CiViTAS
Cleaner and better transport in cities

THE CIVITAS INITIATIVE
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MIRACLES

COMPETITIVE AND SUSTAINABLE GROWTH
&
ENERGY, ENVIROMENT AND SUSTAINABLE DEVELOPMENT
PROGRAMMES

MIRACLES Project GRD1 – 2001 – 40047

Rome Winchester Barcelona Cork

MIRACLES
MULTI INITIATIVE
FOR RATIONALISED
ACCESSIBILITY
AND CLEAN LIVEABLE
ENVIRONMENTS

Deliverable D2.3 and D1.7

REPORT ON CONCLUSIONS AND RECOMMENDATIONS & POLICY RECOMMENDATIONS

Version N°4.1
Dec 2006

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MIRACLES DELIVERABLE n°1.7 & 2.3

Workpackage 1 and 2 / Version 4.1 / December 2006

Classification

This report is:

Draft	
Final	X
Internal	
Public	X

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Issue Date

Version 1	1/6/06
Version 2	7/11/06
Version 3	14/11/06
Version 4	1/12/06
Version 4.1	11/12/06

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Background

Europe is a much urbanised region of the world and it is in these urban areas (which comprise 80% of Europe) that transportation, environmental, and energy policies meet.

Traffic congestion is a prevalent and growing issue in Europe. 80% of urban dwellers believe traffic congestion, accidents and pollution to be very serious problems that need to be urgently addressed. Europe experiences 7,000 – 10,000 kilometres of congestion daily,

The European Commission (EC) desires to see comprehensive, coordinated solutions to these problems and have set policies and developed programs to accomplish this.

Environmental policy sets new air quality standards, in part to assist member states in fulfilling their commitments to the Kyoto Protocol (an international agreement to reduce greenhouse gases) and to address the long-term health effects of transport-related pollution.

The overall objective of the EC's 2001 Transport Policy, pursued since 1992 is to:

> *Meet the demand for accessibility, while minimizing the negative effects of transport, with an expectation of strong economic growth that should not be minimized.*

The CIVITAS Initiative, which tests integrated strategies for clean transport, supports the packaging of technology and policy measures in the area of energy and transport implemented at the local level.

The purpose of this report is to describe the innovative approach undertaken within the CIVITAS Framework by the MIRACLES partners, to report lessons learned, and to recommend future activities.

This report is a synopsis of the technical documentation submitted to the EC. Greater detail on conclusions and lessons learned can be found within the "MIRACLES Report on Evaluation Results" and the "MIRACLES Implementation Report".

1.1 The CIVITAS Initiative: a mix of policies and technology

The CIVITAS Initiative is an integrated approach to clean urban transport, which supports demonstration projects integrating both technologies and policies, stressing both the energy and the transport elements.

CIVITAS OBJECTIVES

- to promote and implement sustainable, clean and efficient urban transport
- to implement and test real change by integrated packages of technology and policy measures in the field of energy and transport in 8 categories of measures
- building up critical mass and markets

CIVITAS MEASURES

1) Demand management strategies based upon access restrictions to the inner city areas and other sensitive zones
2) Demand management and revenue raising strategies based upon integrated area-wide pricing strategies
3) Stimulation of collective passenger transport and the improved quality of service offered to passengers
4) New forms of vehicle use and/or ownership and less car intensive lifestyles
5) New concepts for the distribution of goods
6) Innovative 'soft' measures for managing mobility demand
7) Integration of transport management systems and related information services

8) Energy-efficient, cost-effective and clean public and/or private vehicle fleets and the necessary infrastructure

1.2 MIRACLES and the CIVITAS Initiative and the policy approach

The MIRACLES Project (**M**ulti **I**nitiative for **R**ationalised **A**ccessibility and **C**lean **L**iveable **E**nvironment**S**) is part of the CIVITAS Initiative and has involved four European cities: Rome (IT), Barcelona (ES), Winchester (UK) and Cork (IRL).

The MIRACLES Project, together with VIVALDI, TRENDSETTER and TELLUS was one of four pioneer projects belonging to the CIVITAS Initiative, launched by the EC in the year 2000, and officially started in 2002.

The mix of cities within MIRACLES is unusual, combining the two large, densely populated, Mediterranean cities of Rome and Barcelona with the two smaller, northern European cities of Winchester and Cork (fig 1).

At first sight the two sets of towns do not have had much in common, but the work carried out so far has shown that issues such as traffic congestion, increasing pollution levels due to traffic, and the need to provide citizens with improved mobility services, are common to all cities, notwithstanding their geographical location, character, (Latin or Anglo-Saxon) and scale.

Fig 1 the MIRACLES Project cities

Since its inception CIVITAS has grown from the original 19, to 36 cities (fig. 2), increasing opportunities for cooperation.

MIRACLES and CIVITAS have shown how co-operation between cities can help develop solutions to transport issues, as well as overcome risks and problems associated with implementation.

CIVITAS has proved an important showcase for cities to disseminate their achievements in the Sustainable Mobility field. Opportunities for cross-site evaluation and dissemination of mobility management were of great value. For example, Rome and Winchester were visited in June 2005 by a US scanning group, performing a tour across Europe, aimed at pointing out best practices in the field of travel demand management. The CIVITAS Initiative was one of the points highlighted in their final report.

Fig.2 The "CIVITAS Family"

With reference to the aforementioned CIVITAS measures, Table 1 describes the commitment of each MIRACLES city towards each of the CIVITAS domains.

	ROMA	WINCHESTER	BARCELONA	CORK
WP5 Access Restrictions	●	●	●	●
WP6 Pricing Policies	●	●		
WP7 Collective Transport	●	●	●	●
WP8 New forms of vehicle use	●	●		
WP9 Distribution of goods	●	●	●	
WP10 Soft Measures	●	●		●
WP11 Integration of Transp. Mngt. System	●	●		●
WP12 Clean Fleets	●	●	●	●

Table 1: CIVITAS Domains for MIRACLES Cities

Three measures have been addressed by all of the cities: Access Restrictions, Collective Transport and Clean Fleets. The Integration of Transport Management Systems is the basis for all of the cities to implement their policies, although this was not explicitly implemented through a specific WP in Barcelona.

The common strategy pursued by all the cities while implementing their projects can be summarized in one concept: **Mobility Demand Management**, through a "push and pull" approach.

Some of the measures in force aim to discourage "environmentally unfriendly" behaviour, by limiting mobility, and consequently the impact of certain kinds of vehicles. In addition, measures have been implemented to encourage people to take advantage of the "Sustainable Mobility" package.

In the following Figure an example is provided of how the "PUSH & PULL" policy that has been used while implementing the MIRACLES measures. This means that as on one side the Administration forces behaviours, and adds constrains and barriers, such the limitations to private traffic, causing a (temporary) disappointment by the population, on the other it provides a "premium", as driver to change the citizens' attitude towards a sustainable way of using the means of transport.

Here follows an example of what has happened in MIRACLES

PUSH	PULL
Barriers to Access (e-gates, bollards)	Increase quality of public transport
Limitations to traffic	Improve cycling and pedestrian modes
• polluting cars	Increase the number of appropriate parking areas
• freight distribution vehicles	Increase the number of low emission vehicles
Pricing policies	Rationalize and ease goods distribution
• parking	Improve information for city dwellers in real time (travel time prediction, congestion, best route calculation etc)
• entering clean zones"	
	Innovative payment systems for mobility services

Figure 3 –Push & Pull

1.3 The Cities and the Integrated Approach

It has been essential to generate and retain support from the cities and local partners of MIRACLES, while successfully implementing the packages of measures.

The quality of the environment in cities largely depends on managing traffic appropriately. **Improving mobility conditions means protecting the environment.** This can be achieved through COMBINED ACTIONS that aim to:

- Limit access to cars in a dynamic way, according to the pollution levels;
- Encourage the use of public transport, by improving the quality of the services and information;
- Manage traffic in real time

Through implementing these actions it is possible to achieve the following **objectives**:

Reduction of transport-related environmental impacts at the local level;

Increased urban accessibility;

Enhanced economic efficiency through better transport management; and

Overall improvement of citizens' quality of life.

Added value within the MIRACLES project is generated through an "integrated approach", which has followed two main strands:

- integration of the measures, that have different levels of application in each city;
- an integrated methodology, for addressing technical and strategic issues, through the commitment of stakeholders and technicians working together.

Each city has implemented a different policy mix, based upon the CIVITAS values, taking into account specific local circumstances, but aimed at achieving the objectives listed above.

1.3.1 Rome

Rome is located on the west coast of the centre of Italy, in the Lazio Region. The number of inhabitants in the city itself is about 2.6 million, and the Rome Metropolitan Area hosts about 4 million residents over an area of 5.300 km^2.

Private cars are the most prevalent mode of transport for Romans despite the roads often being narrow, with uneven surfaces and intermittent pavements. In recent times, general improvements have been made to improve the transport supply, especially in relation to the needs of pedestrians and bus/underground users. However, as with most cities, **the last 40 years have seen an increasing reliance on the private motor car**. For instance, during this time the kilometres travelled in Rome have tripled. In the 60's, the public transport modal share was 56% of all the motorised trips, whilst nowadays it is around 34%.

A general Urban Transport Masterplan was recently issued by the Municipality of Rome, in order to increase the modal share of Public Transport, in line with the CIVITAS philosophy. The protection of Rome's inner zone is at the centre of the City Council's mobility strategy, with the main objective being to protect the "sensitive" urban areas and the cultural heritage from congestion and pollution. This has influenced all the MIRACLES measures, bearing in mind that a combination of integrated and flexible solutions provide the best means to limit or restrict traffic

The following measures have been implemented in Rome within MIRACLES:

Work Packages	Measures Implemented
Access Restrictions	Set-up of city centre limited to traffic zones green corridors, pedestrian pathways
Integrated Pricing Strategies	Time based entrance to LTZs/road pricing and parking policies
Collective Passenger Transport	Trialling of innovative security features
	Information: enhancement of multi modal and on board
	Introduction of new lines (e-buses and trolley lines)
	Improved integration of public transport (flexible service)
New Forms of Vehicle Use	Establishment and improvement of new services: cycling opportunities, car sharing, car pooling)
New Concepts for the Distribution of Goods	Preliminary studies to implement efficient goods distribution
Innovative Soft Measures	Awareness measures and Mobility Management measure
Integration of Transport Management Systems	Improved Multi modal travellers services: payment of ticket via sms, mobility information via mobile devices, integration of mobility information
	Improved network management: AVM implementation and provision of information at the bus stop through "electronic poles"
Clean public and private fleets	Clean vehicles: (electric buses, trolleys, EURO IV buses)
	Support services for electric scooters

1.3.2 Winchester

Winchester is the county town of Hampshire, with a population of around 30,000 people. A further 80,000 reside in the main country towns and villages of Alresford, Bishops Waltham, Denmead and Wickham and the rural areas surrounding them. Winchester itself is on the main London-south coast rail line and is well connected by the primary road network to London and the Midlands, as well as the major ports at Southampton and Portsmouth and the south's international airports. The central area of the city experiences the classic problems associated with an historic city: high volumes of traffic using narrow ancient streets, pedestrians and traffic in close proximity, and lorry movements being perceived as intrusive and problematic. Prior to MIRACLES, a limited city centre clean zone had been developed as part of the Winchester Movement and Access Plan which had received a national award for developing ClearZone initiatives.

Building on these previous initiatives, the following measures have been implemented in Winchester within MIRACLES:

Work Packages	Measures Implemented
Access Restrictions	Set-up of city centre clean zone
Integrated Pricing Strategies	Adoption of flexible parking policies and environmentally linked parking charges
Collective Passenger Transport	Improving PT service quality and information
New Forms of Vehicle Use	New cycling opportunities
New Concepts for the Distribution of Goods	Fleet efficiency and home delivery
Innovative Soft Measures	Awareness measures
	Mobility management measures
Integration of Transport Management Systems	Improved multi modal traveller services
	Improved network management
Clean public and private fleets	Cleaner buses
	Cleaner municipal fleet vehicles
	Clean fuel support services
	Alternative fuel demonstration vehicles

1.3.3 Barcelona

Barcelona is located on the east coast of Spain and has a population of 1.5 million, with 4.2 million inhabitants in the metropolitan area. Like most Mediterranean cities, its central area is very densely populated. The urbanised area stretches beyond the two rivers that flank the city, the Llobregat and the Besòs. Barcelona is the capital of Catalonia, a long-established autonomous region in the NE of the Iberian Peninsula, with a population of 6 million and its own regional government, the Generalitat de Catalunya. An underground system comprises 7 lines, 129 km of track and 138 stations. Demand is greatest for the lines that run parallel to the sea and mountains, because they cover the longest routes. Some 726 million passengers used public transport in 1999.

