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**Towards advanced transport for the urban environment**

**User Requirements**

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Author(s)	Kelly C (ITS, University of Leeds)
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## User Requirements Report

### 1 Introduction

During the first 18 months of the CityMobil project the reference group has been formed, involving a gradual process of expressions of interest and acceptance of new members. The current members of the reference group as of October 2007 are provided in table 1 (included with an \*).

The role of this CityMobil reference group is to:

- Provide practice related input and feedback for the Research and Development work:
  - Problems
  - Requirements
  - Questions
- Act as a selection pool for city studies and show cases
- Act as a back up for the city demonstrations.

In order to both engage the reference group cities in the roles mentioned above and collect information from the cities for the CityMobil project two questionnaires were sent out in 2006. The first questionnaire considered which problems the cities wished to overcome and looked in detail at which CityMobil activities they would like to be involved in. The second questionnaire focused on questions relating to the perceived problems and benefits that would be involved in implementing a system in the cities in question and then looked at the potential issues that would be involved in potentially running a showcase or small demonstration for the CityMobil project. The results from this second questionnaire were used to rank the cities' proposals for participation in showcases, demonstrators and city studies. Additional information was available from the presentations given by the cities to the CityMobil meetings relating to their particular scenarios. Not all cities completed both questionnaires and not all cities that completed the questionnaires are in the reference group. The three demonstrators (Castellon, Heathrow and Rome) were also invited to complete questionnaires and made regular presentations on progress. Table 1 provides a summary of those cities and demonstrators that completed the questionnaires and have presented to the SP1 meetings.

This report will look in detail at the results of the questionnaires and the implications that they have for the future implementation of automated transport systems. The ranking of cities resulting from the second questionnaire is reported further in City Mobil (2007).

**Table 1. Summary of cities who completed the questionnaires and presented**

City	Country	Questionnaire		Presented to SP1 - CityMobil			
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup> July 2006	3 <sup>rd</sup> Nov 2006	16 <sup>th</sup> Jan 2007	3 <sup>rd</sup> July 2007
Almelo*	NL						X
Almere*	NL	X	X	X			
Antibes	FR				X		
Cardiff*	UK	X	X		X		
Castellón	ESP	X	-	X	X	X	X
Clermont-Ferrand*	FR	-	X			X	
Daventry*	UK	-	X			X	X
Gateshead* <sup>1</sup>	UK	-	X				
Genova*	IT	X	X		X		
Halver*	DE						
Heathrow	UK	-	-	X	X	X	X
Hyvinkää*	FI	-	X				
La Rochelle*	FR	-	X			X	
Lausanne*	CH	-	X	X			
Limeil-Brévannes*	FR	X	X				
Montbéliard*	FR						X
Milano*	IT	-	-				X
Orvieto*	IT	-	X			X	
Rome	IT	-	-	X	X	X	X
Santa Margherita Ligure*	IT	-	X			X	X
Tampere	FI	X	-		X		
Trondheim* <sup>1</sup>	NO	X	X				X
The Hague	NL				X		
Uppsala*	SW	X	X		X		
Vienna* <sup>1</sup>	AU	-	X				
Valencia*	SP						
Warsaw	PL	X	-		X		

\* Cities in the Reference Group in October 2007.

<sup>1</sup> Cities used for modelling in SP2.

## 2 Data

The data that has been used for this report has been taken from the questionnaires that were sent to the cities plus the presentations that the cities have given to the CityMobil SP1 meetings. A summary of each of the case study cities included in this report is provided in annex 1. A copy of both of the questionnaires used is provided in annex 2 and annex 3, while all the questionnaires completed by the cities are available to download internally at <http://www.citymobil-project.eu>.

### Questionnaire 1: Reference Group Questionnaire

The first questionnaire was sent in August 2006 to potential cities for the reference group. The full questionnaire is provided in annex 2. 8 completed questionnaires were received from the following cities; Almere, Cardiff, Genova, Limeil-Brévannes, Tampere, Trondheim, Uppsala and Warsaw. This questionnaire considered the following questions:

1. Describe mobility problems in your city for which you think that automated solutions could offer a contribution
2. How could automation contribute to a solution of these problems?
3. What phase are you in? Have you already considered concrete solutions for problems or are you still studying them?
4. If you consider the activities in the various CityMobil Research and development sub-projects which concrete contributions can these sub projects offer your potential situation – SP2: Future Scenarios, SP3: Vehicles and Technological Issues, SP4: Operation Issues
5. Are you interested in hosting a showcase for cybercars or advanced city vehicles. If you are, please describe the particular situation where such a showcase could take place. Please also describe what the benefits and impacts of such a showcase would be for your city
6. Can you identify topics for city studies in your own city?
7. Would your city be willing to organise a small demonstration?

A summary of some of the results for the first questionnaire is provided in table 2. The results indicated that there were a range of types of technology proposed and stages of development. For example Uppsala was interested in using PRT, while Limeil –Brevannes focus was cybercars. The cities were interested in working with CityMobil on a range of areas including the future scenario work (SP2), Technological issues (SP3) and Operational Issues (SP4)

A number of the cities as shown in table 1 completed both questionnaires sent out by CityMobil, which show some overlap. The implications for both questionnaires are considered in detail in section 3.

**Table 2. A summary of the results of questionnaire 1 for questions 3 to 7**

	Almere	Cardiff	Genova	Limeil Brévannes	Tampere	Trondheim	Uppsala	Warsaw
Types of automated systems interested in?	Cyber cars	PRT	Cybercars City vehicles	Cybercars	PRT Cybercars	PRT Cybercars	PRT	PRT
Q3- state of progress of existing studies	Early	Advanced	Advanced	Early	Advanced	Advanced	Executed	Early
Q4 – Contributions from sub projects								
SP2: Future Scenarios	√	√	√	√	√	√		
SP3: Technological Issues			√	√	√	√	√	
SP4: Operational Issues				√	√	√		√
Q5- Interested in hosting a demonstration	√		√	√	√	√		
Q6– Have identified topics for city studies?	√	√		√	√	√		√
Q7– Willing to organise a small demonstration?	√	√	√				√	√

## Questionnaire 2: City wide automated vehicle studies

The second questionnaire was sent to cities in November 2006. As table 1 shows 15 cities responded. These were Almere, Cardiff, Clermont-Ferrand, Daventry, Gateshead, Genova, Hyvinkää, La Rochelle, Lausanne, Limeil-Brévannes, Orvieto, Santa Margherita-Ligure, Trondheim, Uppsala and Vienna.

This questionnaire was split into two sections; section 1 considered the potential for a city-wide application of automated vehicles; section 2 considered specific questions for potential showcases and demonstrations. The full questionnaire is provided in annex 3. The questionnaires were completed by both cities who were interested in providing a demonstration / showcase (e.g. Uppsala) and cities who were interested in the modelling work being completed by SP2 (e.g. Gateshead and Vienna). The questionnaire considered the following questions in relation to the potential case studies and the barriers to implementation:

1. Please indicate the area on which your case study would focus and describe the current population and modal split for that location
2. Please specify your city's transport strategy. What specific problems do you consider that the new technologies could address, why might conventional transport measures not be sufficient?
3. Please indicate the type of technology you would be interested in considering
4. In relation to the introduction of a new technological system, who are the key stakeholders and what are their key requirements?
5. What are the principal quantifiable and non quantifiable benefits of a new system that can be identified?
6. Is an official safety certification necessary if you want to introduce an automated transport system in your city?
7. Do you expect that additional procedures to guarantee the safety and security of users and personnel will be necessary in the case of an automated transport system being implemented?
8. Please identify any major legal and administrative barriers you may anticipate when introducing new technologies in your city
9. Please identify any other barriers and risks (e.g. financial, political or public acceptability etc...) you anticipate when introducing new technologies

The questionnaire then focuses specifically on the schemes that were being proposed for each of the cities in more detail. The results of these questions are provided in section 3 for the analysis and in annex 1 (for the individual cities).

### **3 Key Issues resulting from the two questionnaires**

Section 3 summarises the key issues arising from the questionnaires relating to user requirements. A fuller description of the individual cities answers is provided in annex 1.

#### **3.1 Automated system proposed**

The cities that answered the questionnaires had a range of technologies that they were considering. Table 4 indicates that the types of technologies proposed ranges from using platooning to distribute vehicles for a car-pooling scheme in La Rochelle to a PRT system linking the dockland area in Cardiff to the city centre and dual mode vehicles to increase accessibility in the historic city centre of Genoa. These technologies while having many aspects that differ also have many similarities in terms of the barriers to implementation that currently exist. These include the safety implications and acceptance considerations, which will be discussed later in this section.

#### **3.2 Stage of progress**

The cities were asked in both questionnaires how far developed their scheme was in November 2006. The question was based on a standardised project life cycle with 8 stages including the option of *no activities performed yet*. The most advanced stage in this assessment was that the expected impacts of the scheme had been evaluated/ the operations had been simulated. Table 3 provides a summary for all those cities that completed questionnaire 2. It shows that the cities were at a range of stages of the process. For example some cities were at the stage of having identified what problems that needed solving and identifying that autonomous vehicles might be the answer. Uppsala was alone in having already completed the detailed system design. Out of the 14 respondents, 6 had completed an initial evaluation of the proposed scheme. Two cities only answered questionnaire 1. These were Tampere who stated that they were in an advanced stage of progress and Warsaw who was at an early stage of progress (see table 2).

