FROM NICHE TO MAINSTREAM: ASSESSING THE TRANSFERABILITY OF INNOVATIVE TRANSPORT CONCEPTS

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INTRODUCTION

Achieving more sustainable urban mobility is a major challenge. Many cities face common problems associated with congestion, particularly at peak times, which compromises the efficiency of transport networks with clear consequences for society, economy and the environment (TRB 1997). This congestion is often associated with a modal split in which the private car dominates and the potential benefits of more sustainable, collective modes are not being realised (Richards 2001). A wide range of potential solutions are available and the EC 7th framework project NICHES+ (New and Innovative Concepts for Helping European transport Sustainability) is examining the potential for a set of twelve innovative transport concepts to be implemented in seven European cities. This paper will focus upon three such concepts: Personal Rapid Transit, Group Rapid Transit and the use of Electric Vehicles in Car Share Schemes.

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Transferability issues are a key aspect of the process of implementing new transport concepts. This is particularly the case when seeking to translate a successful niche application into a mainstream transport solution. For example, Group Rapid Transit systems have been successfully implemented in ‘closed environments’ such as university campuses and exhibition centres, but the potential exists to transfer such systems to more open environments, such as city centres. This paper will draw upon a methodology developed and evidence gathered in NICHES+ (NICHES+ 2009) regarding the barriers and success factors associated with transferability. It will present the outcomes of transferability analysis undertaken with European experts in the field such as system providers, consultants, local authority decision makers and academics through workshop discussion and interviews. This analysis has provided important generic understandings of the key transferability issues which will support decision makers when considering whether to implement innovative transport solutions.

NICHES+ INNOVATIVE TRANSPORT CONCEPTS

Figure 1 summarises the 12 innovative concepts (ICs) being studied in NICHES+, structured in four thematic areas. Four corresponding Working Groups (WGs) examine these concepts and promote their uptake throughout Europe. The focus of this paper will be upon the three ICs in WG4 Automated and space efficient transport systems: Group Rapid Transit, Personal Rapid Transit and Electric vehicles in city car share schemes.

Figure 1: NICHES+ working groups and innovative concepts

WG1: Innovative concepts to enhance accessibility		
Concept 1.1: Travel training for public transport	**Concept 1.2: Neighbourhood accessibility planning**	**Concept 1.3: Tailored traveller information for users with reduced mobility**
WG2: Efficient planning and use of infrastructure and transport interchanges		
Concept 2.1: Pedestrian friendly intermodal interchanges	**Concept 2.2.: Innovative cycling facilities for intermodal interchanges**	**Concept 2.3: Infrastructure for innovative bus systems**
WG3: Urban traffic management centres		
Concept 3.1: Finance models for traffic management centres	**Concept 3.2: Mobile travel information services for the public**	**Concept 3.3: Using environmental pollution data in traffic management**
WG4: Automated and space efficient transport systems		
Concept 4.1: Group Rapid Transit (GRT)	**Concept 4.2: Personal Rapid Transit (PRT)**	**Concept 4.3: Electric vehicles in city car share schemes**

Group Rapid Transit

Group Rapid Transit (GRT) also known as Cybernetic Transport Systems is a form of collective Public Transport using small automated electric buses to provide scheduled and/or demand responsive feeder and shuttle services connecting e.g. a parking lot with a major transport terminal and/or with other facilities such as a university, hospital, hotels, shopping or exhibition centre (Parent 2006 & Naranjo et al 2009). The system is rather like a lift or elevator, in that the passenger presses a button at the stop to call the vehicle and then another on the vehicle to select the destination. The bus will arrive and then go directly to the selected destination unless called by other users to pick-up or set-down along the way.

The vehicles are supervised by a central control system, but use obstacle avoidance technology so they are capable of mixing with other traffic (cyclists, pedestrians, and possibly other vehicles) at low speeds. Scheduled high frequency services are commonly provided in periods of high demand i.e. peak periods, and an on-demand service during periods when demand is low. This ensures waiting times are kept low at all times.

The implementation contexts represented by experts in NICHES+ are the Parkshuttle GRT system at Rivium Business Park in Rotterdam (2getthere website) and the Cybercar system trialled in Antibes in 2006 for potential future application in the city (Parent 2006).

