INNOVATIVE URBAN TRANSPORT SOLUTIONS

CIVITAS
makes the difference

How 25 cities learned
to make urban transport
cleaner and better

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IMPRINT

ABOUT VANGUARD

Launched in September 2008, CIVITAS VANGUARD was a 74-month grant-based project of the European Commission's Directorate-General for Mobility and Transport (DG-MOVE), funded as part of the CIVITAS Initiative. It was a support action for the coordination and dissemination of CIVITAS Plus, the third phase of the CIVITAS Initiative, and as such served the CIVITAS Plus collaborative projects and the CIVITAS Initiative itself.

Funded under the European Commission's Seventh Framework Programme for Research and Technological Development, VANGUARD focused on the dissemination of research activities, results and experiences from cities and projects participating in CIVITAS.

PUBLICATION

This publication is intended for all those with an interest in sustainable urban mobility and the CIVITAS Initiative. It is available from the Knowledge Base on the CIVITAS website: www.civitas.eu.

PUBLISHER

On behalf of the CIVITAS Initiative, ICLEI – Local Governments for Sustainability, European Secretariat. Executive Director Wolfgang Teubner.

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TABLE OF CONTENTS

FOREWORD

Moving people and goods in European cities is a continuous challenge. Energy use, space use, road safety, air quality and noise pollution are a few of the road transport–related issues that European cities have to cope with. But there is more: local decision makers are concerned about equal and affordable access to mobility. Every day, our mayors and councillors are concerned about finding solutions to urban transport problems that do not slow down the local economy but bring local communities to prosperity.

Europe might be on the verge of a paradigm shift in finding a solution to this problem: integrated planning, smart solutions, clean (electric?) vehicles, better public transport, the uptake of soft modes, and restraints on motorised travel were needed… Step by step, European cities are establishing a European model for urban transport solutions.

The CIVITAS Initiative has proven to be a valuable instrument to help cities experiment with innovative urban transport solutions. And with the experiment come the lessons learned, thanks to a coherent approach to monitoring and evaluation within CIVITAS.

In the CIVITAS Plus phase of the Initiative, 25 cities cooperated to plan, implement and understand the impacts of innovative urban transport measures.

It has been an interesting time, working against a backdrop of EU, national and local policies to tackle the economic crisis. It was also a time when the EU prepared decisive policy documents in the field of transport (the White Paper on transport), and urban transport in particular (the Urban Mobility Action Plan). The experiences described in this publication helped to shape these documents.

On behalf of the CIVITAS Political Advisory Committee, I invite you to be inspired by the innovative transport solutions that have been trialled in CIVITAS Plus.

Sandor Nagy
Chair of the CIVITAS Political Advisory Committee

ABOUT THIS PUBLICATION

The present publication is intended as a critical review of the transport measures that were developed and implemented during the CIVITAS Plus phase (2008–2012) of the CIVITAS Initiative. Running now for 12 years, the Initiative has helped to change the face of urban mobility in Europe. It has established a unique mix of innovation, policy support and public involvement in order to apply integrated strategies for urban transport. By improving mobility in cities, CIVITAS has significantly improved the environment, public health and urban life as a whole.

During CIVITAS Plus, over 300 measures were implemented in 25 cities over a period of four years. These have contributed to improving common transport planning practices, shaping the urban environment and changing the way Europeans move around in cities towards more sustainable, healthy and active living.

This publication, together with the other CIVITAS Plus outputs (the *CIVITAS Measure Directory*, *Living Laboratories*, *Policy Recommendations* and *CIVITAS in Numbers*[1]), aims to inspire transport practitioners, city officials, environment and energy officials, transport and energy managers, town planners, transport planners, municipal leaders and local politicians to make bold decisions, set ambitious goals and follow sustainable mobility principles when designing urban mobility policies.

Each chapter covers one of the eight CIVITAS thematic categories. These are the building blocks of integrated strategies for changing urban mobility in European cities and are part of a comprehensive and integrated approach to transport, as suggested by sustainable urban mobility planning principles. A set of recommendations, focusing on concrete examples, is given for each thematic area in order to encourage the take-up of the appropriate measure for each specific circumstance. Case studies complement each chapter and offer in-depth information.

The closing chapter on changing travel behaviour gives an insight into the shift in personal mobility patterns, how professionals have changed the way people look at transport measures, and how members of the public have learned to adapt to and make use of new technologies.

The information contained in these pages was gathered from material generated by the five demonstration projects under CIVITAS Plus — CIVITAS ARCHIMEDES, CIVITAS ELAN, CIVITAS MIMOSA, CIVITAS MODERN and CIVITAS RENAISSANCE. The evaluation reports compiled by the CIVITAS POINTER Support Action also contributed to the analysis. All materials can be found on the CIVITAS website (**www.civitas.eu**).

1   COLLECTIVE PASSENGER TRANSPORT

Good public transport contributes to more accessible, inclusive and liveable cities by improving air quality, optimising road space use and revitalising city centres. CIVITAS Plus cities put in place innovative measures to enhance public transport use.

Public transport is a key element of sustainable mobility in cities, and its quality should be maintained in order to keep existing users and attract new ones. Ways of increasing the attractiveness of public transport include improving operational efficiency, harmonising tariffs and timetables, and improving accessibility and interchange facilities.

Within CIVITAS Plus, collective transport measures addressed a number of sub-themes: the provision of real-time information; the introduction of single transport passes and integrated multi-modal ticketing systems; improved accessibility for people with impaired mobility; improved bus stops and the installation of ramp metering systems; the integration of public transport with cycling, park-and-ride facilities and vertical transport systems; the introduction of security systems; and awareness-raising campaigns on safety.

Information systems can improve public transport capacity and priority as better information technologies become available. New investments include information infrastructure, and upgraded, more comfortable and more accessible buses.

1.1   A CLOSER LOOK

Collective passenger transport plays a role in any sustainable urban mobility plan. Cities face the common challenge of deploying an integrated, energy-efficient public transport system, with the aim of improving security and safety. High-quality services, including enhanced access to information and adequate ticketing, are essential.

Optimised fleet management technology enables better information services, including the provision of on-board or online route information, SMS or Bluetooth dispatching, or electronic information panels at public transport stops.

Enhanced infrastructure and vehicles can improve public transport accessibility. Low-floor minibuses for people with impaired mobility, as well as

monitoring and communication systems, were deployed in several CIVITAS Plus cities.

Modern ticketing and tariff systems include integrated ticketing across different transport systems, for example through the use of a single (usually contactless) card for payments. Other measures focused on the introduction of vending machines or ticket sales via Internet or SMS.

Improved safety and security for both the general public and public transport users was achieved through the installation of surveillance systems on vehicles, in underpasses and at public transport stops. Information and educational materials were used in campaigns for safe and secure public transport trips.

1.2   THE EU CONTEXT

The European Commission (EC) estimates that congestion costs nearly EUR 100 billion annually, or 1 percent of the EU's GDP[2], and the cost is projected to rise to EUR 200 billion annually if changes are not made to the mobility system[3]. The 2011 EC White Paper on transport[4] suggests that an increased share of urban collective transport with enhanced service obligations would create a virtuous cycle to incentivise public transport use. This would not only contribute to the European goal of reducing

greenhouse gas (GHG) emissions by 20 percent by 2020, but would also directly benefit urban life.

To promote the greater use of collective transport, the EC emphasises the need to improve the quality, accessibility and reliability of transport services[5]. This requires a mixed strategy involving land-use planning, pricing schemes, efficient public transport services and infrastructure, and reliance on cleaner vehicles to reduce both congestion and emissions.