#### **3.3 Key benefits of using unconventional transport solutions**

The cities were asked what problems they were trying to solve and why conventional transport solutions might not be suitable for solving these problems. Table 4 provides a summary of the key reasons given by the cities for not wanting to use conventional transport for their particular scenario. For example, Cardiff had evaluated that using a PRT would be “cheaper than conventional forms” would provide a “superior level of service” would be “well received by members of the public” would “increase access to key services, enhance the image of the city” and would be “quiet safe and efficient”. One of the issues identified in Genova was that in the historic city the streets were very narrow. They had identified that using dual mode vehicles could “increase access to vehicles, in the narrow streets” and therefore contribute to their objective of increasing accessibility levels in the historic centre. Trondheim had identified a number of potential uses for automated vehicles in the city. They proposed that PRT and Cybercars had the potential to be less costly than conventional transport for the shorter distances that were needed. The issue of reduced costs due to not needing a driver, reduced environmental problems, fitting into a niche market, providing a feeder service or door-to-door service and making the current public transport system work better were all recurring themes.

While a number of proposed benefits were cited in the questionnaires a number of barriers were also evident in terms of the actual implementation of the potential systems. These will be discussed next.



Vienna	A range		X						
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**Table 4 Summary of proposed schemes**

City	Co un try	Focus of case study	Type of technology	Expected benefits over conventional transport
Almere	NL	Link between parking areas and city centre	CTS	Using buses has been dismissed as an option due to the length of time between services and cost. Makes car parking more accessible.
Cardiff	UK	Link between former dockland and city centre	PRT	Cheaper than conventional forms, superior level of service, well received by members of the public, increases access to key services, enhance the image of the city, quiet safe and efficient.
Clermont-Ferrand	FR	Link between tramway and city centre services	CTS	Viable alternative to private vehicle. Good at interfacing between tramway and other public transport
Daventry	UK	Link between town centre and north of town	PRT	Could address the current lack of take up of conventional PT. Increase lack of accessibility for disadvantaged group, reduce environmental impact
Gateshead	UK	Modelling novel approaches	Range	Link communities and services
Genova	IT	Historical city Centre	Dual Mode	Increase access to vehicles, in the narrow streets
Hyvinkää	FI	Large retail park separated on two sites by 700m circular route	CTS	Existing measures too expensive to link up the two sites. This would allow a centralised parking area and reduce private car use.
La Rochelle	FR	Extension of car pooling	CTS	Advanced car pooling (Platooning would reduce costs)
Lausanne	FR	Link the lake with the docks	PRT	Environmental benefits

Limeil-Brévannes	FR	Link between community and nearest subway station	CTS Dual mode	Fit with objective of reducing private vehicles, while increasing accessibility.
Orvieto	IT	Passenger shuttle service	CTS	
St Marg. Ligure	IT	Freeing up waterfront	CTS	More competitive to cars than conventional systems
Tampere	FI	Feeder door to door service	PRT	Joined up public transport system
Trondheim	NO	1 - multipurpose city centre complementary service 2 - harbour to city link & 3 - single purpose sub centre service	PRT and CTS	Reduced costs and benefits from shorter distances
Uppsala	SW	Test track	PRT	Lead to reduced travelling time, be economic on a community level, have a high degree of traffic safety, improve air quality, reduce space demands and reduce car ownership.
Vienna	AU	A range of cases to be modelled	A range	
Warsaw	PL	Replacement for tram	PRT	Uses less energy than conventional tram

### 3.4 Barriers to implementation

A number of barriers were explored in the questionnaires. These were consistency of fit between Local, Regional and National Plans, acceptance of the scheme, safety concerns, legal issues, technical complexity and practical implementation and cost. These issues will now be considered in this section. This section focuses on the second questionnaire with evidence added from the first questionnaire where relevant.

#### 3.4.1 Consistency of fit between Local, Regional and National Plans

One of the key concerns of the reference group cities is the ability to realise the plans that they have. Cardiff is a good example of a city whereby political problems had halted the progress of the PRT system with the Welsh Assembly withdrawing its funding allocation in 2003. Cities were asked to assess on a scale of 0 to 4 the consistency between their proposed projects and the existing national, regional and local plans. The description of this scale is provided in Figure 1.

Figure 1 Criterion for assessing the consistency between the proposed project and the national, regional and local plans

<p><i>0 = if the plan does not mention the problems, the objectives or the technology</i></p> <p><i>1 = if the plan identifies the same specific problems (on the site or at a general level) that motivated the implementation of the project;</i></p> <p><i>2 = if the plan also identifies as the methodology to solve the problem the installation of a transport system with characteristics (capacity, frequency and commercial speed) similar to the chosen transport system designed</i></p> <p><i>3 = if the plan also makes specific reference to a transport system based on fully or partially automated vehicles;</i></p> <p><i>4 = if the plan budgets funds specifically for the project.</i></p>
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Table 5 provides the results of this question and reveals that for the majority of proposed projects the consistency of the scheme with the local, regional and national plans is low. For the majority of plans the projects comply with the definition provided for 1 in Figure 1, which is that *the plan identifies the same specific problems (on the site or at a general level) that motivated the implementation of the scheme*. There are exceptions such as Hyvinkää or Orvieto. In the case of Hyvinkää there are specific references to a transport system based on fully or partially automated vehicles at a regional and national level. In the case of Orvieto the plan budgets funds specifically for the project at a regional and national level.

Having a scheme that does not fit into these plans may prove problematic when trying to implement schemes. The demonstrations and showcases proposed by the CityMobil project were mentioned frequently in the questionnaires as providing a catalyst for increasing the awareness of the importance of considering automated vehicles as solutions at an authority (local/ regional and national) level.

Table 5 Consistency of fit between scheme plans and Local, Regional and National plans

City	Type of scheme	Private / public use system	Local transport plan / strategy (0-4)	Regional Transport plan / strategy (0 – 4)	National Transport Plan (0 – 4)
Almere	CTS	Public	1	1	1
Cardiff	PRT	Public	1	1	N/A
Clermont-Ferrand	CTS	Public	2	N/A	N/A
Daventry	PRT	Public	1	1	1
Genova	DUAL MODE	Public & Private	2	2	2
Hyvinkää	CTS	Private	1	3	3
La Rochelle	CTS	Public	2	0	0
Lausanne	PRT	Public	2	N/A	N/A
Limeil-Brévannes	CTS DUAL MODE	Public	1	NA	NA
Orvieto	CTS	Public	1	4	4
St Marg. Ligure	CTS	Public	3	1	1
Trondheim	CTS, PRT	Public	2	N/A	3
Uppsala	PRT	Public	1	N/A	1
Average Score		Public	1.54	1.75	1.77

\*See Figure 1 for the scoring definitions

\* Gateshead and Vienna are not included, as they did not answer these questions

### 3.4.2 Acceptance by end users, operators and decision makers

The next set of questions considered the acceptance and the support of the project users in relation to the project. Three stakeholders were identified; end users, operators and decision makers. Cities were asked to rate on a scale of 0-5 (0 strongly opposing – 5 strongly supporting) how much acceptance there currently was for their proposed scheme for each of these three key stakeholders. The results are provided in Table 6. In contrast to the previous section considering consistency with local, regional and national plans there appears to be a high level of acceptance by end users for the projects being proposed. The results show that the level of acceptance was higher for end users and decision makers than operators. For example in Daventry the operators are reported to be strongly supporting the project, while there is reported to be less support at a end user level.

Clermont-Ferrand noted that the issue did not just need acceptance by the general public, but also acceptance of use by blind users. As part of the EDICT project Cardiff had assessed the acceptance of end users for their particular PRT scheme and found that it would be well received by the public and that there would be a high willingness to use the service. Limeil-Brevannes stated that they could not rate the acceptance by operators as they “don’t have an idea of it yet”. Cities put forward the benefits of the demonstrations and showcases as methods for improving these ratings

Table 6 Acceptance by end users, operators and decision makers for the schemes

City	Acceptance by end users	Acceptance operators	by	Acceptance decision makers	by
Almere	3	4		4	
Cardiff	4	2		3	
Clermont-Ferrand	4	2		4	
Daventry	3	5		4	
Genova	5	4		5	
Hyvinkää	5	5		4	
La Rochelle	4	5		4	
Lausanne	4	3		5	
Limeil-Brévannes	4	-		3	
Orvieto	4	4		4	
St Marg. Ligure	4	5		5	
Trondheim	4-5	5		4-5	
Uppsala	4	4		3	
Average	4.04	4.00		4.04	

\* scale of 0-5 (0 strongly opposing – 5 strongly supporting)

### 3.4.3 Safety Barriers

One of the key barriers to implementing automated transport systems is the safety regulations that are required by law to be in place before the system can be a) trialled and b) open to the general public. The cities were asked in the questionnaire whether an official safety certification was necessary if they wanted to introduce an automated transport system in their city. The results of this question are presented in table 7. It shows that in the majority of cases a safety certificate would be required before implementation.

