CAR POOLING CLUBS: SOLUTION FOR THE AFFILIATION PROBLEM IN TRADITIONAL/DYNAMIC RIDESHARING SYSTEMS

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Abstract. Traffic congestion and the associated pressure in car parking, that results from growing car ownership, require the study of innovative measures to reduce the number of cars traveling every day to the city centers, specifically single occupant vehicles. Car pooling is a system by which a person shares his private vehicle with one or more people that have common, or aligned destinations. Until now this systems have been applied mainly in the United States and some Northern European Countries but with modest results. Trust between occupants has proven to be essential for car pooling viability. This paper presents the concept of car pooling clubs as a means to affiliate its members, increasing trust between them and at the same time allowing a more flexible matching between the participants.

1. Introduction

The rising of auto usage deriving from suburban occupation and car ownership growth is making traffic congestion more frequent in urban areas. This results in air pollution, energy waste and unproductive and unpleasant consumption of people's time. In most Metropolitan Areas of the United States the majority of trips in individual transport are single occupant vehicle trips (SOV). In 1990 approximately 90% of work trips and 58% of the other trips were done in SOV [8].

One may conclude that most of the big cities weren't able to insure effective mobility polices for controlling modal split and traffic congestion, and thus need now recovery measures. Some measures have been tested in the last years like passenger transfer to Public Transport and car pooling systems.

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Public Transport cannot be the only answer to this increasing transport demand, because the ratio of demand between peaks and off-peak leads to high capital costs if peak demand is to be served well, and also (as a consequence) to unsustainable levels of public subsidy required to cover costs.

Automobile utilization is very attractive. Its universal appeal is demonstrated by rapid growth in car ownership levels even in countries with high fuel prices, good public transport systems and dense land occupation. Therefore mobilization of private cars is an option that can be used as an advantage through an increase in vehicle occupancy, moving the same number of people in fewer cars.

Car pooling systems search that higher occupancy in home to work travels, associating neighbours who travel to work places next to each other, using the vehicle of one of them. These neighbours form pool groups that must be stable for the system to work, but the cost of such schemes is a loss of flexibility since all the participants must be able to start the return trip at the same place and time, thus severely restraining extra activities after the working period. These experiences have been obtaining some success but they are always limited for schedule differences between the participants and what is most important haven't been able to reach the scale where they would reduce the congestion problem.

The solution for this low flexibility is dynamic ridesharing, also called real-time ridesharing or single-trip ridesharing. This differs from regular carpooling in that ridesharing is arranged for each trip rather than for trips made in a regular basis, and requests for ridesharing can be made close to the time when the travel is desired [3].

The problem that arises from this approach is how to obtain the same level of trust between car poolers, when in some cases they haven't even met before. Resistance to take contact with strange people is normally the greatest impediment for Long Term car pooling, in the case of Daily car pooling there's the aggravation of instability of riding partner on a day to day basis.

To try to solve that problem we introduce a new concept of car pooling clubs, which are meant to build a certain level of trust between the members. The objective is to make clubs at the (or road-axis) level, whose members are pre-selected and registered in a data-base. This brings a higher level of responsibility to the participants and at the same time enables them to meet each other in social gatherings. Notice that the concept is more than a filtered data base, which could be anywhere on a computer server, the concept of a club is much broader; it could have some physical facilities where people are able to meet the organization and its members. This clubs manage traditional and dynamic ridesharing constituting daily pool groups with both fixed and variable riders.

2. The scale problem in Dynamic Ridesharing

Dynamic rideshare matching differs from traditional rideshare matching in two important ways. The first major difference is the treatment of the traveler's schedule. Traditional systems assume that the traveler has a fixed schedule and a fixed origin and destination. A dynamic system considers each trip individually and must be able to accommodate trips to arbitrary points at arbitrary times by matching users' individual trips without regard to trip purpose. The second major difference is that dynamic ridematch systems must provide the

match information to the user quickly in order to accommodate near-term (same day) travel as well as long-term (future days or weeks) trips.

