities, and linked drivers and passengers through the Facebook Connect application. Zimride eventually became the largest rideshare program in the United States, but later due to emergence of Uber in the market, he decided to sell Zimride, and lunch Lyft to focuse on other business model to compete with Uber and Sidecar.

SIDECAR

Sidecar is a transportation network company that connects people for real-time ridesharing. They oofer the service of ridesharing and also carpooling. Its headquarters are in San Francisco, California, but serves many cities. People can choose a ride based on vehicle, price and estimated time of arrival using their smartphone.(http://en.wikipedia.org/wiki/Sidecar_%28company%29)

It is one of the visionary companies,due to his co-founder SunilPaul, was issued a patent, now held by Sidecar, for using smartphones to coordinate transportation.

Sidecar to try to attract more users, has launched one of its promotions, that consist in if you refer to a new user, you can get free Sidecar Credit.

DIDI DACHE AND KUAIDI DACHE

Didi Dache, a taxi-hailing smartphone app, shows the real-time locations of taxis so that users can hire cabs via their mobile devices. The application shows the real-time locations of taxis on a map using the GPS technology and enables users to find a taxi though their smartphones. The users' request will be sent to proximate cab drivers who will decide whether to accept the order or not. Didi-Dache was launched in September, 2012 and has been downloaded more than five million times.

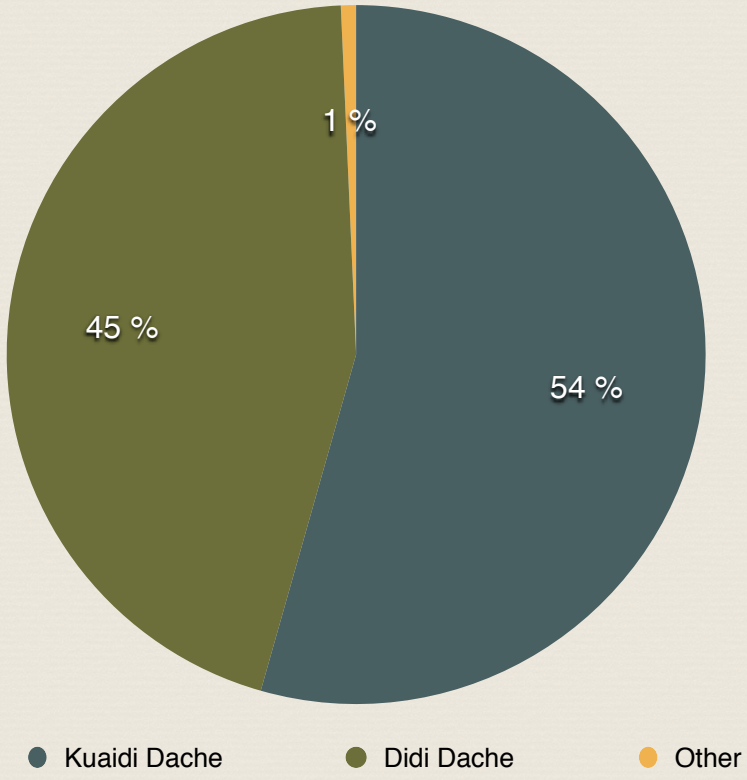
Kuaidi Group, as the most technologically integrated and largest car service company in the world, is rapidly transforming the concept of moving people – starting in China. The app was launched in August 2012, combines integrated mapping and third party payment technology to make its service accessible to everybody, and provides over 1 million taxis and a variety of standard and luxury cars for all lifestyles. To ensure the service fits smoothly into urban life, Kuaidi has developed a framework is that is adaptable to other platforms in China, and works in partnership with China's government and regulators instead of against them. In a country where only 18% of per capita car ownership, Kuaidi is clearly meeting an important need. Kuaidi's unique business model has attracted 100m registered users in over 300 cities, fulfilling 6 million requests per day. To optimize its services and go beyond customer expectations Kuaidi has secured partnerships with Alipay, Ctrip, AutoNavi, Baidu Maps, Qunar, and Beijing's '96106' government official platform.

In February 2015, Didi Dache and Kuaidi Dache announced they merge to create one of the world's largest smartphone-based transport service companies, worth around $6 billion. Now they have become Didi Kuaidi.

Kuaidi Dache and Didi Dache are believed to account for a whopping 99% percent of China's taxi app market. Together they have more than 200 millions users and more than 1 million drivers.

China's taxi and ridesharing app market is a battlefield, both politically and commercially. Even that they have largely in charge of the market, the are not sleeping and trying to take care of their closest competitors like Uber and Yidao Yongche, and do not leaving them to gain market. A new program that allows its app users to use 15 RMB (US$2.42) discounts twice a day if they use Didi Express. Each 15 RMB discount can cover about 10 kilometers, meaning that Didi Express customers can ride up to 20 kilometers per day for free using the service. The heavily-discounted rides are available in 12 major cities, including Beijing, Guangzhou, Shenzhen, Chengdu, Wuhan, Xi'an, and Nanjing, but not including Shanghai. Offering these kinds of discounts doesn't come cheap; Didi Kuaidi will reportedly have to cough up RMB 1 billion (161 millions USD) to cover the month.

China Ridesharing Apps Market Share 2014



DIDA PINCHE

Dida Pinche was founded in 2014. Beijing-based Changxing Information Technology, developer of mobile ridesharing app, has completed received 130 USD millions in founding. This will increase its market expansion efforts, upgrade its customer experience and expand its user base. It currently covers 13 cities and has more than 4 millions of users.

Also DIDA PINCHE investor told Reuters, the have met Uber Chief Executive Officer , Travis Kalanich, to discuss possible investment or tie-ups.

Also in China worth mention two new companies related to carpool and ridesharing apps, Tiantian Yongche and 51yongche, those who are new entrants to China's ridesharing market. The may have funding of some major players, but at present its reach is still quite limited. The service operates in specially in the most important cities.

Part II

Transportation Analysis

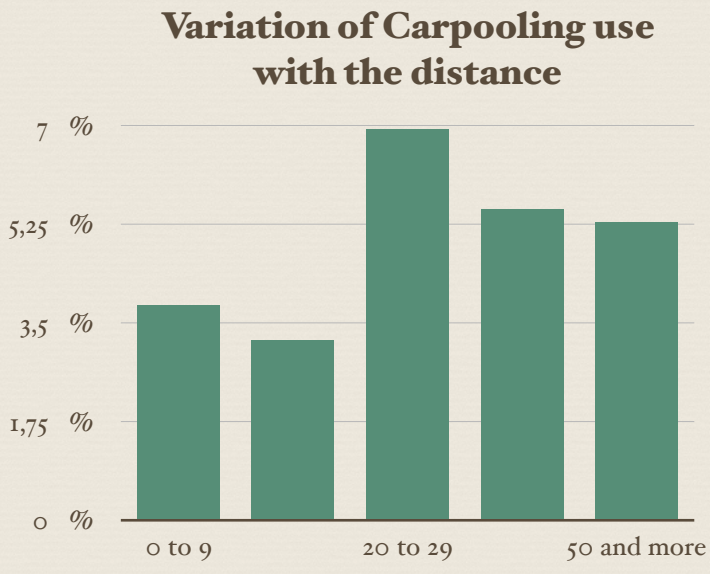
Environment Impacts

The part of atmosphere pollution due to the transportation is very high in the big cities. For these areas, we consider that the transportation by road is the first responsible of emission of NOx and PM10 particles. The process of emission of those particles is:

- The VOC (Volatile organic compounds): those particles are emitted directly from the exhaust of cars.
- NOx: some of those particles are emitted by the engine and some others are produced by chemical reactions in the atmosphere due to the NOx emitted.
- PM10 and PM2.5 are emitted or created by the VOCs. There volatility is due to the traffic.

In this part we are going to calculate the ecological impact of using carpooling. We are limiting our study of ecological impact to the CO_2 emission during the travels. Our statistics are collected from the last ENTD (a French study which is made each 10 years to know how French people are traveling). The study was made with a sample of 20200 representative households of the national (France) tendency.

Those figures are showing that the most important use of carpooling is related to travels between 20 and 30 km.



Short Distance Trips

We learn from ENTD's figures that, the mean distance between house and work place is 14.7km.

This following simulation is made for round trip, 5 working days per week and 52 working weeks in the year.

Part III

Technologies Analysis

Static carpooling

Most of carpooling systems could be described as static carpooling systems. The implementation of the concept is usually made through a simple website which can only save and display the available offers. The only advantage of this solution is the simplicity of implementation. A registration is required from potential users to have access to the full functionalities of the website. But unfortunately, the provided functionalities consists only in adding or consulting the offers with different options like the type of the car that don't change anything to the transportation problematics. For those websites, a data base is necessary to save the uploaded offers and answer the consultation requests. The only technological aspect that is important to deal with is the storage capacity which is absolutely not a problem nowadays. Indeed the management of those databases is very simple.