Cardiff have identified that safety certification would be required by law to run the PRT system. Because of the novel nature of PRT a set of specific approval procedures has been developed with Her Majesty's Rail Inspectorate (HMRI). In order to pass the approval stage a safety case has been produced. The results of the risk assessment indicate that there is a realistic prospect that the applied system can be safer than the current railway system. ATS has received approval from the HMRI to carry public on the ULTra test track at Cardiff. One of the examples providing an exception to the rule was Limeil-Brévannes who identified that Cities in France can introduce an automated system in the city as long as it complies with the Highway Code.

This requirement for a safety certificate before the project can commence provides one of the key barriers to introducing innovative autonomous vehicles. Ensuring that cities have the correct levels of information to satisfy these criteria is one of the key user requirements.

### 3.4.4 Legal Barriers

One of the key requirements for the users is that the projects meet the European, National, Regional and local regulation standards. The cities were also asked whether there were any legal or administrative barriers to implementing an automated transport system. The scoring scale is provided in figure 2. The key reason for asking this question was that CityMobil would have to help with overcoming any legal framework barriers if a city was selected as a showcase. While this issue is very pertinent for cities that are selected as showcases for CityMobil it also has a wider implication for the future implementation of projects.

Figure 7 provides the results of this assessment and shows that on average with the exception of Genova the legal frameworks within the countries would allow the applications with specific approvals and for some under specific limitations. Therefore removing the barriers would involve designing a system that met the specific limitations and allowed the system to be granted the special approvals.

One of the key issues identified in the questionnaire was that there were key legal risks due to there currently being no European regulations or body for such innovative transport systems. Almere identified that they would need assistance in changing the law on safety for such systems.

Figure 2 Criteria for assessing whether the legal framework at a European, National, Regional and Local levels would allow the project being considered.

*0 = if the legal framework expressly forbids the application;*

*1 = if the legal framework allows the application with special approvals and under specific limitations (e.g. a “driver” is requested to be always on board even if the vehicles are fully automatic) or requires modifications (e.g. permanent barriers around vehicle tracks);*

*2 = if the legal framework allows applications as they are but with special approvals;*

*3 = if the legal framework allows the proposed application.*

Table 7 Safety Certification requirements and consistency with legal framework

City	Safety Certification required by law?	Consistency with the legal framework*
Almere	Yes	1
Cardiff	Yes	2
Clermont-Ferrand	Yes	2
Daventry	Yes	2
Gateshead	Yes	-
Genova	Yes	3
Hyvinkää	-	2
La Rochelle	Yes	1
Lausanne	Yes	2
Limeil-Brévannes	Can introduce a system covered by the highway code	1
Orvieto	Yes	1
St Marg. Ligure	Yes	1
Trondheim	Yes	2
Uppsala	Security approval in progress	2
Vienna	Yes	-

\*see Figure 2 for the scoring definitions

### 3.4.5 Technical Complexity

One of the key barriers to the implementation of the schemes is the technical feasibility of the proposed system in terms of driving difficulty for the vehicles. Cities were asked to score how technically complex the systems that were being proposed were on a scale of 0 to 4. The definitions and scoring system is provided in **Figure 3**. The least technically complex system under this scale is a system based in a totally protected site, the most technically complex is where the system is based on automatic vehicles in an unrestricted environment.

Figure 3 Technical feasibility of the proposed system

<p><i>0 = if the system is based on automatic vehicles running in an unrestricted access environment;</i></p> <p><i>1 = if the system is based on automatic vehicles running on shared tracks with restricted car traffic access;</i></p> <p><i>2 = if the system is based on automatic vehicles running in streets without cars, but with cars crossing at intersections;</i></p> <p><i>3 = if the system is based on automatic vehicles sharing their tracks with pedestrians, cyclists and cars manoeuvring slowly;</i></p> <p><i>4 = if the system is based on automatic vehicles running in a totally protected site.</i></p>
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Table 8 provides the results to this question and shows that half of the schemes are based on the system sharing their tracks with pedestrians, cyclists and cars manoeuvring slowly. Three of the systems have been designed to run in a totally protected site (e.g. Uppsala) and two of the sites Almere and Clermont-Ferrand are based on automated vehicles running in streets without cars but with cars crossing at intersections. None of the systems proposed are based on the most technically complex system where the automated vehicles are running in an unrestricted environment. Each of these levels of technical complexity provides user issues, which are being considered in SP3 (technological issues) in CityMobil.

### 3.4.6 Integration with current network

Linked with the question of technical complexity is the issue of how the automated transport system is proposed to integrate with the current transport system. Cities were asked to rate from 0 to 3 the level of integration of the proposed showcase or small demonstration with the rest of the mobility network. The definitions are provided in figure 4.

Table 8 shows that in terms of integration with the mobility network that over half of the cities have designed the new system as either a small network or with traditional interchanges with conventional transport modes. For example the Clermont Ferrand project will interface between a tramway and other public transport in the town centre. The Uppsala system is a totally isolated line and not connected with other transport. The Limeil Brevannes system is not a network but a flexible line, which is not integrated with other transport modes.

Figure 4 Scoring for the integration with the current mobility network

*0 = means the new system is a totally isolated line and not connected with other transport modes;*

*1 = means the new system is not a network but at least a flexible line (e.g. on demand), interacting, but not integrated with other transport modes;*

*2 = means the new system is either a small network or has traditional interchanges with conventional transport modes (e.g. stops from which users can transfer on foot to the other mode);*

*3 = if the new system is an entire network with a high degree of flexibility (e.g. fully on-demand itineraries and times) or has advanced and integrated interchanges with conventional transport modes (e.g. the new system vehicles can bring the user directly to the parking space, bus stop or station).*

In addition, the cities were asked what would be the implications on public space of the introduction of their system. Table 8 shows the results of this question, which asked cities to rate on a scale of 0 to 3 how the public space that was to be used would have to be reallocated. The definitions of this scale are provided in Figure 5. The results indicate that for 50% of the cities the scheme would be introduced into an area of public space which would have to be redesigned but would not be negatively affected. This provides the user issue of how to best redesign the public space to maximise public acceptance.

Figure 5 Scoring system for how the public space will be affected from the introduction of the project

*0 = if no public space redesign is planned in conjunction with the showcase or small demonstration;*

*1 = if the showcase or small demonstration is to be inserted in an area in which the public space will have been redesigned, without affecting it negatively;*

*2 = if the showcase or small demonstration will be introduced together with measures to improve the quality of the urban space around it (e.g. ornamental plants are used as barriers, new advanced pedestrian crossings are made);*

*3 = if the showcase or small demonstration will be introduced together with the comprehensive redesign of the surrounding public space.*

Table 8 Issues surrounding implementation and technical complexity

City	Technical complexity*	Integration with the mobility network**	Integration with the redesign of public space***
Almere	2	3	1
Cardiff	4	3	1
Clermont-Ferrand	2	2	0
Daventry	4	2	1
Genova	3	3	2
Hyvinkää	3	2	1
La Rochelle	3	2	1
Lausanne	3	2	3
Limeil-Brévannes	-	1	-
Orvieto	3	2	0
St Marg. Ligure	3	3	3
Trondheim	1	2	1
Uppsala	4	0	0

\* see Figure 3 for the definitions of the scoring system

\*\*see figure 4 for the definitions of the scoring system

\*\*\* see figure 5 for the definitions of the scoring system

### 3.4.7 Climate Restrictions

A number of the cities identified an additional barrier of implementation and testing of such a system in the extreme weather conditions experienced by their cities (e.g. Tampere and Hyvinkää).

### 3.4.8 Cost

While the questionnaires did not specifically address the issue of scheme cost, a number of the cities raised it as an issue. It was frequently cited that automated systems could reduce costs due to the driverless nature of the system. However other studies have highlighted the high costs of initial implementation.

In their questionnaire Cardiff described the CBA that the EDICT project had produced for the proposed scheme. An economic evaluation of the proposed site was conducted using a start year of 2006 and an appraisal period of 30 years. This analysis predicted that it would attract 5.67m passenger trips per year rising to 7.42 in 2036. This relates to attracting 61% of present bus users, 9% of walkers, 8% of car commuters and is expected to increase the use of car and bus. It is expected to lead to a reduction in CO<sub>2</sub> emissions of 3550 tonnes. The ULTra network was calculated as costing £34.3M (€51.5M) with an annual operating cost of £2.05M (€3.08M). Revenue is estimated at £4.3M (6.5m euros) at £1 fare per vehicle in 2006 rising to £5.6M (€8.4M) in 2036.

Other cities such as Uppsala had identified that previous work on PRT in Swedish cities over the last 10-15 years have been regularly stopped when the full costs have become apparent.

However they had identified that two areas have been highlighted that might reduce this negative aspect. Firstly, in the socio- economic analysis the value of the land saved by using the PRT compared to a conventional ground level transport system has not been taken into account. Secondly, if multiple systems could be coordinated, economies of scale could lead to reductions in the large costs per system. Vienna also highlighted the potential downside of an innovative system having higher capital costs than the conventional system.

These examples suggest that cost can be a real barrier to the implementation of innovative automated systems in addition to all the others discussed above.