The following measures have been implemented in Barcelona within MIRACLES:

Work Packages	Measures Implemented
Access Restrictions	Set-up of city centre clean zone in La Rambla
Collective Passenger Transport	Multioperator AVM and real-time pasenger information
	Tramway in integrated CPT
New Concepts for the Distribution of Goods	Kerbside deliveries with improved logistics support
	Quiet night deliveries
	Multi-use lanes
Clean public and private fleets	Clean vehicles buses
	Clean fuel support services

1.3.4 Cork City

Cork City, situated on the south coast of Ireland, is the commercial, cultural, educational and industrial capital of the province of Munster. Cork City is the second largest city in the Republic of Ireland with a city population of about 124,000 and an extended area population of 345,000. A map of the city of Cork and its surrounding area is given in Figure 2.4. Traffic congestion is endemic in the city centre and along the main radial and circumferential roads, particularly during peak periods. Many narrow streets in the central area are completely inappropriate for the volumes of traffic carried. The Cork Strategic Plan 2001-2020 includes proposals for reviving the city centre and has a major emphasis on public transport including a suburban rail system, quality bus corridors and park and ride.

The following measures have been implemented in Cork within MIRACLES:

Work Packages	Measures Implemented
Access Restrictions	Set-up of a city centre clean zone
Collective Passenger Transport	Introduction of new PT lines and of a P&R area
Innovative Soft Measures	Awareness measures
	Mobility Management measure
Integration of Transport Management Systems	Improved network management
Clean public and private fleets	Municipal fleet vehicles – conversion of municipal cars to run with rapeseed oil

1.4 The MIRACLES Project partnership and roles

Achieving the ambitious CIVITAS/MIRACLES objectives has required a strong commitment by the Cities, which have been leading and monitoring the activities at local level and at the same time have had to retain political support of the CIVITAS objectives. Moreover the cities have set up local teams to support the achievement, evaluation and dissemination of the results. Here follows a description of the actors and their roles within the project:

LOCAL AUTHORITIES:

City of Rome	**Project Coordinator**;
Hampshire County Council	Winchester Project Manager
City of Barcelona	Barcelona Project Manager
Cork City Council	Cork Project Manager

MOBILITY OPERATORS / AGENCIES:

ATAC SpA	Rome Mobility Agency - Project Manager and Rome Site Manager
ATM	Barcelona Transport Authority
TMB	Barcelona Transport Operator

RESEARCH INSTITUTIONS:

University of Southampton (TRG)	**Project Evaluation Manager**
University of Southampton (TRG)	Winchester Evaluation Manager
University of Rome “La Sapienza”	Rome Evaluation Manager
ENEA Institute for renewable energies	Support for evaluation in Rome;
University College Cork	Cork Evaluation Manager

SMEs

Interclub	**Dissemination Manager**
DSD (Barcelona) –	Site manager, local evaluation and dissemination manger, support for technological implementations;
Peopleservice	Transport operator in Rome

2 Making “MIRACLES” happen

The four MIRACLES cities, according to the requirements of the EC, identified defined ‘laboratory’ areas where the integrated approach has been implemented and the impact has been assessed.

Utilising the “push and pull” strategy, the measures have been successfully implemented according to the following:

The implementation of **City Centre Clean Zones** is in force in all four cities. Access for private vehicles to historical and central areas has been increasingly limited. In some cases these areas have been totally closed, to the satisfaction of citizens and PT users and with a good level of satisfaction amongst the retailers.

Parking and Pricing Policies have been implemented in Rome and in Winchester, with different methods of application being assessed in the two cities.

The **bus fleets** have been renewed with low and zero emission vehicles such as the latest generation Compressed Natural Gas, Diesel (EURO III, EURO IV), electric and bi-modal trolleys. Innovative fuels are also being assessed.

New **Public Transport lines** have been implemented, including a new tramway line in Barcelona, and a trolleybus line in Rome.

Park & Ride has been introduced in Cork and Winchester, integrated with bicycle parking and shuttle buses, to facilitate alternatives to car use in the city and to connect the city centres to the P&R areas.

The **car-sharing** service was implemented in Rome in February 2005, while new **cycling** opportunities have been implemented in Cork and Winchester, including an innovative cycle loan scheme.

Information technology has been strongly utilised by all the cities, incorporated within measures such as: the control of the Public Transport Operator (PTO) fleet, the provision of public transport information both on-line (internet, WAP, PDA, sms) and on board; the provision of real time traffic information to drivers; the payment of transport-related services through SMS (bus ticket in Rome and parking in Cork), and; the development of tools to predict pollution levels due to traffic.

Freight delivery solutions have been undertaken in three of the cities. Barcelona improved and extended (5km of new lane) the scheme of multi-use lanes, as well as implementing quiet night-time deliveries, and a pilot internet portal, developed in collaboration with goods operators to identify hot-spots and target illegal parking enforcement. Winchester and Rome were also active in developing innovative urban delivery solutions.

The above approach has been translated into a poster used in the Final Conference to describe in integrated way the achievements of the four cities.

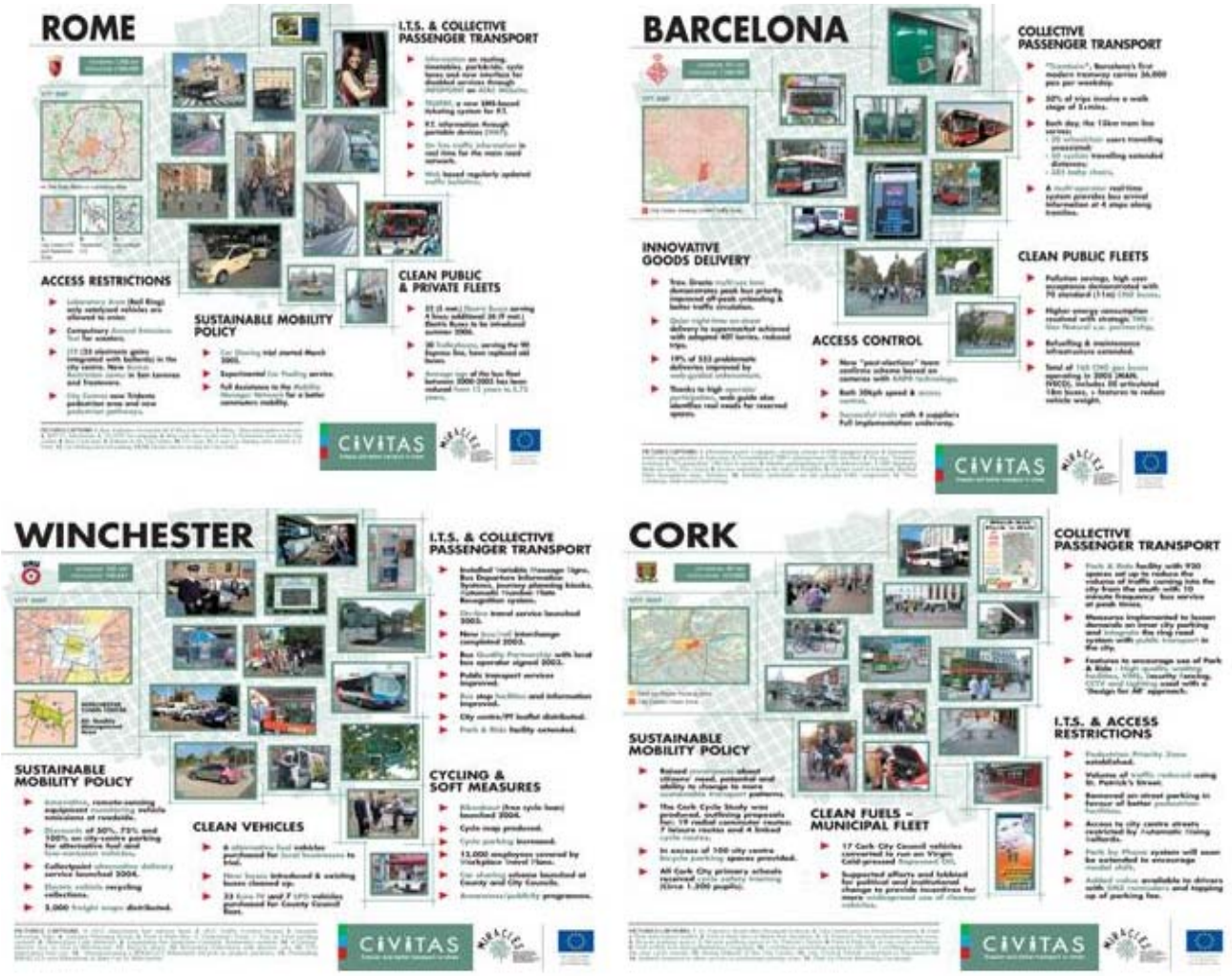

Fig 4 – the posters of the four cities prepared in occasion of the Final Conference

2.1 ACCESS RESTRICTIONS

2.1.1 Key Impacts

Access Restrictions were implemented in all the four cities. Rome has proven to be a flagship in the large scale application of Access Restrictions measures. Its access control system is, together with London, the main example in Europe.
Access Restrictions were found to reduce pollution and improve the pedestrian environment more generally. Overall there were traffic reductions and the displaced traffic was not found to cause additional congestion elsewhere in the network. Whilst the enforcement of powered two-wheeled vehicle traffic remains a problem, the concepts and applications of access restrictions are readily understood and appreciated, and have generated public and political support.
The process required to implement these measures was complex, and included gaining political/institutional support, and choosing the appropriate technology.

Access Restriction Policies have led to significant environmental improvements.

One of the largest measures within MIRACLES was the "set-up of a city centre clean zone" in ***Rome***. The scheme included: the restriction of the Laboratory Area to catalysed vehicles only; compulsory yearly check-up of two-wheeled vehicles, and; closure of the Access Gate System.

The most important benefit was a reduction in pollution levels, both in terms of emissions and concentrations. A comparison between the measured mean values in 2001 and 2004 showed a reduction of concentrations (CO: - 21%, PM10: - 11% and benzene: -37%) and emissions (PM10 and benzene: - 38 %, CO:- 76%). This was a consequence of a 40% reduction in the number of polluting vehicles within the central area.

Although these findings were derived from a combined effect of all the MIRACLES measures, it was considered that the greatest benefits came from restricting non-catalysed private vehicles from the central area, as shown in Fig.4 the implementation of access restrictions also contributed to the re-styling of some areas reduced space for cars.

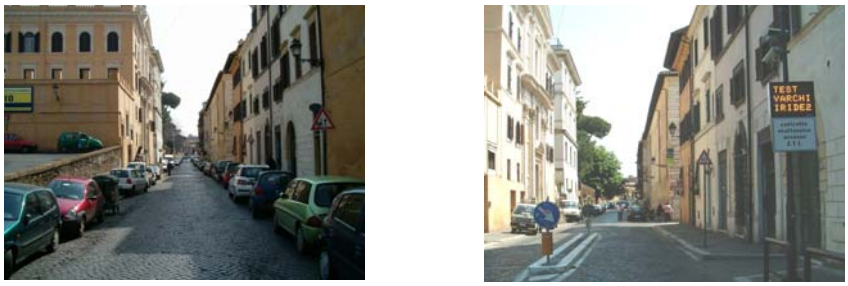

Fig.4 – "before and after" the implementation of e-gates

Access restrictions decreased traffic flows to the city centre during the restriction periods by 20%. It was also found that traffic flows decreased by 20% also outside the restriction periods; thus this measure has contributed to change the citizens' behaviour in the use of their cars.

The creation of a pedestrian network in the city centre in **Rome** improved the overall quality of life both for residents and tourists.

Pedestrianisation was considered the "premium" part of the whole access restriction scheme, but to "gain" it, a strong political will is required.

In **Barcelona**, access restrictions along the Rambla improved the pedestrian environment by controlling the type of vehicle travelling along the route and enforcing speed limits. Surveys

quantified that pedestrian activity was substantial, and that pedestrian crossing volumes were more than six times that of vehicles. is contemplated with “soundwalks” (a technique being developed in the SILENCE project). Observations of 200 pedestrian crossing movements enabled estimates suggest that daily delay savings of 3,800 hours, could be achieved once the scheme becomes fully operational.