1.3   CHALLENGES FACED

The promotion of collective transport requires a variety of instruments to make it attractive and competitive compared to the private car. These instruments include intelligent transport systems (ITS) for smarter ticketing; regulatory and legal measures to enhance safety and security; and improved fleet operations.

Encouraging greater use of public transport and enabling a change in people's travel behaviour requires a paradigm shift in the way people travel in cities. Chapter 9 of the present publication looks in depth at behavioural change techniques and approaches.

Successful smart ticketing implies simple, user-friendly and transparent systems. CIVITAS Plus examples show that improvements to ticketing and tariff systems face technological challenges. In Ljubljana (Slovenia), for example, there were delays in synchronising the existing ID tickets with the new e-tickets[6]. Other technological challenges arise when integrating separate information technology (IT) systems into a unified scheme; and developing adequate hardware and software interfaces. An analysis of ITS measures can be found in Chapter 8.

Safety and security (Chapter 2) have become hot topics in public transport, and local measures in this area require coordination among authorities and operators. Regulatory changes regarding the use of personal data (video recording) are often needed, alongside efforts to boost public acceptance.

In terms of fleet management, lack of technological know-how may cause problems, while the lack of sufficient or adequate co-financing can hamper plans before they are even put into action.

Insufficient cooperation between parties can lead to delays in implementation, while complex legislation and administrative procedures may make it difficult to establish the legal foundations for change.

Improving bus services for disabled people in Brno, Czech Republic

To cater for its approximately 50,000 citizens with impaired mobility, Brno introduced five specially adapted minibuses. Customised public transport had previously been neglected in the city, with standard low-floor buses, designed for only one or two wheelchairs, being the only available option. Minimum criteria were set for each of the new minibuses, according to which each vehicle had to be able to transport at least six wheelchairs at a time. The vehicles also had to be equipped with a modern information system and loading ramp, and were required to be more environmentally friendly than standard buses.

Since the launch of the project, the minibuses have operated on two lines specifically developed for passengers with impaired mobility. The lines cross the city, connecting the main public institutions, hospitals and other public buildings.

The minibuses and routes proved highly successful. All five buses were put into operation and the system met all expectations. In order to further refine the measure, several meetings were held with passengers with special mobility needs. They expressed satisfaction with the current status of the bus system and suggested only minor changes, such as amending the timetable and shifting the position of certain bus stops. All the suggested changes were implemented.

According to an analysis carried out by the public transport operator, the operating costs of the minibuses are far lower than for standard buses, thanks to lower fuel consumption and other costs.

For more information: http://civitas.eu/content/civitas-case-study-improved-bus-services-disabled

1.4 LESSONS LEARNED

The importance of political commitment, urgency and drive cannot be overstated, and CIVITAS Plus saw many examples. The city of Funchal (Portugal) was fortunate that its planned collective transport measures fitted perfectly with the regional sustainable development agenda, ensuring political support from start to finish[7]. In Monza (Italy), political commitment helped to convince citizens to switch to more sustainable modes[8], and in Utrecht (the Netherlands) it was political drive that helped to push through measures to improve the quality of bus lanes[9]. In Perugia (Italy), local elections prompted growing ambitions for the development of the city's public transport infrastructure[10].

In relation to infrastructure measures, authorities should have a positive attitude towards the plans that are made. Infrastructure measures require substantial funding, and construction work sometimes causes severe disruptions to traffic.

Forward thinking based on a detailed plan, combined with a skills development approach, is essential when implementing reliable IT systems. Planning ahead and creating opportunities for training and professional expertise can help avoid delays in preparing the system launch and can ensure compatibility among operators and technologies.

Stakeholder involvement and the smart communication of security measures means involving all affected groups, including those directly targeted by specific measures.

Further legal and regulatory amendments may be required in order to fully implement safety and security measures.

1.5 MOVING FORWARD

CIVITAS Plus measures for collective passenger transport envisaged improvements to the quality of service and ease of use. They also aimed to ensure safe and secure services. In general, while expected outcomes create a positive image, measures may encounter some resistance if implementation does not meet expectations. The lessons mentioned above are thus important for the transferability of measures.

Investing in infrastructure and networks and improving accessibility are usually quite costly. Experience gained from implementing measures can be valuable. Infrastructure improvements are usually well accepted by public transport users because they have a direct impact on comfort and service quality. However, if the measures require spatial adjustments, they may not be easy to transfer, as numerous institutional, organisational and financial hurdles will arise. Political support is therefore a further prerequisite for the success of such measures.

Public transport information, ticketing and fleet management measures have transferability potential. The main condition is that the technical equipment functions well, and that systems can be integrated where necessary. This requires thorough research, cooperation between stakeholders, and a realistic financial plan and time schedule within a stable organisational structure.

Safety and security measures relying on camera technology systems are quite transferable. However, they are also affected by local or national legislation, such as laws on privacy in relation to the use of cameras and data. European legislation must also be taken into account. Safety measures targeting specific groups (e.g. schoolchildren and elderly or disabled people) have great transferability potential.

Public transport communication system in Tallinn, Estonia

CIVITAS supported the installation of a modern communication system comprising a driver communication unit and an operator workstation based on the 3G mobile communication standard. The system was installed on 145 of Tallinn's 350 buses and enabled greater information-sharing possibilities, more rapid communication and better traffic management.

Survey results showed that on average 90 percent of bus drivers and managers/operators believed that the new communication system had improved their working conditions. In addition, 90 percent of drivers and managers/operators believed that the system had improved traffic safety. One important lesson learned was that the entire fleet should be equipped with a similar and integrated IT system in order to achieve maximum impact.

For more information: http://civitas.eu/content/public-transport-communication-system

1.6 RESULTS/IMPACTS

CIVITAS Plus cities that implemented measures to modernise collective passenger transport have seen an increase in user acceptance and the level of service use.

Operational financing and efficiency generally require that technologies in the collective transport thematic area contribute to several measures and must be integrated with existing information and payment systems. These technologies have also been used to collect data for public transport providers, detect problems, monitor passenger journeys and optimise traffic.

Cities in Eastern and South Eastern Europe had less experience with the latest technologies and therefore welcomed support, help and experience from other cities. Brno (Czech Republic) developed a network[11] of CIVITAS Plus partners to discuss best practices. Tallinn (Estonia) experienced delays in introducing its new contactless card system, as the challenge of identifying the most suitable and competitive solution held up the procurement process. Although appeals from bidders further undermined the process, the city launched a working group to prepare terms of reference for the launch of the public tender[12].

CIVITAS Plus cities that explored measures in this thematic area recorded increased levels of acceptance and service satisfaction as a result of the new technologies implemented. In Iasi (Romania), where passengers had no previous experience with vending machines and e-ticketing systems, public transport users were very happy with the new opportunities for purchasing tickets[13].

Monitoring and evaluation revealed that the number of public transport users and/or the modal share of public transport increased as a result of the measures implemented in CIVITAS Plus. In the surveys undertaken, the proportion of satisfied public transport users was significant, rising above 70 percent[14].

Indicators for transport quality also showed progress. More accurate timekeeping was recorded, including a 25 percent improvement in Craiova[15] (Romania). Losses of drivers' time were reduced: in the case of Donostia–San Sebastian (Spain), this resulted in a 2.5 percent reduction in operating costs[16]. An important contribution to social inclusion was the improved accessibility of targeted areas, with Funchal (Portugal) achieving a significant improvement[17]. Improvements were not restricted to public transport users, however. In response to surveys, public transport employees in Tallinn[18] (Estonia) and Donostia–San Sebastian[19] (Spain) stated that they appreciated the better working conditions that resulted from the measures.