## 4 Conclusions and Recommendations

The questionnaires have highlighted a number of user requirements that need considering in full detail when considering implementing a system based on autonomous vehicles; hence, the importance of such a project as CityMobil in considering these issues. The key issues are cost, user acceptance, the requirement for safety certification and the restriction that currently there is a low level of inclusion of such systems within local, regional and National plans in Europe. It also highlighted the differences in climate across the EU and the implications for innovative transport systems that this has.

Based on the cities answers to the questionnaires a number of recommendations can be made. These are :

- there is a need for a European Body for innovative transport systems.
- there is a need for a European standard for safety certification of innovative transport systems. Currently each country is developing an individual approach as and when needed
- there is a need for the wider publication of the CityMobil demonstrations and showcases. This will help address some stakeholder issues and highlight the potential to include automated systems within local, regional and national plans to aid implementation.

## 5 References

CityMobil (2007) WP1.5.4 Selection of the city sites for detailed studies and demonstrations  
European Commission DG Research 6<sup>th</sup> Framework programme Thematic Priority 1.6

City Responses (2006) Downloaded from [www.citymobil-euproject.eu](http://www.citymobil-euproject.eu)

## Annex 1 City Descriptions

This section provides a summary of the answers that the Cities gave to the questionnaires.

### Almere

Almere is a city in the Netherlands of 200,000 residents. It has plans to grow to 400,000 in the next 20 years. Almere has decided to have only one city centre, which means that due to this expected expansion the capacity and accessibility needs to be enhanced. The current key transport problems in Almere are the traffic jams on a daily basis both within the town centre and on the roads leading up to it. The modelling that has been done has shown serious mobility problems and issues in the area of congestion, accessibility, environmental impacts and lack of infrastructure. The public transport system requires upgrades in terms of capacity and quality. Parking is also an issue. Almere plans to reallocate space in the centre currently used for parking and reallocate the parking spaces to a short distance away from the centre. There is currently no public transport linked to this car park. For the future the city wants to develop a high quality local public transport network and sees CTS<sup>1</sup> as a potential opportunity here.

They have identified that automated vehicles could provide the solution for a numbers of these problems. They are looking to keep cars out of the city centre by developing parking areas on the outskirts. This has created a demand for a transport mode, which can take these people from the car parks and into the centre quickly. Using buses has been dismissed as an option due to the length of time between services and cost. CTS is the preferred option using a high frequency service which would be possible as there would be no driver costs. Going down this route has a number of benefits. Firstly, less capacity would be needed on the road networks and as a result less parking spaces required in the town centre. Secondly, traditional public transport bus lanes upgrade would not be necessary as CTS could take over this task. Thirdly, parking can be reallocated outside the town centre, which would be cheaper and better accessible. Fourthly if a system like CTS were introduced this could provide the solution to making the new car park accessible.

The stakeholders that would be involved in such as project would be the city of Almere, Frog and Transumo. Official safety certification would be necessary if the system were to be introduced. Current legislation does not recognise driverless vehicles and so the law would have to be altered to solve this problem and remove this barrier. Other potential barriers identified were political and public acceptance, which would be crucial.

The town of Almere has created its own simulation transport-modelling programme called Meso. This model is capable of demonstrating how transport, environmental impact and landuse can interact over the next 20-30 years. Almere has identified that it could work with CityMobil in determining solutions for mixing automated vehicles with other traffic in the city centre. They have identified Almere Port as an area that sees CTS as a good opportunity. A small demonstration is planned.

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<sup>1</sup> A CTS is a fleet of driverless vehicles coordinated by a supervision system, and operating as a public transport service.

## Cardiff

Cardiff is the capital city of Wales with a population of 320,000 people. The city of Cardiff was the lead partner in the EDICT 5<sup>th</sup> framework European Project. It is at an advanced state of planning an ULTra (PRT) system in the city. Cardiff hosts an ULTra 1km-long test track, which opened in 2002. The case for considering an advanced transport system in Cardiff is to meet environmental and lifestyle goals and local development plans. These have been based on a future vision of Cardiff as a sustainable “City of Tomorrow”. It is envisaged that an innovative transport system might be the answer to achieving a balanced distribution of trip increases over all modes, increasing levels of safety, improving accessibility to achieve social and economic regeneration, improving environmental and health impacts of transport, encouraging economic regeneration and social regeneration.

Cardiff's plan is to use the ULTra system (PRT) to link the city centre with Cardiff Bay, a former dockland area that is now being regenerated but has relatively poor transport links. The mode split within this area is 48% car, bus to station 1%, walk to station 26% and other walk 24%. An evaluation of the potential benefits and costs of the 20 km ULTra system have been conducted in Cardiff through the EDICT project. They concluded that the PRT:

- Can provide significant benefits
- Can be cheaper to build than conventional forms of guided PT
- Provides a superior level of service compared to conventional PT due to issues such as low wait times
- Would be well received by the public – attitudinal surveys show a high willingness to use the service
- Promotes social inclusion – through increasing access to key services
- Is regarded as a quiet, safe and efficient and convenient way to travel
- It could potentially enhance the image of cities – leading to increased investment
- Provides positive rates of return from Investment.

Issues that were raised as part of this evaluation were; concerns about city image and visual intrusion, and problems with gaining political support for new and untried systems. Legal risks were identified due to there currently being no European regulations or body for such innovative transport systems. Political problems had halted the system with the Welsh assembly withdrawing its funding allocation in 2003.

Cardiff have identified that safety certification would be required by law to run the PRT system. Because of the novel nature of PRT a set of specific approval procedures has been developed with Her Majesty's Rail Inspectorate (HMRI). In order to pass the approval stage a safety case has been produced. The results of the risk assessment indicate that there is a realistic prospect that the applied system can be safer than the current railway system. ATS has received approval from the HMRI to carry public on the ULTra test track at Cardiff.

An economic evaluation of the proposed site was conducted using a start year of 2006 and an appraisal period of 30 years. This analysis predicted that it would attract 5.67m passenger trips per year rising to 7.42 in 2036. This relates to attracting 61% of present bus users, 9% of walkers, 8% of car commuters and is expected to increase the use of car and bus. It is expected to lead to a reduction in CO<sub>2</sub> emissions of 3550 tonnes. The ULTra

network was calculated as costing 34.3M (51.5 m euros) with an annual operating cost of £2.05M (3.08M euros). Revenue is estimated at £4.3M (6.5m euros) at £1 fare per vehicle in 2006 rising to £5.6M (8.4M euros) in 2036.

Cardiff identified that potential subjects for city studies in Cardiff could concern the integration of PRT and other modes, the influence on existing systems, integration into the urban fabric, legal issues and financial issues. They also identified that SP2 could be used to update the work already completed in the EDICT work. A small demonstration was already being considered in 2007/08 providing an example of a PRT in a city environment.

### Clermont-Ferrand

Clermont-Ferrand is the capital of the region “Auvergne” in central France. It has a city population of 150,000 and a surrounding population of 280,000. The modal split is 63% car, 27% pedestrian, 6.6% public transport, 0.8% by bike, 0.9% by motorcycle and 0.8% others. The city has identified that due to increased travel within the city they are facing problems of air and noise pollution, decline in quality of life and attractiveness of the city centre, dominance of the road network over other modes and worsening of economic and social activity.

Clermont-Ferrand have identified that one of the solutions to this is to offer the population a public transport system, which is a viable alternative to using private motor vehicles. The Syndicate Mixte des Transport en commun (SMTC) is in charge of organising the local public transport system. They have identified that an autonomous public individual vehicle (PIV) could solve some of these problems by interfacing between the tramway and other public transport in the town centre. They are currently looking at these issues with Blaise Pascal University and in particular LASMEA research group. The key stakeholders identified for such a system would be LASMEA, SMTC, the city of Clermont-Ferrand and the Ministry of Transport within the Government.

The expected benefits of such a system include by using battery powered vehicles there will be limited air and noise pollution so improving the local environment. It is also expected to improve the levels of accessibility within the city.

Official safety certification is necessary from the state service of ministry of transport if automated vehicles are to be introduced. Decree N 2003-425 was passed concerning the safety of guided public transport systems. Other barriers identified were the acceptable usage of the system by a blind person

Clermont-Ferrand is wishing to test whether a PIV implemented in the city centre would increase mobility between modes of public transport and for people with mobility problems. The site selected is a 1km<sup>2</sup> area which interfaces with the tramway, a taxi station and a bus station. There will be 6 vehicles: 3 CyCAB and 3 RobuCAB. The LASMEA laboratory has participated in the French PREDIT 3 project called MobiVIP which demonstrated the autonomous navigation of PIV in an urban context.<sup>2</sup> The demonstration that they proposed

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<sup>2</sup> A video of this is available at: <http://www.lasmea.univ-bpclermont.fr/ftp/pub/derutin/jaudetramCycab.wmv>

is to look at how members of the public would use the system in the town centre and finally evaluate whether such a system would be relevant to real usage in urban zones.