The websites like Blablacar is included in this category. The consultation of the offers is public but all other functionalities are accessible after a registration. After accessing the result of research on the database, the user can exchange some messages with the driver for the details. All the communications are made publicly and on the website. The carpoolers can have access the personal contact of each other only after buying and finalizing the transaction. Other website, with nonprofit objective, can give access to the personal contacts directly on the offer to reduce the number of operations made on the website.

The success of those systems doesn't guarantee a stability for those companies. Indeed, regarding the development of new technologies and the evolution of people's habits, the existing websites are becoming obsolete and a modification of the technologies seems to be a must.

Technologies to boost the market

Dynamic and flexible system

This is a new concept in the area of carpooling and transportation in general. It consists on managing a continuous access to the carpooling available offers. A real time access is provided through a continuous updating of the offers and the demands. The development simultaneous development of this new “Smart” concept and the new technologies is not a coincidence. Indeed with the popularization of smartphones, tablets, connected devices (particularly for the cars), free access to the Wifi, GPS, 3G, 4G... the ‘in real time” became totally possible and accessible for all people. This evolution is directly relevant to the carpooling industry in the way that it is going to transform and change this industry by giving more solutions to solve the problem of flexibility.

But even if the access to these technologies is a big opportunity for all the companies in the transportation industry, the all potential of this situation is not exploited. The major part of the startup projects have been failed due to security problems, automation of the procedure and optimization in the process of offers association. But all the concepts developed are based on one unique technology which is the recuperation of GPS position in real time and sharing it with

A distributed system for more flexibility

Solving the problem of flexibility of carpooling is a major challenge for all the companies in this industry. Regarding the dynamic aspect of carpooling environment, a good carpooling system has to be adapted to this evolving environment. Indeed the variation speed of the inputs are a major obstacle for the development of reliable system. The collection of data is made through a large area and large number of users. The prediction of evolution of those data (like the position of cars, the time that people need to carpool...) through statistical methods become impossible. The only solution is making a dynamic model of the network with decentralized decision making. It means that the decision of association a user to a car must be done autonomously.

This aspect could be implemented by decentralized systems like Multi-Agent Systems (MAS) or Blockchain. The objective of these Agents is to successfully associate the different users through an optimization process subjected to several, complex and variable constraints. The choice of using MAS is directly related to the variation, the increase and the distribution of information sources. Indeed, in the classic systems, when the size of the network increases the complexity of the medialization became high and the limits of the systems are revealed. But with the MAS, the size of network increases the relevance of the solution. Indeed, managing a high number of data sources is not a constraint anymore. Then, the system become interesting because it offers more possible solutions.

Technologies to boost the market

The optimization is a key point for our analysis. Since the development of IT, people started studying optimization applied to different areas. We can easily use the large number of studies about optimization in transportation and specifically in transportation by taxi as a start point for our carpooling problem. Indeed, we can easily identify similarities between a taxi network and a carpool network especially for travels home – work.

In the carpooling industry, some optimization algorithms have been developed but not in order to make the system more flexible. Those algorithms focus more about associate rides after collecting static data. Indeed, two limitations can be listed.

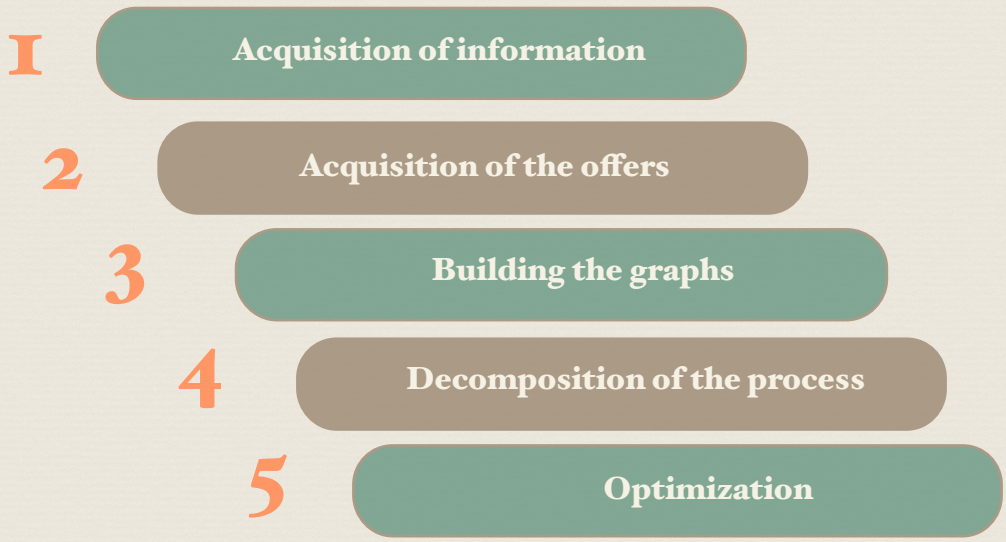
- The first one is the limitation of geographic area. Indeed, if we look to carpooling websites that use optimization concept, we can notice that the geographic area is limited to one company, one university or one small organization.
- The second one is the problem of flexibility. The results that have been applied don't take in consideration the dynamic aspect of problem. After making the combinations and association of drivers and passengers, the system will not be able to adapt to other situation like an introduction on a new user (driver or passenger), modification of location of one of them....

If we assume that the taxi optimization problem is a good starting point, we have to emphasis an important point which is specific to the carpooling system. Indeed, for the taxi problem, we need to associate clients to drivers. For this we consider the current positions of the taxi, the initial and the final positions of the clients. In the carpooling system, the driver and the client have two different objective. It means that the driver has his own itinerary and we should consider whether a deviation from the initial itinerary is acceptable or not. It means in the carpooling system, we should introduce a concept of tolerance that is going to quantify to what extent the deviation is importance. users and the arcs are the itinerary that can be token. These two kind information are automatically updated using GPS localization module. For this part of technology, there is nothing innovative and a lot of applications like Uber are already using this.

The second graph is built by collecting the information, the constraints and the preferences of users. It is built with the initial position, the final position, the number of people and the total duration of the trip. This last variable is calculated using an adapted function and including other parameters like the late time admitted, the tolerance about distance and all constraints that are considered as relevant.

With a similar way, we can build the last graph about the offers. We will build it using the initial position of cars, the destination of cars, the number of available sits, the duration of the trip and also one more parameter which consist in a vector of intermediate destinations. Indeed, to simplify the resolution of the problem, it is better to create a vector that groups all the information about the points that are possible to serve. Doing this, we can easily check if a user's destination can be served by comparing this final destination of the user to the intermediate points of cars.

When this basic concept if developed, we need to develop a strategy of treating the data. For this we are going to use 5 major steps.



Step I: Acquisition of the

For this step we need to receive all the demands for carpooling and treat them in parallel. For this, the time is one of most important parameters. Each interval of time t, we refresh the entering data and build the new matrix containing the information for the graph of demands.

In this part we need to use 3 major technologies. The first one is the internal clock of the system with a precision of a few seconds or less. Then we need to use GPS inside user's device. If the device doesn't contain any GPS technology, other solutions are possible like using Wi-Fi signal or 3G/4G localization system. Then the last one is the communication protocol. Indeed, to send all these data from a device to another, we need build first a communication protocol which is going to guarantee in one hand, the transmission without any loss of information and in the other hand, the security of users by the cryptography algorithms.

Step II: Acquisition of the offers

During this step, we are going to perform the same tasks than last part. Also in this part we need to update the data in "continuous" flow. For this we are going to setup a time t before each new acquisition. The technology that we are going to use is the same. But, as we are talking about cars moving, we need to use better quality technology to have accurate data processing. Indeed, if for the users, a simple GPS in the smartphone is adapted, for the car we need to use the integrated GPS with more precision and high frequency of updates.

Step III: Building the graphs

This step is totally virtual and doesn't use any real hardware technology. But even if only algorithms are involved for this step, it is a critical step. Indeed, for the 2 previous steps we defines the way to collect and to store data in Matrix. Then using theories coming from "Graph theory", we are able to build a Graph. Here graph refers to mathematical concept of graphs.

Acquisition of the offers : Step IV

This step is also a virtual one. It consists on grouping the users and the cars in small geographic areas. In order to simplify the calculations and the then reduce the complexity, different studies agreed to group the data within circular areas.