1.7 RECOMMENDATIONS

Based on the experiences of the CIVITAS Plus cities that implemented collective transport measures, some general recommendations can be made for other cities.

Partnerships and stakeholder involvement are key to successful implementation, as part of an integrated approach to urban sustainable mobility planning. In order to integrate and utilise all the functions of information and ticketing systems, partnership between public transport operators and public authorities is essential. A positive attitude on the part of the relevant authorities towards public transport is a precondition for success.

Public transport users' wishes need to be investigated in order to ensure that public transport developments meet real needs, rather than imaginary or estimated ones. When introducing dial-a-ride services, in particular, it is a good idea to carry out a demographic study in order to identify who is in the service catchment area and what level of technological literacy exists. Measure objectives should then be embedded in policy documents, so that synergy can be maximised among all planned measures.

The use of new and innovative technologies for public transport has contributed in recent years not only to improving access to public transport but also to making fleet management more efficient. It is essential to ensure compatibility between the different technological systems and measures, such as global positioning system (GPS) data outputs, communication systems, driver communication, ticketing, positioning and real-time passenger information.

Modern technologies enhance travel comfort, especially for passengers with specific mobility requirements, such as the visually impaired. This was demonstrated by the "talking bus stops" introduced in Brighton & Hove (UK)[20]. Close cooperation with representatives of such groups is essential for the successful implementation of targeted measures.

Measure funding is an important element of agreements between public transport operators and the public authorities. Although some measures apparently pay for themselves (e.g. the implementation of ticket vending machines, e-ticketing, and even on-demand transport), a substantial subsidy is usually needed. Good financial planning is therefore a must. Zagreb (Croatia), for example, has good experience with its closed-circuit television (CCTV) system, and if funding becomes

available, cameras will be installed in all its public transport vehicles [21].

Some European countries have limited experience with the latest technologies in public transport services, thus the sharing of experience and data between cities is very valuable, allowing them to accurately benchmark their situation.

The Green Line turning point in Funchal, Portugal

The city of Funchal set out to demonstrate that improvements to the urban mobility system can be beneficial for tourism and for overall quality of life. The city introduced the Green Line, a high-frequency low-emission bus line operating in major tourist and residential areas affected by heavy congestion. The measure was publicised by means of communication and promotional campaigns that encouraged locals and tourists alike to choose the cleaner bus more often.

As feasibility tests indicated that electric and hybrid buses were not suitable for the hilly areas where most hotels are located, low-emission diesel buses were purchased instead. All the buses operating on the line meet Euro 5 standards.

To promote the Green Line, the sale of public transport tickets was encouraged at hotel reception desks through the Tourist Kit, which includes an information brochure on the most interesting destinations reachable by public transport. Hotel managers were also invited to use the Tourist Kit to promote their hotel as an environmentally friendly establishment.

As a result of the measure, operating revenues in the Green Line target area increased by 10 percent, while operating costs fell by 13 percent. Air pollution also fell by between 13 and 43 percent, depending on the specific pollutant measured. The number of passengers rose, and high levels of satisfaction were recorded.

For more information: http://civitas.eu/content/civitas-case-study-new-green-bus-line-funchal

2   SAFETY AND SECURITY

Safety and security are core components of sustainable urban mobility and are primary areas of action within the CIVITAS Initiative. Emphasis is placed on making roads safer and giving vulnerable road users a greater sense of security. Improving safety and security can be an extremely important step in encouraging users to switch to (or even try out) alternative modes of transport that may be perceived initially as unsafe. This may be the case in relation to cycling in cities with little dedicated infrastructure, or using night bus services where limited extra security is provided.

All CIVITAS Plus cities took action in this area. Measures implemented focused on safer roads, cycle paths and footpaths; speed reductions; improvements to road safety through cycling and walking; safety improvements in public transport; and enhancing passenger security.

Image: Stephan Köhler

2.1   A CLOSER LOOK

Safety and security must be ensured for urban travellers, especially for the most vulnerable groups of passengers, if a shift to non-motorised transport modes is to be achieved.

CIVITAS Plus — for the first time within the CIVITAS Initiative — took action in the area of public transport security. Measures were aimed at reducing the risk of accidents (safety) and preventing vandalism and aggression towards staff and passengers (security). Special attention was given to well-defined target groups, such as young people, marginalised groups and senior citizens.

Several CIVITAS Plus cities considered both safety and security in comprehensive action plans for public transport, or by means of safety and security audits. Measures included video surveillance on vehicles and at public transport stops, increased personnel and enforcement. By ensuring the valuable, safe and secure use of public spaces, these measures were aimed at finding solutions to the challenges that cities face.

Very few people would raise objections to improving the safety of pedestrians and cyclists. However, discussions may arise regarding the sharing and prioritisation of public spaces when designating cycle paths or pedestrian areas. In city centres,

stakeholders such as shopkeepers, hotels and other businesses often protest against such plans, thus the involvement of, and communication with, all stakeholders is key to successful implementation.

2.2   THE EU CONTEXT

The EC communication "Towards a European road safety area"[22] aims to reduce road deaths by 50 percent by 2020 through a mix of measures.

The communication calls for a coherent, holistic and integrated approach and identifies seven strategic objectives, many of which have been explored within CIVITAS: to improve the education and training of road users; to increase compliance with road traffic rules; to create safer road infrastructure; to make vehicles safer; to promote the use of modern technology in order to improve road safety; to improve emergency and post-care services; and to improve the safety of vulnerable road users.

Some of these elements have been tackled directly by cities. CIVITAS Plus measures followed the EC guidelines as regards creating safer road infrastructure, improving the education and training of road users, and protecting vulnerable road users. The guidelines propose concrete initiatives to identify and promote best practices and achieve safer mobility.

2.3 CHALLENGES FACED

Efforts to improve road safety and security in CIVITAS Plus cities encountered a number of difficulties. These were related to infrastructure and spatial challenges, as well as political and public support. Experience shows that modifying mobility habits is an ambitious goal. Chapter 9 of the present publication contains further discussion of behavioural change techniques and approaches.

Lack of political and public support was shown to reduce the potential for improving the safety and security of vulnerable road users. While the stable pro-cycling local government in Donostia–San Sebastian (Spain) made big investments in infrastructure, other local authorities showed a reluctance to develop cycling due to negative public perceptions. In these cases, cycling was usually perceived to be unsafe or primarily as a sports activity[23]. A reluctance to take away road space from motorists undermined the effectiveness of the measures[24].

The spatial barriers posed by a city's topography were another challenge. Again in Donostia–San Sebastian, where the hilly topography entails high investment costs, evidence was needed in order to inform decision makers and persuade them that the benefits were worthwhile[25].

The state of the existing infrastructure (e.g. public transport not adapted for use by disabled or older passengers) sometimes undermined the overall aim of improving the safety and security of vulnerable public transport users. In Ljubljana (Slovenia), safety improvements included not only installing video surveillance systems on buses, but also implementing qualitative measures such as sensitivity training for drivers[26].

Complex administrative procedures in relation to the deployment of surveillance cameras were encountered in Zagreb (Croatia)[27].

Craiova (Romania) faced technological problems in connection with a recording system that did not allow real-time data transmission[28].

2.4 LESSONS LEARNED

The following conclusions can be drawn from the examples implemented by CIVITAS Plus cities.