Personal Rapid Transit

Personal Rapid Transit (PRT) is a form of personal Public Transport using small automated electric 'Podcars' to provide demand responsive feeder and shuttle services connecting e.g. a parking lot with a major transport terminal and/or with other facilities such as a university, hospital, hotels, shopping or exhibition centre. The passenger presses a button at the stop to call the vehicle and another on the Podcar to select the destination. The 'Podcar' will arrive and go directly to the selected destination without making any stops along the way.

The Podcars run on a segregated guideway in order to avoid any interaction with other traffic, and provide clean, green, efficient and sustainable transportation. With the higher vehicle speeds and very small headways that are possible and on large networks with off-line stops, PRT can provide fast, individual, on-demand and point-to-point Public Transport with very low waiting times (Parent 2006 & Muir et al 2009).

The implementation contexts represented by experts in NICHES+ are UK based being the ATS ULTra PRT system being deployed at London Heathrow airport (Benmimoun 2009) and the proposed implementation of a PRT system in Daventry, Northamptonshire (Daventry District Council website).

Electric vehicles in city car share schemes

Electric vehicles in city car share schemes are smaller, cleaner cars particularly suited for use in cities. These represent the current and immediate future implementation of a longer term vision of advanced city cars. These vehicles will combine clean engine technologies with advanced driver assistance systems (ADAS) such as automated systems for obstacle detection, car following, braking, lane keeping, collision avoidance, ISA (Intelligent Speed Adaptation) and parking assistance etc. All of these systems are currently available in the marketplace, and from a number of different manufacturers. There is potential to combine these features in vehicles to be specially equipped for use in city centres, making them safer not only for the drivers and other vehicle occupants, but also for pedestrians and other road users (Parent 2006 & Herrtwich et al 2003). Such vehicles are ideally suited for use in city car share clubs where the main advantages would be from savings in parking and environmental impacts, and the associated costs, that could be achieved by reducing the number of normally polluting private cars in the city, and replacing them with shared, smaller, cleaner, greener and safer vehicles (Zito et al 2003).

The implementation contexts represented by experts in NICHES+ are the Liselec self-service electric car rental scheme in La Rochelle (Boussier et al 2005) and the Transport for London car share scheme in London which is in the process of adopting electric vehicles into its fleet (Myers et al 2008).

WHY IS TRANSFERABILITY IMPORTANT?

The process of seeking to promote innovative transport concepts, initiatives and projects from a niche position to a mainstream urban transport policy application is very much dependent on transferability issues (Hoogma et al 2002). The extent to which innovative transport concepts can be successfully implemented in different contexts will be determined by the degree to which transferability issues can be addressed.

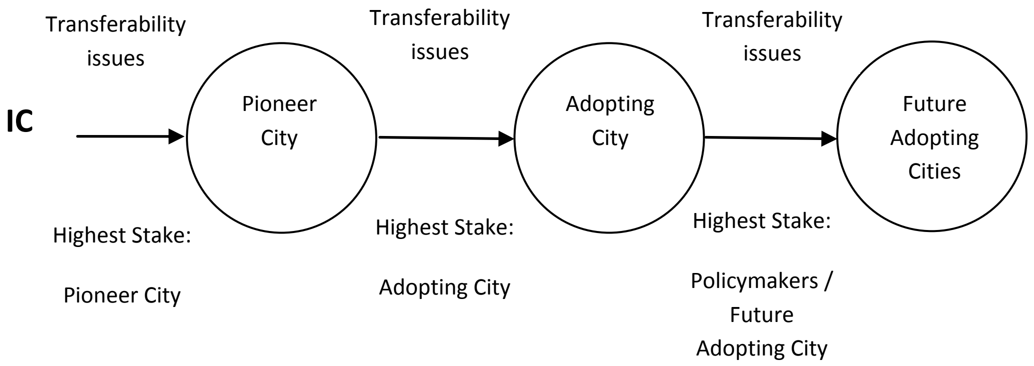
There are reciprocal benefits from the successful transfer of an innovative concept (IC) from a donor city to an adopter city. For a donor city, there is considerable prestige in holding the status of a pioneer or catalyst for a transport intervention which makes a significant contribution to more sustainable urban mobility. This status may result in direct benefits for the donor city, particularly when seeking funding for future transport interventions where the track record of success (both in the local context and as a catalyst to wider implementation benefits) may prove persuasive. Donor cities may also benefit from being in a position to sell their experience to future adopting cities.