Examples of the application in Dynamic ridematch have been tested in the United States, as an alternative to traditional ridematch systems. These experiences have led to the conclusion that there is a car pooling market for other types of trips other than commuting trips; those are additional recurring trips, and the occasional trip or single trips to single destinations [1]. The number of users participating in a ridesharing program can have a significant influence on the success of such ridesharing; however, the absolute number of users needed to be successful is difficult to quantify.

In 1994 Krishnamoorthy [6] started with the assumption that an 80% match rate would be the minimum to make a dynamic pooling system viable, then he divided Melbourne in zones and formulated lists of acceptable trips between zones. A relation was identified for the percentage of matched trips:

$$S = 100 * \frac{offersmatched + requestsmatched}{offers + requests + ambivalents} \quad (1)$$

The main conclusion of this work was that a 2.5% of population participation rate would result in an 80% success rate. But this is a result made with various simplifications that doesn't consider the attitudinal factors as an impediment for the final step of making the real rideshare, thus Equation (1) reflects the matches but not the real trips.

Figure 1 shows the results from the project Seattle Smart Traveler [1], where one is able to see that the number for Match Attempts is very different from the number of successes and this, in turn, is different from "E-mail sent", that means a real contact being made. Notice that not even the fact that an E-mail was sent is sufficient to guarantee that a trip is going to be shared.

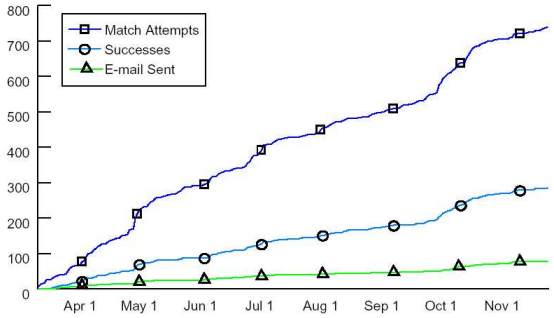

Figure 1. Usage as a function of time (Source: Seattle Smart Traveler)

3. Psychological Factors that affect car pooling

We must conclude that scale is essential to obtain a certain level of real travel sharing, but at the same time as the number of participants increase, also the probability of matching with a strange person increases. This brings the problem of intimacy between participants and a person's availability to share his private vehicle with a strange person.

The question of psychological factors as an impediment for car pooling has already been studied. In 1977 Dueler et al. [2] analyzed these psychological factors, having reached the conclusion that simple information dissemination and provision of incentives are not sufficient to increase car pooling, so an identification of preferences was proposed, and in these preferences gender and acquaintance of the riders were identified as key factors.

Research by Levin, et al [5] at the University of Iowa reached the conclusion that gender of the potential poolers was of little consequence when the other part was an acquaintance, but became of great consequence when the other part was a stranger, see Table 1.

Number of Riders	Respondent	
	Male	Female
Single Rider		
Male acquaintance	10.06	12.50
Female acquaintance	10.47	12.32
Male nonaquaintances	7.00	3.29
Female nonaquaintances	9.50	6.53
Three Riders		
Three acquaintances	10.76	12.15
Two nonacquaintances – one nonacquaintance	9.70	10.84
One nonacquaintance – two nonacquaintances	9.03	7.69
Three nonacquaintances	8.16	3.49

Table 1. Carpool Desirability (15 point scale) as a function of gender and Acquaintance-ship of Potential Ridesharers (Source: Levin, et al., 1976)

As can be seen in the table, the desirability of ride sharing decreases with the increase of strangers in the pool, especially for females. These results suggest that gender and prior knowledge of the potential pooler combine to determine the desirability of the other person for ridesharing. Moreover, different combination of these factors can lead to very different results: when the driver is a Female there's a great difference between transporting two acquaintances-one nonaquaintance (10.84 points) and three nonaquaintances (3.49 points).

4. Car pooling clubs

Having identified the dimension of car pooling systems and the psychological factors as the two main reasons for limited success of car pooling systems (traditional and dynamic), we present a new concept of car pooling clubs that takes advantage of the integration from both systems, while increasing trust between the users.

