



Workpackage 2: Literature Review

**A Review of User Innovation in the context of
technological development, everyday mobility
and social practice**

By

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EXECUTIVE SUMMARY

Introduction

User Innovation is one of three collaborative projects funded under the Future Intelligent Transport Systems (FITS) initiative with the Engineering and Physical Sciences Research Council, Department for Transport and Technology Strategy Board as sponsors.

The FITS programme aims to address the challenge of delivering better transport services while reducing negative environmental impacts.

The User Innovation project aims to seek, understand and promote bottom-up innovations that address this challenge. The assumption is that user-initiated/user-led innovations are a potentially rich, but untapped, resource in the ITS (Intelligent Transport Systems) domain.

The project's specific objectives are as follows:

1. to examine the potential for the field of ITS to be advanced in terms of its applications and their effectiveness (commercially, economically, environmentally and socially) by studying the creativity and innovation of users;
2. to develop an understanding, through the application of a mixed method approach, of how user innovation related to IT can be searched for, identified, understood and potentially exploited;
3. to develop an 'ITS Observatory' which is used, for given types of individuals and/or contexts, to search for and catalogue instances of user innovation and to enable cross-comparison of case studies to draw out common features;
4. to take forward a selected number of user innovations as sub-projects to develop a deeper and/or accelerated understanding and to critically examine in what ways such innovations can lead to derivative commercial innovation and exploitation; and
5. to work in the wider context of the FITS programme of projects to ensure the understanding and insights from the project are widely promoted for greater (future) take up.

An early activity within the project has been an examination of a multi-disciplinary base of literature and existing evidence surrounding the topics of innovation, technology development, mobility practices and social context. The resulting review document is organised in terms of its structure and content as a working document: it is intended to be an ongoing resource for the research team. Therefore it will act as a repository for insights uncovered within the literature, pointers to new avenues of subsequent enquiry and questions prompted from examining existing understanding. This Executive Summary highlights the main findings from the working document to date. The following four research questions have framed the review:

1. What is an innovation? What is a user innovation?
2. What are the catalysts for user innovation?
3. What are the enablers and barriers to user innovation progressing to an envisaged outcome?
4. What are the challenges and approaches to discovering (uncovering) user innovation, and evaluating its potential progress?

What is an innovation? What is a user innovation?

Creativity, invention and innovation are three terms between which some distinction is needed (whilst acknowledging that different definitions and distinctions are used). *Creativity* is 'the production of new ideas or combining old ideas in a new way' (Heye, 2006; 253). Meanwhile *invention* is making an idea real. Finally, *innovation* 'is an invention that has a socioeconomic effect; innovation changes the way people live' (Chayutshakij and Poggenpohl, 2002). Thus it can be seen that the three are strongly related - an idea emerges which can then be converted from concept to reality and in turn applied in society.

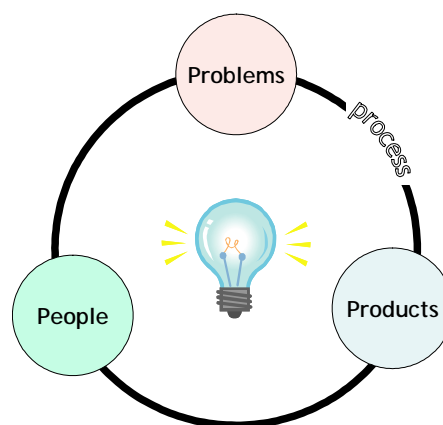
Von Hippel (see, e.g., 'Democratising Innovation', 2005) coined the phrase '*user innovation*'. What then distinguishes user innovation from other innovation?

'Users' refers to firms or individuals that expect to benefit from *using* a product or service themselves as distinct from producers who expect to benefit from *selling* a product or service. Developing products or services concerns *need and context of use* information (from users) and *generic solution* information (from specialised producers). Both information types can be 'sticky' - difficult and/or costly to move from one situation to another. Consequently users tend to have a more accurate and detailed model of their needs but less knowledge of the solution approach than a specialised producer. Accordingly, user and producer innovations tend to be different - user innovations focus on functional novelty and are associated with needing a rich understanding of user needs, while producer innovations often focus on *incremental* improvements on well-known needs associated with requiring a rich understanding of technological developments.

There is a general neglect of the study of the impact of *existing* technology on society in favour of looking at the impact of emerging technologies. This suggests a tendency to limit the opportunity to learn from the study of how technologies become socially embedded and indeed to better identify what unmet needs or unintended uses may arise.