Safety audits have been proven to be effective prior to the planning of safety measures. While measures

Anti-vandalism policy for public transport in Gdansk, Poland

Like most medium-sized and large cities, Gdansk struggles with regular acts of vandalism and anti-social behaviour targeted at public transport vehicles. Within CIVITAS, the city introduced several measures aimed at improving the image of public transport by ensuring the comfort and security of users. The city's anti-vandalism strategy included awareness-raising meetings with schoolchildren; training for drivers on effective methods for dealing with difficult passengers; the introduction of CCTV monitoring on a large scale; and the reinforcement of the long-running "Clean Public Transport Stops" campaign.

Prior to the city's involvement in CIVITAS, Gdansk's citizens frequently posted flyers and adverts on shelters at public transport stops. This created an untidy mess, and the unattractive appearance of the shelters merely encouraged further acts of vandalism. In order to create a change in public attitudes, the clean stops campaign was launched with the ultimate aim of improving perceptions of safety and security among service users.

In addition to anti-vandalism discussions with primary-school children (held in damaged buses and trams), a drawing competition was organised on the theme of preventing vandalism.

As a result of the measures, perceptions of safety and security among citizens rose by 20 percent, while perceptions of safety at public transport stops rose by 29 percent. The number of flyers illegally posted on shelters decreased substantially. The CCTV system has also proved to be an effective solution for reducing vandalism.

For more information: http://civitas.eu/content/civitas-case-study-anti-vandalism-public-transport-gdansk
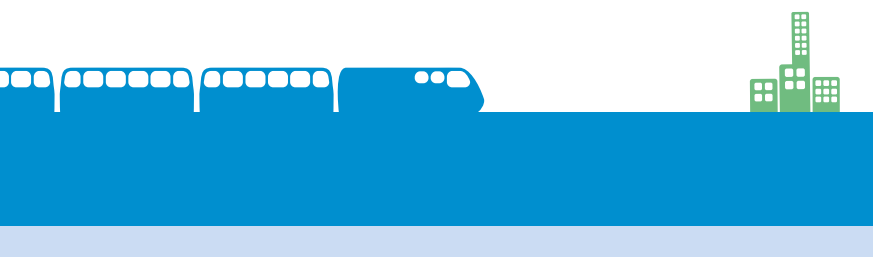
often target specific groups, such as schoolchildren and elderly or disabled people, they may be counterproductive if the groups are not addressed appropriately. A measure related to safety and security in public transport, implemented in Ghent (Belgium), showed that targeting the right group under the right conditions leads to success. The goal of the Trammelant project[29] was to raise awareness of the consequences of vandalism in buses, and the campaign targeted schoolchildren using an educational rather than a judgemental approach. The success of Trammelant then served as a basis for discussion with young people in Zagreb, Croatia.

Public opinion can be either a major obstacle or a powerful engine of support. Donostia–San Sebastian demonstrated the importance of providing clear information in order to overcome negative reactions on the part of drivers towards measures restricting car use[30]. Bologna (Italy) managed to establish constructive and open cooperation with stakeholders and institutional partners in the framework of the "Safer Roads to School"[31] campaign. The partnership has held together for several years since its creation.

Infrastructural modifications and road markings play an important role, along with effective traffic regulation, in improving the safety of pedestrians, especially schoolchildren.

2.5   MOVING FORWARD

CIVITAS Plus measures aimed at improving safety are generally transferable. However, there is always likely to be some opposition to measures to reduce speed. Acceptance may also become problematic when priority is given to one transport mode and taken from another. Stakeholder involvement, effective communication and the use of local champions are therefore important.

A first step in improving road safety is to identify locations where there are particularly high numbers of accidents. The most common measure taken by cities was to develop speed limit zones, generally in residential areas with a high population density, in the vicinity of schools, or on sections of road used by high numbers of pedestrians.

Measures related to driving and safety courses have great transferability potential, although they need to be targeted at very specific groups. Some cities combined safety measures with awareness-raising campaigns: the introduction of new infrastructure to ensure safe road crossings for schoolchildren in Szczecinek (Poland), for example, was accompanied

by activities to foster acceptance of speed limits among car drivers[32]. A similar approach was undertaken in Usti nad Labem (Czech Republic), where the city implemented the "Drive Safely" campaign[33].

Measures to improve and maintain existing infrastructure, such as traffic signals and zebra crossings, are in theory relatively easy to transfer. In practice, however, they require the development of maintenance plans and the release of funds to carry out maintenance.

Easily transferable measures for safety improvement, aimed at raising awareness, include educational programmes for schools, workshops on safety, and the creation of a cyclists' platform to bring together stakeholders for the exchange of experience.

Many public transport safety and security measures rely on camera technology and are transferable. However, they depend to a large extent on local and national legal parameters, such as privacy laws regarding the use of cameras and data.

2.6 RESULTS/IMPACTS

While the outcomes of individual and separate measures are difficult to assess, evaluation surveys indicate improvements to overall safety as a result of combined and complementary initiatives.

Gdansk (Poland) aimed to promote and enhance the use of public transport and address vandalism and anti-social behaviour[34]. The implemented measure combined the installation of video surveillance systems with the start of collaboration with major stakeholders such as the police, school and other authorities. The campaign resulted in a 20 percent decrease in acts of vandalism compared to 2009, and an almost 25 percent improvement in perceptions of the safety and security of public transport. Based on the success of this measure, the anti-vandalism campaign was expanded throughout Poland.

Utrecht (the Netherlands) was also successful in improving safety and security[35]. Acknowledging that the improved security of children is the shared responsibility of the city, its schools, the children and their parents, the city council launched the Utrecht Road Safety Label. The scheme included a structural traffic education plan to raise awareness of road safety around schools. In 2012, 67 percent of schools voluntarily participated in the scheme. Fifty-four of the 70 participating schools were located within a redeveloped school zone. The measure succeeded in changing mobility patterns. Survey results indicate that although 12 percent of parents were reluctant to abandon their cars, cycling and walking appeared to be the most used mode of transport for travelling to primary schools. Thanks to the success of the measure, the city decided to continue funding the label after project funding ended.

Among other measures to improve security in public transport, the city of Ghent (Belgium) implemented the cooperative and participatory Trammelant programme (see above), which resulted in a 53 percent reduction in the number of incidents involving youngsters under the age of 18[36].

Positive results based on a combined approach were noted in Ljubljana (Slovenia). In addition to focusing on more vulnerable public transport users and reducing acts of vandalism, the Slovene capital introduced speed restrictions in strategic zones[37]. The combination of measures had a positive impact on safety and security. In the reduced-speed zones, average speeds were cut by approximately 5.2 km/h, or 12 percent. The number of minor injuries in pedestrian areas was reduced by 33 percent.

2.7 RECOMMENDATIONS

Implemented measures were generally effective in enhancing safety and security, particularly when part of an integrated approach. CIVITAS Plus recommendations in the field of safety and security are outlined below.

Policies to improve safety and security rely on a complementary approach. In speed limit zones, the reduction in average speeds was found to be more effective when coupled with infrastructure changes,

Safe and secure roads in Brescia, Italy

In an effort to reduce the number of road accidents, the city of Brescia decided to collect more accurate accident data, implement an innovative road safety plan and establish a road safety monitoring centre. The monitoring centre transfers geo-referenced data to a web platform in real time. Integrated with smart devices, it allows for instant communication with the municipal police and statistical agencies. Data are also fed into a road safety planning tool.

The new information system is able to collect photographs of accidents, which is useful for improving the road safety scenario; standard reporting information obtained at the scene of the accident; and the precise location of accidents according to GPS referencing. This information is then transferred to the planning database.