For an adopter city, there are clear benefits when seeking to introduce an IC from being able to demonstrate feasibility by reference to an acknowledged existing successful application. It also reduces risk associated with implementation to be able to point to proven success. Equally, an adopter city can learn the lessons from the donor city's experience of implementation to hopefully avoid mistakes and better exploit opportunities associated with implementation.

Figure 2 demonstrates that transferability issues must be considered at three stages in the implementation process envisaged in NICHES+. Firstly, these issues arise when an IC moves from a theoretical idea to its first application in a pioneer city. At this stage the pioneer city is taking a significant risk and therefore has the highest stake in terms of reaping the benefits of a successful implementation or dealing with the consequences of a failed implementation. Secondly, there are important transferability issues when another city looks to adopt an IC deployed in a pioneer city. These issues primarily relate to the degree to which the concept as defined in the pioneer city is compatible with the implementation context in the adopting city. The pioneer city clearly has an interest in this process, but the highest stake sits with the adopting city seeking to find an appropriate solution to an existing transport problem.

The third stage of the implementation process where transferability issues are important relates to the desire to move ICs from niche to mainstream applications. In this context the highest stake is held by the policy makers who are seeking to demonstrate the benefits of implementing a transport intervention on a scale which will realise regional, national or even international benefits.

Figure 2: Implementation of Innovative Concepts: the context and stake for transferability issues



METHODOLOGY

Understandings of transferability issues relating to the ICs in NICHES+ were developed by engaging in dialogue with experts in the field. An international two-day workshop was held in Budapest in April 2009 attended by around forty experts to identify, discuss and refine the key issues. This was followed by a series of structured interviews with individual experts.

The workshop operated primarily through focus group sessions. Each of the four focus groups contained between 8 and 11 members comprising working group representatives, champion city representatives[3] and independent experts. Two exercises were undertaken to stimulate and focus discussion. Firstly, a PESTE (Political, Economic, Social, Technological, and Environmental) analysis exercise was undertaken to brainstorm and scope transferability issues relating to the ICs[4]. PESTE analysis is a technique most commonly applied in the worlds of marketing and business management and is used to consider the macro-environmental factors that influence the introduction of an idea, product, or in the case of NICHES+ an IC (Gillespie 2007). The transferability issues identified in this exercise were categorised under the two categories of success factors and barriers. Secondly, a refinement of the issues identified in the PESTE analysis was undertaken. This involved ranking the identified success factors and barriers in terms of their importance (minor, significant, major) and the stage of the implementation process at which they were most important (continuous, planning, implementation, operation, evaluation).

Following the workshop a series of structured interviews were undertaken with experts on each of the ICs:

- to engage experts unable to attend the Budapest workshop;
- to obtain more detailed responses than could be obtained from the workshop discussions;
- and to develop understandings on subjects that were not anticipated or inadequately covered at the workshop.

[3] Seven NICHES+ Champion Cities were selected based on a call that was launched through the Polis and EUROCITIES city networks : Daventry and Worcester (UK), Cork (Republic of Ireland), Trondheim (Norway), Artois-Gohelle (France), Burgos (Spain) and Skopje (Macedonia). NICHES+ provides resources and support to these cities, helping them to develop implementation plans for NICHES+ concepts.
[4] The PESTE analysis involved two activities in the focus groups, a brainstorming exercise was undertaken in small break-out groups (2 or 3 participants) and this was followed by whole-group plenary discussion of the findings. This process was repeated for the refinement of the PESTE analysis.

In order to assess the transferability of the 12 ICs being examined in NICHES+ in a meaningful, comparable and coherent manner a common framework for the interviews was required. The framework has been developed in conjunction with parallel research undertaken in the CIVITAS GUARD project (CIVITAS Guard website) and involves a 6 step approach:

Figure 3: Framework for transferability interviews

	Step	**Description**
1	Clarify the impacts and measures of success of the IC	Discuss justification and supporting evidence for why an IC should be considered for application by another city.
2	Identify if up-scaling is required and take into account subsequently as appropriate	Determine if scaling up (or in occasional cases, down) of the measure is required for transferability. If it is, recognise the requirement and implications in the subsequent steps.
3	Identify the main components of the IC and its context relevant to transferability	Many factors can contribute to the success (or failure) of a measure including the components of the measure itself, transport/traffic conditions, geographical, environmental, demographic, socio-economic, cultural backgrounds, institutional and legal frameworks, etc. Some of these factors may already have been identified as success factors and barriers from the process evaluation, but there may be other aspects of the measure or its context which have had an influence on its success or caused problems. These need to be identified so that their relevance or necessity concerning transferability can be assessed.
4	Identify the main characteristics of each component and their level of existence / achievement in the current context	Break down the main components into characteristics relevant to transferability and note the current level (i.e. high/medium/low) of each characteristic in its current context.
5	Assess the likely ease or difficulty in achieving the necessary level of the characteristic in an adopting city	This is a subjective assessment informed by the ease or difficulty experienced in implementing the measure in its current context, but modified by potential beneficial changes that could be made in a subsequent application The assessment should be made using the following scale: +2 strong support for transferability +1 modest support for transferability 0 neutral -1 modest constraint for transferability -2 strong constraint for transferability
6	Consider the set of values across the characteristics and assess the likely potential for transferability and any conditions that may be required.	Draw conclusions about the potential for transferability by considering factors identified and assessment values ascribed. If there are one or more strong constraints to transferability, it is likely that the measure is not generally transferable unless the constraining conditions can be overcome. If there are no strong constraints, but one or two modest constraints, it may be difficult to transfer the measure unless the constraining conditions can be properly addressed. If there are no constraints at all, it is likely that the measure could be successfully transferred particularly where supporting factors can be put in place.

RESULTS OF TRANSFERABILITY ANALYSIS

A summary of the results of the transferability analysis undertaken through the workshop and interview research described above is presented below in relation to each IC:

Group Rapid Transit

The initial PESTE analysis identified more efficient use of road space as an important economic success factor. GRT offers higher capacity than a car lane. Response to demand and level of service in peak demand periods are also key economic issues that are likely to be strong success factors for GRT. The operational flexibility of GRT and its demand responsiveness are selling points compared to traditional public transport line based services. Technological requirements were identified as a current barrier to implementation, but once addressed they might become success factors as users are drawn to a 'hi tech' system and operators benefit from system efficiency.

Meeting national and local policy objectives is crucial to funding and it is relatively simple to demonstrate that GRT supports transport, environmental, economic, social inclusion policy objectives. GRT can complement existing public transport services by linking up such services within cities.

The key political barrier is the scale of initial investment and innovation associated with implementing GRT, so risk and fear of failure are major concerns. The critical importance of developing stakeholder support means that awareness raising and consensus building are very important issues. Initial legal barriers (such as certification of vehicles and mixed mode running) were also important constraints, but progress was being made to address them.

In terms of the refinement of transferability issues for GRT, financing was identified as a continuous issue of major importance. GRT is likely to lose money on an ongoing basis and so requires heavy investment/subsidy. Most investments are unknown at the beginning of the implementation process and tend to grow as the project progresses. Even the best plans are not wholly accurate as there is less knowledge of real costs than with conventional public transport. Rising costs and establishing the commercial viability of schemes are significant risks which may be a barrier to public subsidy. Initial money raising is a concern at the beginning of the project and should be seen as a distinct activity from the ongoing financing of the project

Legal issues are major concerns which are best addressed at the planning stage to avoid frustration and delay in implementation. Some issues are technical problems requiring minor legislative change, but it depends upon who has decision making power. Engine system reliability is a technical barrier in the operational phase. There is also a clear need to prove/guarantee safety for successful implementation.

The evidence derived from structured interviews with experts reinforced many of the key messages which emerged from the workshop discussions. The strongest beneficial impacts and measures of success for GRT were identified as system efficiency (demand responsiveness/reduced waiting times) and attractiveness (quality of service and the environmental benefits of electric vehicles). The strong compatibility between GRT systems and prevailing transport policies and strategies relating to pollution reduction, public transport use, accessibility and land use (particularly reduced land take for car parking) were seen as strong success factors for transferability.

Optimism was tempered by the identification of barriers to transferability. Modest constraints for transferability (-1 on assessment scale – See Figure 3) included:

- **Funding**, particularly capital costs, which are significantly higher than for an equivalent bus (though not for a tram) scheme, even though running (and whole life) costs could be significantly lower because the vehicles did not need drivers.
- **Stakeholders**, because of the effort required to involve the users and businesses likely to be affected by implementation from the outset, and get them on-side; and, if necessary for funding, to involve national government as a partner.
- **Technical requirements**, in terms of technology risk and cost, mainly because a special guideway is required equipped with buried cables or magnets for vehicle guidance, bespoke communications infrastructure and control software is needed to operate the system.
- **Awareness and communications**, including the extra effort needed in public relations to raise awareness and encourage public acceptance.