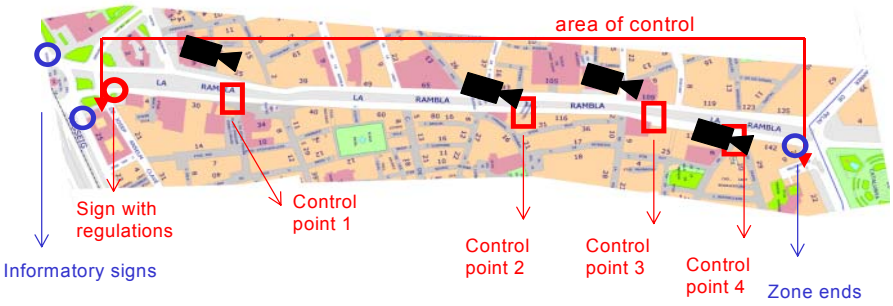

Fig 5 – the access control scheme in Barcelona

In **Cork**, the set up of a city centre clean zone provided a safer, healthier, more comfortable environment for pedestrians and cyclists in the city centre by halving the number of lanes on the main thoroughfare (St. Patrick’s Street), widening pavements, and providing new bicycle-parking facilities and better public transport alighting facilities. In addition, redesign created space for cultural events which have since attracted many visitors to the city centre.

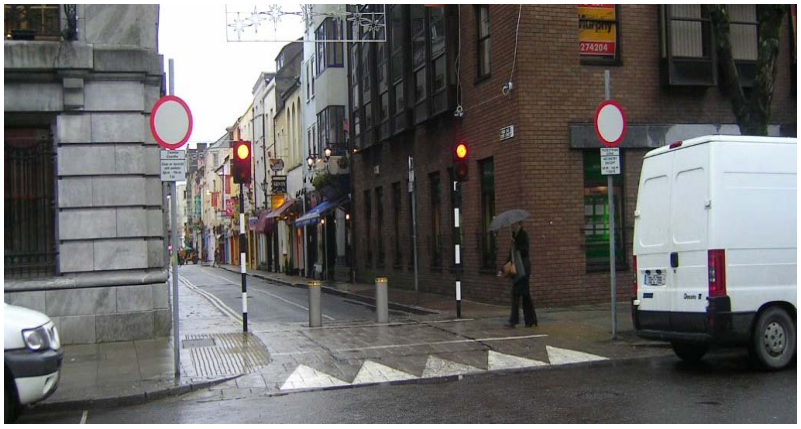

Fig 6 – bollards in Cork

Access Restriction of powered two-wheeled vehicles is important, but can present enforcement problems, as demonstrated both in Rome and in Barcelona.

In ***Rome***, recorded flows showed that two-wheeled access was substantial during the morning peak and the late evening, with motorcycles accounting for about 30% of all traffic accessing the LTZ.

In ***Barcelona***, the ***Rambla enforcement scheme*** was trialled using Automatic Number Plate Recognition (ANPR) technology, but could only be used if larger registration plates were adopted as the norm. In the meantime, the scheme is being implemented, using manual enforcement.

Consequently, the implementation of technology to control powered two-wheeled vehicles access is crucial and is one of the next challenges for the Administration.

It is recommended that large registration plates be adopted across Europe (national legislation for this has been established in Italy, following the access control experience of Rome). Since this will take time, tags may be required to recognise authorised entry by PTW users who are residents of the controlled central area.

The technology relating to an innovative, Remote Sensing Device to identify high polluting vehicles was developed and successfully used in an urban environment. Environmental access control was encouraged through information strategies.

In ***Winchester***, the aim was to identify high polluting vehicles by measuring emissions using an innovative, roadside remote sensing device, and implement feedback strategies to inform drivers of the results. The objective was to encourage voluntary maintenance of high polluting vehicles and to restrict them from the city centre.
The remote sensing equipment found that the percentage of high polluting vehicles was very low (approximately 0.1% for CO, 0.4% for HC and 0.01% for NO_x).

Local Urban Traffic Plans can reduce traffic speed and improve pedestrian safety.

In ***Rome***, it was estimated that the redesign of crossing areas would result in a 50% decrease in traffic flows and a 5-10% reduction in emissions. In addition, the upgrading of traffic signals at some accident black spots should improve pedestrian safety.

2.1.2 Recommendations and Lessons learned

The implementation of infrastructure to support the access control system requires high investment.

In ***Rome*** the completion of the Access Restrictions installations has been a quite demanding process, which has suffered delays compared to the initial schedule, because of the necessity to comply with the timings for the supply of the high level of National Funding, coming from the Ministry of Environment, necessary to implement the infrastructures.

In ***Barcelona*** considerable time and cost was dedicated to establishing fibre-optics connections from the roadside ANPR equipment to the Traffic Control Centre. It is possible that, for some applications (such as the Winchester environmental access control), mobile communications can offer lower installation costs. Apart from the concern about higher operating costs, the decision to use more-proven communications technology in Barcelona was taken to avoid further complication of the measure implementation.

Implementation of environmental access control schemes should be undertaken in conjunction with the creation of tangible benefits for the public.

In ***Cork***, parallel improvement of the streetscape made the new street layout more attractive to pedestrians of all abilities raised the awareness of the associated benefits.

Location of access control and enforcement control points may be partly dictated by the road network conditions and this may require some flexibility in determining access control boundaries and hence areas of impact.

The use of retractable bollards is a common feature of the access control schemes in ***Rome***, ***Barcelona***, and ***Cork***. They provide effective enforcement (for 4-wheeled vehicles) without limiting essential access for priority vehicles. In Cork, the bollards had been implemented after discussions with business representatives. While successful some enforcement issues remain on loading time restrictions and illegal parking, which had also caused additional delays to the bus service. Consultation with business representatives is ongoing. In Barcelona, the trial of ANPR technology has been motivated as an alternative to bollard-based control – which is proving costly to maintain. However, greater experience with ANPR-based sanctions is required before Barcelona can consider substituting the gates with bollard installations.

The use of roadside emissions measuring equipment, for environmental access control, could be successfully used in areas with high numbers of high-polluting vehicles.

Whilst the number of high polluters in ***Winchester*** meant that it was inappropriate to implement the proposed information "enforcement" strategy for this group, the research did show that with further development this type of technology could be utilised successfully in areas where the proportion of gross polluters is higher. The number plates of polluting vehicles must be able to be uniquely identified so that their owners can be contacted subsequently. Many vehicle owners in Winchester indicated a high level of acceptance of the use of information to encourage voluntary access control, and that they would welcome feedback on the emissions of their vehicles.

ANPR technology is increasingly being installed in car parks, and this should be taken into account when designing access control schemes.

Concerns about vehicle security are leading to more car parks installing ANPR technology. This trend was not so clear when the Ramblas scheme was designed. Future access control using ANPR in Barcelona will seek system designs that integrate car park equipment with wider access control.

Here follows a scheme to summarise some crucial aspects concerning the implementation of access restrictions/clean zones in the four cities:

City	Roma	Winchester	Barcelona	Cork
Typology of clean zone	Area (Rail Ring & smaller LTZs)	Area (Air Quality Management Area)	Rambla boulevard + surroundings	St Patrick street + surroundings
Main objectives and reasons for implementation	Reduce pollution due to traffic (PM_{10} Benzene) Incentive the renewal of the car park; Implement pedestrian areas	Reduce pollution due to traffic (PM_{10} NO_x) Reduce and manage traffic flows Encourage clean-up of high-polluting vehicles	Increase pedestrian amenity, Reduce the volumes of car traffic Improve security from terrorism	Increase pedestrian and cyclist amenity, Reduce car traffic flows
Enforcement time band	Y	N	Y	N
Technological equipment (ITS and physical barriers)	ANPR (electronic gates) Retractable bollards	ANPR Remote sensing for air Quality, VMS (info on emissions)	ANPR Retractable bollards	Retractable bollards
Benefits	New pedestrian areas and LTZs; Safety increased; Reduced car traffic flows	Air quality improved; Traffic flows managed more effectively	Road safety increased;	New pedestrian areas; Safety increased; Modern disabled friendly surfaces implemented
Problems/side effects	Increased share of two wheels; Technology yet cannot detect two wheels plates	Sensitivity of the equipment requires specific geographical & environmental conditions; Very low numbers of high-polluters detected	Technology needs further testing to determine whether recognition of motorised two wheelers can be enforced.	Some bus delays due to the reduced green signal time;

2.2 INTEGRATED PRICING STRATEGIES

This measure has been implemented in Rome and Winchester. Fiscal parking policies can influence car parking behaviour, and reduce traffic flows in city centre clean zones.

2.2.1 Key Impacts

Fiscal parking policies can influence car parking behaviour.

In ***Winchester environmentally linked parking charges*** were introduced. This involved the implementation of a variable tariff that offered a discount of 75% or 50% on the usual cost of a season permit for those vehicles belonging to the A or B road tax bands, which affected those vehicles with the lowest CO_2 emissions (<120 kg CO_2/km). In addition, owners of electric or hybrid vehicles were offered free season permits.

Amongst the target market, awareness of the discounted parking scheme was good (75%), and 70% of the respondents generally agreed with it. Initially 8% of season-ticket holders were eligible for a discount and this increased to 10% by the end of the project. Importantly, 31% of season-ticket holders stated that the discounts would encourage them to purchase a more environmentally friendly car in the future.

In parallel with the parking discount scheme, car park charges in ***Winchester*** were generally increased to develop a ***parking policy to discourage long stay parking in the city centre*** and encourage use of the Park and Ride site. It was found that ticket sales for the seven busiest city centre car parks decreased by 16% (about 235,000 tickets) during 2002-05, but increased at the P+R sites by 34% (36,000 tickets). There was therefore evidence that the parking policy/charging measures led to more drivers parking at the outskirts of the city centre area or the P+R site, producing benefits in terms of less circulating traffic and reduced pollution in the city centre. Revenue at the city centre car parks increased by 11% (as a consequence of the increased parking charges) but only by 6% at the P+R sites, a result biased by the increased take-up of the P+R smart card discounted ticketing system.

In ***Rome,*** the number of payment parking lots increased from 52,000 to 79,000 units during the project lifetime. The quantity related to Park & Ride facilities increased by about 50%. Overall, there were clear economical benefits: Rome Municipality doubled its net income during the period 2001–05. From a qualitative viewpoint, it was considered that the increase in parking supply in conjunction with a policy to introduce parking charges according to the different uses of a given urban area reduced the use of private cars. Payment parking discouraged circulating traffic looking for an available space, particularly in residential areas, and such changes contributed to reducing the overall pollution level.

There is a need to clearly disseminate the potential benefits of 'restrictive' measures.

In ***Rome***, the parking policy was part of a package of measures aimed at modifying modal split in favour of public transport, decreasing air and noise pollution, improving safety and security, and upgrading the general quality of life. However, when the public were questioned about parking issues, they tended to only focus on the aspects which limited their own freedom.
Therefore, there should be greater communication between citizens and administrators, and better dissemination about the scheme. It was concluded that for ***time based road pricing*** to become a best practice, additional time and resources were required to make the citizens aware of the potential benefits, and hence to disseminate the good results already achieved.

It was also considered that the low general acceptance of the ***environmental parking charge*** measure was probably influenced by a general unwillingness to pay for parking and emphasises the need to promote integrated mobility measures and to make people perceive them as a whole.

2.2.2 Recommendations and Lessons Learned

The environmentally linked parking charge scheme should be seen as a long-term measure.

In relation to the **environmentally linked parking charges** in *Winchester*,, despite low-polluting vehicles currently constituting only a small percentage of the vehicle fleet, the number of qualifying vehicles has risen steadily during the project lifetime (from 17 in May 2005 to 41 in March 2006). This showed that the scheme is having a positive influence and there is potential for a greater shift in future years as new vehicle technology becomes accepted.

The environmentally linked parking charge scheme could be implemented on a wider level.

The scheme could have been demonstrated at a wider level by targeting additional vehicles (for example, those in road tax band C or LPG vehicles), but this would have reduced the parking revenue generated from the city centre car parks, which subsidises the P+R site. One possibility for the future is to revamp the overall charging regime, which might then make this measure worth following further. It may also be possible to implement the scheme at additional car parks, and for ad-hoc, pre-registered users, by using Automatic Number Plate Recognition technology to recognise vehicles entering the car park and assigning the appropriate tariff to the ticket. The environmentally linked charging scheme was recently expanded to include residents parking permits.

An urban Road Pricing scheme is very complex and requires a great deal of communication to promote understanding.

In ***Rome***, the complexity of the ***time based urban road pricing*** scheme required a substantial amount of communication, more than originally estimated. The provision of information to the public regarding sustainable mobility was considered of fundamental importance, especially in view of the lack of a general policy or directives relating to road pricing at the national level.

Expanding the number of paid on-street car parking places to the whole city should be integrated with a package of sustainable mobility policies.

In **Rome**, on-street road parking policy is a driven element of the environmental parking charge scheme to encourage a sustainable development. The main lesson learned was that the system can only work if it is integrated with a package of sustainable mobility policies to be progressively extended to the whole city. Such a large scale implementation depends greatly on political willingness, public participation and awareness of the benefits.

