

Credit-based mobility system.



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Traffic congestion is nowadays one of the biggest problems of livability of cities. The continuous growth of number of vehicles and the difficulty to use funds effectively to improve the capacity of the road is bringing bad times to the local administrators. Mobility managers are in crisis while they are choosing which prohibition to apply to improve the fluidness of cars' flow. The motorists, as usual, are not happy with the continuous rise of new constraints to their freedom. Consequently, new models that act to control the demand rather than to eliminate the demand are rising up. This paper describes methods for the demand control, in particular road pricing and the recent credit-based mobility system that promise to create a virtuous circle that self-adjusts the demand while it preserves the motorists' freedom.

1 Introduction

The traffic is one of the major factors that create problems inside cities. Average citizens and public authorities are both trying to live everyday with road congestion, which is becoming bigger and bigger. The problem is such that also European Union is specifically working on this issue [1].

Traffic congestion [2] occurs when roadway demand is greater than its capacity. Relations of cause/effect between high traffic connections and other problems exist, for example: the traffic increases the stress of motorists which can cause accidents and ultimately leads to a reduced health of motorists; the traffic increase fuel needs (energy needs in general) and pollution; the traffic increases drive times subtracting time for productive activities which damage local economies.

Historically the increase of traffic congestion comes from: (i) the development of private transportations such as cars; (ii) the difficulties arising from the modification of urban infrastructures; (iii) the difficulty to convert the private transportation demand into a public transportation demand (e.g. to convince a private motorist to use a public bus instead of a private car).

Thus, considering the traffic congestion definition there are two ways to decrease the traffic congestion level, the first one is to increase the roadway capacity, the second one is to

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modify the roadway demand. These two solutions are on the conceptual level completely different. The former solution considers the increase of the traffic congestion as a natural fact so a way to cope with that fact is to use a road with bigger capacity. The latter solution, instead, considers the increase of the traffic congestion as a vicious thing and it tries to decrease the problem from the root, the demand. In spite of that, public actors usually prefer to create new roads (increasing roads capacity) rather than apply normative rules that the citizens have to comply.

This paper focuses on solutions for demand control and in particular, on the concept of mobility credits, it is structured as follows. In the next paragraph, the paper describes a general overview of techniques for demand controls and some relevant cases. The paragraph 3 focuses on mobility credits while the paragraph 4 presents some suggested improvements of this model. The paragraph 5 contains the conclusions.

2 The control of the demand

Roughly speaking the actuation of the demand control consists in enforcing some norms to the motorists. There are various kinds of norms, which municipal authorities know well, and they can be classified from how much they constrain the motorist freedom:

- The pedestrian zone that completely closes the access to some zone of the city to motorists.
- The traffic limited zone that controls the access of a specified zone through some policy based on hours of the day and motorists type (e.g. a rule of this type could be motorists can not access to the historic centre between 10.00 and 17.00 but cars with physical disabled people can).
- The stop of circulation can be used when special condition occurs, for example if the pollution level is above a defined threshold. A similar measure consists in stopping only some motorists depending on their numberplate.

The presented solutions have in common that all of them are normative. In this sense there are no alternative for the motorists that want to use the car against the norms. It is highly effective, because it can be supposed that only few citizens are ready to act against the law, and from the other side it is too rigid because it imposes a strict behavior to citizens.

The limitation of this approach opened the road to new approaches, such as road pricing and mobility credits (which will be the topic of the next paragraph).

In [3] road pricing is defined as:

“Road pricing is a generic term for charging for the use of roads using direct methods, charging the users of a specific section of the road network for its use”

The term *value pricing* is used to emphasize the fact that road pricing can directly benefit motorists through reduced congestion or improved roadways.

Road pricing gives fundamentally two benefits to the municipal authorities: it generates revenue and it manages congestions. In fact, applying a charge to the road use authorities can

generate a cash flow and the congestion can be reduced adopting a policy which stimulates people's behavior using money. As transport policy expert Professor Stephen Glaister, from Imperial College, said *"people do respond to price incentives"*.

With recent improvements in the technology the traditional road pricing, that typically uses crossing point to gather the tolls, is becoming electronic. In fact the crossing points are progressively disappearing in favor of cameras, radio transmitters and so on.

Relevant cases of these implementations include the Singapore Area Licensing scheme [4] and the London congestion charge [5].

Moreover, these technological innovations should not be underestimated, in fact with the information management capabilities provided by modern ERP it is possible to enable new scenarios that were not possible in past. For example, it is possible to apply a variable congestion charge mechanism which estimates in real-time how many vehicles are present in the area and charges the new motorists consequently.