Major constraints for transferability (-2 on assessment scale) included the need to involve national government, not only as in the role as Stakeholder, i.e. as potential funding partner (as identified above), but also under:

- **Legal and contractual requirements**, where national government is the ultimate authority for providing necessary safety certification for a scheme; and
- **Organisational and institutional aspects**, where national and local government need to be involved to establish the planning and procedures required to obtain approvals and realise implementation.

The technical feasibility of GRT has been shown in Europe through the Rivium and Antibes demonstrations and the systems are very persuasive in terms of their potential, particularly for providing sustainable transportation systems, but they are very new. They are not accepted by government as schemes that should be considered at the planning stage, the procedures to get them accepted are difficult, and there is widespread suspicion of the unproven technology. There is growing interest in such schemes, but realistically, they are likely to be considered by only by a handful of cities in the foreseeable future.

Personal Rapid Transit

In common with GRT, the initial PESTE analysis identified more efficient use of road space as an important economic success factor for PRT. PRT also offers higher capacity than a car lane. Response to demand and level of service in peak demand periods are also key economic issues. The flexibility of PRT (network not line operation) and its demand responsiveness are selling points compared to traditional public transport line services. Quality of service is the key test of PRT technology. PRT must have close headways (2 seconds) for viable capacity and operations.

PRT faces great political challenges in terms of the use of public space with significant land-take requirements for PRT infrastructure. This can also lead to issues of severance, visual intrusion and privacy associated with elevated guideways in an urban environment. Indeed, retrofitting the infrastructure can be a serious spatial and environmental barrier. There are considerable cost increases associated with elevation, compared to at grade guideways, but overall the revenue generated will pay the capital costs. There are land space benefits associated with the removal of car parking land.

Meeting national and local policy objectives is crucial to funding and it is relatively simple to demonstrate that PRT supports transport, environmental, economic, social inclusion policy objectives. PRT can complement existing public transport services by linking up such services within cities.

The key political barrier is the scale of initial investment and innovation associated with implementing PRT, so risk and fear of failure are major concerns. Determining who makes the decisions and exercising influence upon those people is therefore vital. The critical importance of developing stakeholder support means that awareness raising and consensus building are massive issues. Initial legal barriers relating to the certification of vehicles seem daunting, but progress is being made in addressing them.

In terms of the refinement of transferability issues for PRT, as with GRT, financing is a continuous issue of major importance, although subsidy free operation of PRT is a major selling point. Clearly there are significant financial risks concerning the capital investment required for PRT, although this can be mitigated through public-private finance partnerships.

The introduction of PRT has significant consequences for city planning although the extent to which spatial, environmental, severance and visual intrusion issues will be barriers to implementation will depend on the local context. These issues will always be more significant with an elevated system. System attractiveness, quality of service and potential compatibility with existing public transport services are major success factors for PRT. The fact that, at present, PRT applications are all ‘one of a kind’ systems is a barrier to compatibility and an economic constraint.

The evidence derived from structured interviews with experts suggested a high degree of commonality between the success factors and barriers for transferability associated with PRT and those associated with GRT. System efficiency and attractiveness allied to the high degree of compatibility with prevailing transport policies and strategies were the key success factors for PRT as for GRT. A significant added attraction for PRT identified by the experts is the potential for subsidy free operation in the longer term in direct contrast to GRT. When considering modest constraints for transferability (-1 on assessment scale), there was a high degree of commonality with GRT

- **Funding**, particularly capital costs, which are significantly higher than for an equivalent bus (though not for a tram) scheme, however operational costs for PRT are likely to be significantly lower than conventional services and indeed GRT
- **Stakeholders**, as for GRT.

More major constraints for transferability (-2 on assessment scale) were identified for PRT than GRT

- **Technical requirements**, as for GRT, but more so in terms of the infrastructure required by PRT because it must be segregated. Where the guideway is elevated, there are possible problems of visual intrusion, where the guideway is at ground level, there are possible problems of severance.
- **Awareness and communications**, as for GRT, but more so because the system is so radically different from existing services that it will require greater effort to educate and familiarise potential users/stakeholders.
- **Legal and contractual requirements**, as for GRT
- **Organisational and institutional aspects**, as for GRT.