Using the data analysis and mapping system, the municipality drew up a list of critical sites where priority actions were needed. Priority sites were assigned by calculating the road accident rate, or by counting the absolute number of accidents.

The development of a road safety plan was an innovation for Brescia and an outstanding result for Italy, where such planning tools are not commonly used. Brescia has used the results to install speed checks and to improve pedestrian crossings and intersections with traffic lights.

For more information: http://civitas.eu/content/civitas-case-study-safe-and-secure-roads-brescia

such as the introduction of speed bumps or road narrowing, rather than signage alone. This was proved in several cases by reductions in the number of accidents.

Several examples indicate that the successful promotion of public transport is closely connected with improving public perceptions of the safety and security of the public transport system. This has become a hot topic, especially in new EU member states. Measures to address security in public transport require partnership between authorities and operators. Legal changes in relation to the protection of personal data (video recordings) are also needed in some cases. The installation of surveillance cameras is not usually sufficient to achieve the goals: communication activities are also needed to make potential vandals aware of the new surveillance equipment.

Education and awareness raising are also an important focus of action. Involving citizens in the identification of pedestrian zones in Ljubljana (Slovenia) had positive results in terms of gaining public acceptance for the infrastructure changes[38].

Safety and security improvements are an ongoing process, requiring constant information and data gathering in order to respond to specific challenges. Many of the results will be seen only in the medium to long term.

Consideration of the overall regulatory and legal context can help in the implementation of safety measures. This should be taken into account in a well-developed strategy.

More efficient road markings in Perugia, Italy

The municipality of Perugia manages and maintains a large road network, and its tasks include the installation and maintenance of new road markings. In order to assess whether the budget allocated for road surface markings was being spent appropriately, Perugia created a scientific tool to judge the quality of the markings.

As a first step, existing technologies and standards were used to measure the performance of horizontal markings. This exposed gaps and enabled a better understanding of what was required from the new technologies.

Based on university research, the public tenders for road marking were redefined to include (among other things) stricter controls on the work carried out by external contractors. New equipment was selected and purchased, based on the analysis. A series of test sites were also selected, representing various conditions for road markings within the municipality.

The measurements carried out in Perugia showed that the quality of road markings was often poorer than the minimum quality established by EU reference standard EN 1436. It was also found that the intensive use of pre-mixed paint led to the poor visibility of markings at night. As a consequence, the company initially contracted to paint the markings was obliged to redo the work.

An economic analysis identified which materials should be used in order to reduce the costs of maintenance. Sprayed thermoplastic was recommended as the most economical material in the long term.

For more information: http://civitas.eu/content/civitas-case-study-more-efficient-road-markings-perugia

3 CAR-INDEPENDENT LIFESTYLES

Offering alternatives to private car ownership and private car use is an essential component of any comprehensive strategy for transport in and around European cities. CIVITAS Plus explored innovative ways to break the car habit, such as public bicycles, improved infrastructure, promotional campaigns, car sharing and car pooling. It also promoted the sharing of successful strategies among cities.

Cycling promotion measures were very popular among the participating cities, proving that there is still untapped potential for getting more people into the saddle. Five new car-sharing schemes were launched during CIVITAS Plus and six existing schemes incorporated cleaner fleet vehicles. Additional users were recruited through promotion and information campaigns.

Car sharing has proved to be a very effective and sustainable transport solution in urban areas. It targets people who have only the occasional need for a car and who do not want to own one. These users may not want to pay upkeep costs, or may live in historical city centres or other areas where parking spaces are scarce or expensive. Avoiding car ownership also encourages walking, cycling and the use of public transport.

3.1 A CLOSER LOOK

Dependency on oil to fuel our daily mobility patterns and the unnecessary use of private cars for short trips need to be reduced if cities are to achieve cleaner air and liveable urban environments. Measures to stimulate less-car-intensive lifestyles have helped cities towards achieving their goals by introducing a more sustainable way of using cars — that is, car-pooling and car-sharing schemes — and by promoting non-motorised modes such as cycling and walking.

Car usage has increased in recent decades and has resulted in high levels of atmospheric pollution, noise, traffic congestion, and an overall reduction in levels of physical activity. According to the World Health Organization, sedentary lifestyles come second only to air pollution as a cause of premature deaths in urban areas[39]. Hence the urgent need for cities to take action to change their policies, improve air quality, make provision for alternative modes, and reduce the number of journeys made by private cars.

Cycling and walking are sustainable travel modes that respond to both environmental and social needs. Active travel has zero emissions, is fast and convenient, and directly addresses lack of physical activity by replacing short, everyday car journeys to work or school. They are good for the environment, and good for health.

In the context of economic constraints, when car ownership may be an additional financial burden for households, interest in alternative modes and new forms of shared ownership is rising. As a result, in line with worldwide trends, there has been a major increase in the number of public bicycle and bike-sharing systems in the CIVITAS demonstration cities since 2008.

3.2 THE EU CONTEXT

In its 2011 White Paper on transport[40], the EC recommends that the facilitation of active travel should be a crucial part of urban planning and transport infrastructure design. More cities are developing sustainable urban mobility plans (SUMPs), which foster the better integration of

different urban mobility modes and encourage a shift towards more sustainable alternatives, thus increasing levels of cycling and walking.

The CIVITAS Initiative allocates resources to creating more suitable conditions for alternative transport solutions, and to facilitating a shift in mentality by promoting new forms of transport use and ownership. Most measures implemented in CIVITAS Plus cities focused specifically on creating better conditions for cyclists and pedestrians, and on offering new and flexible services for individual mobility.

Cycling, walking and vertical transport in Donostia–San Sebastian, Spain

Donostia–San Sebastian promoted car-free lifestyles by greatly improving alternative mobility options. This included the enhancement of public transport services; the further promotion of cycling; the development of vertical transport systems; and infrastructure improvements to encourage walking.

The city extended its pedestrianised area by 4 kilometres and made improvements along the network. The cycle network also saw the addition of 22 kilometres of cycle lanes, and gaps were filled where possible in order to enhance continuity.

To further promote cycling, particularly among visitors to the city, a public bike scheme was launched. The system will soon be up-scaled to the whole city, including hilly areas thanks to the addition of electric bicycles. Other cycling improvements include the implementation of 600 new bicycle parking spaces in 60 locations. The enforcement of safe districts and 30 km/h speed limit zones also helped to improve cycling and walking conditions.

To encourage citizens in hilly areas to travel by non-motorised modes, the municipality also initiated the development of a vertical transport network, installing additional lifts and new escalators/ramps.

The measures resulted in a 33 percent rise in bicycle usage. The public bike scheme saw registered users steadily increase, reaching over 5,000 subscribers in 2011. The number of trips made using the system reached a total of 167,659 in 2011, representing a 64 percent increase compared to the previous year.

For more information: http://civitas.eu/content/civitas-case-study-walking-cycling-and-vertical-transport-donostia-san-sebastian

3.3 CHALLENGES FACED

Efforts to shift people's travel behaviour towards car-independent lifestyles, or to encourage people to rethink car ownership, require a paradigm shift. This is often hampered by social norms that make cars into status symbols. Behavioural change techniques and approaches are discussed in greater depth in Chapter 9.

The lack of appropriate policy frameworks with strong political support from decision makers is a barrier to making changes in regulations and local laws that could help accommodate on-street parking for car-sharing schemes, recharging points for electric vehicles, cycling infrastructure and bicycle rental schemes.

Dealing with topographical conditions (hilly cities) or lack of space may lead to higher budget requirements than originally foreseen.