The method that is used is called “hierarchical clustering”

Hierarchical clustering - Wikipedia

Optimization : Step V

Considering the definition of the problem, the multiple objective optimization seems to be a must. Indeed, more and more problems can’t be solved by optimizing one function. Our problem is one of them. The distributed modeling that we choose imposed to use this kind of optimization.

Many possible algorithms and methods can be used to solve this kind of problems. In the literature, and for the multiple objective optimization problems, we can find the following algorithms.

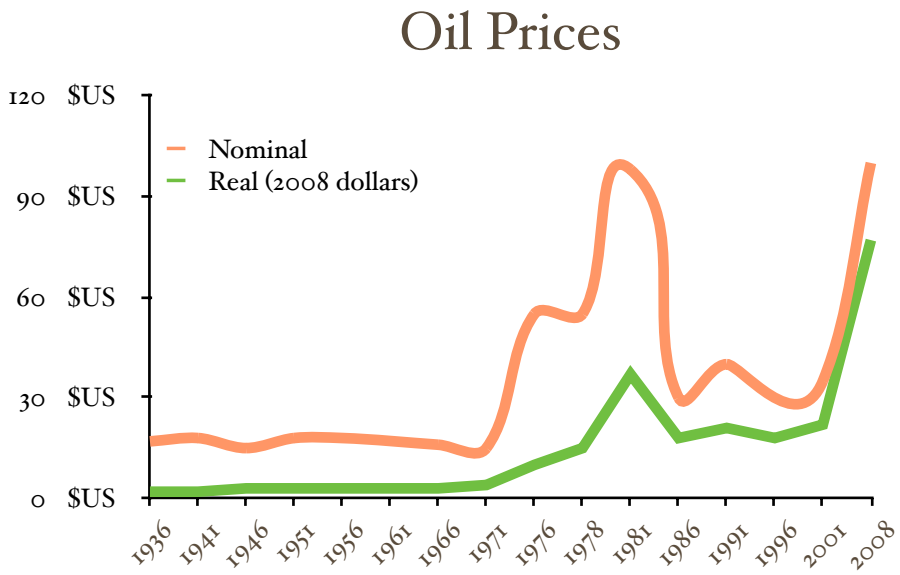
Simulated Annealing using Metropolis algorithm which is based on the research on an equilibria inside the system, Tabu Search for the problems where we need to record the different tries, Evolutionary algorithms and Ant colony which are the most flexible, robust, and decentralized algorithms that we have developed. The only obstacle is the evolution of the research in this area. Indeed, even if the concept is developed, the application on real cases are difficult. Maybe this algorithm will be the future of this industry, but for the moment, the specialists agree to say that the most adapted algorithm for carpooling is the “Dijkstra's algorithm”

Dijkstra's algorithm - Wikipedia

Security for carpooling users

Even if the management of the transportation offers is a big issue for all the companies in this industry, from the point of view of users, the security and the traceability is the most important aspect and obstacle for the development of dynamic carpooling. The development of systems as “eNotions” in Germany, “EasyRider” for Amsterdam and “T.écovoiturage” in France haven’t solved those problems.

Blockchain and carpooling


Oil Prices
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Real (2008 dollars)
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Executive Summary

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Introduction

Concept of Carpooling

Carpooling is an option whether or not own or drive a car. If someone know that travel the same route as a neighbor or co-worker, consider arranging to carpool or ride-share. Carpooling is seen as a more environmentally friendly and sustainable way to travel as sharing journeys reduces carbon emissions, traffic congestion on the roads, and the need for parking spaces. Authorities often encourage carpooling, especially during high pollution periods.

Carpool commuting is more popular for people who work in places with more jobs nearby, and who live in places with higher residential densities. Is significantly correlated with transport operating costs, including gas prices and commute length, and with measures of social capital, such as time spent with others, time spent eating and drinking, and being unmarried. Is significantly less likely among people who spend more time at work, older workers, and homeowners.

Carpooling over the years

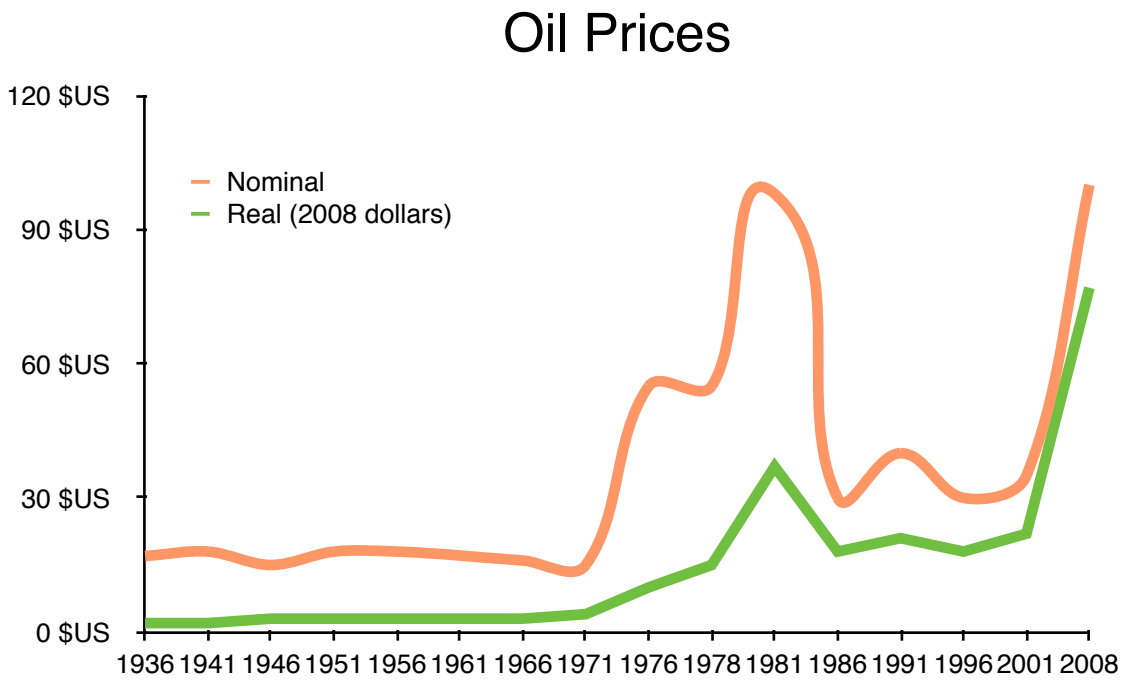
World War II car-sharing clubs (1942-1945)

Focus on conserving resources for the war. Car sharing clubs exchange and self-dispatching system. Matched riders and drivers via bulletin at work.

Fig. 1 Propaganda for Carpooling during the Second World War. Sources: Oregon State Archives, US Archives and Records Administration

Major responses to the energy crises (1970-1980)

Grew significantly in the 1970s in response to the energy crisis and the Arab oil embargo of 1973 to 1974. Focus on conserving fuel. Employer and government sponsored ridesharing projects.



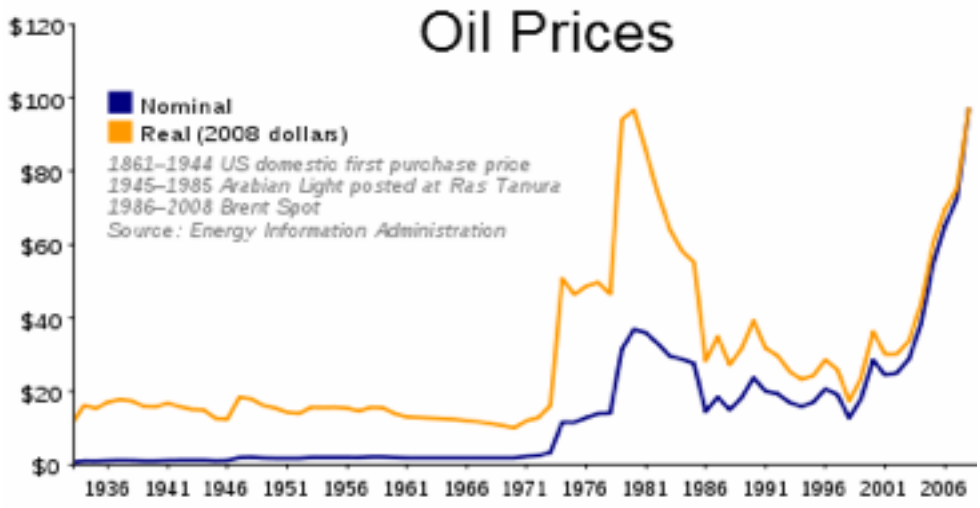


Fig. 3 Cars wait in long lines during the gas shortage in 70´s

Early organized ride sharing schemes (1980 - 1997)

Focus on mitigating traffic congestion and air quality issues. Telephone based ride matching.