### Daventry

Daventry is a town in the UK with a population of 23,000. One of the goals of this town is to increase this population size to 40,000 by 2021. The current modal split between car and bus is 97% to 3%. The key objectives for Daventry are tackling congestion, improving accessibility, safety, and environmental impacts, encouraging healthier travel, improving highway maintenance and accommodating the large population growth target. They have identified that new technologies could address some of these problems. In particular the current very low use of public transport, the environmental impact of transport, the lack of accessibility to certain groups of the population (e.g. older people, younger people), and the adverse land use effects of transport in particular parking. Modelling work has shown that by improving the bus service this could achieve a 10% share of the market. However there are adverse effects in terms of increase in transport energy use and significant operating costs to keep the improved service running. The same modelling work has identified that PRT could achieve a 33% share, reduce overall energy use and run at an operating surplus. To confirm the benefits of this system a more detailed study for a pilot was commissioned in December 2006.

### Gateshead

Gateshead is a polycentric area in the North East of England. Its population is 191,000, which contributes towards the Tyne and Wear regional population of 1.1 million. The transport objectives of this area are “the provision of an effective, affordable, and attractive public transport system; the ability to move around the borough safely in an attractive, secure environment and curbing traffic growth”. It has been identified that innovative technologies might provide the solution to link communities and facilitate freight distribution. The city was interested in modelling novel approaches for passengers and freight including, future buses, cybercars, new approaches to distribution, and services that link existing public transport to services.

Gateshead has been selected as one of the modelling cities in SP2.

### Genova

Genova is a city in Italy with 800,000 residents. The harbour is the most important in Italy and among the main in the Mediterranean. The key focus for this study is the historical centre. The key issues identified in Genova are that the historical city centre is constrained by the city walls causing a barrier between the driveable part of the city and largely crowded pedestrian city within the walls. Access to vehicles within the walls is currently limited due to narrow streets and city regulations. The city council's objectives are to not stop traffic entering but limit it to urban freight, people with mobility issues and green vehicles, while maintaining a vibrant city centre and increasing real estate values. The city had identified that automated vehicles could provide the solution to the city's problems in a number of areas. Firstly, due to the city being crowded this reduces the number of conventionally sized vehicles that can travel through the walled city. They identified that this in some cases has caused cities to lose out to more modern cities where access by vehicle is easier. Secondly, due to the roads being narrow and corners tight it can be difficult for drivers who are unaccustomed to the city. One issue identified was that in some cases it is impossible to turn the vehicle, so automatic reverse driving assistants become useful. Thirdly, city centre shops are becoming less competitive than the more efficient big shops, easily reachable by

car and bigger and cheaper stocking areas. A new logistic platform has been proposed for moving and stocking goods based on shared warehouses and automated procedures.

Genova has a plan to use automated vehicles to solve some of the problems identified above. In 2004 the Genoa faculty of Architecture in cooperation with Genoa city administration founded the Urban Mobility Council to start talks with universities, municipalities and industries to find solutions for urban mobility in historical Mediterranean cities like Genova. They are currently working with IVECO (commercial vehicles) on the project FIDEUS, which is looking at *Complementary vehicle systems for improved urban freight transport*. Discussion are currently taking place between the Genoa faculty of Architecture, the city council, Leitner ropeways, the research department for Fiat and IVECO, with the plan to bring to Genoa, Leitners innovative solutions based on ropeway systems. There are also plans with CRF to test cybercars in Genova city centre. They have identified that cyber cars would make most sense given the narrow streets in Genova city centre.

Genova identified that SP2 could help by providing advice on the legal and cultural issues in implementing the ropeway concept. They were most interested in SP3 (technological issues) as they were looking to study automated vehicles with CRF. They are already working on the issues covered in SP4 with IVECO in the European FIDEUS project.

### Hyvinkää

Hyvinkää is a town in Finland with a population of 44,306. The key objectives of the city are to reduce private cars, increase the use of public transport, walking and cycling and to centralise parking. The city has identified an application in a large retail park that is due to be completed in 2007. This key issue is that the retail park is located on two separate sites 700m apart and divided by the main road into the city centre. The city has identified that an advanced traffic system could allow the centralising of parking, reduction in private car use and minimise internal traffic between the two sites. Existing conventional transport measures have been dismissed as too expensive to solve the problem. The key stakeholders for this system are the citizens, retail operators and customers and the city.

The system that is being proposed contains the following characteristics:

- Collective and individual with on-demand trips on assigned routes
- Either reserved infrastructure earmarked from the existing infrastructure or infrastructure shared with pedestrian and cyclists earmarked from the existing infrastructure.
- Fully automated
- Length 1.4km (circular)
- 30% of traffic is expected to replace car traffic
- It is expected a waiting time of 2-3 mins and a commercial speed of 10-15km/h

They have identified that the contribution from CityMobil could be:

- Preparing the showcase plan
- The field of safety security assessment
- On the city and business modelling aspects

One of the key requirements is that the system can be operationalized in Nordic conditions

### La Rochelle

La Rochelle is a city on the west coast of France with a population size of approx 80,000. They are currently looking to extend their car pooling system both for freight and passenger services. The current car pooling system (Lisetec) has been designed to complement the public transport network and fill a gap where demand does not justify operating public transport. They are aiming to reduce the use of private cars within the city centre while offering a viable alternative. This should have the potential benefits of less noise, less pollution and a nicer environment. One of the problems that has been identified is how to optimise redistributing cars between the stations. One solution that is being considered is advanced car pooling (Platooning). Platooning would reduce the major cost that is involved in transferring the vehicles (labour).

The city has identified the following stakeholders as being critical in this new system; users (residents, tourists, work trips), La Rochelle as the organisation institution and the transport operator. If implemented several levels of certification would have to be complied with. Additionally it would be necessary to have clear separation between the normal public lanes and those used by automated vehicles. The major administrative barrier would be to gain the ability to run the vehicles among normal traffic.

The extension to the current car pooling system that is being proposed is to set it up within the current already defined part of the car sharing network, with the following characteristics:

- Individual demand with set departure and arrival locations
- Existing infrastructure shared with buses to be modified for use
- Dual mode (fully automated on specific infrastructure)
- Network length 4km
- Forecast 20 trips/ day (to be redistributed)

There is a strong acceptance and support for the system among end users, operators and decision makers.

### Lausanne

Lausanne is a city in Switzerland located on the shores of Lake Geneva. The system being tested is the serpentine system (PRT) at the Ecole Polytechnique de Lausanne (EPFL) in a restricted area. The site is entirely on private land belonging to the confederacy, which allows the testing of prototypes, without interacting with road transport. This test track interfaces with the public transport system.

The serpentine capsules are small battery driven vehicles. The key advantages to this are the reductions in the environmental effects. Including no release of flue gas by capsules, no emission of particles at the level of the motorization and of the transfer of energy.

If successfully tested it is expected that this system will be expanded to connect a large range of services on the campus. Full details of this system are provided in CityMobil (2007).

### Limeil–Brévannes

Limeil–Brévannes is a suburb of Paris with 650 inhabitants. Mobility is a key problem with a lack of public transport in the community and low car ownership levels in some social housing areas. The nearest subway station is 5km away and it then takes a further 20 minutes to commute into Paris. The objective of this city is for sustainable growth with only policies including 1 car parking space allocated to each dwelling. They have identified that automated vehicles may provide a solution both within the community and then between the community and the nearest subway station. They are looking to use cyber cars. They have also stated that Limeil–Brévannes has not set any limit “in terms of innovation for this area”. They have also set up an environmentally sustainable policy for future growth. They are

looking to plan and integrate CTS to connect to the existing public transport network and connect the area to the Parisian RER network with a cable car.

They have identified that SP2 would allow them to consider the advantages and disadvantages of range of tools and potential technologies. Therefore helping them to make the best choices in the future. With regards to SP3 they have identified that this should help them answer the technical questions in particular the methods of construction. Finally SP4 will enable support on system management.

Limeil–Brévannes is interested in hosting a showcase for cyber cars, as it would provide public awareness for new innovative transport systems. In terms of case study cities they are interested in changing the inhabitant's perceptions of the area and looking at potential solution to integrating and proposing alternative means of transport. They have already been having discussions with Robosoft about ideas for potential demonstrations.

### Orvieto

Orvieto is a small town with 25,000 inhabitants in Italy. It is in the region of historic, religious and artistic interest, which welcomes 2 million tourists a year. The town is interested in innovative solutions to solve two area of concern where passenger shuttle services are required. The first is to connect the existing funicular system to the historic centre and the second is a shuttle service between the scholastic pole of the area of Ciconia and the train and funicular stations. The key stakeholders for such a system would be the Ministry of Transport, the region of Umbria, the municipality of Orvieto and the building trade association. The key operators would be the ATC (consortium transport company); Municipal Police; citizens, shopkeepers associations.

The historic centre of Orvieto is situated atop of the platform of tufa rock and is known as "la Rupe". "Due to the geological problems associated with this area the Italian Government has passed a special law entitled "urgent Measures for consolidation of the rock of Orvieto and the preservation of the scenic Archaeological and Artistic Heritage". One of the major causes of these problems are the tourist buses. Therefore the two proposed projects would fit under this law in reducing transport on La Rupe.

The town has identified that the key benefits of these shuttle systems would be the reduction of pollution, noise, and accidents in the historic centre and increased accessibility to the most important tourist areas. If the city wanted to introduce an automated transport system then law would require safety certification.