Lack of knowledge about the planning of cycling infrastructure can stop cities from taking the leap towards policies promoting an advanced cycling culture. Despite the large amount of information available through CIVITAS, city officials and practitioners need guidance and the possibility to exchange know-how with experienced peers.

Technology-driven measures based on Internet use and smartcards for booking vehicles or public bicycles are sometimes hindered by malfunctioning websites and software problems. The availability of appropriate and well-functioning software plays an important role in a measure's success.

3.4 LESSONS LEARNED

The following conclusions can be drawn from the numerous measures implemented on this theme during CIVITAS Plus.

A long-term transport strategy or plan provides a framework for innovative transport measures, as in Tallinn (Estonia), where the Traffic Safety Development Plan 2005–2014 created an outline for implementing measures on safe walking and cycling that led to

improved visibility for cyclists and pedestrians and fewer drivers exceeding the speed limit[41].

The involvement of stakeholders and implementers is essential from the earliest stage. In Perugia (Italy), an agreement between the municipality and the city car-park operator led to an additional car-sharing service that is of benefit to the city[42].

Making a less-car-intensive measure part of a larger package of actions works better than carrying it out in isolation. The integration of interventions related to cycle path and footpath networks into an overall mobility vision should be considered, including multi-modal links and promotional activities.

Mutual learning is particularly important in the case of planning for cycling and walking, as many cities lack experience with these modes of transport.

Measures to promote cycling and walking are best implemented in compact cities where travel distances are shorter. Aalborg (Denmark) witnessed a 4 percent modal shift from car to bicycle[43]. In CIVITAS Plus, both physical interventions and soft measures were implemented in order to provide better infrastructure and create conditions for safe cycling and walking. In Ghent (Belgium), for example, a new cycle street concept was adopted[44].

3.5   MOVING FORWARD

Generally, measures aimed at constructing new bicycle infrastructure — or improving existing infrastructure — are suitable to transfer, as cycling and walking have an overall positive image. However, there may be strong opposition to certain measures that require speed restrictions, or that give priority to one transport mode over another. Stakeholder involvement and information campaigns are important in this case.

Educational programmes for schools, workshops on safety, and cycling platforms that bring together stakeholders for the exchange of experience are measures that are easily transferable.

Bicycle rental schemes have proved to be quite transferable, although substantial investments are required in terms of money, time, space and organisation. The first priority should be to create an environment that is safe for cyclists. It is also important to identify sites for docking stations. The rental bikes must be reliable and well maintained, and the payment system must be simple and easy to understand.

Information and communication technology (ICT) can support routing, way finding and car sharing. The experiences of CIVITAS Plus cities demonstrate that such measures can be difficult to transfer. When implementing projects that involve ICT, it is essential to test hardware and software thoroughly and involve experienced and reliable technical staff. Carrying out a study on the penetration of ICT use among the target group can also be beneficial.

Creating synergies with public transport operators can boost the take-up of car-sharing services by providing through fares or special tariffs to enable a seamless transfer between different transport modes. Public transport can benefit directly from the resulting reduction in private car use.

Encouraging car pooling to and from industrial areas in Craiova, Romania

Prior to the CIVITAS measure, although many industrial areas on the periphery of Craiova could be reached by bus, services were infrequent and some buses only operated during peak hours. With the support of CIVITAS, the city set up a software programme for the city's western industrial area to support car pooling among people living within walking distance of one another. As a result, 33 car-pooling groups were created.

The municipality provided these car poolers with a special parking area, access to which was limited to vehicles transporting at least three people. There was close collaboration with the companies located in the industrial area.

The measure was launched only two months before CIVITAS Plus ended, but in this short time good results were apparent, with cost savings realised and users eager to continue the experiment. The number of cars used by participants decreased from 122 to 33 during the trial period.

The city decided to implement the measure at other industrial sites and in several other areas of the city. Based on its experience, the city would recommend allowing sufficient time for the preparation of all the necessary parking arrangements in advance.

For more information: http://civitas.eu/content/encouraging-car-pooling-and-industrial-areas

Upgrading car-sharing schemes and expanding existing services can also involve the deployment of more environmentally friendly vehicles. Changing from petrol to cleaner fuels can make a further contribution to reducing emissions and pollution.

3.6   RESULTS/IMPACTS

CIVITAS Plus cities that implemented measures in this thematic area saw an increase in the number of cyclists, improved safety for vulnerable road users, and increased levels of awareness of the benefits of car-free lifestyles.

Cycling and walking measures have resulted in the extension of pedestrian networks by 22 kilometres in the involved cities, and the extension of cycling networks by 80 kilometres overall. This was achieved by filling in missing links and connecting existing major routes. In the case of Aalborg (Denmark), an ordinary cycle lane was upgraded to a high-class cycle highway[45] connecting the city centre and the university.

New cycle parking spaces were provided at bus stops, and bike racks were fitted on buses in Funchal (Portugal), for example, improving multi-modal travel options[46]. Thirty-four new cycle rental stations were installed in four cities in addition to existing stations, and over 470 cycles and 10 rickshaws were made available for public use.

Tailored campaigns were designed to encourage the take-up of cycling among specific target groups. These campaigns focused on the use of smartphones and the Internet, in order to engage with youngsters. Promotional items such as bike lamps and maps were distributed at public events and festivals. In some cities, including Monza (Italy), the number of people cycling doubled[47].

The upgrading of the existing car-sharing scheme in Bath (UK) helped to quantify the social benefits (or net present value) of replacing a traditional car with a hybrid vehicle. This value was calculated to be GBP 179.41 per vehicle over five years (at 2010 prices), or GBP 1,077 across a six-car fleet. The system turned out to be 36 percent less expensive in terms of fuel costs[48].

When car-pooling measures were trialled in large companies in Craiova (Romania), 6,190 driven kilometres were saved over two months during the evaluation period[49]. This is equivalent to around 712 litres of fuel saved, assuming an average consumption of 11.5 litres per 100 kilometres[50].

Both car-sharing and car-pooling measures can be implemented in inner suburbs, along busy corridors, and in city centres, commercial areas and district centres. The core requirement is a high density of potential users. New car-sharing schemes introduced during CIVITAS Plus were both private and public initiatives, combining traditional internal combustion engine vehicles and vehicles running on alternative fuels[51]. In Brescia (Italy), a car-sharing service with hybrid and biofuelled vehicles was launched[52]. New services targeted private citizens, employees, universities and public bodies. Ghent (Belgium) upgraded an existing network of car-sharing stations by targeting new users, such as businesses, and introduced additional sharing stations[53]. A marketing campaign boosted the number of subscribers.

Car-pooling schemes encourage car owners to cut congestion by inviting people who are making the same trip to share their vehicle. Perugia (Italy) developed a web portal to match participants' travel schedules[54]. The portal used IT recognition systems to prevent abuse of the service.

3.7   RECOMMENDATIONS

The experiences of the CIVITAS Plus cities that implemented car-independent lifestyle measures gave rise to recommendations from which other cities can benefit.

Despite the encouraging results achieved by the CIVITAS Plus cities, there is a continued need to increase awareness and to incentivise users to test new technologies and find out the positive benefits for themselves.

It is essential to define a long-term vision for sustainable transport, with specific attention to the promotion of cycling and walking. This vision should integrate measures into the overall transport network from a multi-modal perspective. When several cycling and walking interventions are implemented at the same time, or within a short interval, their impacts can be far greater due to the synergetic effect.

Stakeholders should be involved in strong partnerships. Communication and active involvement are vital at each stage of measure implementation. It is very important to communicate what is being done. The target group needs to be given information, and members of the public need to be engaged in order to support modal shift and change travel behaviour.