Reliable ride sharing systems (1999 - 2004)

Focus on mitigate traffic congestion. Online ride matching services. Traveler information services.

Technology-enabled ride matching (2004 - to present)

Focus on reducing climate change. Financial incentives for "green trips" through sponsors. Growing dependence on foreign oil and traffic congestion. Partnerships between ride matching software companies and regions and large employers. Internet, mobile phones, and social networking platforms. Real time ride sharing services.

Part 1: Market Analysis

This period encompasses the fifth ride sharing phase, called: "technology-enabled ride matching". In this period is most notable for the widespread integration of the Internet, mobile phones, and social networking (i.e. an online community where individuals connect and interact) into ride sharing services. At present, the majority of North American ride matching services use online websites as their chief technology medium. Many of them are based on a ridesharing software platform purchased from a private company. As of July 2011, there were approximately 12 such companies in North America that offer this software. (E.g. Ecology and Environment, Inc. offers Green Ridew, and Pathway Intelligence Inc. provides Jack Bell Ride-Share). While the abundance of online ridesharing systems is promising, it has resulted in disparate, non-standardized databases that leave many programs with a lack of critical mass.
There are approximately 638 ride matching programs in North America.

As of July 2011, the authors estimated that there were 638 ride matching services in North America, based on an extensive Internet search. This tally includes both online (most have an Internet-based component) and offline carpooling and vanpooling programs. Those located in sparsely populated rural areas, which appeared to have very low use, were excluded. Institutions that have their own ride matching website but employ a common platform were each counted separately. Of the total, 401 are located in the USA, and 261 are in Canada (24 programs span both countries). Carpooling attracts the largest focus, with 612 programs offering ride matching, and 153 providing vanpool ride matching; 127 offer both.

Market size and Growth

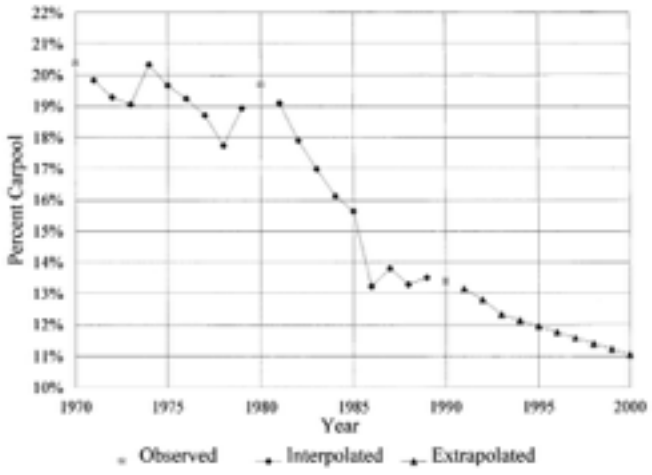


Fig. 4 Interpolated and extrapolated carpool trends in the United States 1970-200. Source: The rise and fall of the American carpool: 1970–1990, Erik T. Ferguson & Associates, P.O. Box 888729, Dunwoody, Georgia 30356, USA

International Comparison of Work Trip Mode Share							
Nation	Personal Vehicle, Driver	Personal Vehicle, Passenger	Public Transit	Walked	Cycled	Other	Carpool & Public Transit
United States	78.2%	12.6%	4.7%	3.0%	0.4%	1.0%	17.3%
Canada	73.8%	6.9%	10.5%	6.6%	1.2%	1.0%	17.4%
UK	62.0%	8.0%	14.0%	11.0%	4.0%	1.0%	22.0%
Australia*	71.0%	7.6%	8.5%	4.7%	1.2%	7.1%	16.0%

Fig. 5 International comparison of work trip modes shares. Sources: US Census, 2000 Journey to Work, StastCan, 2001 Commuting Patterns of Canadians, UK DfT, 1999 National Travel Survey, ABS, 2001 Census of Population & Housing

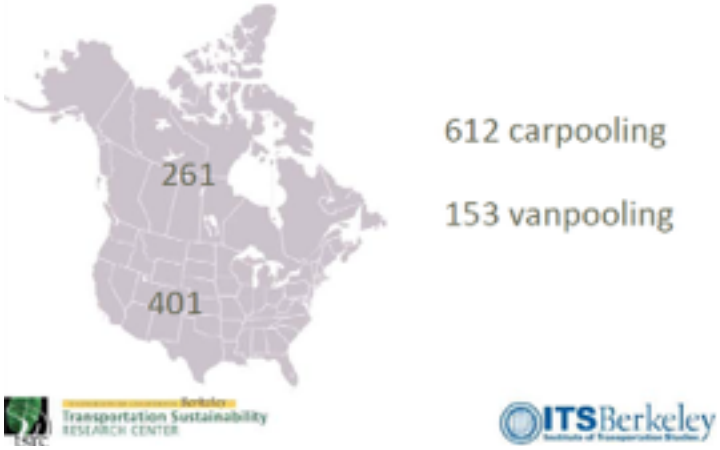


Fig. 6 North American Ride matching Services (July 2011). Sources: ITS Berkeley, Transportation Sustainability Research Center

Ride matching platform partnerships

From 2004 to the present, a new generation of ride matching platforms has been developed for regions and employers to use. Moreover, there has been significant growth and overall success with this strategy. Partnerships between ride matching software companies and its large-scale clients take advantage of existing common destinations and large numbers of potential members. These firms sell their ride matching software "platforms" to public agencies and employers, which are sometimes used as standalone websites for each group. While this partnership strategy has gained more users than previous ridesharing phases, it is most suited for commuters with regular schedules.

"Green trip"-sponsored incentives

Many public agencies and companies promote ridesharing by providing its members with incentives. One example is NuRide—an online ridesharing club with over 63 000 members in seven US metropolitan areas (NuRide, 2011). NuRide rewards points when members carpool, vanpool, take public transit, bike, walk, or telecommute for both work and personal trips. These points can be used for restaurant coupons, shopping discounts, and attraction tickets. NuRide partners with public agencies, employers, and businesses to sponsor the incentives. Similarly, RideSpring works with employer commute programmes and participating employees can enter monthly drawings for prizes from over 100 retailers (RideSpring, 2010).

Social networking platforms

The rise of social networking platforms, such as Facebook, has enabled ridesharing companies to use this interface to match potential rides between friends or acquaintances more easily. These companies hope that social networking will build trust among participants, addressing safety considerations. One example is Zimride, which has partnered with 86 US and Canadian colleges, universities, and companies that each has their own "network" of members (Zimride, 2011). In addition to each network's website, Zimride also uses the Facebook platform to attract public users. Another service is PickupPal (2011), with over 156 000 members in 120 countries. It allows members to create their own groups based on common area, company, school, and shared interests. However, social networking may limit itself by relying on more isolated groups and excluding less tech-savvy users. At present, there are four major North American ridesharing programmes focused on social networking: GoLocoTM, Gtrot, PickupPal, and Zimride.

Real-time ridesharing services

In North America, two companies are beginning to offer real-time ridesharing services: AvegoTM and Carticipate. Real-time ridesharing uses Internet-enabled "smartphones" and automated ridematching software to organize rides in real time. This enables participants to be organized either minutes before the trip takes place or while the trip is occurring, with passengers picked up and dropped off along the way. These programmes attempt to address the inconvenience of traditional carpooling and vanpooling. As in most ridesharing services, a high subscriber base is required. These key developments and their target journey purposes are summarized in ´Table 3.