2.3 COLLECTIVE PASSENGER TRANSPORT -

Improved Public Transport services and information, particularly Park & Ride schemes, can encourage modal shift, but service frequency, reliability and cost are critical. Larger-scale impacts on mode share require more radical interventions. New infrastructures (tramways and trolley lines) can generate new public transport trips, can achieve a significant switch from car usage and, (with attention to design) can induce high usage of high capacity public transport, combined with walking and feeder bus. The introduction of new public transport lines has supported in some cases the introduction of the Limited traffic areas.

2.3.1 Key Impacts

Improving bus service quality and information can contribute to an increase in bus patronage and remove a substantial proportion of vehicles from the road..

A range of measures to ***improve bus service quality and information*** were implemented in ***Winchester***, including the introduction of new cleaner buses on two city centre routes and a P+R route, better information for passengers at bus stops, discount ticketing schemes, greater integration of bus and rail, and access to real-time passenger information through electronic information kiosks and the internet.

On the three 'MIRACLES routes', patronage increased by an average of 12%, but this varied between routes. There was evidence that the physical improvement of the interchange area outside the railway station was very successful, with the number of passengers boarding the MIRACLES bus services increasing by 97% at this stop. Two non-MIRACLES 'control' routes saw an average decrease in patronage of 6% during 2002-05, which implies the real gain in Winchester was nearer 10%. Passenger satisfaction ratings on the MIRACLES routes were already very high, and the percentage of respondents rating the service as good increased slightly during 2002-05 from 83% to 87%.

Along the two MIRACLES city centre routes, revenue increased by an average of 27% whilst the revenue generated on the two control routes increased by 16%. Analysis of emissions estimated significant reductions of NOx, PM10, CO and HC (43%, 62%, 47% and 52%, respectively) on the two MIRACLES city centre routes as a consequence of replacing the older vehicles with new Euro III buses. There was also evidence of improved reliability: the number of early/late bus journeys reduced from 0.95% in 2002/3 to 0.34% in 2004/5.

In ***Rome*** the ***introduction of new PT lines,*** with reference to the MIRACLES targets, has been achieved by implementing two new lines operated by electric buses and through the realisation of an important trolleybus line with high passenger capacity and running a long distance from the suburb to the city centre. This last measure also required the conversion of a former bus depot to a trolleybus depot.

The two electric bus lines have been specifically dedicated to the two new limited traffic zones (Trastevere and San Lorenzo), in order to provide a zero emission shuttle service during the closure of the areas to car traffic. This measure can be considered as the **"pull"** part of the access restrictions strategies.

In quantitative terms, the two types of PT lines were viewed as an addition to the current transit supply, dedicated to special events or improved city centre accessibility. The overall electric fleet (five lines) carried about 10,000 – 12,000 passengers daily. The trolleybus line upgraded a service previously operated by common buses, and now transports about 32,000 passengers per day, with consequent reductions in travel times of about 50%. This measure achieved the highest satisfaction rating in Rome. 86% of the people interviewed were in favour of the trolley line extension, primarily because it was environmentally friendly, had a low noise level, and operated frequently and punctually.

In ***Barcelona***, The "Trambaix" scheme which, combined the latest tram vehicle technologies with a radical re-allocation of street space with other modes,was implemented. Based on ticket validations, a general pattern of progressive growth was found, with average weekday passenger numbers exceeding original forecasts.

On-tram passenger surveys revealed that two-thirds of tram users had previously made the same journey. Of these, 18% used to travel by car, and 3% by motorcycle. The remaining 79% were previous bus and metro users. In addition to this substantial car switch to CPT, Trambaix also promoted walking and cycling, enabled social inclusion of those with mobility

In ***Barcelona***, ***multi-operator real-time passenger information*** was integrated across the metropolitan area. This involved the acquisition and implementation of a common Automatic Vehicle Monitoring (AVM) system for the 20 private medium bus operators, processing the AVM information, and the installation of information panels at three bus stops along a tram corridor.

In ***Rome***, the ***multi-modal information measure*** updated the INFOPOINT website, and improved the mobility information provided, particularly concerning cycle paths and accessible bus stops for the mobility impaired.

In addition, the MOBY on-board system was implemented to provide real-time transit information to bus passengers on 200 buses. This was very innovative, PT users are now provided with a wide range of information during their trip: route characteristics, interchange points, points of interest for each bus stop (i.e. cinemas, museums, PT offices, etc.), real time variations to the route (due to events, demonstrations, works, etc); in the same time other kinds of information are provided, such as: news from the world, events in Rome, meteo information, sport news etc.

Park and Ride sites have been shown to be well-utilised and popular with the public.

In ***Cork***, a ***Park and Ride (P&R) service was established*** about 3 km from the city centre, which provided approximately 900 P&R spaces (double the amount originally planned). By October 2005, daily patronage was of the order of 500 vehicles per day, which meant the site covered its operating costs, and saved approximately 450 trips each way to the City Centre.

Prior to MIRACLES two P+R sites were in operation in ***Winchester***, and they provided a total of 360 spaces. In February 2004, ***one of the sites was substantially extended***, providing a total of 780 spaces. Although the capacity increase was not a specific MIRACLES application, P+R buses and bus shelters were re-branded with the MIRACLES logo. P+R ticket sales increased by 34% during the project lifetime. As in Cork, the majority of the survey respondents rated the Winchester P+R service very highly (e.g. 92% rated it as "very good" or "good") and female usage was high (72%). In addition, 43% of the P+R passengers were aware of MIRACLES, more than any other passenger group.

2.3.2 Recommendations and Lessons Learned

The cost of the Park & Ride service is a significant factor in its success.

In both ***Cork*** and ***Winchester***, it was considered that reliability, cost, perception of security and frequency of the bus service were all significant factors in the success of ***the P+R service***. The cost of using the P+R in Cork and Winchester was relatively cheap (daily vehicle rates of €5 and £1.50, respectively), which meant that users obtained a significant saving compared with the tariffs in city centre car parks. In Cork, 56% of users surveyed in 2004 cited the cheaper price as the reason for using P+R, and limited parking space in the city centre was the next most important consideration. Indeed, a successful P+R scheme

may require a subsidy (as in Winchester, this can be achieved by maintaining significantly higher city centre parking charges).

A key driver in improving bus service quality is the setting up of a Bus Quality Partnership (BQP).

In **Winchester**, the key driver to improving the bus service quality and information was the setting up of a Bus Quality Partnership (BQP) covering two city centre bus routes and the P+R service. The BQP brought together the key stakeholders of the local bus company and the local authorities. The local bus company were responsible for thirteen new low floor buses, a marketing campaign, discounted tickets and driver training whereas the local authorities sought to improve bus stops and information, introduce clean bus technology, investigate bus priority where possible and encourage bidders to submit bids for hybrid/electric vehicles for the extended P+R scheme. Research elsewhere has shown that passenger growth is linked to the extent of the BQP with predicted general increases in patronage of 5% for minimal infrastructure improvements, 15% for a comprehensive route upgrade and 30% for high quality schemes. The same research found that passenger numbers take up to two years to peak after implementation of improvements. After this time, if further improvements are not made then patronage can either level off or decline, and so it is important that the BQP continually refresh the BQP to meet rising passenger expectations.

Integrating relevant real-time bus arrival time information from all operators is difficult (but can, and should be, achieved).

The integration of relevant information from all bus operators was the main challenge in providing real-time ***bus arrival time information*** to travellers in the ***Barcelona*** metropolitan region. The approach taken was based on equipping smaller operators with a common modern AVM system. However, this caused institutional difficulties during the initial stages of the project with larger operators (with older AVM systems). Solutions were found and a full-set of real-time bus arrivals of all operators was demonstrated at bus-stops. Indeed, a key lesson learned is that the implementation of an AVM system for small/medium bus operators requires a large-scale commitment that can only be assumed by an authority with responsibilities for integrating passenger services across a metropolis or region.

The introduction of a street-running rail-based transport mode is complex, and the attention given to achieving an integrated design will not be popular during the implementation phase.

In ***Barcelona***, the ***re-introduction of the tramway*** provoked much debate and considerable initial resistance to the scheme. One aspect concerns the disruption caused by road works. Another aspect was private vehicle drivers' initial intolerance of movement restrictions. However, lane segregation and attention to signal timings and traffic queue management are important design factors to ensure the higher tram running speed.

Advertising is vital when implementing a new Park & Ride scheme.

There was a risk that the P&R service in ***Cork*** would not attract sufficient passenger numbers and so much thought was put into site selection, and advertising via diverse forms of media. Road signs, newspaper advertisements and radio adverts were found to be especially effective. In addition, the service was integrated with other mobility management and awareness measures and Park by Phone. The City Council also ran a number of "free days" on which usage peaked and which attracted new customers.

Implementation of new technology within historical city centres presents particular challenges.

The implementation of the ***new PT lines*** in ***Rome*** is a good example of how obstacles were successfully overcome. An important consideration regarding the implementation of the trolleybus line was that it required a special design of the wire lines, and required an integration of new and old street furniture to preserve the historical features of the boulevard. Moreover, no aerial wires were allowed to be used on the final part of the route (where the line entered the historical city centre) and so on this section the trolleybus had to be powered by batteries. It is also important that the views of end-users and stakeholders are included within the scheme design, although such participation can cause delays. For instance, retailers in one of the areas where electric buses were operative claimed their turnover would decrease as a consequence of the restriction policy, but soon found that their business activities had in fact increased by 20%.

2.4 NEW FORMS OF VEHICLE USE

The cycle and car sharing initiatives were implemented in Rome and Winchester and played relatively minor roles within the overall scheme of improving environmental and traffic conditions.

2.4.1 Key Impacts

The cycle sharing scheme was popular with users and increased the number of people cycling in Winchester.

A major initiative to ***increase the level of cycling*** within ***Winchester*** was the introduction of the ***Bikeabout*** scheme, which had 160 members by the summer of 2005. The ***Bikeabout*** scheme consisted of a pool of 50 bicycles situated at two main locations in ***Winchester*** city centre, available for the public to borrow free of charge (although there was a membership fee of £15). In addition, the scheme was extensively promoted through leaflet distribution and by the Bikeabout operators providing face to face and telephone contact to both members of the public and Bikeabout members. The operators were able to deal with issues as they arose and undertake maintenance on the bicycles.

There are currently around 250 members of the scheme and peak usage in the summer resulted in all the 50 bicycles being used at any one time, although during the winter, demand reduced substantially and so the scheme operating times were reduced. Members of the scheme included residents, commuters, tourists and students, with an even split of age groups, gender and journey purpose. The average trip length was 2.7 miles and most users stated that they had previously travelled by bicycle or foot within Winchester, although three people stated that they had switched from car. The majority (83%) of members thought that the scheme was generally good and 28% of members stated that they did not have access to another bicycle. During 2002-05, cycle parking surveys found that the peak number of cycles parked in Winchester increased by 46%, influenced by the additional Bikeabout bicycles, although cycle count data at eight sites on arterial routes outside the city centre showed a 12% decrease in cycle flows.

It is important to note that any increase in cycling will be capped by the number of Bikeabout bicycles being limited to 50. However, Bikeabout has met the UKs aims to make cycling more convenient, attractive and realistic for short journeys at the local level, and set in the context of decreasing journeys by cycling in the UK the scheme has proved successful.

The car sharing scheme was popular with users, but could not significantly affect modal split.

The ***car sharing*** measure in **Rome** consisted in the implementation of a rental car fleet scheme (of 10 cars) at seven parking areas and active 24 hours per day. The aim was to create new alternative mobility habits among the citizens. The experimental phase began in March 2005, which involved 140 users. A key indicator was the ‘number of trips’, for which the city value was 2.5 trips per vehicle.

Public perception of car sharing is still in its infancy, which partly explains the small index of awareness. However, the “satisfaction level” was quite high which implies that the initial scheme was well accepted by the participants. This was despite only modest advertising of the scheme by and the Roman habit of regarding cars as vehicles not to be shared with other people.

2.4.2 Recommendations and Lessons Learned

A more distributed and technically advanced cycle sharing scheme would have provided a more flexible approach, but was too expensive.

The ***Bikeabout*** scheme in ***Winchester*** was operated manually. Although this meant it could be actively promoted, a more flexible approach would have been to use a multi-modal automated system, which would allow key nodes to be installed throughout Winchester and its residential areas. Access to the bicycles registered through smart cards would allow 24 hour access and the ability to make point-to-point journeys without the need to return the bicycles to a single location. However, the cost of such a scheme was prohibitive: approximately £250,000 for three sites and 75 bicycles. Another major barrier was the topography and road layout within Winchester. The city itself is very compact, and is set in an area with a considerable number of hills. In addition there is only limited scope to develop and install new infrastructure such as cycle lanes.