The key barriers identified by Orvieto are; economic as Orvieto is a small city supported only by local taxes and tourism. There are numerous historical buildings in the town.

### Santa Margherita Ligure

Santa Margherita Ligure is a municipality of 10,405 people in the Genoa province. The modal split is 80% private vehicles and 20% public transport. The city is concerned with the integration of mobility. They have identified that automated systems have the potential to free up the waterfront area. While more conventional systems are not as competitive when compared to cars.

The city is considering an automated passenger transport system which would be scheduled on assigned routes. This would be on infrastructure built for purpose with a fully automated system. The network length is 0.8 km with demand forecasting 360 trips per days. It is expected that 40% of trips would come from private transport and 60% from walking.

The key benefit of such a system would be a higher level of satisfaction with the level of mobility. The main stakeholders that have been identified for such systems are; Santa Margherita Ligure municipality, public company Progetto Santa Margherita S.R.L and Frog as the producer and consulting company IB informatica.

### Tampere

Tampere is a city of approximately 200,000 inhabitants in southern Finland. The problem identified in Tampere is the lack of door-to-door transport facilities; in particular to hospitals, campus's and shopping centres. They have identified that automated vehicles could act as feeder services to public transport stations or to car parking facilities so providing a joined up public transport system. Between 2004 and 2005 three PRT feasibility studies were conducted to look at supporting the existing public transport system. However nothing further has been implemented from these initial studies.

Tampere had identified that SP2 would be useful to them to help with forecasting methods for future transport demand, legislation questions and inputs into impacts assessment frameworks, SP3 the safety and operability of the vehicles and SP4 through looking at the impact assessment framework from the perspective of unconventional public transport investments.

They suggested that a potential showcase would be a shopping and leisure facility on the outskirts of Tampere, with the potential for cybercars or advanced city vehicles to operate as public transport and car park feeder services. One issue that was highlighted was the climate restrictions for use of such systems in the extreme northern conditions. This would have to be tested. Additional questions surrounded how these systems would be owned and operated.

### Trondheim

Trondheim is a large city in Norway with a population of 600,000. 26% of trips within the city are by public transport and 74% by individual modes of transport. The cities car ownership levels are low. The public transport system has three terminals, one in the city centre and the other two at the harbour and railway station. This system runs along 2 corridors one east west and one north south. There is a lack of parking in the heart of the city with hotels relying on public parking to service their customers.

Trondheim has identified three possible purposes for introducing automated vehicles.

The first is a *multipurpose city centre complementary service*. One of the key transport problems that has been identified is the clash between the past where there has been an emphasis on travel using private cars, compared to the next generation city transport plan focus, which is on restricting private motor vehicles and an improved public transport network. The key emphasis is on keeping accessibility levels constant while changing how people travel. By reducing the traffic levels this will lead to space for a new feeder service. They have identified that the growing distances between parking and bus stops to the centre of Trondheim may reduce the acceptance of the public for accessing the centre. One option to reducing this distance that people have to walk could be to introduce this automated feeder service, which could be expanded in the future to cover areas such as caretaker service for shopper, or assistance for the disabled.

The second is a *harbour to city link*. The harbour is located 10-15 minutes walk from most city destinations, but few people walk due to the harsh environment. Buses serve the route

on 10-15 minutes intervals. However it is felt that the best solution for servicing this link has not yet been found. This link is due to suffer from major construction work on the city centre harbour bypass up to 2010.

The third possibility is a *single purpose sub centre service*. Trondheim has a number of sub centres that may require new transport systems. Examples of services that require new transport systems are the university campuses and hospitals, which are dispersed over the city. The new hospital buildings have been built have limit parking and so a future park and ride solution will be required. Additionally another example is a major shopping centre with many superstores and separate parking areas along a 1km stretch.

Trondheim has proposed that conventional measures might be less suitable for cases in the city centre, between sub centres or within other limited areas, where transport distances are low. In terms of public transport the key cost is the high labour cost and while improvements have been made to include automated ticketing, information devices and bus priorities the next logical step would be automation of the driver. They also highlighted that future city space dedicated to pedestrian traffic has much in common with air terminals and superstores where vehicles of assistance, service vehicles and lifts (among others) operate both manually and automatically without conflict to the pedestrians.

Trondheim had produced a new draft transportation plan up to 2015. Pilot studies that look at improved mobility in city centres is invited as part of this plan. One system called TRAMPE, is a lift for cyclists to overcome climbing hills is running a demonstration in Trondheim.

Trondheim has identified that bringing experience and foresight into the processing of scenarios that have been created is where they might contribute some information and expect some results in SP2. They have identified that dual mode operation for the city centre is relevant and legal and safety issues will be raised as a result of this in the planning stages. They also see links with SP4.

### Uppsala

Uppsala is the fourth largest city in Sweden. It has identified that for them a PRT system could be more efficient than a conventional urban public transport system at solving some of the mobility problems in the city. Studies that they have undertaken into the PRT system have indicated that the PRT system could; reduce travelling time, be economic on a community level, have a high degree of traffic safety, improve air quality, reduce space demands and reduce car ownership.

Uppsala is currently implementing a PRT test project developed by the Korean company Vectus Ltd. It is a 395m track. The first tests on the track are scheduled for spring 2007 and it is expected that approval from the Swedish rail agency by middle 2007. The station and cabins are being designed to be usable for people with mobility difficulties. A feasibility study regarding the dimensions of a real PRT system is being carried out.

Uppsala have identified that their use of LIMs (Linear Induction motors) could provide a link with SP3. Other links are with the human interactions, safety and security issues and the influence of the Nordic climate on performance.

One of the key issues flagged up by Uppsala is that previous work on PRT in Swedish cities over the last 10-15 years have been regularly stopped when the full costs have become apparent. Two areas have been highlighted that might reduce this negative aspect. Firstly, in the socio- economic analysis the value of the land saved by using the PRT compared to a conventional ground level transport system has not been taken into account. Secondly, the costs of building such systems are large. However if multiple systems could be coordinated then economies of scale could lead to reductions in the large costs per system.

## Vienna

Vienna is a city in Austria with a population size of 1630,000 inhabitants. 35% of the trips are currently made by public transport. The key goal of the city is to increase the market share of trips by public transport up to 40%. They have identified that automated vehicles could provide a solution for this goal for passenger transport. In Austria, a safety certification would be required by law if an automated vehicles were introduced onto the road network. Any new system would have to be licensed by the Ministry of Transport in Austria. They have identified that one of the barriers to introducing such a system could be that the infrastructure required for a new system maybe more expensive compared to the existing system.

## Warsaw

Warsaw is the capital of Poland with a resident population of 1.7 million. The key transport problems that Warsaw has identified are congestion and pollution. They are considering PRT as an option used to integrate large interchange hubs with public transport and for access to tourist attraction such as the zoo. PRT is seen as a potential benefit in transferring ground level commuting to above street level and on a non- collision track. The vision is of high transport speed, attractive sights and safe and comfortable cabins.

The city of Warsaw is setting up a working group to study the application of a PRT (MISTER) solution in terms of technical, business and organisational aspects. It is hoped that a pilot project will be approved. It is envisaged that the energy requirements of such a system would be less than the current tramway system.

Annex 2 Questionnaire 1 = Reference Group Questionnaire

Please answer the questions below. Please use text, pictures, drawings or whatever means you think are helpful to clarify your situation.

City : \_\_\_\_\_

Your name : \_\_\_\_\_

Your e-mail address : \_\_\_\_\_

Date: \_\_\_\_\_

1. CityMobil focuses on automation as a solution for tomorrow's mobility problems in cities. More specifically we are looking at the possibilities of Cybercars, PRT systems, advanced buses and advanced city cars or dual-mode vehicles. Describe mobility problems in your city for which you think automated solutions could offer a contribution. Name as many as you like and please add some statistical data as you see fit.

2 How could automation contribute to a solution of these problems?

3. What phase are you in? Have you already considered concrete solutions for the problems or are you still studying. If you already have concrete thoughts, please explain.

4. If you consider the activities in the various CityMobil Research & Development sub-projects. Which concrete contributions can these sub-projects offer to your particular situation?

SP 2: Future Scenario's This SP will develop tools for suggesting potential technologies, conducting exploratory business case analyses, predicting their impacts and resolving legal and safety barriers.

SP 3: Vehicles and Technological Issues. This sub-project addresses the technological and HMI issues that are in the way of large-scale introduction of advanced urban transportation systems. In principle it only addresses those issues that are typical for advanced transport. General issues like energy supply that are also subject of research in other fields are left out in this project.

SP 4: Operational Issues. This sub-project will extend the current requirements, strategies and policies to the new advanced urban transport systems that CityMobil is going to study. The challenge will be not only to achieve a level of service comparable to the one proposed by the current transport modes, but also to improve it.

In the second phase of the project there is a budget (roughly 400.000 Euro) available for supporting city studies, execution of the showcases and possible small demonstrations.

City studies are studies with a limited scope, focusing on a single problem that exists in a specific (Reference Group) city but might be representative for many cities.