Some companies

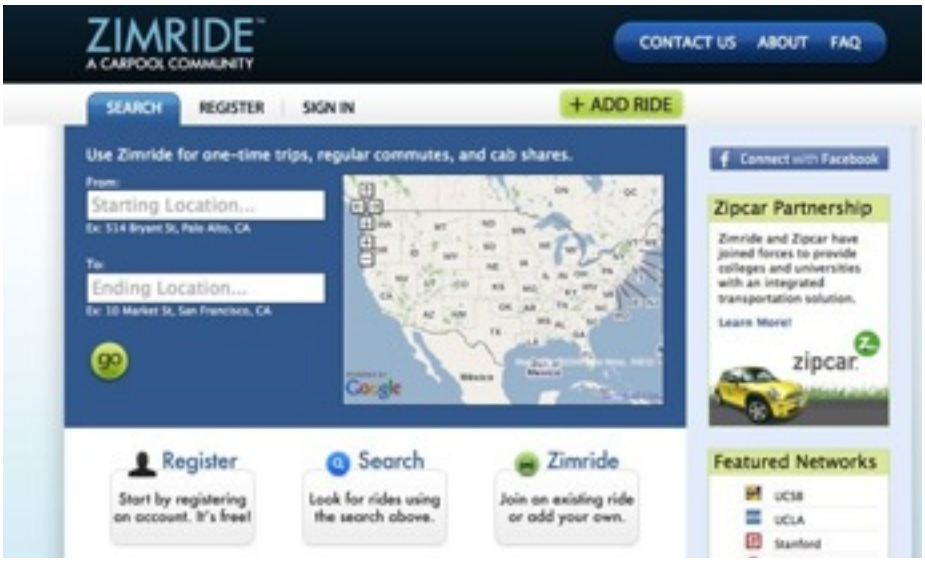
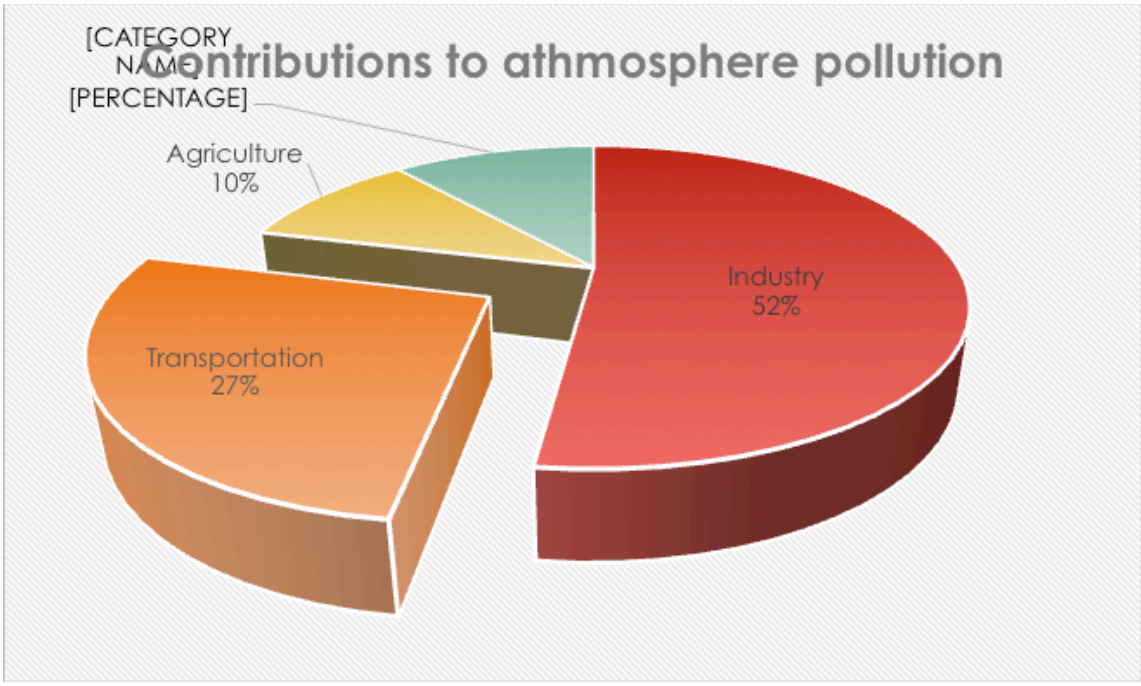


Fig. 7 Zimride.com: Ridesharing with Facebook (USA

Fig. 8 Nuride.com

Part 2: Transportation Analysis

Environment Impacts



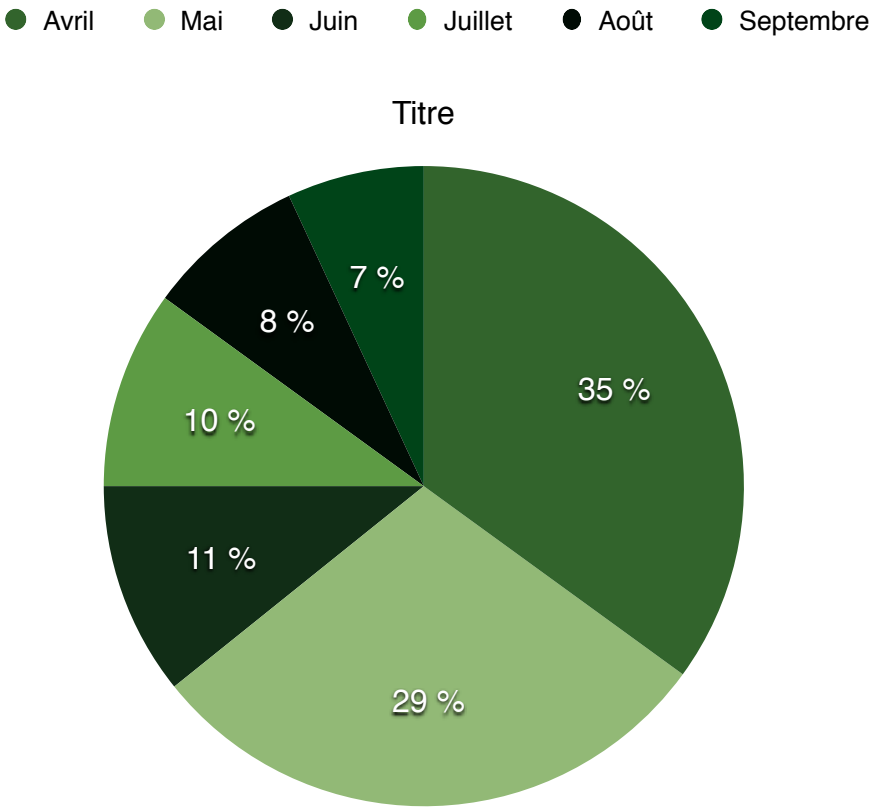
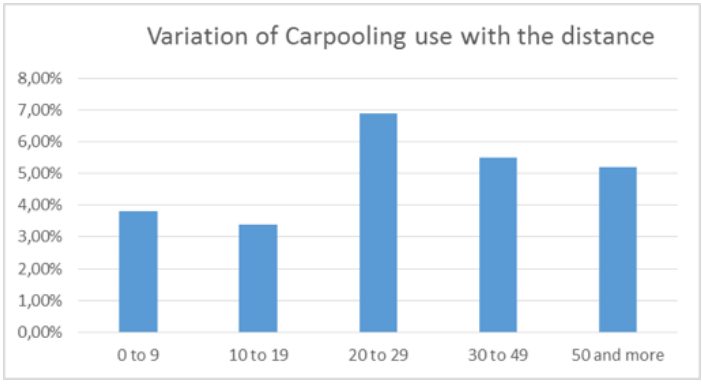


Fig. 9 Contribution on transportation to the atmosphere pollution. Source http://www.ec.gc.ca

The part of atmosphere pollution due to the transportation is very high in the big cities. For these areas, we consider that the transportation by road is the first responsible of emission of NOx and PM10 particles. The process of emission of those particles is:

- The VOC (Volatile organic compounds): those particles are emitted directly from the exhaust of cars.
- NOx: some of those particles are emitted by the engine and some others are produced by chemical reactions in the atmosphere due to the NOx emitted.
- PM10 and PM2.5 are emitted or created by the VOCs. There volatility is due to the traffic.

In this part we are going to calculate the ecological impact of using carpooling. We are limiting our study of ecological impact to the CO2 emission during the travels. Our statistics are collected from the last ENTD (a French study which is made each 10 years to know how French people are traveling). The study was made with a sample of 20200 representative households of the national (France) tendency.



Those figures are showing that the most important use of carpooling is related to travels between 20 and 30 km.