It is important to offer incentives and promote the benefits of a car pooling scheme.

In ***Rome***, users of the sharing scheme benefited from a series of incentives. For instance, a car-sharing permit was offered to transit season permit holders at a discounted cost. However, it was not possible to estimate how these incentives influenced the ex-post results. Possible solutions are to increase the role of technology to improve the management conditions of the services, and to continuously support such initiatives with awareness campaigns.

2.5 NEW CONCEPTS FOR THE DISTRIBUTION OF GOODS

Barcelona trial has demonstrated an innovative and more efficient freight distribution scheme at a big city level, the "multi use lane".

A number of small-scale trials were also undertaken, in Winchester and Rome.

2.5.1 Key Impacts

A "multi-use lane" in Barcelona resulted in journey time reductions of about 15%, primarily because of a decrease in illegal parking.

The ***multi-use lane*** aimed to achieve an efficient distribution of goods throughout the city of ***Barcelona***. One lane was allocated to bus priority and goods deliveries during peak hours, with on-street parking allowed overnight. The multi-use lane resulted in the journey times of general traffic being reduced by 12 to 15% depending on the time of day.
The bus operator also perceived **improvements in the bus running speeds**. The delay reductions were mainly as a result of a decrease in overall illegal parking activity for both cars and goods vehicles, thereby reducing the possibility that the second lane became blocked due to double parking.
Special kerbside regulations were trialled at three locations in ***Barcelona***, and consisted of temporary short-term loading/unloading spaces with special regulations restricting access to the kerbside directly in front of the supermarket to "authorised" vehicles only.

The *night-time delivery* demonstration showed that quiet deliveries to supermarkets were possible and reduced the number of day-time deliveries required.

In ***Barcelona***, the ***night-time delivery*** demonstration used adapted 40T lorries and special equipment to make night-time deliveries to supermarkets with a large capacity and substantial refrigeration facilities. Noise measurements recorded on-street showed that the maximum values recorded varied by only 0.1 dB(A), so residents were not unduly affected by the night-time deliveries.

Large trucks cannot access historic centres, so quieter medium-sized trucks are needed to make a wider implementation of quiet night delivery.

The Municipality of Barcelona is working with a second operator to trial solutions for quiet night delivery using a 17T truck. Ideally, a quieter 12T truck is required so as to gain access to the majority of local streets in historic centres.

The exchange of web-based information demonstrated that congested delivery problems can be resolved in the short-term using targeted enforcement.

In ***Barcelona***, the '***Loading/Unloading' (L/U) Active Guide*** involved the exchange of web-based information between the Municipality and distribution companies to enable "hot spots" (such as times and locations of congested delivery) to be avoided. The information was then used by the municipal police to prioritise on-street enforcement. (The Municipality has substantially increased the number of on-street spaces reserved for goods deliveries, in consultation with district authorities, commerce and operators, within the Green Area scheme)

Winchester implemented a combination of measures to reduce the impact of goods distribution.

The ***sustainable urban distribution*** measure in ***Winchester*** included the ***Collectpoint trial***, which aimed to reduce the number of missed home deliveries by using a chain of local

convenience stores as a delivery point. Questionnaire surveys of 1,600 households found that the average first-time failure rate of a typical home delivery was 20%, and the majority of respondents stated that they would consider using a Collectpoint-type scheme. Simulation also estimated that a fully operational scheme would provide potential benefits in terms of reduced time and distance travelled. A 10-week Collectpoint trial was undertaken and heavily promoted, including the prior distribution of flyers to 20,000 households. It was marred by technical difficulties on the Collectpoint website, and only a few people used the service (75 registered and eight used their voucher). This meant it was difficult to assess whether a fully working Collectpoint scheme would have been commercially viable, although this trial indicates it would not.

In **Winchester**, a ***waste recycling scheme*** was managed by Dove Recycling who used an electric vehicle to undertake a waste cardboard and paper recycling service for Winchester city centre businesses. A questionnaire survey of 100 Winchester businesses had previously assessed the demand for such a service and gathered information about the type of waste being produced and recycled. By late 2005, the waste recycling service served 30 businesses in Winchester, although initially only a relatively small amount of recyclable waste was collected (about one tonne per month, predominantly cardboard and paper). Nevertheless, this appears to be an economically viable venture for the company running the scheme since the service is operated on a full-time basis and has been expanded to other nearby towns in Hampshire.

A ***freight map*** was developed and published in ***Winchester*** and distributed to organisations or companies receiving deliveries, service stations and filling stations, to improve the efficiency of urban freight delivery.

A feasibility study found that it was possible to increase the number of delivery bays to provide sufficient capacity for night-time deliveries.

In ***Rome***, a feasibility study was carried out to improve goods delivery conditions in the Laboratory Area. Core objectives included the identification of suitable loading/unloading areas, especially inside pedestrian precincts of the historical city centre, and to assess the possibility of undertaking night-time loading/unloading operations. The feasibility study focused on assessing the real need of loading/unloading areas in the city centre as a pre-requisite to the other initiatives to be implemented. It was estimated that about 600 new lots were required. Such an increase should provide sufficient capacity to enable night-time deliveries.

2.5.2 Recommendations and Lessons Learned

The initial trial of the Collectpoint delivery service in Winchester was not a great success.

Website technical difficulties and unfamiliarity of the staff at the local convenience stores with the system affected public perception and ease of use. For the Collectpoint scheme to be successful, Internet retailers need to incorporate it into their system as an alternative delivery option. However, they would first need to see the scheme being demonstrated successfully.

The use of an electric van encouraged businesses to sign up to the waste-recycling scheme.

Many of the local businesses signed up to the ***waste-recycling scheme*** in ***Winchester*** primarily because an electric van was used to collect the waste. The businesses believed that their involvement with such a scheme created a good impression with the public and was therefore a useful public relations exercise in addition to the environmental benefits of having their waste recycled.

It was difficult to find evidence that the freight map was used by freight companies.

There was no evidence collected that the freight map was used by freight companies, although this was partly attributable to the monitoring / evaluation process since there was no easy way for genuine users to provide feedback. Some subjective comments suggested that the map was being used as a basis for providing directions to the public or as a simplified parking map. More effective means of tracking the use of the map and receiving feedback would have been beneficial for this measure.

2.6 INNOVATIVE SOFT MEASURES

*In all cities, the main objective of the **innovative soft measures** was to raise public awareness and acceptance of CIVITAS and MIRACLES among residents, businesses and visitors to the city. A variety of dissemination methods were used and public awareness and acceptance were assessed through questionnaire surveys.*

There were relatively high levels of public awareness of the individual MIRACLES measures. Public awareness of individual project initiatives varied between measures, but generally ranged from 10% - 50%.. Awareness of the CIVITAS initiative among the citizens was higher in the smaller cities.

2.6.1 Key Impacts

The number of employees covered by a travel plan increased during the project.

In ***Winchester***, one objective of the ***innovative soft measures*** was to encourage the development of ***workplace and school travel plans***. By the end of the MIRACLES project, 11,835 employees (or approximately 35% of the total Winchester workforce) were covered by a travel plan in the Winchester area (excluding staff at schools), which was an increase of 7,772 since 2002.

In ***Rome***, the ***mobility management*** measure was concerned with the promotion of alternative forms of vehicle use for commuters and to raise awareness of the need to limit home-to-work trips. Ten Home-To-Work Plans (HTWPs) were in operation by the end of MIRACLES, and the total number of participants increased substantially during the project lifetime, exceeding the predictions of the ex-ante evaluation. In 2002, there were 2,391 regular participants of HTWPs, belonging to just two organisations (a private company and a university). By October 2005, there were 41,805 users, “consuming” 15.72 vkm. About 1,400 users share HTWP daily.

Improved cycling facilities and an important awareness campaign resulted in an increase in the number of cyclists.

In ***Cork***, the overall objective of the ***awareness measure*** was to raise awareness about sustainable transport modes by providing ***improved cycling facilities***. The cycling improvements involved the provision of about 300 additional cycle stands in the city centre, and these were well-accepted. the number of cycles parked in the city centre increased substantially (from seven to 105) during MIRACLES, with the majority parked at cycle stands. Besides work commenced on the production of brochures to promote and inform the public about cycling measures. It was decided to produce a Cartoon-Style Brochure which would be enticing for people of all ages to read. The story narrator is a cartoon character called “Heddy Hobbit” modelled on Irish Champion of Consumer affairs (Fig 10.1).
All Miracles Soft Measures were intensively promoted in conjunction with European Mobility Week.

Fig 10.1 Poster promoting sustainable transport in Cork

The car pooling scheme was not popular and did not achieve a substantial shift in modal split.

In ***Cork***, the ***mobility management*** measure implemented a ***car-pooling scheme*** for Cork City Council employees to reduce the number of commuter trips. A Travel to Work survey established their commuting patterns and a car pool register was established. In 2002, 70% of employees commuted by private cars, which reduced to 61% in 2004. In addition, the proportion of people travelling in private cars alone decreased from 42% to 35% during this timeframe. However, it was considered that the main factors influencing this change in modal split were the increased access restrictions in the city and the reduced number of parking spaces available to City Council employees (approximately a 20% reduction in parking spaces over 3 years).

Indeed, the number of responses from employees relating to possible participation in the car pooling scheme was very poor. There was evidence that people preferred car pooling privately with friends and/or relatives rather than the workplace initiated scheme. People were concerned about issues such as insurance and restrictions on the use of vehicles for work. Others stated that car pooling could not be relied upon because their journey patterns varied with school drop offs, site visits, different activities after work, etc.

2.6.2 Recommendations and Lessons Learned

A mixture of promotional methods was best at reaching a range of different audiences.

Within MIRACLES, sustainable transport options were promoted by using methods as diverse as demonstration days, cycle safety training, advertisements, competitions, leaflets, posters, website promotion etc. Public awareness and acceptance were assessed through questionnaire surveys. It was generally found that a mixture of methods was best at reaching

a range of different audiences. Long-term repetition of promotional material and tools is also key to the success of a marketing campaign. For instance, in ***Cork***, advertising and a prolonged media campaign for many measures (particularly Park and Ride) along with the integration of MIRACLES with existing sustainable transport promoting activities increased awareness and acceptance.

In ***Winchester***, of those people aware of MIRACLES, 13% stated that they had been informed of the project through the local newspaper, 13% by a leaflet / poster, 11% by the Bikeabout bicycles, and 7% through Bike Week. In terms of individual project initiatives, there was some indication that events with a high visual presence resulted in the highest levels of awareness in ***Winchester***, although they were not as effective in raising awareness of MIRACLES as a whole. It should also be noted that some publicity methods had only limited success in raising awareness, particularly impersonal methods of promotion such as radio advertisements.

Incentives may encourage effectiveness of workplace travel plans or car pooling schemes.

Despite considerable success in implementing workplace travel plans in ***Winchester***, it is accepted that staff resistance to car sharing or restricted workplace parking can reduce their effectiveness. With additional resources a more pro-active role could be undertaken by the local authority in encouraging companies to develop green travel plans, perhaps by providing greater financial incentives subject to travel plan approval. In ***Rome***, despite strong political pressure at the national level to support sustainability, take-up of the HTWPs represented just 2.7% of all the potential participants. It was concluded from this that even though decision makers were fully aware of the potential offered by this measure, users still required strong reasons to stop driving to work. It was recommended that future work should target employees to promote the concept that driving alone to work is not the best solution. In ***Cork***, the official City Council car pooling scheme did not achieve a substantial shift in modal split on its own. A more prominent change towards sustainable modes of travel is likely to be achieved only in conjunction with a heavy emphasis of promoting sustainable modes as well as restrictions to car use.

There is a particular need to actively promote the potential benefits of car-restrictive measures to the public.

In ***Rome***, there were many dedicated awareness campaigns targeted at various categories of citizens (e.g. pupils, employees, mobility managers, residents of areas affected by specific measures etc). This was an innovative approach since prior to MIRACLES, mobility awareness campaigns had only been presented at a very general level. However, despite such efforts, increasing awareness is a never-ending process, and people need to be continuously informed and kept up-to-date. In particular, persuading the public to change their car-based habits is extremely difficult, and such attitudes explain why decision-makers have traditionally been reluctant to move away from car-based options. A key lesson learned is that the more car-restrictive a measure is, the greater the need to inform the public about the potential benefits. This requires a total revision of the measure implementation process with an increased need for communication and dissemination at all stages.

Awareness of sustainable transport issues is likely to increase in the longer-term.

In parallel to MIRACLES, the ***Winchester*** Movement and Access Plan has been a local sustainable transport initiative, ongoing since 1995. Awareness of WMAP increased from 20% in 2003 to 25% in 2005, which indicates that there is scope to increase awareness of sustainable transport issues in the longer term, although even then it may not produce 'high' awareness ratings.