Showcases are meant to demonstrate to city authorities the new mobility concepts offered by cybercars and advanced city vehicles. Vehicles will be developed which can be brought to various cities or to specific ITS or Urban Transport events for short demonstrations (typically 2 weeks).

A fourth, smaller demonstration might be organised, for instance to demonstrate issues that are not covered by the three selected city demonstrations.

In all cases the parties executing the work must invest an equal amount in order to be eligible for funding. In the third meeting of the Reference Group decisions will be made about these studies and demonstrations.

5. Are you interested in hosting a showcase for cybercars or advanced city vehicles and if you are, please describe the particular situation where such a showcase could take place (please use drawings photo's, text, etc.). Please also describe what the benefits and impacts of such a showcase would be for your city.

6. Can you identify subjects for city studies in your own city? These can be studies on a variety of issues: technological, operational, infrastructural, etc. Considering the goals of the CityMobil project we are very much interested in subjects that contain an integration aspect.

7. Would your city be willing to organize a small demonstration? The chance that CityMobil can support such a demonstration is bigger, if there are already plans in existence with a budget attached to them or if there are concrete ideas that can be realized within the timeframe of the project.

8. The answers to the questions above will help us in preparing for the second meeting. Are there any issues that you could not enter into the text above and that you consider important for the discussion. Please mention that here.

### **Annex 3 - 2ND QUESTIONNAIRE**

EUROPEAN COMMISSION

DG RESEARCH

SIXTH FRAMEWORK PROGRAMME

THEMATIC PRIORITY 1.6

SUSTAINABLE DEVELOPMENT, GLOBAL CHANGE & ECOSYSTEMS

INTEGRATED PROJECT – CONTRACT No 031315



#### Questions for Site Selection

Questions for the Reference Group Cities to select candidates for city-wide studies and site-specific applications

Dissemination level	Public
Work Package	WP 1.5.5 and WP 2.4.3
Author(s)	DITS, ITS
Co-author(s)	GEA, TRG, SINTEF
Status (F: final, D: draft)	D
File Name	CM Site Selection questions-adm0611.doc
Project Start Date and Duration	01 May 2006 – 30 April 2011



## Introduction

The objective of the CityMobil project is to achieve a more effective organisation of urban transport, resulting in a more rational use of motorised traffic with less congestion and pollution, safer driving, a higher quality of living and an enhanced integration with spatial development. This objective is brought closer by developing integrated traffic solutions: advanced concepts for innovative autonomous and automated road vehicles for passengers and goods, embedded in an advanced spatial setting. The city of tomorrow is in need of integrated traffic solutions that provide the required mobility in an efficient, safe and economic manner. Automation, in all possible forms between providing information at one end of the spectrum and fully autonomous driving at the other, could play a major role.

At three sites: Heathrow, Castellón and Rome, large scale demonstrators are being set up to supply proof of concept of innovative transport systems integrated in the urban environment.

Alongside the three demonstrations CityMobil will investigate the effects of these advanced transport solutions on urban areas through **showcases** and **small demonstrations** which will be limited in size and time, and also through **city studies**.

**Showcases** are temporary displays of Cybercars and Advanced City Vehicles, which will be brought to a number of interested cities after the first phase of the project. In the first phase of the project (18 months) the vehicles will be prepared and the sites selected. In the second phase the showcases will be mounted. A total support of €100,000 is available for the second phase which means about €50,000 per showcase. Showcases are temporary events (typically two weeks) and are not expected to continue immediately after the demonstration but should contribute to the decision-making of implementing an advanced transportation system in the city.

**Small demonstrations** would be additions to the three current large demonstrations. It might be that we find another city that is able and willing to invest in the implementation of an advanced transport system and that we can benefit from including this city in the CityMobil project. Whether or not there is funding for these small demonstrations will depend on our ability to be flexible with the current budget.

**City studies** are designed to assess the wider implications of these advanced technologies, linked to SP2 on scenarios. Four cities are to be selected as a focus for predictive analysis of the potential impact of these advanced technologies if applied extensively within the cities. The same four cities, and potentially others, will test the applicability of the business case model which is being developed. A wider set of cities will be involved in discussions on the legal, administrative, safety and acceptability barriers which might arise, and ways of overcoming them. We may also wish to have in-depth discussions with cities which raise specific design and implementation problems.

Many European cities expressed their interest in investigating, either through modelling or through showcases and small demonstrations, the possibility of addressing some of their mobility problems through advanced transport solutions. These cities have been included in the CityMobil Reference Group. *Membership of the Group is being kept open to allow other cities which express similar interests to join.*

This document is designed to ascertain the interest of each member city in any of the activities outlined above. The questionnaire is divided into two sections as follows:

**Section 1:** The first part of the questionnaire (1.1 to 1.9) deals with the general requirements of each city, and the potential for their involvement in the city-wide studies. These cities are not expected to have made a firm commitment to a city-wide application, but are expected to perceive these technologies as significant contributors to their overall transport strategy.

**Section 2:** The second part (2.1 to 2.20) relates to site-specific applications which might provide opportunities for demonstrators or showcases.

**Please complete the cover sheet on the following page and return it by Friday 24<sup>th</sup> November, with:**

**Section 1: Questions 1.1 to 1.12 if you are interested in participating in the city-wide studies**

**Section 2: One copy of questions 2.1 to 2.20 for each potential showcase or demonstrator which you are interested in offering.**

**Cover sheet**

City \_\_\_\_\_

Your name \_\_\_\_\_

Your email address \_\_\_\_\_

Date \_\_\_\_\_

**My responsibility for these matters is as [please specify; e.g.: politician responsible; principal technical officer; head of . . . ; consultant to the city]**

\_\_\_\_\_

**I understand that it is particularly important that our city is fully committed to its involvement with CityMobil. The status of the city's commitment to these answers is [please specify; e.g.: formal approval by the relevant committee; informal discussions with politicians; an agreed element of technical studies; an exploratory interest]**

\_\_\_\_\_

**The status of the city's commitment to support in cash or in kind is [please specify; e.g.: formal approval by the relevant committee; informal discussions with politicians or senior officers; commitment from a devolved budget; potential commitment subject to later approval]**

\_\_\_\_\_

**I am returning (please specify)**

**Section 1: Questions 1.1 to 1.12, reflecting my interests in city-wide studies [Yes/No]**

**Section 2: [ please specify] copies of questions 2.1 to 2.20, reflecting my interests in offering potential showcase sites or demonstrators**

**Please note, if completing both section 1 and 2 of the questionnaire, some questions may be repeated. As the two sections are to be used within separate sub-projects, please provide answers to both sections (feel free to 'copy and paste' answers in this instance).**

**Please return your completed cover sheet and your answers to the questions indicated above to Han Heijboer by 24<sup>th</sup> November 2006. If some information is not available to you by then, it would still help us to have your remaining answers, so please indicate where answers to specific questions will take longer to answer.**

## Section 1: City-wide questions

### 1.1 City description

This first open question is designed to identify the case study area. Please indicate the area on which you would wish to focus (which could be a conurbation, an individual city within a conurbation, or a significant part of a city). Please indicate for that area the current population and modal split.

### 1.2 Objectives and problems

Please specify the overall objectives of your city's transport strategy. What are the specific problems which you consider that new technologies could address? Why might conventional transport measures not be sufficient to solve these problems?

### 1.3 Potential applications

Please indicate the type(s) of technology which you would be interested in considering, whether it would be used for passengers, freight or both, and the types of journey for which it would be provided.

### 1.4 Stakeholders

In relation to the introduction of a new technological transport system, who are (or are likely to be if you have no specific plans) the key stakeholders, and what are their requirements?

### 1.5 Potential benefits

What are the principal quantifiable and non-quantifiable benefits of a new system that can be identified? (e.g. environment, safety, accessibility, etc.)

### 1.6 Safety barriers

Is an official safety certification necessary if you want to introduce an automated transport system in your city? Please answer either: no; yes by law; or, yes this is optional.

If the answer is **'yes, by law,'** please outline which procedures/ regulations apply. Please describe and provide documents or references to the relevant procedures/ regulations

If the answer is **'yes, this is optional,'** please outline which procedures could be used. Please describe and provide documents or references, and inform us if this has not been a relevant situation.

### **1.7 Safety and security requirements**

Do you expect that additional procedures to guarantee the safety and security of users and personnel will be necessary in the case of an automated transport system being implemented? If so, please outline what these are expected to be.

### **1.8 Legal and administrative barriers**

Please identify any major legal and administrative barriers you may anticipate when introducing new technologies in your city.

### **1.9 Other barriers and risks**

Please identify any other barriers and risks (e.g. financial, political or public acceptability etc...) you anticipate when introducing new technologies.

### **1.10 Data availability**

Data will be required on patterns of travel demand and performance of the current transport system for any future scenarios modelling work, and for developing business cases. Please indicate what type of data you have available and how readily available this will be to use.

### **1.11 Model availability**

Please provide details of any transport or transport and land-use models you have for your city. Please indicate which models they are, their level of detail, and the geographical area they cover. Are these available for use within the CityMobil project?