Fig. 10 Variation of Carpooling use with the distance. Source ENTD 2010

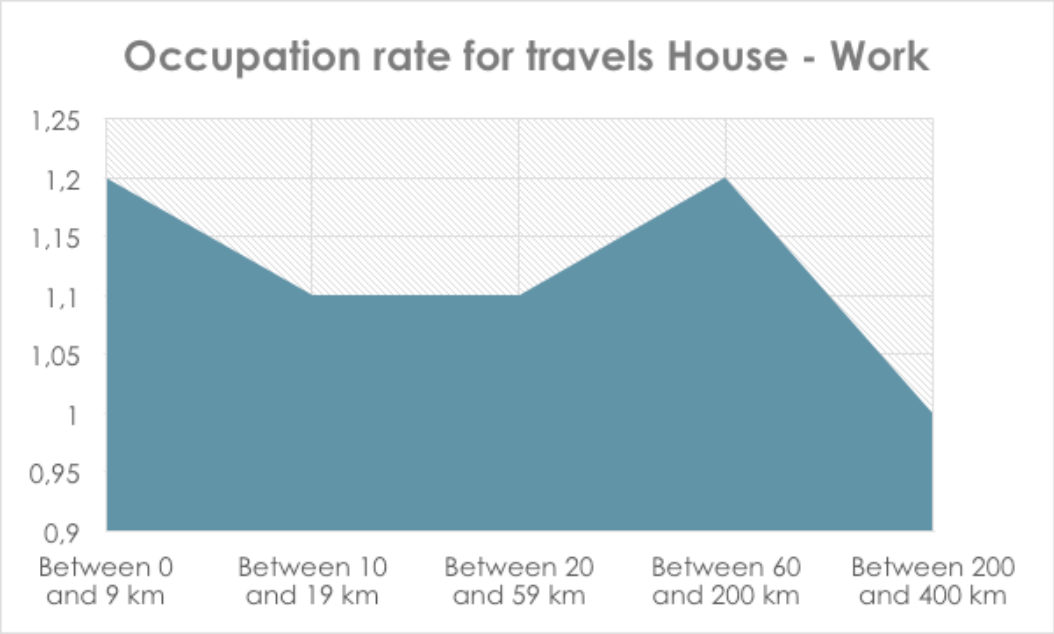


Fig.11

Variation of occupation rate for a type of travels. Source ADEME 2013

Shot Distance Trips

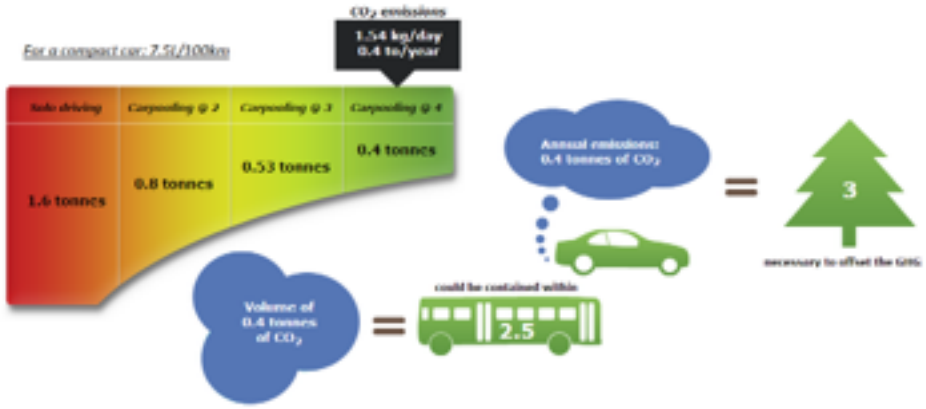


Fig. 12 CO2 Emissions for different scenarios with small car. Source Canadian ministry of transportation

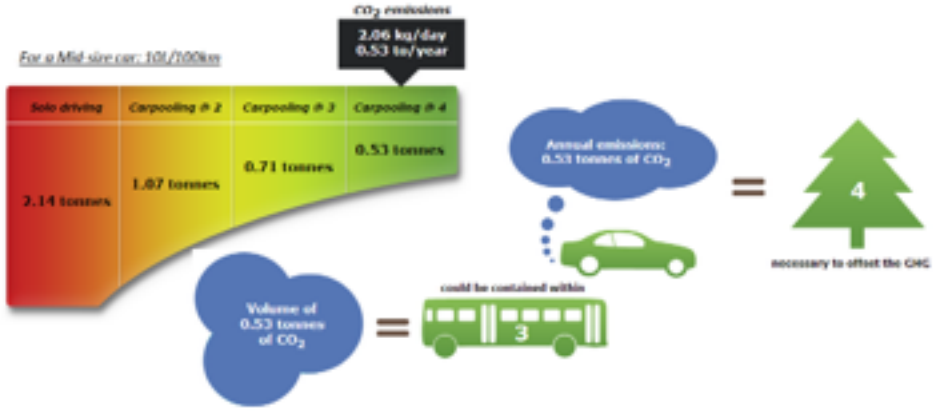


Fig. 13 CO2 Emissions for different scenarios with medium car. Source Canadian ministry of transportation

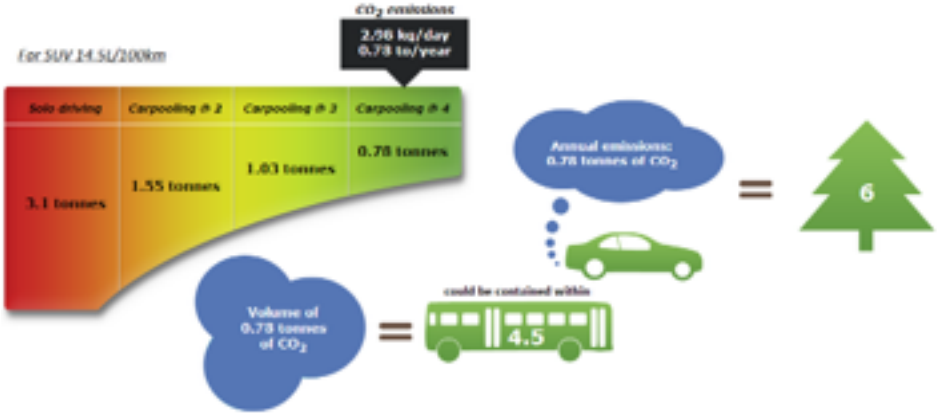


Fig. 14 CO2 Emissions for different scenarios with SUV. Source Canadian ministry of transportation

We learn from ENTD's figures that, the mean distance between house and work place is 14.7km.

This simulation is made for:

- round trip
- 5 working days per week and
- 52 working weeks in the year.

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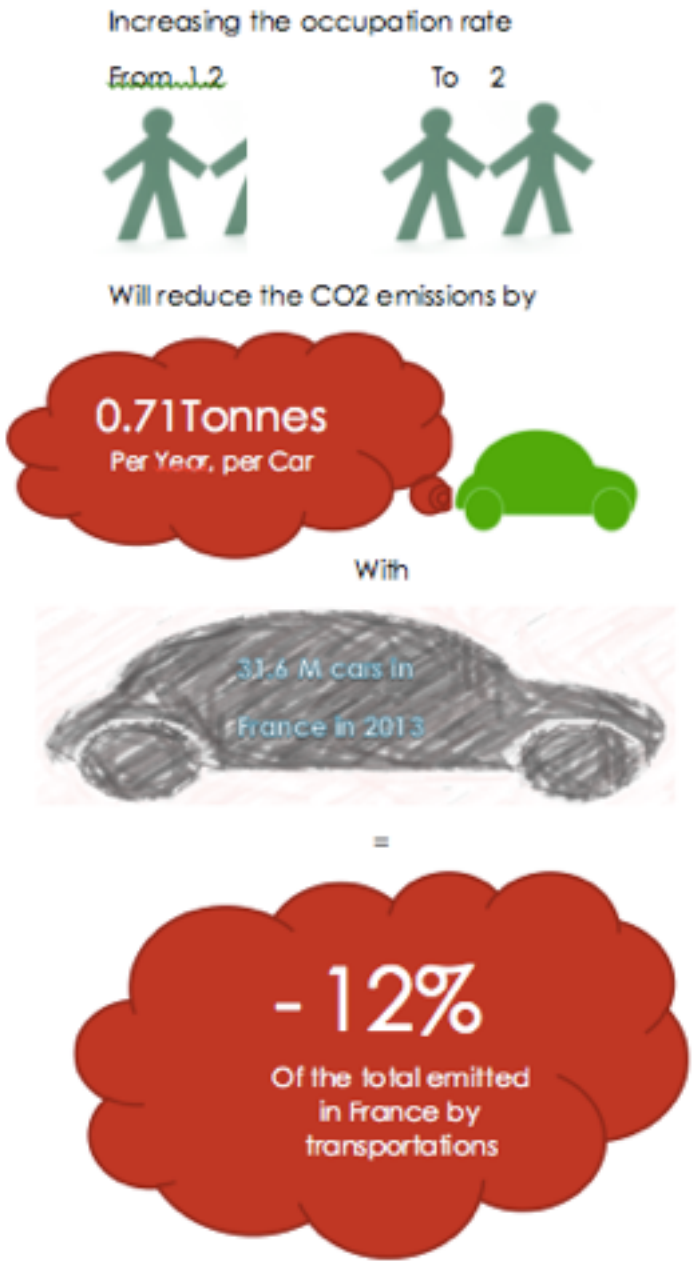

Long Distance Trips

From the previous part, we estimated the emission due to short travels and the potential to reduce this value.