2.7 INTEGRATION OF TRANSPORT MANAGEMENT SYSTEMS

All the measures relating to technology and telematics applied to mobility purposes were successfully implemented within MIRACLES.

It was demonstrated how information plays an important role in supporting the modal choices of the city dwellers, provides added value to the mobility system in town and helps monitoring the pollution levels..

2.7.1 Key Impacts

Cork and Rome experimented the use of Mobile phone both to pay for parking and to pay the PT ticket

The "***Park by Phone"*** measure in ***Cork*** established an innovative parking management / payment scheme where subscribers can pay for on-street parking using their phones and access system information. A user of the Pay by Phone scheme pays no more for parking than a user using the traditional disc system.
Park by Phone was rated by 69% of users to be 'very easy' to use with a further 10% rating it as 'fairly easy'.
Regarding "**BIT via sms"** in Rome, 95% of the users were satisfied with the service, and 97% stated that they would recommend it. The main advantages of the system were time savings and 24h-availability.

Information kiosks, providing a wide range of real-time information, were highly rated by the majority of users.

In ***Winchester***, ***information kiosks*** were installed with the aim of providing ***improved multi-modal information for travellers***, especially public transport users. The first two kiosks were installed in September 2004 in indoor locations, and an average of 500 users per month was recorded. When a third kiosk was installed outside on a pedestrian precinct in January 2005, the total number of users quadrupled to about 2,000 per month. This increase was primarily because of the much greater footfall at the outdoor site, but there was also evidence that people felt less comfortable using the kiosk in the confined indoor location of the Tourist Information Centre. The kiosks were highly rated by the majority of users, who stated that they found the kiosks easy to use and that the information was readily accessible. An on-street survey of non-users was also undertaken: many respondents had simply not noticed the presence of the kiosks.
In **Rome**, five information kiosks providing PT information were installed. The functionality, including a new interface, was tested within a small scale trial.

Services to improve PT - related information increased user satisfaction.

Three BDIS (Bus Departure Information Systems) were installed at the railway and bus stations in ***Winchester***. Two small interview surveys were undertaken to evaluate public opinion of the BDIS systems. The majority of respondents had noticed the BDIS and found the screens easy to read and the information understandable. However, initially only 14% regarded the information as accurate and many passengers were reluctant to switch to BDIS from printed timetables.
Infopoint is the Journey planner developed in **Rome** to provide information via Internet, based on geographic information.
Now the same service is available via Mobile devices. PT services are quickly identifiable and the user can easily combine and integrate them for personalised journey planning.
The integration of web technologies and increased PT services has provided added value to public transport services.

For access to Infopoint service, also by mobile phone (pc, mobile imode or Umts), type http://infopoint.atac.roma.it/wap/: in this way it will be possible to have the latest news on public transport in Rome or calculate the journey with public transport.
The user-friendliness of the INFOPOINT services was crucial for the success of the measure. (the number of visitors accessing the webpage hosting INFOPOINT increased by 30%)

The "*Improved Network Management*" measure was successfully implemented.

In ***Rome***, the "Improved Network Management" measure was sub-divided into ***information*** and ***environment***.
The ***information*** applications concerned the large scale implementation of the AVM project on the bus fleet.
The basic idea was to implement a system that enabled both the distribution of a correct information to the citizen/user (electronic displays) and the regular monitoring of the fleet, in compliance with the existing service contract with Rome Municipality, as for the operations of the other local public transport operators.
The routes along which are installed the electronic displays are 189. Electronic poles are placed so to serve bus stops with most passengers along each one of the interested routes.
As for Rome complexity and for its urban structure, the result obtained with the electronic poles installed has been important currently Rome in Europe is second only to London where there are 480 displays installed.
The ***environment*** application concerned the environmental analysis of Traffic Demand Management Strategies (TDMS) with mapping of the air pollutant concentration levels (CO, particulates and benzene) using a suite of simulation models.
In addition, additional field measuring activities were undertaken using a mobile laboratory (a "floating van") to collect data on driving patterns and relevant speed profiles along specific routes, and also to acquire local concentration levels of the more critical air pollutants.
A general "traffic index" was also developed to enable assessment of city congestion levels and the classification of weekdays according to traffic indicator values. It was considered that the one-off MIRACLES trial provided clear and positive indirect benefits to the community and it was recommended that both sub-tasks should become systematic features of overall urban management.

2.7.2 Recommendations and Lessons Learned

Rome and Cork found commonalities while implementing their mobile phone based systems: A marketing and legal campaign is required to promote the wider use of Pay by Phone services.

From the "**BIT via sms**" trial in ***Rome***, it was found that information based on mobile communication needs to operate on a larger scale before benefits from integrated information systems can be achieved. For Rome, this means overcoming the local financial and legal barriers that prevent such a service from entering the mobile communications market at a European level, and so enabling improvements and better customisation to be achieved.

The implementation schedule for the ***Park by Phone*** scheme in ***Cork*** was very ambitious and did not fully take into account the time required to enact legislation changes and overcome technological issues. By the end of 2005, less than 35% of those Cork motorists who received registration packs had registered, although it is hoped that the numbers of users will rise in response to the multi-media marketing campaign developed by the Park by Phone consortium.

Providing real-time bus arrival time information to passengers may further increase the effectiveness of BDIS systems.

It is possible that the effectiveness of BDIS could have been further enhanced if the information provided was updated automatically when the bus operators alter services, or in real-time (as shown in Barcelona). Although this was outside the scope of the MIRACLES project an updated real-time system was due to be installed in May 2006.

The location of information systems in an historic town, or on third-party land or property, requires a long lead-in time, as negotiations and installation works can cause delays.

The main objective of the ***improved network management*** measure in ***Winchester*** was to use an ***ANPR*** system to collect real-time journey times on radial routes into the city centre and then disseminate this to travellers using Variable Message Signs (***VMS***) and the ROMANSE website. Some delays occurred when equipment was sited on third-party land or property. For example, installing ANPR cameras in an historical city such as Winchester proved difficult since the camera locations were partly chosen to minimise visual intrusion. Installation problems were also faced with the fourth information kiosk at the railway station, due to power supply problems, and the three ***IDU***s (Information Display Units), sited at the local authorities and the hospital, due to refurbishment works.

There is a need to develop a standardised decision support system, using integrated data sources, to compare the effects of various measures, and to disseminate the findings effectively to the public.

In ***Rome***, a number of lessons were learned from the simulation modelling of Traffic Demand Management Strategies (***TDMS***). There is a general lack of information regarding the quality of the models currently being used, and a primary step is for all involved parties to define a standardised working model, including the integration of traffic data with air quality, noise and safety aspects. There is a particular need to improve emissions factors for air pollution caused by urban traffic since they are currently based upon EU-standardised test-cycles, which are not always representative of urban traffic characterised by “stop-and-go” driving and cold catalysts. The development of such a model would then enable various traffic measures (such as speed control or vehicle restrictions) to be developed, their potential effects evaluated, and action plans stored within a decision support system. There is also a need to develop effective public information approaches regarding the impact of noise and air pollution caused by urban traffic. Such information may be disseminated via a website or by the media, and may include recommendations on preferred public response to it.

Public perception of telematics-based measures is tangible, especially for products that are innovative.

In ***Rome*****,** telematics measures were readily appreciated by the citizens, as demonstrated by the overall satisfaction rate), which meant it was the measure with the second highest rating. Even though such success was partly attributable to the measure not limiting an individual’s personal freedom, it is undeniable that, in the local experience, “innovation” was a key feature in contributing to such assessment. Indeed, most of the telematic-based measures were implemented for the first time or enhanced during MIRACLES.

2.8 CLEAN PUBLIC AND PRIVATE FLEETS

The clean vehicle fleet demonstrations were generally popular with the users and, at a localised level, emission reductions were estimated. In several cases, the CIVITAS funding, combined with strategic investments by other stakeholders, led to radical implementations that contributed to significant reductions in pollutant emissions from city bus fleets. In some instances, the innovative nature of the applications meant that several were affected by technical problems.

2.8.1 Key Impacts

Through CIVITAS further support for Irish government action on Biofuels at national level was solicited and helped creating a market.

The task of introducing of Biofuels in the Cork municipal fleet was twofold: on one hand technical problems had to be overcome, on the other a lobby activity to reduce taxation on biofuels in order to comply with the Biofuels Directive was carried out, with the objective of achieving a much more widespread supply of biofuels.

Cork City Council has also asked the EC to put pressure on the National Government. As main outcome a Finance act has been issued that provides the legal framework in which for the “Scheme” that should allow Ireland to achieve market penetration of over 2% by 2008, it is reported that the European Commission have accepted this target.

It has also been publicly acknowledged that Cork City Council’s EU-funded Biofuels project created the market in Ireland, giving farmers the incentive of a regular demand for their biofuel crops.

Next step is to set European and national standards on biofuels

Pure Plant Oil (the biofuel first used by Cork City Council) still has no European EN standard, Irish Government Departments are liaising closely with the Commission on these issues, and welcomes the Commission’s further engagement on the issue, particularly in relation to fuel standards, sustainability standards and promoting a balance between imports and indigenously produced biofuels.

The rapeseed-fuelled clean vehicles were not initially popular with the drivers.

Within the clean vehicles measure in Cork, 17 council-owned diesel-engine vehicles were converted to permit the use of rapeseed oil as an alternative fuel (see measure 12.2). Driver surveys and focus groups found that the acceptance of the measure was “negative” to “neutral” at the beginning of the project due to initial problems. The chief concerns raised related to the possible health impacts on drivers, extra visible smoke, exhaust smell, power losses, and concerns that the converted vehicles were more likely to cut out abruptly. Upon investigation, it was found that some of the vehicles required an oil filter change, and adjustments to the idle speed and injectors. The drivers initially recommended the use of a mix blend (of diesel and rapeseed oil) which, in their opinion, produced better power and an improved smell (a mixture of 25% diesel and 75% rapeseed oil was considered to be optimum). By November 2005 pure rapeseed oil was being used, and the driver opinions had improved. Involvement of the drivers throughout the process was considered essential and it was vital to explain the advantages and disadvantages of the scheme to any drivers involved in the trials.

The clean-up of the bus fleet reduced the bus emissions.

The cleaner vehicle bus measure in **Winchester** succeeded in reducing the emissions of 27 buses (of the fleet of 60 vehicles). A desktop study using a vehicle activity model estimated that, compared to the baseline, bus emissions of CO, HC, NOx, PM and CO2 along a key city centre street reduced by 44%, 42%, 26%, 53%, and 2%, respectively. This complements the general improvement in air quality in Winchester, where recorded levels of NOx have fallen by 35% since 1997 and the level of CO has fallen to such a low level that monitoring is no longer necessary. The level of PM is around 30% lower that the annual mean objective It is acknowledged that a fairer comparison of buses and the rest of the vehicle fleet would have been based on emissions per passenger km, but it would be difficult to estimate a weighting for the 'freight mileage' to enable goods vehicles to be compared to non-goods vehicles.

In **Barcelona**, the extension of the CNG bus fleet integrated Compressed Natural Gas (CNG) buses into the public transport fleet of the main bus operator (see measure 12.3). Substantial savings in pollutant emissions were estimated based on measures of fuel consumption and emission models. For the initial batch of 70 CNG buses, reductions of polluting emissions (CO, HC, NOx, particulates) of between 82% and 98% were calculated

Other impacts concern the implemented infrastructure improvements and these made important contributions to the overall satisfactory CNG bus fleet operation (refuelling of a standard 11m bus within 3 minutes, reduced maintenance costs associated with special-purpose workshops).

Trials of the alternatively powered buses were popular with the public, although they are significantly more expensive than standard buses.

In ***Winchester***, a secondary aim of the ***cleaner vehicle bus*** measure was to introduce the public to different vehicle fuel types by demonstrating a diesel/electric hybrid bus along the P+R route. Surveys found that 63% of passengers perceived that the hybrid bus was more comfortable than the usual P+R bus (Euro II with CRT, but changed to Euro IV in June 2006) and 81% thought it was quieter. However, a few commented that the smaller size of the hybrid bus could cause overcrowding and that the whining noise of the turbine on one of the prototype buses was discomforting. 24% stated that the permanent introduction of such a hybrid bus would make them use the P+R service more frequently. The benefits of hybrid buses (compared to standard buses) in terms of their emissions, noise levels and comfort should be balanced against their increased cost.

In ***Barcelona,*** user acceptance surveys showed high levels of CNG bus acceptance in terms of lower pollution levels, less smell from fumes, and reduced noise).

In ***Rome***, the ***clean bus measure*** (electric buses and new generation trolley buses) was popular among the public. Thereby being the most "satisfactory measure" within the Rome MIRACLES applications.