Word-of-mouth promotion and strong community engagement, including the use of local "ambassadors" or "nudgers", are more effective in sustaining the use of car-sharing schemes in the long term. Cities should continue to promote alternative car-use schemes via marketing campaigns, and might consider offering financial or other incentives, such as free trials, to attract new business and private users.

CIVITAS recommends taking a long-term view of evaluation and carrying out a public health appraisal of the measures. Behavioural change takes time, and health and economic impacts resulting from higher levels of physical activity can only be captured in the longer term.

It might also be helpful to count on extra investments for, and synergies with, vertical transport solutions that respond to challenging topography. A detailed planning and feasibility study will help avoid unexpected costs.

Tailored car-sharing and car-pooling business models can help to meet the needs of both private users and business users. This will optimise the use of vehicles during the day, and can help to increase

Comprehensive cycling strategy in Ljubljana, Slovenia

One of the most innovative CIVITAS measures in Ljubljana was the development of a comprehensive cycling strategy. The strategy defined quality conditions for the city's cycling network, addressed safety issues and accessibility, and granted priority to cyclists. The document outlined the city's cycling vision and aimed to link cycle paths, improve bicycle parking facilities and intensify cycling promotion.

The city also established the Bicike (LJ) public bike scheme, making 300 bicycles available at 31 terminals. The city hired a cycling coordinator and developed an interactive and regularly updated cycle map featuring information on bicycle infrastructure, Bicike (LJ) terminals, bicycle racks, services and potentially dangerous spots.

The cycling strategy was drafted following an intense process of citizens' engagement and innovative promotion campaigns. The strategy was subsequently included in the city's Transport Policy until 2020, which was adopted by the city council in September 2012.

The bike-sharing system was a success, surpassing expectations, and was replicated in other Slovenian cities. The share of cycling in Ljubljana increased by 20 percent, based on the number of journeys. Input from citizens during the planning process indicated that safety is the biggest factor influencing people's decision to get on a bike to move around the city.

For more information: http://civitas.eu/content/comprehensive-cycling-strategy

the number of subscribers. One approach might be to provide a corporate pooling card. It can also be a good idea to target businesses located in suburban areas that have limited parking spaces or that are not well served by public transport, since such conditions can generate high levels of demand.

The introduction of more environmentally friendly vehicles into car-sharing fleets helps to reduce pollution and emissions. The higher leasing costs incurred for these vehicles can be offset by lower fuel consumption costs.

4 URBAN FREIGHT LOGISTICS

A significant amount of traffic in cities is generated by deliveries of goods to shops, factories, offices, hotels and households. Delivery vehicles take up more space than cars and require large bays for loading and unloading. Strategies to create cleaner and better transport in cities must address the issue of goods deliveries and encourage the use of cleaner vehicles and the better coordination of logistics. This will reduce congestion, free up space for sustainable modes and reduce emissions from idling vehicles.

Europe's historical cities were not designed to cope with the volume of freight deliveries required in order to meet the demand for products and services in 21st-century societies. The challenge is to mitigate immediate freight delivery problems, in terms of congestion and air quality, while ensuring sufficient supplies to make the city economically attractive. The measures undertaken in this thematic area comprised various interventions: implementing new freight operating modes and distribution schemes; introducing access restrictions for freight vehicles; developing technical assistance for vehicles and drivers, including route planning and freight logistics optimisation; and identifying best practices in terms of the organisational set-up, programmes and measures of freight partnerships.

The measures implemented by the CIVITAS Plus cities provided valuable insights into the importance of planning, communication, research, testing and, in particular, effective collaboration between stakeholders. Project results and experiences can provide valuable input to guide future logistics and freight distribution schemes

4.1 A CLOSER LOOK

Since the mid-1990s, interest in freight transport in urban areas has grown considerably and is now the focus of several research projects and policy initiatives. Freight is at the heart of the conflict between reducing environmental concerns and facilitating economic growth in city centres. On the one hand, improving air quality and reducing congestion in residential areas and city centres are primary concerns in sustainable mobility planning. On the other hand, city centres need to be attractive places in which to live, work, shop and spend leisure time. High-quality deliveries are essential if city-centre businesses are to compete against out-of-town shopping malls.

The CIVITAS Initiative and other European projects have progressively tackled this dilemma and made proposals about how to balance the need for freight vehicles to deliver retail products, documents and supplies or collect household waste, with the obligation to reduce congestion, pollution and noise in these areas.

4.2 THE EU CONTEXT

The EC's 2011 White Paper on transport[55] allocates specific space to increasing freight efficiency, both economically and environmentally. Based on a study of urban freight transport and logistics carried out in April 2012[56], the EC introduced the quantified policy goal for urban freight transport of "essentially CO_2-free city logistics in major urban centres by 2030"[57] and suggests concrete actions using policy instruments that are already available. The document promotes efficient deliveries, low-emission vehicles, intelligent transport systems, night deliveries, intermodal transfer facilities, and the development and dissemination of good practices throughout Europe.

CIVITAS demonstration cities explored and implemented these possibilities. Their experience shows that encouraging efficient deliveries in urban areas can be a positive way to address the challenges facing cities.

4.3 CHALLENGES FACED

While recognition of the potential of urban logistics measures is growing, the CIVITAS Plus experience highlights some remaining challenges. The practical knowledge acquired through the implemented measures can serve as a basis for other cities keen to take forward their freight mobility plans.

Firstly, building stakeholder involvement into the process emerged as the key challenge in terms of creating new distribution schemes and enforcing access restrictions for freight vehicles. Making clear the positive impacts of individual measures and of the overall strategy on pollution and congestion was more difficult than initially thought. This is an area to consider for the future. Stakeholders often commented on the lack of a shared sense of urgency as a barrier in the preparation phase of the measures.

One striking example of this is the Utrecht measure "Merchandise pick-up point"[58], where an insufficient number of companies and visitors were interested in turning the idea into reality. In addition, the measure should have been linked to an e-commerce pick-up centre in a residential area. As this did not happen, the measure remained isolated.

Technical challenges can hamper or delay the process. Bath (UK), for example, experienced software issues when implementing its demand management policy for freight vehicles[59]. The city installed a variable message sign triggered by large vehicles to inform them of weight restrictions in the historical centre. The system redirected heavy-duty vehicles away from the historical centre if they were not making deliveries to this zone. An automatic number plate recognition system issued further warnings to vehicles breaching this restriction.

4.4 LESSONS LEARNED

The activities carried out under the theme of urban freight logistics revealed a number of lessons learned.

Measures tend to be more effective when they are part of a larger city programme, or when they emerge as a consequence of the implementation of a municipal sustainability vision. In the "Efficient goods distribution"[60] measure in Iasi (Romania), activities were part of a wider city strategy, based on a vision for more sustainable urban transport. This contributed to measure credibility and gave a genuine mandate to the city.

Political support for new distribution schemes helped to get measures through local decision-making processes. Again in Bath, the "New concepts for goods distribution"[61] measure called for cooperation among all stakeholders and different levels of governance. Continued political support played an important role at all stages of the measure's lifecycle.

Access restrictions and controls always provoke strong responses on the part of stakeholders.

Taking a more sustainable approach to freight delivery in Utrecht, The Netherlands

The city of Utrecht introduced an ambitious action plan during its time as a CIVITAS demonstration city, aimed at optimising and greening its freight traffic.