For our FITS project we propose a definition of user innovation as follows: "*the creation and application of an invention initiated by affected individuals that stems from user need or curiosity to address a problem or challenge within social practice*". More specifically, user innovations in FITS are defined as new ways of organising access and associated travel relating to a configuration of the actors involved - people, information, technology etc. User innovation can be about using existing technologies for purposes not originally intended. Innovation can often be unremarkable but concern lifting technologies or services outside of their prescribed contexts and introducing some reconfiguration such that their development trajectory is then changed.

We have conceived of and plan to frame our thinking in the project in terms of the '4 Ps of user innovation':



1. *Problems* can reflect both features of an individual and their situation - e.g. being dyslexic and having trouble navigating journeys, or working parents managing multiple and/or conflicting demands on available travel options. The term 'problem' also includes the features of the wider context in which it occurs, e.g. geographical, political.
2. *People* concerns the individuals that are responsible (directly or indirectly) for the user innovation and the characteristics of those individuals - to qualify as a user innovator they must have some association with the problem or the people affected by the problem; e.g. a partner of a dyslexic individual who also happens to be very competent with Javascript.
3. *Products* concern existing IT/ITS products and services which are available and which are playing a (potential) part in the user innovation - e.g. the Javascript expert realises that they can create a customisation module for outputs from an existing travel information service such as Transport Direct.
4. *Process* finally reflects an understanding of how problems, people and products have come together, and progressed over time, to create the interplay of actors that gives rise to the User Innovation.

What are the catalysts for user innovation?

Key motivations for a user to innovate are (after Leadbeater, 2006; and Luthje, 2000):

- a need not being met (adequately) by the market;
- expertise and capabilities (skills, tools, facilities);
- fun and enjoyment of the development process (and other incentives such as gaining social capital); and
- an ability to share ideas (and knowledge/expertise) and work co-operatively with others.

Often, direct financial benefit is not a motivation for the user innovator. Among the motivations above it could be said that only the *need not being met* by the market is a catalyst to innovation. This then relates strongly to the *problem* component the 4 Ps model and suggests that this could be the key starting point in looking for user innovations or for contexts which are ripe for user innovation to occur (see later). This orientation of motivation may lend itself more naturally to the generation of innovations that attune to *true* user needs (and thus have market potential) than commercial motivations in a producer innovation context where *perceptions* of market potential may be less well grounded at an early stage in the innovation process. In other words - user innovation concerns problems looking for solutions as opposed to solutions looking for problems.

The problem catalyst can be distinctive to user innovation in part because, as market segmentation research suggests, users' needs for products are highly heterogeneous in many fields. Producer innovations tend to seek to meet need with minimal development costs and to account for *perceived* (future) need of a *wide(r)* user base. User innovators meanwhile are motivated by seeking to meet a more precise need in a given context. They are thus more likely to be able to truly meet such a need. It can be suggested, however, that it may not be the case subsequently that the innovation does not find wider appeal beyond the target user setting giving rise to the innovation.

The catalyst of a need not being met can be in the context of unanticipated uses of existing or emerging technologies. Important here is an appreciation that technologists can often have a linear view of a technology's evolution. Meanwhile the reality is more complex and affected by social context. The Social Construction of Technology (SCOT) model (Pinch and Bijker, 1987) recognises that the direction in which an artefact evolves depends very much upon the meanings different groups with a problem construct for it.

Different groups have different needs, interests or concerns (in support of or against the artefact). One must go further in recognising that the way a product is interpreted is not restricted to the design stage of the technology but can continue during the product's use as is well illustrated with the automobile with users embedding new meanings into the technology - for example American farmers seeing the car as a general source of power with a propped up rear axle with a drive belt introduced for other devices.

Financial benefits from user innovation are much more likely to be a *consequence* of successful innovation rather than a catalyst or motivator. Grabher et al (2008) note that "financial incentives are often at odds with the collaborative ethos of communities and undermine credibility, which is built on passion and not profit". This underlines a very different motivation behind *user* innovation (as opposed to innovation per se) and suggests a likely difference in outcomes. However, it can also be noted that some individuals are motivated to innovate by the technical/intellectual challenge moreso than by community sharing/belonging. Such individuals can be enlisted (outside of our notion of user innovation) as 'creative customers' by producers seeking to innovate - people who either are allowed to develop or customise a product belonging to an organisation or do it anyway. Their innovation is likely to be driven less by need than curiosity.