Re-powering older city centre buses is a cost-effective and efficient way of reducing their pollutants.

The objective of the ***cleaner vehicle bus*** measure was to reduce the environmental impact of the bus fleet owned by the main operator in ***Winchester***. In addition to the purchase of 13 new Euro III buses, 10 buses were re-powered from Euro I to Euro III standard and four Euro II buses on the Park & Ride (P+R) route were fitted with Continuous Regenerative Traps (CRTs). The re-powering of the older buses to a higher Euro emissions standard was considered to have been a cost-effective and energy efficient way of reducing their pollutants. However, for the slightly newer Euro II buses, it was less expensive to fit CRTs

than to re-power to Euro III standard, and even resulted in lower emission factors (apart from NO_x).

The cleaner bus fleet meant that maintenance costs decreased by 60%, although fuel consumption of the new buses increased because they were one tonne heavier and used only in the city centre area. For those buses that were re-powered to Euro III standard, fuel consumption remained constant.

Cleaner municipal fleet vehicles resulted in emission reductions.

In ***Winchester***, the ***cleaner municipal fleets*** measure involved the purchase of 27 new Euro IV diesel vehicles for the Hampshire County Council (HCC) company car fleet. As a result of using these clean vehicles, a 2.3% reduction in CO_2 per vehicle was estimated. This reduction, in terms of assessing the impact of MIRACLES alone, was small since they were derived from a comparison with Euro III vehicles (which HCC would have purchased instead) whereas in practice much older vehicles were replaced by Euro IV. Companies with older vehicles (e.g. pre-Euro, Euro I or Euro II) would also see greater reductions in emissions and fuel costs.

The loan of a clean vehicle proved popular with local businesses.

Within the ***clean fuel support services*** measure, participating businesses in ***Winchester*** were loaned a clean vehicle (either a LPG/petrol dual-fuel, a petrol/electric hybrid or a battery electric vehicle) for a period of up to one month. Prior to the trial, each business was asked which factors would influence their decision to purchase a clean vehicle. The three most important factors cited were operating costs, reliability and purchase cost. After the trials, 82% of respondents rated the trial vehicle as generally good, 55% thought it was generally better than their usual fleet vehicle, and 65% stated that they were likely to purchase a clean vehicle in the future for business use. Follow-up interviews later found that one business had actually purchased a clean vehicle and three businesses stated that an employee had bought one for private use. (In all cases, the trial had been a major influence). In addition, 11 businesses stated that they would purchase a clean vehicle in the future.

An analysis of the vehicle trial data estimated significant reductions in emissions and fuel costs for clean vehicle types.

The vehicle trial data collected within the ***clean fuel support services*** measure in ***Winchester*** was analysed. A comparison with the corresponding data if the usual business vehicle had been used estimated significant reductions in emissions and energy for all three clean vehicle types. The battery powered electric vehicles resulted in emission, energy and fuel cost reductions of 100%. However, such vehicles are about £5,500 more expensive than a similar petrol vehicle and they require a £10,000 battery every 5-8 years. The petrol hybrid vehicles and LPG/petrol dual fuel vehicles provided average fuel cost savings of about 40% and 20%, respectively.

The rental fleet of electric scooters was a niche measure and barely affected the overall pollution rate or modal split.

In ***Rome***, the aim of the ***clean fuel support*** measure was to better manage the rental fleet of nearly 400 electric scooters, thereby reducing the pollution caused by the increasing use of conventional motorcycles (see measure 12.3). About half the scooters were used by the Municipality and the remainder were transferred or donated to non-profit organizations. In addition, a set of recharging points was located in the Laboratory Area. In quantitative terms, this was only a “niche” measure since the fleet of e-scooters only represented approximately 0.001 of the powered two-wheelers in Rome. Hence, the contribution to the reduction of the overall pollution rate was modest and hardly affected the modal split.

The clean buses were shown to be less noisy than the older buses.

In ***Rome***, the ***clean bus*** measure involved the renewal of the bus fleet, including the purchase of 908 Euro III buses, 30 "new generation" bi-modal trolleybuses, and 10 electric buses (see measure 12.1). As of late 2005, 38% of the bus fleet was composed of new, eco-compatible vehicles, lowering the average age of the fleet (from 12 to 6.9 years). The old generation of buses was noisy and an important improvement concerned noise reduction. A survey monitored traffic noise before and after the implementation of trolleybuses. Even though the "white noise" (i.e., the combination of all the sounds of all different frequencies in that given urban environment) was very high, a Euro 0 bus (i.e. an old-style bus) passing by increased such noise by about 10 dB(A), whereas a trolleybus only led to an increase of about 5 dB(A). This result was especially striking given that dB(A)s are measured according to a logarithmic scale. However, other factors also contributed to the noise reduction, including a change of the road surface from block pavement to asphalt and/or concrete.

By implementing special-purpose maintenance workshops, the CNG bus maintenance costs were minimised, and economic performance improved.

In ***Barcelona***, ***CNG buses*** had lower operating costs (due to new maintenance workshops and lower maintenance costs, plus fuel cost parity under the strategic partnership) compared to the diesel buses being replaced (see measure 12.3). It was calculated that the higher investment cost in bus acquisition could be recovered within 5 years.

2.8.2 Recommendations and Lessons Learned

Initial technical complications will be overcome as conversion processes become more common-place and more experience is gained.

In ***Cork***, the conversion process (from diesel to rapeseed) of the ***clean vehicles*** measure was considered generally successful, although there were some initial technical difficulties. For example, technical problems relating to the cold starting of engines and gauze filter problems were experienced, and one vehicle had to have its conversion reversed due to the position of the engine. However, the reliability of the converted vehicles increased following modifications, and Cork City Council intends to continue the use of bio-fuel. The Council is also going to experiment with the use of **bio-diesel**. Valuable insights were gained which will be of use to any city contemplating a similar project.

In ***Winchester***, the 13 Euro III buses purchased within the cleaner vehicle bus measure were to be fitted with Selected Catalytic Reduction (SCR). However, this was an untried process and technical problems with the conversion of the first vehicle resulted in the programme being delayed. Having overcome these problems it is still anticipated that SCR conversions of all 13 vehicles will occur during 2006.

A strategic partnership with a utility provider proved to be a good way of extending CNG bus fleets, although there is still a high economic cost of investment and other bus technologies are also improving.

In ***Barcelona***, the ***extension of the CNG bus fleet*** yielded positive results that justified the effort made in establishing the strategic partnership with the utility provider. With the gas supplier subsidising fuel costs in the initial years, the main barrier concerned the high economic cost of investment required to set up the refuelling and maintenance infrastructure as well as the acquisition of more expensive vehicles. However, the CNG buses had lower operating costs than diesel buses and the investment cost was estimated to be recovered within five years. Indeed, the economic performance could be further enhanced if values are attributed to the environmental benefits of reduced pollution and noise. The fleet of CNG buses has already been expanded to 160 buses (including 50 18m articulated buses with

improved energy performance – not available at the first phase of bus procurement) and is expected to be further extended to 250 vehicles before the end of 2007.

For the use of bio-fuel to be sustainable, political support is essential to ensure that the cost of the fuel is competitive with fossil fuels.

At an early stage of the project, ***Cork*** City Council raised concerns about the running costs of the converted vehicles since the alternative fuel was 33% more expensive than diesel, and a case for a tax reduction on this type of CO_2 was submitted. The issue of bio-fuel taxation was raised at various discussions in the Irish parliament and in early 2004, the Finance Act was amended to allow for an exemption on the use of rapeseed in certain projects. By then it cost about 50% more than diesel. Accordingly, Cork City Council supported the fuel supplier's application for permission to sell duty-free rapeseed oil as a vehicle fuel.

Providing alternative fuel vehicles to local businesses helped break down some of the barriers to previously unknown technology.

Businesses tend to renew their company vehicles at cycles of several years, and so it is likely that the effects of the vehicle trials in ***Winchester,*** in encouraging businesses to purchase clean vehicles, may not be evident in the short-term. Following the vehicle trials 63% of businesses stated they would or may buy a clean vehicle in the future. However, improvements to infrastructure, would help to support the move to these vehicles, as the limited refuelling places for LPG and electric vehicles is still a deterrent to more widespread use.

The limited range of the batteries casts doubt on the large-scale implementation of electric scooters.

In ***Rome***, users were generally satisfied with the e-scooters, but complained about the limited range of the batteries. Indeed, this represented the largest barrier to the implementation of e-scooters, which casts doubt on the possibility of implementing these vehicles on a wider scale. Another difficulty was the implementation of the on-street recharging stations because of the poor supply of such items on the market.

Initiatives such as electric scooters should be implemented in conjunction with promotional campaigns.

In Rome, the benefits of electric vehicles were advertised by dedicated campaigns and funds were allocated to provide incentives to people to purchase e-bicycles, e-scooters and electric vehicles. Despite this, response was slow and such modes of travel were regarded with caution. A key challenge is to implement such initiatives in synergy with more in-depth educational campaigns, so as to involve citizens in local policies. The e-scooter measure was a typical example of an initiative applied in a context where the majority of users were still strongly convinced that their private cars were the only available option for all types of trips, and that any alternative should generate the same performance as their own vehicle.

Other bus technologies are improving and some of the CNG bus emission results are dependent upon the sustained performance of catalysers. Further evaluation is recommended.

Progress is being made concerning the direct measurement of emissions during bus operation. These techniques are particularly useful for evaluating the continued performance of vehicles using catalysers, but can also be applied to evaluate vehicle types that were not available at the time of demonstration in MIRACLES (e.g. the 18m articulated bus vehicles, recently acquired in Barcelona).

3 Conclusions

3.1 Policy Recommendations

Managing mobility demand in cities requires an integrated set of strategies, many of which are common to all cities. Despite the difference between the MIRACLES cities, as highlighted at the beginning of this deliverable, issues of congestion and also the solutions adopted have shown commonalities.

As highlighted in the Final Implementation Report, there have been drivers and barriers while pursuing the CIVITAS targets and **policy** can either facilitate, slow down the process, or even become a barrier. But only policy can guarantee the **financial support**.

Political commitment must be strongly guaranteed as well as continuity in the commitment towards the initial targets. The measures concerned with the CIVITAS initiative have an impact on the population of cities; politicians must believe and support Sustainable Mobility, both with formal acts and with facts.

Especially for Rome the commitment to gain the financial support had to be found also at National level. The Environmental Ministry has in fact awarded funding to Rome for completing the Sustainable Mobility Policy.

Political commitment can act as a barrier: policy has got its own **timings**. Often the formal compliance with statutory procedures requires more time then expected and can cause mismatching with the project gannt (CIVITAS aims to implement rather than trial, and this means more formal procedures). Thus a risk management strategy is necessary, but in some cases there are issues that are outside a project manager's control.

The case of Barcelona's implementation of ANPR-based access control on the Ramblas has been reported in the Site Technical Review; having benefited from changes in key staff following elections the preferred technical design was subsequently subject to a review of security interests and alternative designs following the Madrid terrorist attack on March 11th 2004. Nevertheless the delay to activities lasted until the meeting of councillors, held in November that year, when the decision was taken to go ahead. Perhaps the more disappointing aspect is that the more interesting policy measure, the "Green Area" Integral Regulation of road space was not chosen as the primary action for integrating other (cycle network development and goods and public transport) measures. It is recommended that the central demand management action cover a substantial part of the city area.

On the other hand the contractual constraints imposed by the CIVITAS project, in this sense have proven to be a driver; in some cases it has contributed speeding up some processes.

Another important issue is **consensus**. A local administrator would not act against the public consensus. Thus, once citizens must trust and support the politician's, policy has to guarantee continuity in pursuing objectives, despite some initial "disappointment".

For example during the creation of the City Centre Clean Zone in Cork, there was initially some dissatisfaction with the impact of the street works on the city aesthetic, noise pollution, road congestion, road safety and commerce, and some political problems were also encountered in introducing the pedestrianisation scheme. In general physical barriers were not well accepted, and this is common to all the cities. Nevertheless satisfaction levels have increased after the implementations were completed and people could take advantage of a better environment.

For Cork the experience of other Civitas cities was helpful in anticipating and preventing some problems.

Policy must help creating **Public Private Partnerships** (PPP) these help improving the quality of the services provided, for example in Winchester the BQP (Bus Quality Partnership) brought together the key stakeholders of the local bus company and the local authorities. This has shown that passenger growth is linked to the extent of the BQP.

The "Push and Pull" strategy has been pursued and actually was an objective of the policy aspects linked to MIRACLES.

To conclude, the MIRACLES Partners have identified some points that relate to the strategies required to address traffic congestion and to implement Sustainable Mobility solutions.