### **1.12 Financial and resource support**

Cities with whom we conduct predictive modelling will be expected, in addition to providing data and, ideally, models, to offer support in cash or through staff effort, for conducting and interpreting the model tests, equivalent to that available from CityMobil (around €12,500 per city). Those with whom we work on the business case models and barriers will be expected to provide staff time to discuss the development and application of these analyses. Please indicate the extent to which these resources are or could be made available.

--

## Section 2: Application-specific questions for showcases and small demonstrations

### 2.1 Site description

This first is an open question necessary to define the site and the proposed application. You are free to describe your site as you wish, but please indicate:

Site location and area

Suitable for a showcase? If so, when would the site be available, and when would it best be mounted?

Suitable for a small demonstration? If so, when would it be implemented?

### 2.2 Objectives and problems

Please specify:

The overall objectives of your city's transport strategy;

The specific problems which you consider that new technologies could address;

Why conventional transport measures might not be sufficient to solve these problems;

Who the main stakeholders are;

(For a showcase) what the particular benefits would be of mounting a showcase, and what problems (e.g. acceptability) might a showcase help overcome.

### 2.3 Application description

Please indicate against the characteristics below what type of showcase you would ideally wish to host or, for a small demonstration, the planned nature of that demonstration.

Service type

Collective scheduled on assigned routes (conventional bus like)

Collective with on-demand trips on assigned routes (on-demand bus like)

Collective totally on demand (shared taxi like)

Individual demand (taxi like)

Infrastructure type<sup>3</sup>

Reserved infrastructure to be built for the purpose

Reserved infrastructure earmarked from the existing infrastructure

Infrastructure shared with pedestrian and cyclists earmarked from the existing infrastructure

Existing infrastructure shared with any traffic

Driving mode

Fully automated

Dual mode (fully automated on specific infrastructure and manual elsewhere)

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<sup>3</sup> In case the application has not homogeneous infrastructures multiple answers are possible but then the length of each kind of infrastructure is required

Manual-assisted guidance

Network length [km]

Foreseen demand [trips/day]

Which current modes you would expect that demand to come from (with % shares)

Required level of service:

waiting time [min] and commercial speed [km/h]

#### 2.4 Application classification

Please classify your intended showcase or small demonstration as follows:

##### **Public applications**

Citywide

City-centre

*For general user*

*For special user: Tourists, Conference centre, etc.*

*For freight*

Suburb

*For general user*

*For special user: business-park, shopping centre, etc.*

*For freight*

##### **Private Application**

Airport

Theme-park

Large Business

Tourist Resort

University Campus

Other (please specify)

#### 2.5 Application consistency with local transport plans or strategies

Please rate on a scale from 0 to 4 the consistency between the proposed showcase or small demonstration and the local transport plan or strategy (please check the relevant box):

[ ] 0 if the plan does not mention the problems, the objectives or the technology;

[ ] 1 if the plan identifies the same specific problems (on the site or at a general level) that motivated the implementation of the project;

[ ] 2 if the plan also identifies as the methodology to solve the problem the installation of a transport system with characteristics (capacity, frequency and commercial speed) similar to the chosen transport system designed;

[ ] 3 if the plan also makes specific reference to a transport system based on fully or partially automated vehicles;

4 if the plan budgets funds specifically for the project.

#### 2.6 Application consistency with regional transport plans or strategies

Please rate on a scale from 0 to 4 the consistency between the proposed showcase or small demonstration and the regional plan where levels from 0 to 4 are defined in question 2.5. If regional transport plans do not exist or are not relevant to the city level, please indicate not applicable (N/A).

#### 2.7 Application consistency with national transport plans or strategies

Please rate on a scale from 0 to 4 the consistency between the proposed showcase or small demonstration and the national plan where levels from 0 to 4 are defined in question 2.5. If national transport plans do not exist or are not relevant to the city level, please indicate not applicable (N/A).

#### 2.8 Application consistency with legal framework

Please rate on a scale from 0 to 3 the consistency between the proposed applications and the local legal framework:

0 if the legal framework expressly forbids the application;

1 if the legal framework allows the application with special approvals and under specific limitations (e.g. a “driver” is requested to be always on board even if the vehicles are fully automatic) or requires modifications (e.g. permanent barriers around vehicle tracks);

2 if the legal framework allows applications as they are but with special approvals;

3 if the legal framework allows the proposed application.

#### 2.9 Application project progress

Please rate on a scale from 0 to 7 the progress level of the proposed showcase or small demonstration where:

0 means no activities performed yet;

1 means problems have been identified and objectives defined;

2 means the network has been defined;

3 means demand has been forecast;

4 means system pre-design completed;

5 means initial evaluation completed / impacts forecast;

6 means system detailed design completed;

7 means expected impacts have been evaluated.

#### 2.10 Application integration with the mobility network

Please rate from 0 to 3 the integration level of the proposed showcase or small demonstration with the rest of the mobility network where:

0 means the new system is a totally isolated line and not connected with other transport modes;

1 means the new system is not a network but at least a flexible line (e.g. on demand), interacting, but not integrated with other transport modes;

2 means the new system is either a small network or has traditional interchanges with conventional transport modes (e.g. stops from which users can transfer on foot to the other mode);

3 if the new system is an entire network with a high degree of flexibility (e.g. fully on-demand itineraries and times) or has advanced and integrated interchanges with conventional transport modes (e.g. the new system vehicles can bring the user directly to the parking space, bus stop or station).

#### 2.11 Application integration with other policies and complementary measures

Please rate in a scale from 0 to 4 the changes in policies and measures adopted to integrate the showcase or small demonstration where:

0 means no complementary measures are adopted to favour the application;

1 means the application's operation (e.g. ticketing) is integrated with the other transport modes;

2 means the application is supported by a range of "soft policy measures" (e.g. information campaigns, support for walking and cycling);

3 means the application is favoured by a range of management and pricing measures (e.g. changes in public transport service levels, regulatory controls on car use, changes in parking charges, road pricing);

4 means the application is supported by other infrastructure measures (e.g. new roads, new public transport lines).

#### 2.12 Application integration with the redesign of public space

Please rate in a scale from 0 to 3 the actions related to the redesign of public space (e.g.: reallocation of road space, relocation of parking, new surfaces or planting):

0 if no public space redesign is planned in conjunction with the showcase or small demonstration;

1 if the showcase or small demonstration is to be inserted in an area in which the public space will have been redesigned, without affecting it negatively;

2 if the showcase or small demonstration will be introduced together with measures to improve the quality of the urban space around it (e.g. ornamental plants are used as barriers, new advanced pedestrian crossings are made);

3 if the showcase or small demonstration will be introduced together with the comprehensive redesign of the surrounding public space.

#### 2.13 Application technical complexity

Please rate on a scale from 0 to 4 the technical complexity of the proposed showcase or small demonstration:

0 if the system is based on automatic vehicles running in an unrestricted access environment;

1 if the system is based on automatic vehicles running on shared tracks with restricted car traffic access;

2 if the system is based on automatic vehicles running in streets without cars, but with cars crossing at intersections;

3 if the system is based on automatic vehicles sharing their tracks with pedestrians, cyclists and cars manoeuvring slowly;

4 if the system is based on automatic vehicles running in a totally protected site.

#### 2.14 Application acceptance by end-users

Please rate on a scale from 0 to 5 the end user acceptance of the proposed showcase or small demonstration where the level of acceptance is assessed on the basis of their anticipated support for, or opposition to the project. The level of acceptance should be scored from 0 (strongly opposing the project) to 5 (strongly supporting the project).

#### 2.15 Application acceptance by operators

Please rate on a scale from 0 to 5 the operator acceptance of the proposed showcase or small demonstration where the level of acceptance is assessed on the basis of their anticipated support for, or opposition to the project. The level of acceptance should be scored from 0 (strongly opposing the project) to 5 (strongly supporting the project).

#### 2.16 Application acceptance by decision-makers

Please rate on a scale from 0 to 5 the decision-maker acceptance of the proposed showcase or small demonstration where the level of acceptance is assessed on the basis of their anticipated support for, or opposition to the project. The level of acceptance should be scored from 0 (strongly opposing the project) to 5 (strongly supporting the project).

#### 2.17 Data availability for application evaluation

Please rate on a scale from 0 to 3 the data availability being the level:

- 0 if no specific data collection will be made and no data is available now;
- 1 if specific data collection will not be made but the site has a good mobility database to be given to CityMobil partners for studies;
- 2 if the site is willing to perform before and after data collection but no previous data are available; and
- 3 if the site is willing to perform before and after data collection according to the instructions and timing provided and has a good mobility database to be made available to CityMobil partners.

#### 2.18 Support for showcases

Please indicate the level of financial and in-kind support which you would be able to offer to enable a showcase to be mounted.

#### 2.19 Support for small demonstrations

Please indicate the total project capital cost, and the percentage which is:

- Already available or firmly committed;
- Anticipated from other sources (please specify);
- Sought from CityMobil.

#### 2.20 Consortium partner involvement within the site

Please rate the level of involvement in the local application project of a CityMobil partner according to the scale below.

- Level 0: not involved.

- Level 1: involved in the project as an external advisor or consultant.
- Level 2: actively involved in the project as system provider.
- Level 3: actively involved in the project at decision-making levels.

This is the end of the questionnaire. Thank you for taking the time to complete it