Regarding the percentage of long distance trips, and by ponderation operation, we estimate the total reduction of CO2 emissions in France

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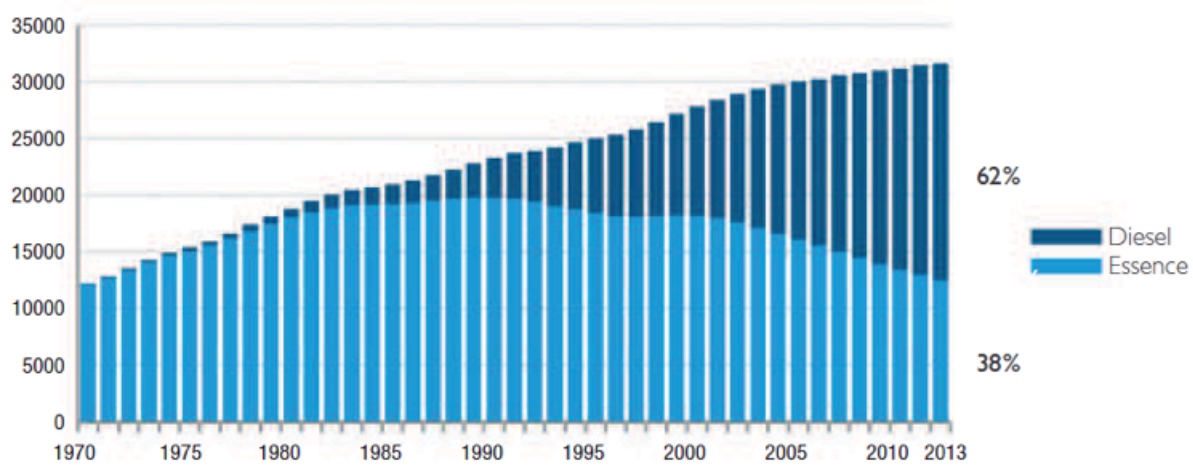
Transportation Cost



Source: SOeS - «Comptes des transports» - Juillet 2014
Champ: France Métropolitaine

Traffic Flow

Part 3: Technology Analysis

Used Technologies

Limited Possibilities

Technologies to boost the market

Part 4: Law and Public policy

Countries Examples

China

The Directorate General for Competition, Consumer Affairs and Fraud Control (DGCCRF) points out in a press release of February 7, 2014 , that carpooling is permissible under the condition that it is free or that the money paid by people transported corresponds to a cost sharing generated by the use of the vehicle.

USA

The Directorate General for Competition, Consumer Affairs and Fraud Control (DGCCRF) points out in a press release of February 7, 2014 , that carpooling is permissible under the condition that it is free or that the money paid by people transported corresponds to a cost sharing

Government Actions

HOV Lanes

High Occupancy Vehicle Lanes

Restricted traffic lane reserved at peak travel time or longer for the exclusive use of vehicles with a driver and one or more passengers.

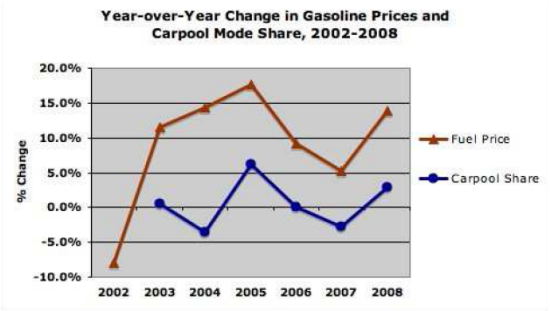
HOV Lanes

All over the world

Part 5: Social awareness

Motivations

Oil Prices and Carpooling



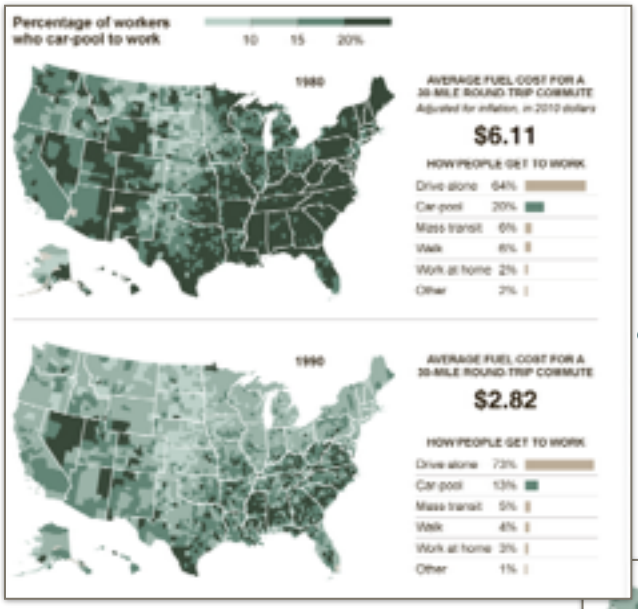
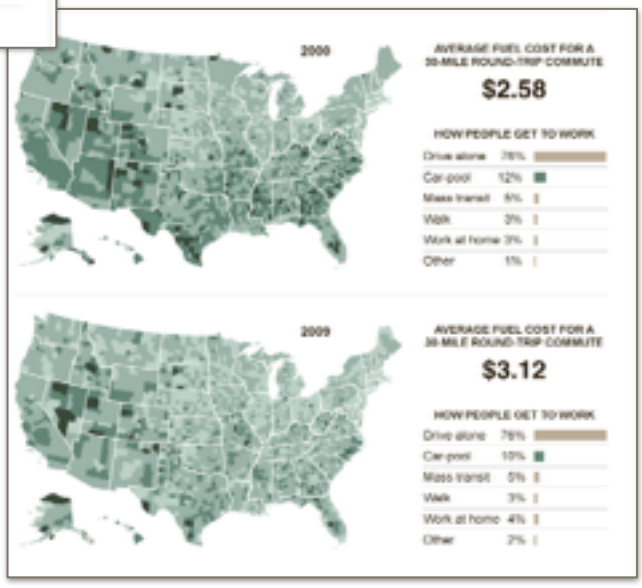


Fig. 13 Relation between oil prices and carpooling, Park, Haeyoun; Gebeloff/, Robert (28 January 2011). "Car-Pooling Declines as Driving Becomes Cheaper". The New York Times



Motivations for Carpooling

Factor	Frequency Selected	% of Total (N=789)
Sharing vehicule expenses	703	89
Access to HOV lanes	699	89
Enjoy travel with others	691	88
Travel time saving	690	87
Preferred parking at work	687	87
Help environment and society	684	87
Carpool partner matching program	680	86
Encouraged by program at work	677	86
Drop off kids at school/day care	674	85
Reliabilityy of arrival time	666	84
Slitting tolls on toll roads	159	20
Other	109	14
Get work done while traveling	79	10
Relaxation while traveling	77	10

Reasons for not Carpooling

Main Reason	Frequency Selected	% of Total (N=789)
Location and schedule limitation	1682	55
Travel flexibility	1394	45
Need a vehicule during the day	1190	39
Need to make other stops during trip	862	28
Appreciate alone time	567	19
No program to encourage me	417	14
Other	248	8
Like to listen to radio that others do not	175	6
Potential partners have disagreable traits	125	4

With who you carpool

Type of Carpooler	HOV2	HOV3+
	Frequency	Frequency
Adutl family member	335	94
Coworker, nearby office building	141	51
Child	91	95
Casual carpooler	22	14
Neighboor	17	10
Other	33	7