The issues surrounding the potential transferability of PRT are very similar to those relating to GRT. The notable difference is that the stakes are higher with the potential risks associated with implementing PRT (capital costs, impacts, legal concerns and technology risks) being significantly greater. However there is a corresponding potential for greater benefits being delivered (subsidy free operation, order of magnitude improvements in service compared to existing transport options, positive transformation of environments). As with GRT the potential for PRT to provide sustainable transportation systems is very persuasive, but it is yet to be effectively demonstrated in Europe. This leads to the same barriers as for GRT in relation to government acceptance and suspicion of unproven technology. As with GRT there is growing interest in PRT, but realistically, it is likely to be considered by only a handful of cities in the foreseeable future.

Electric vehicles in city car share schemes

The initial PESTE analysis identified the status associated with pioneering innovative transport solutions as a significant success factor for this IC. La Rochelle has retained its image as a pioneer in the field twenty years after implementation. The variability of political support is a major contingency. It can be a success factor or barrier – most solutions take more than one political term to be delivered, although electric vehicles in city car share schemes offer the prospect of quicker implementation than either GRT or PRT, primarily because of the much lower levels of investment required.

Meeting national and local policy objectives is crucial to funding and it is relatively simple to demonstrate that electric vehicles support transport, environmental, economic, social inclusion policy objectives. It is also very easy for politicians to support electric vehicles in city car share schemes because of the very low capital investment costs. Availability of parking is the key complementary policy to support uptake. It is necessary to demonstrate clear benefits from implementation compared to conventional car use in terms of journey time, access and parking locations. This will promote the convenience of electric vehicles in city car share schemes and their suitability in urban environments.

Vehicle technology remains a significant barrier in terms of vehicle range and design; new types of vehicles better suited to urban sharing can be envisaged, but they are not yet available. Availability of technology at the right price is an important economic barrier.

In terms of the refinement of transferability issues, there are major issues at the planning phase. Electoral support is either a success factor or barrier according to attitude of politicians who will not provide funding without public support, especially as commercial viability is unproven. The concept of Electric vehicles in city car share schemes is poorly understood and there is a confusion of terms. It may be easier if distinct vehicles are used which are visible and desirable to use.

There are also major issues at the operational phase. Currently there are limited or no training aspects to car clubs and car rental schemes. Advanced technologies would mean training is needed and this could be a barrier to use. Automation issues are ongoing technological and legal concerns for car manufacturers. Most car clubs have focussed on environmental benefits and not driver aids (except safety). The intelligence should therefore be placed in the vehicle not the driver. Electric vehicles in city car share schemes should be promoted as simply the next generation of car clubs.

There are more issues in the evaluation phase for Electric vehicles in city car share schemes than for PRT/GRT. It is harder to predict usage for Electric vehicles in city car share schemes and consequently it is difficult to anticipate the impact on the overall transport network. Evaluation of actual use is simple as trips can be monitored and car distance travelled is the key measure to evaluate success.

The evidence derived from structured interviews with experts suggested that the key success factors for transferability were improved accessibility, land use and reduced environmental impacts. Particular advantages from car sharing are reduced traffic flow resulting from fewer vehicles on the network and the saving in land space needed for parking. The services offered are specific and available only to persons who can drive and join the car share scheme. The IC scored very positively on the assessment scale (overwhelmingly +1 and +2 scores) suggesting great potential for successful transferability. No major constraints for transferability were identified, although two minor constraints for transferability were highlighted:

- **Stakeholders**, the need to find a champion to promote a scheme, and to persuade national and local government that they should support it.
- **Technical requirements**, the need to set up an infrastructure of parking places at the roadside with facilities for charging the vehicle batteries, and to provide vehicle maintenance.

A major difference between the two schemes assessed was the funding mechanism employed. In La Rochelle the cars and infrastructure were effectively procured by the city, (although the scheme has subsequently been transferred to the private sector to run). In the scheme operating in London, the city has provided the parking spaces and the operators have met all other costs. The London model clearly involves less expenditure, and risk, to public funds.

In conclusion, Electric vehicles in city car share schemes are very transferable. There are very few obstacles, and while an infrastructure of parking places and charging facilities is needed, the way to provide them has been shown. Growing interest in these schemes is evident across Europe with London and Paris (McCarthy 2009) picking up the reins.

