Designing participation in agile ridesharing with mobile social software

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ABSTRACT
Growing participation is a key challenge for the viability of sustainability initiatives, many of which require enactment at a local community level in order to be effective. This paper undertakes a review of technology assisted carpooling in order to understand the challenge of designing participation and consider how mobile social software and interface design can be brought to bear.

It was found that while persuasive technology and social networking approaches have roles to play, critical factors in the design of carpooling are convenience, ease of use and fit with contingent circumstances, all of which require a use-centred approach to designing a technological system and building participation. Moreover, the reach of technology platform-based global approaches may be limited if they do not cater to local needs. An approach that focuses on iteratively designing technology to support and grow mobile social ridesharing networks in particular locales is proposed. The paper contributes an understanding of HCI approaches in the context of other designing participation approaches.

Author Keywords
Designing participation, sustainable, green, agile ride-sharing, carpooling, participatory design, user-centred design, intelligent transport, dynamic ride-sharing, localization, local, localisation, locales, community.

ACM Classification Keywords
H5.3. Information interfaces and presentation: Group and Organisation Interfaces: Asynchronous interaction.

INTRODUCTION
For classes of problems and opportunities that manifest themselves at the level of community, one of the major challenges is to design and grow participation by the community itself. Growing participation is key to achieving impact in sustainability initiatives. This paper focuses in particular on initiatives enacted at local levels, by examining the problem of growing participation in ridesharing.

With respect to human-computer interaction, our interest is in understanding the problem of designing participation in order to better locate the design of interfaces and social technologies with respect to the problem at large. While HCI has traditionally concerned itself with design at the interface, it is well established that any theory of user interfaces must be part of a larger theory of human work, (Bodker 1990).

Persuasive technologies (Fogg, 1999) and social software have been proposed to assist in the design of participation in sustainability initiatives (Dourish, 2008). Social software with global reach has been little explored in the context of solving significant problems in physically co-located communities. Many sustainability initiatives such as recycling, local organic food distribution, carpooling etc. depend upon there being sufficient uptake within a locality in order to make the initiative work. Uptake rates in local contexts have to be much greater than for global virtual services with global reach. Moreover participatory initiatives take on a different character in local communities than in virtual communities. Communication occurs face to face as well as through ICTs. Concerns relating to physical security, trust and privacy shift when dealing with neighbours and this has implications for designing participation. The paper proceeds by:

1. Defining the problem of designing participation;

2. Examining the literature on the design of carpooling schemes in order to summise how ICT interventions might assist designing participation in a new agile form of ridesharing;

3. Examining the literature on persuasive technologies and social networks and locating these with respect to the problem of designing participation in agile ridesharing.

The problem of designing participation
Problems of designing participation have distinct characteristics. First, and by definition, the aim is to grow participation by a sufficient number of people in a scheme, because society will benefit as a whole the more that people participate. Second a common problem to be addressed is Hardin's Tragedy of the commons (1968), the paradox of increased personal benefit resulting in decreased social well-being. Using the analogy of grazing cows, Hardin argued that it is in each herder's interest to graze as many cows as possible on common land, even if the commons is damaged as a result. The herder benefits from the additional cows, while the damage to the commons is shared by the community. But, if all herders make this individually rational decision, the commons is destroyed and all suffer.

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In the case of congestion, individuals benefit from the convenience of individual car use resulting in decreased social well-being caused by congestion and environmental damage. However any individual making a decision to take the bus does not significantly benefit from less congestion because it requires a large number of individuals to take such action before congestion is eased.

This problem results in the third characteristic, the "chasm of critical mass" that is often difficult to cross -- the problem of getting sufficient uptake of services to make a difference and encourage further uptake.