Gaining social capital as a motivator relates to the important notion of gift relationships. As Currah (2007) observes: "Gifts are driven by the accumulation of alternative forms of capital - for example, social capital ... or cultural capital Quite simply, the overriding objective in a gift economy is to give away resources to secure and retain status." (p475).

The ability to share ideas is seen as a key motivator for user innovation. Traditionally this would have been very much dependent upon spatial proximity. However, the peer-to-peer communication now made possible by the Internet underlines a distinction between spatial proximity and opportunity to be co-present - including virtual co-presence alongside the capacity to more easily co-ordinate physical co-presence. Thus the centrality of networks and co-operative behaviour to user innovation occurring is greatly supported through advances in information and communications technology.

Having noted that problems faced by users are a central catalyst for user innovation, there is also the intriguing notion of 'taboos' which can sometimes stand in the way of users innovating. These reflect reactions which immediately stand in the way of progressing certain avenues of innovation - what is then referred to as prohibitive disadvantage. It can then take a 'non-user' to propose an idea or invent something which turns out to be the great idea which overcomes the taboo. One example of a taboo in transport might be the proposition of getting somewhere more slowly rather than more quickly. Because we experience time as a scarce resource, a key goal of transport policy and innovation has been to make journeys quicker (and more reliable). The 'taboo' of allowing journeys to be longer (slower) rather than quicker could be blocking innovations that could champion slower 'green' travel; and, indeed, the positive value of travel time and travel time use is now emerging from research studies (see Lyons and Urry, 2005). As Peters (2006) argues, fast and slow, old and new are polarised and infrastructure innovations always favour the new and speed.

What are the enablers and barriers to user innovation progressing to an envisaged outcome?

Prior to focusing upon user innovation, it is instructive to recognise a number of design flaws identified from considering various 'experiments' concerning alternative transport approaches which may characterise the top-down producer innovation approach (Hoogma et al., 2002):

- insufficient user involvement;

- too much focus on technical learning with the starting point being not a local problem but a solution;
- projects too focused to allow 'co-evolutionary' learning to occur (the combinations of policies, technologies etc that will impact on travel behaviour);
- experiments dominated by insiders who wanted to maintain the status quo; and
- too much of a technology push.

It is also important to consider how technology solutions will become socially embedded (relating to the earlier reference to SCOT). Geels and Smit (2000) identified a number of key features associated with transport technology developments:

- the importance of culture;
- the fact that technological trajectories sometimes change;
- old and new technologies co-existing;
- the generation of new social practices as a result of new technology; and
- the importance of understanding the cultural and psychological aspects of many seemingly functional activities.

Take-up of an innovation has been consistently found to relate to three characteristics of the innovation - perceived relative advantage, perceived complexity (or conversely, ease of use) and perceived compatibility (with lifestyles, values etc.).

Such factors have proved pertinent to the fortunes of conventional innovation in transport and they are also likely to feature as enablers and barriers to successful *user* innovation.

Expertise and capabilities are noted as key motivators for user innovation - they are also key enablers. Allied to this is the matter of innovation support resources. These are becoming more widely available, accessible and affordable such that design and prototyping (especially in relation to information products) becomes possible for users to engage in without much, or any, support from the services of producers. This is an important liberating factor for user innovation progression. Further to this, if innovators can test their innovations in environments that they are exposed to anyway (e.g. work or hobby) this minimises testing costs.

Again, while the sharing of ideas can be a motivation for user innovation it can also be an important enabler. If multiple users with similar needs are all individually innovating this makes for a socially inefficient approach. By freely revealing and sharing innovation, similar users can co-operate. Freely revealing what one has done often results in others then improving it, or suggesting improvements to it, to mutual benefit. Revealing innovation can also yield recognition and reputation (social capital). Free and open-source software projects are good examples of successful Internet-based innovation communities. As noted earlier, thanks to the Internet, communities are re-ordering around on-line groups, which can be interest-focused with members geographically dispersed, or, replicating existing communities such as villages, urban areas etc, and sometime associated with local democracy and shared action. Place is important - both in terms of arguments about close physical proximity being helpful to innovation (e.g. Silicon Valley) and also in terms of the sensitivity of innovation to where it is taking place (as well as who the innovator is). There may thus be an importance of meeting a 'place'-based need as opposed to a generic need.