3 Mobility credits

The critics to the previous systems are principally related to their lack of flexibility and concerning the road pricing the principal critics is its fairness. Firstly because charging the road that was once "free" is perceived by citizens as unfair, secondly because the system charges the same amount of money for different people profile.

In these years credit-based systems are becoming popular: from frivolous internet peer to peer to international CO2 bank. A credit is an atomic entity which can be used to make operations inside the system. For each operation a certain amount of credits is required and using a startup phase the credits is distributed to the user of the system.

In [6], [7] and [8] the road space rationing is a credit based system where the credit is an equivalent of peak period. Using a revenue-neutral credit-based system, for example, each motorist receives 100 credits that can use, trade or sell to somebody else. The result is a form of congestion pricing in which the benefits are captured by residents rather than road owners or governments.

The credit-based mobility system proposed by Fondazione Accenture [9] is similar but the credit concept differs from the previous one, no more equivalents of peak periods, but calculated using manifold parameters. In particular, the model proposes a complex expression to calculate the credit equivalent consumption based on: the dimension of the vehicle, the kind of propulsion system (e.g. electric cars spend less credits to travel the same kilometers of road), the hours in which the travel occurs, the kind of zone traveled (e.g. motorists consume more credits for the historic centre zone) and obviously the length of the journey in kilometers.

However, in this project the ICT role is underestimated. While the project focuses on credits definition and calculation there are no particular hints on how to practically implement the system. At a first glance this could be just a simple choice: since the problem is too complex the analysis is limited to important factors such as credits calculation, but at a deepen look underestimating the ICT role could cause some important scenarios to vanish. Some of these improvements are suggested in the next paragraph.

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4 Suggested improvement

A first suggestion is to implement an in-car device connected through other devices placed on the roadway to exchange data with a municipal server. Moreover, the architecture should be flexible enough to allow software suppliers to develop their own services for the in-car device. This box should provide services that are also useful and amusing for the final user. The idea is to integrate for example and hi-fi device, a monitor and a service for the navigation inside the in-car interface. In that way the user will perceive something that is designed for him and not only a black box that monitor his behavior. Moreover, this improvement could enable a business model where the user pay for the box and the government give incentives for its buy.

The law [10] already introduced the figure of the “*mobility manager*” for firms with over 800 employees, a policy for adoption of the box could prescribes the use of the box for this kind of firms. In that way the company receives the benefits enabled by services developed for the box, for example a service for direct monitoring vehicles of the firms and a service to coordinate the workforce. The public authority will see in this way an increment of adoption of this in-board box.

Other actors that can take benefits of this product are the local authorities, such as the municipal police or the firemen, for example to coordinate their operations between different vehicles in a rich manner.

Other synergies could be used by actors such as insurances companies, car and IT producers, motorist assistants, local shops, local events organizer:

- With a box that constantly monitor the kilometers traveled by the car the insurance company can apply a tariff that better fits with the motorist’s profile. This can give advantage also to the car owner if he will pay less compared to the standard tariff. Moreover, also security applications could be developed thus the insurance company could apply a reduced tariff to cars that mount this kind of devices.
- Car and IT producers can integrate the technology offered by the box in a fruitfully manner, both new hardware and new software should be developed to enable a wide spectrum of application for the final user.
- Motorist assistants companies can offer a better service to the user. For example with the box inside the car it is possible to make a diagnostic test of the car also if the mechanic is kilometers away from the car.
- Local shops and events organizer can offer services based on location of the user. For example a merchandise shop can offer special deal when the user is near the shop. Local event organizer, furthermore, can use the box to transmit information about historical places, events and so on.

5 Conclusions

This paper presents a review of demand control methods used to reduce the traffic congestion.

The road pricing seems a valid alternative to alleviate the problem, however, as claimed sometimes it is not fair and thus new methods are under research.

The credit-based mobility system is much more complicated of the road pricing but it seems somehow fairer and more effective. For this approach there are a number of problem that need to be solved before the fully implementation will be presented: technology problems are relevant in that case, there are no working prototype of an in-board interface such as the one described in this paper; economic problems need more focus, for example is not defined how to estimate the total number of credits to give to a person, how much is the economic value for a single credit and how much is the credits consumption rate.

Political and social problems need further investigation, in particular if the real implementation could be accepted by the population and therefore if the political leaders will be interested by this kind of system.

Finally seeing the trail leaved by similar systems, such as the bank of CO₂, and considering the difficulties of the beginning phase we are optimists.

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