From carpooling to agile ridesharing

Brisbane and Melbourne have been identified as cities at risk with respect to their transportation systems. Fixing the problem of urban growth and congestion with more infrastructure for more cars is not a viable solution for a sustainable environment. Hard infrastructure has large embodied energy, is extremely disruptive to build and is extremely expensive costing hundreds of millions to billions of dollars. Increasing use of vehicle sharing and public transport is a simple, more effective way to reduce emissions as compared with the approach of producing slightly more energy efficient vehicles at a high cost.

Carpooling is a form of travel in which people share a car to a common destination, often from clustered origins. A Queensland Government Carpooling Feasibility Study (2008) found that carpooling is often cited as an alternative mode of first preference for single car occupants in staff travel surveys. It represents a way to share costs while retaining some of the flexibility of a car for commuting. Carpooling has been found to have a strong impact on the mode of commuting at the workplace level, attracting up to 15% of trips by only offering information, incentives and a partner matching program. Financial incentives such as reduced parking costs or fuel subsidies can drive that share higher. (York and Fabricatore 2001). Carpoolers tend to come from higher income, white-collar households and tend themselves to reside in areas not generally well served by public transport. (Winters, Axton and Gunnell, 1991). Workplaces that are not served well by public transport are considered good candidates for introducing carpooling schemes. Carpoolers tend to have longer trips than average commuters and subsequently larger reductions in vehicle kilometers travelled.

Finding 1: Many of the factors cited that encourage carpooling may be considered to be direct use benefits -- reduced costs, better flexibility than public transport, transportation from areas not served well by public transport, guaranteed ride home, large savings in car kilometers travelled etc..

The Queensland Carpooling Feasibility Study (2008) found that while prior carpooling research indicates that programs can achieve 20-30% uptake, the existence of ride partner matching software alone will not serve to build a ridesharing network. Technology facilitated rideshare matching needs to be augmented by outreach (awareness raising campaigns), and incentives (guaranteed ride home, prioritized parking) understanding of local circumstances and a staged approach. It concluded that pilot studies should focus on getting the process of software integration right and testing suitable promotional materials and incentives. They should also test the resources required in terms of staff time to develop and deliver a successful carpooling program, and gain the support of major employers. The study recommended a destination based program rather than an area wide system. Galizzi (2004) found that destination based programs are easier to roll out in a staged approach, give greater control over their implementation and are less of a demand on overall resources. Other trials of demand responsive transport have also concluded that a gradual growth strategy was needed that ensured successful customer interaction throughout the evolution of the system, (Carlson, 1976).

Finding 2. Web based partner matching technology had to be augmented by outreach, and testing of incentives and promotional materials in order to grow participation. So, while socially networked mobile rideshare software can take advantage of social software methods to reach out, traditional forms of outreach may also be needed.

Finding 3. Successful participant interaction through out the evolution of the system must be ensured, influencing how the service is rolled out.

Wider transport system approaches such as the provision and policing of high occupancy vehicle lanes can further encourage participation. The East Bay of San Francisco has developed a practice of *Casual car pools* or *ad hoc car pools*, "informal car pools that form when drivers and passengers meet – without specific prior arrangement – at designated locations". People queue to rideshare across the Bay Bridge, which has a carpool lane, with the toll waived for car pools. These casual car pools, in existence for 30 years have evolved an etiquette such as a three per car requirement and a practice that women can wait for other women if preferred. For thirty years the car pools have operated without incident, (http://www.ridenow.org/carpool/#locations).

Finding 4. Local circumstances pertaining to topography, roads, the existence of popular destinations and facilities such as carpooling lanes can determine the form that carpooling takes and its viability.

Finding 5. People develop practices that suit local circumstances and cultural concerns such as the practice of women waiting for other women.

Benefits notwithstanding, uptake of traditional carpooling schemes has been limited by the inflexibility of having to schedule ahead of time, the coordination problem of finding suitable partners and attachment to the privacy of the individual car (Galizzi, 2004). Peoples' daily plans vary due to flexible work hours, sickness, errands or meetings in different parts of town. An examination of dynamic ridesharing in Los Angeles, (Hall and Querishi, 1994) found:

Finding 6. The greatest barrier to ridesharing for people with similar trip patterns is logistics.