Co-operative behaviour may also be important in terms of 'situated action'. An important consideration is how users learn to use a product or service or engage in a process. Each user is unique and as a result they learn differently and this is also likely to be context dependent. Conventional product design may render a product or service incapable of adapting to this variety in learning. User innovations centred around co-operative behaviour may be better placed by their very nature to overcome this.

A potential barrier to innovation (though not necessarily user innovation) is, perhaps ironically, intellectual property law. This was introduced with the intention of supporting innovation. However, it is being used by major firms to develop portfolios of patents leading to the notion of 'patent thickets' through which innovators have to try and negotiate (Chapter 8, Von Hippel 2005; Shapiro, 2001). Such negotiation may be easier for communities of user innovators than large producer innovators because generation of IPR is shared and distributed. Freely revealing IPR also begins to build an 'information commons' (Benkler 2002) that can counter dominance of patent cultures.

We recognise that innovation constitutes a process or pathway that is followed. A user innovation begins with a trigger that, through creative thinking, becomes a local/personal invention; this may develop into a 'service' and can lead subsequently to wider adoption and diffusion. At each point in the innovation pathway the innovation can either progress, halt or fail. This innovation pathway relates to context (people, problems, environments, cultures, social practices), process (enablers, barriers) and outcomes (attitudes, behaviours, culture change, costs, benefits). Again in the context of co-operation, while the innovator is key, there will be other people (stakeholders) who along the pathway of innovation development play a part in supporting, funding and marketing.

What are the challenges and approaches to discovering (uncovering) user innovation, and evaluating its potential progress?

From examining the earlier questions it is clear that the starting point to discovering (uncovering) user innovation relates to the catalyst of a 'problem' and characteristics of 'people' who are, or have the capacity to be, user innovators. We can thus first consider the social context/practices surrounding transport and hence FITS.

The purpose of transport (for passengers rather than goods) is to access people, goods, services and opportunities. Access is central to social participation and inclusion and concerns the importance of co-presence (but can also be realised virtually, without co-presence) and the creation, development and maintenance of ties between people that constitute social (including business) networks. Access fundamentally involves the co-ordination of (virtual) presence in both time and space.

The context of everyday mobility to support access cuts across social practice, identity and consumption, policy, economics, the spatial and temporal, the built environment and associated 'mobility' infrastructures. Yet within this complex set of issues, people are conducting very generic activities such as commuting to work, escorting children to school, shopping, making business trips, and travelling to see friends, family and doing fun things (e.g. sporting, cultural and leisure activities).

The legacy of industrialisation is the social structuring of time around the clock (and calendar) (although some are now moving away from set hours to task-oriented flexible schedules that can be less time-space dependent/constrained). Nevertheless, schedules (of whatever form) are essential for synchronising activities and people. As people seek to pursue their accessibility needs and desires and face constraints of time and space, their social networks can play an important part in family management strategies. Childcare is a good example. Nurseries are reputed for their strict scheduling - the need to arrive on time - irrespective of whether a parent's work commitments are flexible and whether or not traffic is predictable. Managing the time-space co-ordination between work and childcare often involves complex negotiations within the family and immediate social/kin networks.

Thus our consideration of user innovation is about people's everyday schedules and how they accommodate and service these time-space patterns of activity through the use, or not, of the transport system. Herein will reside the problems that catalyse user innovation.

This 'domain' is further evolving as a result of mobile technologies (alongside the Internet). Mobile technologies facilitate social arrangements on the move. They allow micro-coordination. They permeate the travel environment which is constituted by multiple flows of bodies, information, conversations, as the corporeal and non-corporeal flows intersect, through transport infrastructures and mobile technologies.

Mobile technologies draw out a gender-based distinction. Women are reported to use their mobile phone more for social networking and arrangements related to family activities than men (e.g. 'remote mothering'). Women are defined as keepers of social networks. Typically, men are more interested in the technology, women more interested in the symbolic nature of the phone and expressive aspects. Gender may also be an important clue to discovering (uncovering) user innovation. Men have traditionally been associated with technical innovation and tend to 'gender' their developments - they consider themselves as representative of (all) users. Women can interact differently with technology. This raises interesting questions about how women may now have an important role in user innovation - reconfiguring existing technologies to meet their unmet needs.