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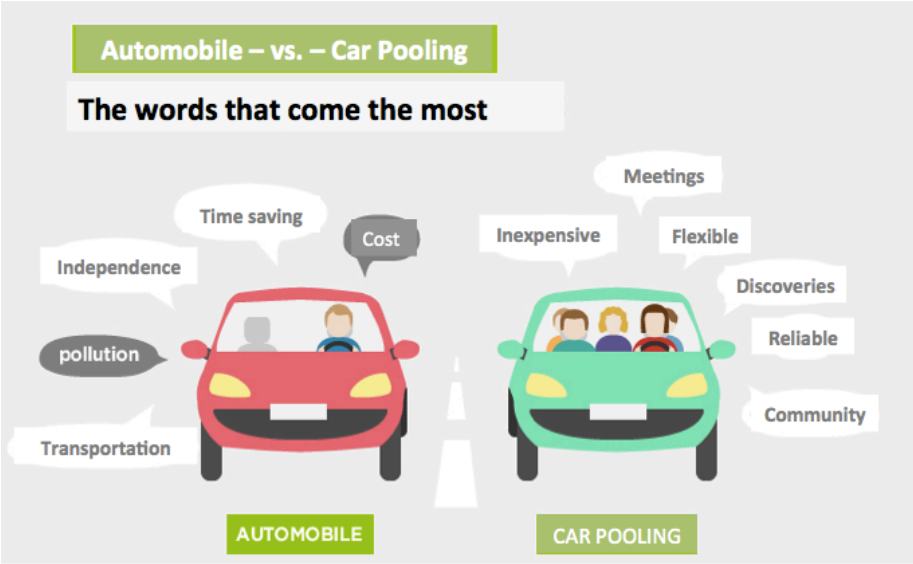
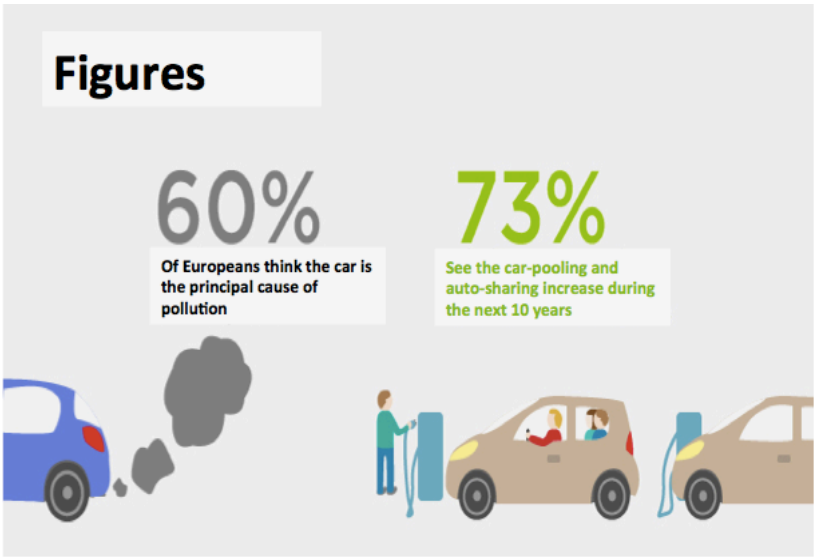
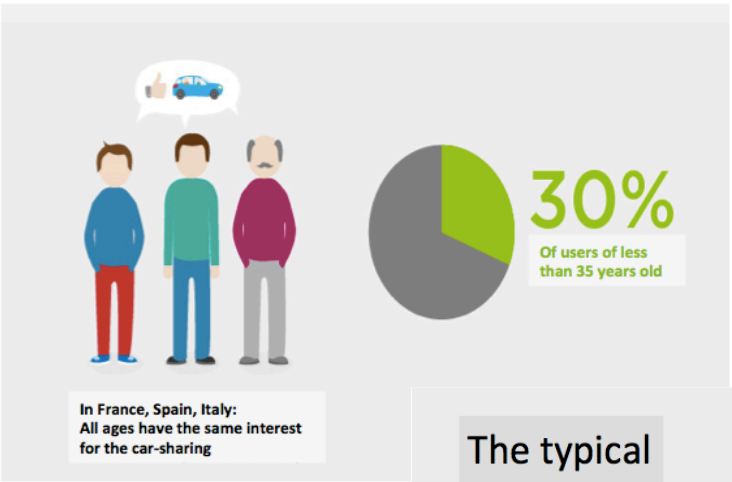

Automobile – vs. – Car Pooling
The words that come the most
Time saving
Cost
Independence
pollution
Transportation
Meetings
Inexpensive
Flexible
Discoveries
Reliable
Community
AUTOMOBILE
CAR POOLING


Figures
60%
Of Europeans think the car is the principal cause of pollution
73%
See the car-pooling and auto-sharing increase during the next 10 years


30%
Of users of less than 35 years old
In France, Spain, Italy:
All ages have the same interest for the car-sharing


The typical profile
High level of education
Active on social networks
Young

Part 6: Challenges

Conclusion

Blabla

Blabla

Blabla

« BlablablablablablablablablablablablablablablablablaBlablablablablablablablablablablablablablablablaBlablablablablablablablablablablablablablablablablablaBlablabl »

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Appendix

GitHub

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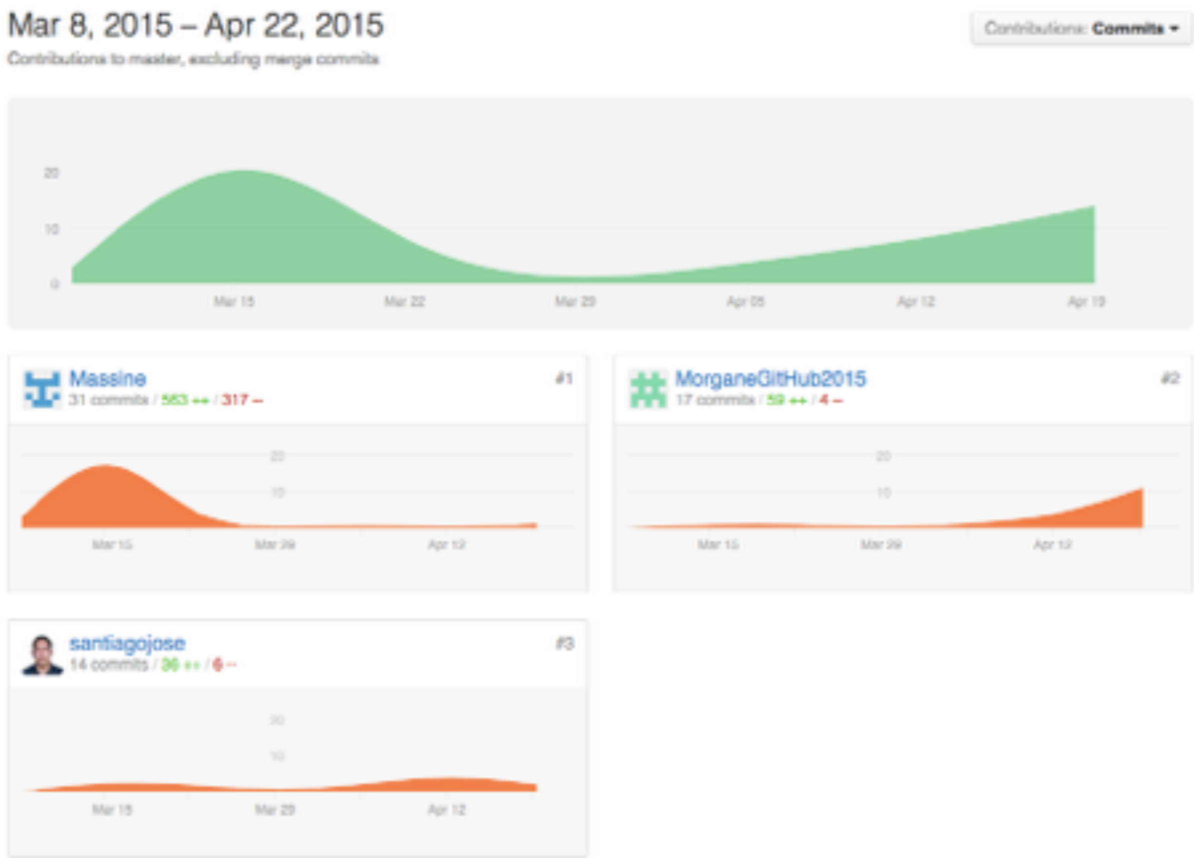

References

ADEME. «ALLÉGER L'EMPREINTE ALLÉGER L'EMPREINTE DE LA CONSOMMATION DES FRANÇAIS EN 2030.» 2014.

Leviers d'actions pour favoriser le covoiturage de courte distance, évaluation de l'impact sur les polluants atmosphériques et le co2. France, 2014.

Amey, Andrew M. *Real-Time Ridesharing: Exploring the Opportunities and Challenges of Designing a Technology-based Rideshare Trial for the MIT Community*. Massachusetts Institute of Technology, 2010.

ATEMA. «CARACTERISATION DE SERVICES ET USAGES DE COVOITURAGE EN FRANCE.» *ADEMA* (2010).

CERTUS. «LES CHIFFRES CLÉS 2014 CLIMAT, AIR ET ÉNERGIE .» 2014.

durable, Ministaire developpement. *http://www.statistiques.developpement-durable.gouv.fr/transports/trv/deplacement-mobilite/mobilite-reguliere-locale.html*. s.d.

Lyon, Mairie de. *RAPPORT D'ANALYSE DE L'ENQUETE 2011*. Lyon, 2011.

Ministère de l'Écologie, du Développement durable et de l'Énergie. «Le covoiturage en France et en Europe: État des lieux et perspectives.» 2007.

«Politiques climat et efficacité énergétique.» *Ministère de l'Écologie, du Développement durable et de l'Énergie* (2013).

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