It appears that *mobile social software* could significantly ease these logistical problems and provide improved convenience and usability of ridesharing by allowing people to easily contact potential ride-sharers in their

extended ride-share social network in real time through mobile phones rather than through a static matching program (addressing Finding 6) There is greater potential for ridesharing **IF** it can be spontaneous, easy to organise, if probability of finding a ride partner is high, if potential ride partners are known to be of good character (because they belong to ones rideshare network) and if it is possible to get back home either through another ad hoc ride or through public transport. It is conceivable that if agile ridesharing were adopted on a massive scale, that one could ride in with one person and ride home with another waiting only a few minutes for a ride. On-demand shared taxi services could fill in where private transport was unavailable. Demand-driven agile rideshare is not envisaged in the long term as a replacement for public transport but rather as a means to help manage capacity to achieve citywide traffic management objectives especially for people in places not served well by public transport. However, some measures may need to be taken so that ridesharing does not replace public transport use, as found in a Melbourne study (DeGruyter, 2005).

New technology supported methods of organising ridesharing (e.g. http://www.gishigo.com/) are beginning to emerge, however few if any have been evaluated and reported on in the academic literature. Zimride's Carpool application, supports making ridesharing connections through groups and contacts on the social networking site Facebook. However, there is no easy means for dynamic notification of rides leaving and so ad hoc ride sharing is not well supported. Engaging sufficient uptake is difficult in most localities in spite of the global reach of Facebook. Zimride has to be used within the Facebook platform indicating the limitations of the platform centred approach from the perspective of use. One user comments "too much friction". Moreover Facebook social networks and one's potential rideshare network are likely to have quite different membership sets. There is no particular support for building the local rideshare social network.

Mobile phone applications are emerging, such as Piggyback on Google's Android platform, and Avego for the I-phone platform, however the general approach taken is one of technology push based upon new platform availability, rather than a use-centred platform independent approach that pays attention to evolving participation. There are moves to establish open standards for ridesharing software at dynamicrideshare.org which calls for open information sharing, open standards and recommended feature bases. Although social software and mobile phones can potentially lower the barriers to ride-sharing, www.dynamicrideshare.org notes that "the concept of dynamic rideshare is yet to be proven".

On reflection, it is apparent how platform dependent is this latest trajectory in the development of ride-sharing technologies. Rather than developing ride-sharing for cities, localities or chains of localities, the focus is on development of technology for a platform perhaps in the belief that the platform will grow large enough to develop a significant user base.

In contrast Findings 1 to 6 indicate the need for a use and locale-centred iterative (or staged) approach to defining the design of ridesharing technical support that ensures convenience for users. In addition a rideshare coordination technology may need to be augmented by further outreach, incentives and promotional materials.

The findings indicate a need for technology that works across platforms and channels, that takes into account aspects of the locale and that supports local social network development specific to ridesharing.

Heyer et al (2008) report on the evaluation of a cross-channel mobile social software system (Rhub) that allows a group to connect to each other easily across web, email, sms, internet message and chat on any kind of basic phone. The lesson from Heyer et als work for designing participation is that it is important to use the technology and the variety of channels that the people are using. This may entail arranging rides by Web, email, SMS, landline and many basic types of mobile phone as well as from mobile computing platforms. Moves towards open standards for ridesharing software are also important.

Application of HCI approaches to designing participation

Two areas of HCI research that we might learn from in designing participation in sustainability initiatives are "persuasive technologies" and social software.

Fogg (1999) among others has developed a research program in the use of computers as "persuasive technologies", which he defines as computer systems or applications intentionally designed to change a person's attitudes or behaviours. Fogg's early examples of persuasive technologies included a computerized doll designed to motivate responsible sexual behavior, a CD-ROM that persuades kids to eat fruits and vegetables, and a virtual social environment that increases safety by motivating responsible drinking.