We know that a great number of people have rather stable commuter trip schedules, those people are able to constitute stable traditional pool groups, but there are always people with variable schedules which are hindered of any possibility of integration in a stable group. Besides these two classes of people, there are also situations in which a member of a group has a different activity on one particular day, having temporarily to leave that group.

The idea of these new car pooling clubs is to manage both Traditional and Dynamic systems in the same structure. Traditional Pool Groups are the core of the system and are

constituted preferably by means of heuristic mathematic methods which associate club members having in consideration several capacity and time restrictions. These methods have been studied by several operational research groups [4] [7].

When space is available in a car group, either because the group is small or because a member has a different schedule that day, that space can be allocated dynamically to an occasional demand. This demand is requested on an hourly or daily basis, and has to obey a maximum driving extra time for picking up the club member.

In Figure 2 a scheme is presented for the operation of such clubs. One is able to see that Traditional Pool Groups are at the centre of the system supplying the necessary space for those who have near term trips, permanently or temporarily. If we have in consideration that these groups are formed by people who know each other, we reach the conclusion that the desirability of these groups is sufficient to receive a new nonacquaintance without disbanding.

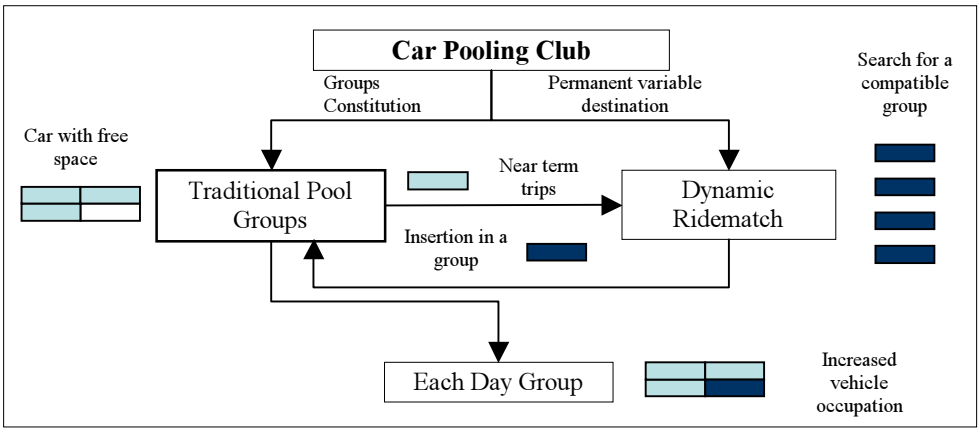

Figure 2. Car pooling clubs scheme

Payment has to be made each day with a digital card and through exchanging points not money. This system allows a certain degree of flexibility, which a monthly or year basis payment is not able to reach because this way one only "pays" for those trips really made.

Points are bought in the car pooling club, and can be exchanged latter for several things, depending on specific agreements between the Car pooling club and suppliers. This may include payment in gas stations, parking, etc.

The big question that arises from this system is: what's the minimum scale for the system to work? The answer has not yet been found, but it's easy to understand that a set of 10 or 20 people probably are not sufficient to ensure the system's viability. There are some fixed costs with equipment and system organization that have to be paid; on the other hand this number of users brings no significant change to traffic congestion. What we know is that this kind of system architecture is prepared to absorb nonacquaintances as well as short term trips increasing the number of potential users.

5. Conclusion

Car pooling Clubs are a means to affiliate carpooling members in a traditional and dynamic system of ride matching. They manage the scale problem while building trust between members.

These Clubs take advantage from the integration of both traditional and dynamic systems increasing the number of members transported independently from schedule or prior acquaintance with the other riders.

Investigation has to be made in what concerns to the minimum number of members for the Cub to be viable, some modeling and application to a real case study should help to understand this and other subjects. At this point one is only able to say that in theory the path is open for a large scale matching and thus contributing actively for congestion reduction in the big cities.

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