The policies adopted must include the following:

- **Physical measures** – these include the implementation of access restrictions to the "Clean zones", Park & Ride systems, all measures designed to modulate private traffic through infrastructure changes and physical restrictions;

- **Financial/Pricing measures** - these measures are aimed at increasing the city revenues to allow higher investments in infrastructure for transport; examples in MIRACLES are the pricing schemes in Rome that employ payment/fines both for parking and for entering the clean zones; and environmentally linked parking charges in Winchester;

- **Institutional/Organisational** measures – generally these are at the heart of the local transport plans of the cities; these include the involvement of key stakeholders in the decision-making process, the development of Partnerships, and the reorganization of processes to increase the effectiveness of the measures; they are also aimed at increasing awareness of commuter plans.

  We had examples in Barcelona, where PPP has been set up to increase efficiency of goods distribution; Winchester and Cork have also encouraged employers/employees to adopt **green travel plans** and have been encouraging pupils and their parents to use sustainable transport modes.

  Rome has adopted a reorganization of the mobility agencies through the merger of ATAC and STA, in order to rationalize and unify competencies on mobility services; further Mobility Managers in Rome have stimulated colleagues to implement green travel plans, reductions on PT passes have been allowed for those implementing these plans etc

  - **Strong Project Management** by the local authorities. It is important to develop and maintain a clear vision of what is required, and cultivate good staff and political support

  - **Effective Communications Plan** – this is required in order to inform all stakeholders and influence behaviour and understanding of the issues in question. In Winchester an effective communications plan incorporated a variety of dissemination methods (leaflets, radio advertisements, website, demonstration days, a school art competition etc.),

- **An Integrated Strategy -** integration of measures has been important for all cities. In Winchester the benefits of integrated strategies have been recognised and play a key role within the local transport plan. Integration is particularly important for Barcelona, where different transport operators own the information, requiring integration of the information provided in real time at the bus stops.

- **Operational** – including dynamic travel information, ITS support. This set of measures has been implemented in all the cities.

  All the four cities, have implemented different systems, tailored to their specific situations. IT solutions have tackled different aspects, for example, SMS to pay for parking and PT in Cork, and travel information in real time in Rome, using innovative tools to provide information and best routing calculation.

- **Pan-European Working and cooperation** – there are many benefits in sharing expertise and knowledge with other European partners, and in gaining support from the European Commission.

What we have learned is that the right mixture of limiting measures, flexible solutions & technological support and specific awareness campaigns, are the solution to cope with everyday problems. It is important to implement a long-term strategy aimed at complying with the International Kyoto Protocol, the new emission standards issued by the EC, and to provide European citizens with a more "sustainable" lifestyle and to pass on these concepts the future generations.

The transferability of results is also a key factor, enabling results and lessons learned to be disseminated to a much wider audience.

3.2 Key recommendations for CIVITAS from the MIRACLES team

The CIVITAS programme presents Europe's cities with a serious challenge for the development of best-practice in urban transport management. It poses a greater level of project complexity (8 measures, plus 4 horizontal work activities) than has been previously attempted, requiring the involvement of different organisations over four years of contractual engagement.

The main recommendation that we propose is to try to simplify the vertical workpackage structure to better support the EU's key objectives for competitiveness, safety and safeguarding the environment.

Like other CIVITAS I projects, MIRACLES cities have found the focus on vehicle access restrictions to be the central common element – both to the development of the project of integrated local measures as well as for the wider EU interchange comparing the various approaches to restricting access. It is proposed that the management of urban road traffic either through access restrictions or through schemes for charging for road space and use remain the central focus of the programme.

It has been shown many times that a consensus on regulating / restricting car traffic in urban areas has to be developed through a package approach. Hence, we recommend that the classic package (of improvements to collective passenger transport, plus the improvement of non-motorised modes (walking and cycling)) continue to form the three central pillars of the CIVITAS programme's vertical activities.

It is of key importance for EU policy that more cities demonstrate indicators that show the preferential access is being given to cleaner and safer vehicles; it is essential that local authorities assist in the development of market signals that support vehicle manufacturers committed to EU directives on emissions and quotas of clean vehicles. The current division of access restriction and pricing measures is not helpful to the conception of actions to minimise urban motorised road traffic.

In order to bring a concerted focus to delivering this basic (demand management) package, it is recommended that the number of additional vertical work lines be reduced, and that actions for goods management and innovative forms of vehicle use should both be articulated within the main demand management action. Furthermore, there is increasing evidence of a growth of Powered Two-Wheelers in those cities that have imposed restrictions on car traffic (London, Rome, and Barcelona's Green Area…). Future projects should explicitly take this effect into account, not only because of the risk of not meeting road safety targets, but also because the good practice regarding PTWs needs to be more widely considered if we are to compare European best practice with developments in other urban areas of the world.

With respect to the promotion of non-motorised modes, it is recommended that an improved focus be achieved by focussing on a number of options such as:

- Safe routes to schools, stations and main bus stops;
- Interconnection of urban cycle networks with recognised greenways and networks being developed at the regional or national levels.

There are some measures within the CIVITAS programme that fit more comfortably at the metropolitan or regional level. These include:

- Intelligent Transport Systems (ITS);
- Measures for improving traffic safety;
- Measures for demonstrating cleaner vehicle fleets.

Concerning ITS, it is recognised that DATEX2 (developed in the Euroregional programme) now offers a standard mechanism for interchanging traffic data across Europe. The next Euroregional programme recommends that the implementation and use of this tool be extended to include urban traffic control centres. We recommend that CIVITAS be pro-active in supporting this as a compulsory element of future ITS actions (it is in cities' interests to receive up-to-date, standardised information about the traffic it interchanges with the surrounding region).

In spite of the four-year duration of the CIVITAS projects there is no comprehensive data available to compare safety performance, and there are relatively few achievements that clearly contribute to the EU objective of halving road deaths between 2000 and 2010.

Projects leading the benchmarking of European road safety (such as Saefynet, SUNflowerplus, SECbelt..) use accidents involving deaths as the basic, reliable basis for comparison. To achieve a meaningful comparison such statistics need to be compared for the regions within which the CIVITAS cities are located.

A regional lead on procurement of cleaner vehicle fleets is also recommended. On the one hand, it has been shown to be effective in CIVITAS 1 cities pioneering the development of

the bio-fuels market (Stockholm, Cork, Lille...). On the other hand, it is easier to influence national policy development from the regional level than from the city level.

To summarise, we recommend that the CIVITAS initiative be re-organised to better ensure its contributions to EU policies and directives, with a clearer and simplified division of the actions being led at local city level:

- Access restrictions and pricing regulations (integrating goods, Powered Two-Wheelers and new forms of vehicle usage)
- Collective Passenger Transport
- Non-Motorised modes....

....and with regional organisations taking the lead for:

- Intelligent Transport Systems (ITS)
- Measures for improving traffic safety
- Measures for demonstrating cleaner vehicle fleets.

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References

- Barcelona Municipality, reports on goods delivery management innovation reported in NICHES project
- Barcelona Municipality, reports on goods delivery management innovation have formed a part of the candidature presented for the OSMOSE mobility innovation awards.
- DSD, 2006, Barcelona presentation at FIDEUS 1st Year Project Review, Hannover, May 2006;
- Managing Travel Demand “Applying European perspectives to the U.S. practice” - Federal Highway Administration May 2006 , following the visit to some European CIVITAS Cities (Rome and Hampshire)- http://international.fhwa.dot.gov/traveldemand/t1_p05.htm
- The on board system developed in for Rome, can be accessed on http://www.mobytv.it/;
- ATAC has been pointed out on WURFL web site (http://wurfl.sourceforge.net/links.php) for being the first PT company to use multi serve maps to mobile users, developed within MIRACLES;
- MIRACLES results will be used for the “Report on Mobility in the city of Rome in 2005”
- MIRACLES in Hampshire short listed for the National Energy Efficiency Awards 2006 – results awaited
- Parliamentary records of the presentations to the Irish Parliament about the Miracles project may be viewed on line at http://193.178.1.238/DDebate.aspx?F=MAJ20050622.xml&Ex=All&Page=2
- Sarah Danaher and Brian Cassidy gave a joint presentation entitled “Municipal Case Study: Biofuel Use in Cork City Council” in which they discussed the Miracles Project using the Miracles Powerpoint Template for slides etc. Reference: http://www.energyireland.ie/transport/Energy_in_Transport_Speaker_Panel.htm
- Information about the Miracles WP 12 measure was given to the Department of Public Enterpirse and incorporated in to their Sustainable Energy Ireland Briefing Note; *http://www.sei.ie/uploadedfiles/RenewableEnergy/SEILiqBiofuelsBriefingNote20030912.pdf (Page 19 and 36)*
- Lessons learned from Miracles Mobility Management and Public Transport measures spurred Cork City Council to get involved in the Interreg IIIC funded mascara project: www.mascaraproject.com

- Cork City Council also became involved in a project to train its staff and other council representatives about Sustainable and Energy Conserving Transport throught its involvement in the "Competence" Steer project: www.transportlearning.net Miracles information was disseminated and exploited at the National events for this.

Cork City Council Traffic Division supported the work of Sustainable Ireland in organising events and a directory to promote sustainable living in Ireland. On-line listing describing Civitas: http://www.sustainable.ie/directory/subcategory.php?id=216

Glossary

ACS – Access Control System
ADSL - Asymmetrical Digital Subscriber Line
AGM–Annual General Meeting
AGS - Access Gate System
ANPR - Automatic Number Plate Recognition
AQAP – Air Quality Action Plan
AQMA - Air Quality Management Area
AVL – Automatic Vehicle Localisation
AVM- Automatic Vehicle Monitoring
BAT – Best Available Technology
B2C – Business to Consumer
BDIS –Bus Departure Information Screen
BQP – Bus Quality Partnership
Bollino Blu - Blue sticker certifying the passed analysis of exhaust gases (Rome)
CCTV – Close Circuit Television
CLT – City Level Templates
CNG – Compressed Natural Gas
CPT – Collective Public Transport
CRT - Continuous Regenerating Trap
CO – Carbon Monoxide
CZ – Clean Zone
DLG – Dissemination Liaison Group
DoW – Description of Work
EC – European Commission
ECS – European Car Sharing organisation
EPA – Environmental Protection Agency
EST – Energy Savings Trust
EURO I, II, III, IV – European emission standards
FO – Fibre Optic
GIS – Geographic Information System
GPRS - General Packet Radio Service
GPS – Global Positioning System
Guides Plan – Barcelona Internet and Mobile information services
HC – Hydrocarbons
HCC – Hampshire County Council
HTM – Hampshire Transport Management
HWTP – Home Work Trip Plan
ICS – Iniziativa Car Sharing
IDU – Information Display Unit
INFOPOINT – ATAC web system to provide the best routing calculation (Rome)
ITEMS – Evaluation tool
LEV – Low Emission Vehicle
LPG- Liquefied Petroleum Gas
LTP – Local Transport Plan
LTZ – Limited Traffic Zone (Rome)
METEOR – Accompanying Measure of the CIVITAS Projects
MIRACLES – Multi Initiative for Rationalised Accessibility and Clean Liveable EnvironmentS
MLT – Measure Level Templates
NOx – Nitrogen Dioxide
P&R – Park and Ride
PM10 - Particulate Matter – fraction below 10 micron
PPP – Public Private Partnership
PRM – Personal Reduced Mobility
PTO - Public Transport Operator
PTW – Powered Two-Wheeler
OBU – On Board Unit
OCR - Optical Character Recognition
OD – Origin Destination
P&R – Park and Ride
PT – Public Transport
PTW – Powered Two Wheeler
Rail Ring – (Anello Ferroviario) Rome Laboratory Area, identified by the local railway system
RP – Road Pricing
RSD – Roadside Sensing Device
SCR – Selected Catalytic Reduction
TAXIBUS – “on demand” service (Rome)
TCC – Traffic Control Centre
TED – Traffic Executive Decision
TDMS - Traffic Demand Management Strategies
TEMC – Traffic Environment Model Chain
TIC – Traffic Information Centre
TIP – Technologicla Implementation Plan
TMB Transportes Metropolitanos de Barcelona
TMC – Technical Management Committee
TRIDENTE – area of Rome at the heart of its historical city centre (LTZ)
TTIC – Traffic and Travel Information Centre
UMTS - Universal Mobile Telecommunications System
VMS – Variable Message Sign
VPS - Vehicle Positioning Satellites
WiFi - Wireless for Fidelity
WCC – Winchester City Council
WAP - Wireless Application Protocol
WMAP – Winchester Movement and Access Plan
WP – Work Package
ZEV – Zero Emission Vehicle
ZTPP – Zona Traffico Pedonale Privilegiato (pedestitan island max vehicle speed 30km/h, pedestrians always have the priority)