The principal focus of the persuasive technology approach is to combine information and simulation to lead to persuasive messages that change people's behaviour. This approach is certainly applicable to ridesharing particularly in terms of the provision of critical information about the ridesharing opportunity, visualisation of the environmental benefit and Finding 2 that promotional materials and incentives were important.

Critically different though is that the persuasive technology approach does not appear to focus on understanding the individual's circumstances and facilitating their use of the service, which was found (Finding 1) to be critical for ride-sharers. Rather than being persuaded to rideshare, people want ridesharing to be convenient, useful and to fit their contingent circumstances so that it makes travel easier for them.

There are prior examples of people using internet based technologies to reach out to extended social networks in order to achieve sustainability initiatives. E.g. the Freecycle network has encouraged gifting of used items to others in ones locale since 2003 and now has 7.2 million members, organised through 4200 Yahoo groups mailing lists and a website. The latest wave of social technologies, such as Facebook are more explicitly social networking applications which connect people together with friends, acquaintances, people from their past,

friends of friends etc. in what is known as the online social graph, a map of everybody on the internet and how they are interlinked. The success and growth of participation in social networks like Facebook and LinkedIn is attributed to i) socially filtered information -- information that is about and from people you know ii) continual engagement -- news feeds, update notification, self updating, tagged photographs etc.; iii) trusted identity and iv) clearly defined networks. (Shih, 2009). Hagen and MacFarlane (2008), in arguing the importance of seeding participation within social networks, found that it was important to maintain momentum so that engagement and ownership did not attenuate. They also emphasised the importance of partnering with existing social networks among other factors.

Many successful Web 2.0 sites incorporate reputation systems, recommender systems, forums etc. in order to reward and encourage participation and these features are likely to be used in ridesharing mobile social software. However such features still cannot ensure that a Web2.0 system will achieve a self-sustaining user base. In the development of PIPWatch, a Firefox extension that enables web users to monitor the privacy policies and practices of websites, Clement (2008) found that after 2 years of having a working service, they had still not achieved practical value, due to insufficient contributors.
Drawing upon Snow's (1986) concept of "frame bridging" Dourish (2008) has argued that social technology might be used to show how particular actions or concerns link one into a broader coalition of concerned citizens and social groups. The social connection of friends, neighbours and colleagues related to oft frequented locales does offer an excellent opportunity to grow participation in ridesharing through the design and use of a mobile social software system. The trust engendered within these networks is critical to the decision of whether or not one chooses to share a car with someone. Clearly social software approaches such as reputation systems could be employed.

Finally, with respect to sustainability initiatives there is also a clear role for legislative and policy initiatives, such as carpooling lanes and priority parking as well as social and persuasive technology initiatives.

CONCLUSION

Paralleling the serious gaming movement, one can imagine green social networks that are designed to support and grow sustainable living practices. Ultimately the success of such networks will be measured by the uptake of sustainable practices. Growing membership in a social network is not enough, if that membership only consists of lurking and does not translate into action.

This paper has undertaken a brief examination of lessons learned from carpooling schemes, social software and persuasive technologies in order to examine the possibility of designing participation in agile ridesharing with support from mobile social software.

It was found that a combination of persuasive, social and legislative approaches is needed, but above all that critical factors in the design of carpooling are convenience, ease of use and fit with contingent local circumstances. Thus above all the design approach taken should be use-centred and location centred focusing upon building critical mass and refining the technology through iterative design. See e.g. (Heyer and Brereton, 2008). This is not to say that a mobile social technology to support ridesharing cannot be generalised, but rather that a promising way to design participation and technology is to do so hand in hand in particular locales as a starting point to understanding the issues involved. Findings indicate the need for a socio-technical system that: (a) Works across platforms and channels and runs on basic phones; (b) Allows aspects of local customisation and design, and; (c) Supports local social network development specific to ridesharing.

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