CONCLUSIONS

Participating experts and champion city representatives felt that all the ICs had the potential to deliver significant positive impacts and societal benefits. There were issues regarding the measurement of success with many of the concepts. It is difficult to quantify the benefits of new systems or concepts that have been insufficiently tested to provide a robust evidence base for quantitative assessment. The case for the transferability of an IC is strongest where demonstrated and measurable application with associated positive benefits can be shown rather than relying on forecasts and predictive models of application.

The innovative nature of the concepts under discussion inherently means it is difficult to demonstrate a track record of successful application that would enable the rapid transferability of the concepts to other areas. Lack of familiarity can be a particular barrier to implementation of ICs because potential adopters may be reluctant to risk the implementation of a system or service of which they have little experience or limited awareness.

However, past experience can also be a barrier to transferability. If it is seen that an IC has been poorly implemented elsewhere, or that the context for an existing implementation is not comparable with that being considered for future application, then take-up can be hindered. This is particularly likely to be an issue if the system or service is not well aligned to the existing land use/urban design/transport service environment.

A major factor in the transferability of ICs is the degree of impact that implementation is likely to achieve. If the system or service that the IC provides can offer order of magnitude improvements compared to existing/conventional systems and services then it is likely that barriers to implementation can be surmounted. Successful implementation is also most likely if the IC being introduced is clearly aligned with existing policy objectives both in terms of transport policy and the wider urban environment policy context.

Consideration of potential success factors and barriers at the planning stage of the application of an IC is critically important to successful implementation. If the key stakeholders are united in their understanding of the issues surrounding transferability at the planning stage they are more likely to be able to successfully address barriers and exploit opportunities further downstream in the implementation process.

It is also important that a clear and coherent message regarding the benefits of implementation can be agreed and understood at the planning stage. This is particularly important when considering the economic justification for implementation; any successful application must be supported by a compelling business case. There was some discussion regarding who is best placed to take forward implementation. For some of the more radical/futuristic ICs it was argued that the private sector is best placed to embrace the innovation and risk associated with implementing and running a system or service.

Political will was seen as a critical success factor or barrier in relation to transferability across all the ICs. Securing a committed champion to argue the political case for an intervention is vital. However the balance between political and public will was a matter of debate amongst the different focus groups. Some argued that a political champion was key to generating public good will towards an intervention whereas others stated that the key issue was to engage and secure public support and then the politicians would follow the prevailing mood. Either way, the positive engagement of both these communities at the earliest possible stage was seen as key to the successful transferability of ICs.

Knowledge transfer from existing best practice in donor cities was seen as a vital ingredient for any successful implementation. The use of generic templates for best practice was advocated as a useful tool for implementation and a guard against 're-inventing the wheel'. The spatial context for transferability was seen as an important issue. The issues involved in transferring ideas between cities in the same country compared to those involved in transferring ideas between cities in different countries were quite different. This is particularly an issue when considering factors like cultural and geographical issues and the political and environmental context.

The analysis of constraints upon transferability afforded by the interview process enabled some generic understandings to be developed. Some of the most common strong constraints across the ICs relate to the financing of implementation and concern issues such as the difficulties of obtaining funding from relevant bodies such as national and local government and of obtaining the scale of investment required to meet the capital costs of design, planning and implementation.

Organisational and institutional aspects were another area of common strong constraint upon transferability. Issues such as obtaining interest and support from major stakeholders, most typically national and local government, were most significant. Once support has been obtained a common issue was the facilitation of cooperative working in the implementation of solutions.

Strong constraints relating to technical requirements were necessarily more specific than generic in nature. For ICs involving significant infrastructure and technological developments some major constraints upon transferability were identified. In broad terms, the degree to which strong constraints upon transferability were identified across the ICs was strongly influenced by two factors:

- The scale of the intervention being considered in terms of cost and its perceived impacts on travel behaviour and the urban environment – the greater the costs and impacts associated with the intervention the greater the likelihood of barriers to transferability being identified
- The degree of innovation involved in the intervention – the more radical the intervention the greater the likelihood of barriers to transferability being identified

The methodology deployed for the transferability analysis proved beneficial. It provided a common framework and evaluation mechanism to enable important generic understandings to be derived from the interview process. The use of a consistent set of topic areas (components relevant to transferability) is essential to enable comparison of results across the ICs. However the flexibility to use bespoke sub-headings in these topic areas (characteristics of the components) is essential to enable rigorous analysis of the specific transferability issues relating to the individual innovative concepts.

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