It is important to work with the strengths and weaknesses of different people rather than making or expecting individuals to conform to a single ideal. As such, there may be a case that focusing upon mobility inequalities can provide avenues into discoveries of user innovation. Social exclusion and mobility disparities can be considered in four key areas: poverty, women, life stage (notably children and older people), and disability. There is an impact of income inequalities on social networks, managing child-care, policies on returning people to work etc. There are gender differences in access to transport opportunities and spatial needs relating to licence acquisition, car ownership and access and spatial patterns of activity. Access disparities are also exacerbated by personal safety concerns. Increasingly children's access to independent mobility is being limited and older people can have higher dependencies on others for their mobility. Disability whether because of physical impairment or learning difficulties can expose the individual to the problems of a world and transport system predominantly designed for those without disability. Disability may well represent an area where technologies designed for the community at large are being used and being found to be useful by those with disability in ways not planned by the designers.

An innovation need not be 'great' but merely better than the available alternative. This does not necessarily imply such small improvements are difficult to detect. However, it is found that where innovation concerns a process rather than a service or product it *can* be difficult to detect.

More specifically relating to the person/people than the problem(s) faced, it is found that *user* innovators (see the work of Lettl, e.g. 2007):

- tend to face heightened frustrations by trying to problem solve using existing products and services;
- transfer their professional technical know-how to solving problems outside of this professional domain;
- engage in different activities thus getting cross-fertilisation between activities; and
- may have an openness to new technologies.

In the travel domain it may thus be the case that idea generators if not actual innovators may be found amongst individuals who travel a lot, have varied /extreme journeys and who come from particular professional areas of expertise.

Von Hippel refers to the importance of *lead users* of a product - those that currently experience needs still unknown to the public and who also benefit greatly if they obtain a solution to these needs. Producers can progress their own developments more effectively by identifying and working with lead users. It is suggested that one can find lead users through working up a 'pyramid of expertise' (based on the assumption that

those knowledgeable in an area will tend to know those even more knowledgeable). This may point towards an intersection between user innovation and producer innovation. However, it is important to note that lead users as referred to by von Hippel are *not* synonymous (though could overlap with) user innovators who co-operatively develop innovations. In turn, finding user innovators may well not lend itself to the 'pyramid of expertise' approach; and may prove even more challenging.

It seems there is little specific guidance on how to approach the task of discovering (uncovering) user innovation. The insights from the review however point towards understanding the importance of the problem as a catalyst and recognising the other motivating and enabling factors as highlighted earlier. It will be the task for the project and the ITS Observatory development to develop insights into methodologies for discovering (uncovering) user innovation. Further clues here are being sought from development of the User Innovation Catalogue and interaction with already discovered (uncovered) user innovators and their innovations. Evaluating the progress of innovations (once *started*) along their development paths is likely to be more achievable although once again different (qualitative) research methods may need to be explored.

Conclusion

It is clear that motivations, knowledge and abilities differ between the user innovator and the producer innovator. The former is likely to have a much more intimate and accurate acquaintance with user need. Need arises from problems or challenges and thus user innovation is about specific and personal problems looking for solutions. Solutions are possible when users combine their appreciation of need with their (different) professional or technical skills. Working co-operatively appears key. Indeed the importance of social networks, social capital and co-presence are central to both user innovation and to the social practices that give rise to the problems to be overcome. The peer-to-peer connectivity afforded by the information age, and the mobility challenges people and society face, make for potentially fruitful territory for user innovation. There are important lessons to draw from conventional approaches to innovation and development in transport and well-defined generic indicators of catalysts, motivators and enablers for user innovation. The initial challenge that emerges clearly for this project is being able to discover (uncover) *user* innovators and *user* innovations. The broad definition of the 'problem space' in which to search appears to be that of people's schedules - their management of activities in time and space and the role therein of mobility. Heterogeneity of user need may offer important clues to further identifying problems and associated users. What then remains is to determine how to identify users who also possess the other qualities to create the right environment for innovation. Further to uncovering user innovation, the literature to-date also offers suggestions for how to understand the barriers and enablers to user innovation which will also be a focus of the research. Ultimately the project will also identify how interventions (e.g. collaborative tools for user innovators) could encourage user innovation and its success.

From the wider ITS perspective the review reveals different roles for users in innovation - in this project we are concerned in the first instance with user innovators. The concept of lead users reflects an alternative approach to innovation which sees the producer and user working together. A future challenge for this project will be to assess how user innovators, in moving down their innovation pathways, may link up with commercial organisations to achieve mutual benefit.

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