Road freight traffic contributes significantly to air pollution, particularly on busy delivery routes. To combat this, the city council introduced vehicle restrictions in the inner city. Time windows were allocated for deliveries, and a low-emission zone was established for lorries (extended in 2013 to vans). Utrecht now allows freight deliveries during the night by clean and very quiet vehicles.

Utrecht also defined a number of new ideas for sustainable freight traffic, including flexible access for cleaner freight traffic; distribution by boat (the Beer Boat, which makes deliveries along the city's canals); merchandise pick-up points; and distribution centres for bundling fresh and perishable food.

In April 2009, the Cargohopper electric mini-train appeared on the city's streets. The fully CO_2 neutral solar-powered train can transport a load equivalent to that of five to eight vans. The measure reduced traffic flow, noise and air pollution; increased safety; and created new opportunities and cost savings for businesses. A decrease of 4,080 vehicle trips and a reduction of 5.8 tonnes of CO_2 (73 percent) were recorded, along with a 27 percent drop in nitrogen oxides (NOx) and a 56 percent decrease in particulate matter (PM10).

For more information: http://civitas.eu/content/civitas-case-study-taking-more-sustainable-approach-freight-utrecht

However, measures of this kind are very often implemented in direct response to an existing issue. This was the case in Brighton & Hove (UK), where air quality was poor in many areas of the municipality and the issue had a high profile locally. As the proposed access restriction measure[62] sought to improve air quality, it attracted both political and public support.

Although there are always possibilities for cities to develop new distribution schemes, geographical factors may play an important role. The canals in Utrecht (the Netherlands) made it possible for the

city to reintroduce waterborne transport[63]. In contrast, in Donostia–San Sebastian (Spain), the characteristics of the old city quarter are hard to reconcile with standards for efficient distribution[64].

4.5   MOVING FORWARD

The complex structure of 21st-century urban freight transport can no longer be seen as a chain, but should rather be looked at from the perspective of a network, owing to the inclusion of many activities and the involvement of a wide variety of stakeholders with different interests. Achieving this new perspective is the main prerequisite for measure transferability, largely because all subsequent measure activities have to be decided and implemented from this perspective. If this does not happen, measures cannot be implemented successfully — there will be no stakeholder involvement and consultation, no political support, and no adjustments to legislation or regulations.

An important basis for transfer, which cannot be overstated, is the establishment of a structure whereby the freight measure in question can become part of a city's programme, or emerges as a consequence of a municipal sustainability vision.

Other variables affecting transferability were seen as less significant: these included cultural circumstances; the availability of public funds or the willingness of the business community to contribute financially; the availability of technology; and the availability of space for experimentation zones.

In the implementation of access restriction measures, political support is clearly an absolute necessity. Time window restrictions[65] in Brescia (Italy) and zoning activities[66] in Aalborg (Denmark) proved to be highly sensitive issues. Access charges, vehicle standards and other aspects also need to be taken into account.

When implementing measures aimed at supporting drivers, it is important to have real-time data available and well-established IT support, as was the case in Tallinn[67] (Estonia).

Measures aimed at setting up freight quality partnerships should take into account the complexities involved. Vitoria-Gasteiz (Spain) relied on its earlier experience when defining a scheme targeted at efficient urban freight logistics[68].

Reducing goods deliveries in Bath, United Kingdom

The impacts of heavy goods vehicles in the historic centre of Bath, which included traffic congestion, poor air quality, excessive noise levels and damage to historic buildings, were addressed during the city's involvement in the CIVITAS initiative.

Bath established an urban freight consolidation centre (UFCC) to serve both Bath and the neighbouring city of Bristol. The aim was to reduce the number of large delivery vehicles entering the city centre by providing a conveniently located facility where goods could be consolidated for onward dispatch at prearranged times using two low-emission and low-carbon electric delivery vehicles.

Recyclable waste was also collected from 19 participating businesses. The establishment of the UFCC led to a fall in the number of deliveries to participating outlets that exceeded the target set at the start of the project.

In total, the measure resulted in a 76 percent decrease in the number of deliveries to participating businesses. The electric vehicles used by the consolidation centre achieved a 55.7 percent reduction in energy consumption compared to the equivalent diesel delivery vehicles. Air quality improved and users of the scheme recorded high levels of satisfaction: 81 percent of surveyed participating retailers said they were very likely to recommend the scheme to other businesses.

For more information: http://civitas.eu/content/civitas-case-study-freight-consolidation-bath

4.6 RESULTS/IMPACTS

Tackling the urban freight dilemma is possible, but it is a complex task. Effective stakeholder involvement, political support and appropriate institutional processes are necessary in order to get measures under way to contribute to better quality of life in cities while not compromising economic objectives. When stakeholders are clearly defined and targeted, investment in efficient freight logistics undeniably results in positive outcomes.

Political context played a crucial role in the sustainable freight logistics measure implemented in Ljubljana[69] (Slovenia). Reluctance on the part of some city departments that were not directly involved in the CIVITAS-funded activities affected measure implementation. As the measure could not proceed without the city's cooperation, the implementation of the consolidation scheme was cancelled.

The measures defined in Donostia–San Sebastián[70] (Spain) demonstrate that slight modifications in communication are able to overcome initial difficulties when changing logistics patterns. Donostia–San Sebastián launched a freight quality partnership (FQP) to serve as a forum for resolving difficulties during the implementation of the new, efficient freight distribution scheme. However, unwillingness to participate led to the cancellation of the FQP initiative, which was replaced by bilateral meetings supported by a communication campaign focusing on the trade sector. The measure resulted in increased efficiency in urban goods distribution in two highly populated neighbourhoods, with an annual reduction of 23 percent in energy consumption due to reduced journey length. The private sector also benefited from the measure, since transport companies cut their operation costs by EUR 6,800 a year.

The most efficient measures in terms of access restrictions resulted from broad stakeholder involvement, along with a comprehensive approach to freight handling.

The urban freight consolidation measure in Bath[71] (UK) involved 20 retail outlets and a contractor to organise delivery outside the city. The measure resulted in a reduction in GHG emissions, as well as reliance on electric vehicles for the last mile of delivery. A 56 percent reduction in energy consumption was measured.

The Beer Boat[72] introduced in Utrecht (the Netherlands) is an electric boat operating six times a day, four days a week, to supply more than 60 bars and restaurants. It was initially launched to avoid lorry-based freight distribution on the city's roads and replace fuel-powered boats on the canals. In addition to immediate emissions benefits, the measure was warmly welcomed by the public. The Beer Boat measure is estimated to represent a net present value of well over EUR 420,000.

Low-emission zone in Aalborg, Denmark

When Danish legislation made it possible to establish a low-emission zone, the city of Aalborg saw a perfect opportunity for implementing change. A low-emission zone covering 3.5 square kilometres was soon established in the city centre. To gain access to the area, diesel lorries and buses above 3.5 tonnes had to meet Euro 4 standards or be equipped with a retrofitted particle filter.

By the end of 2008, the first registration of lorry and bus licence plate numbers had been carried out to determine their compliance with Euro standards. The collected data were subsequently used to assess the impacts of the environmental zone.

During the registration period, freight operators were informed about requirements for access to the zones, and meetings were held with freight operators, city associations and others to obtain feedback about the process and to evaluate the effectiveness of the zones.

The results were impressive: emissions fell by around 25 percent, air quality improved, and the measure enhanced the image of Aalborg as a green city and as an attractive place for residents, companies and students.

A key element in the success of the measure was the strong cooperation between city authorities and local stakeholders. This cooperation laid the groundwork for collaboration on future urban freight and city logistics projects.

For more information: http://civitas.eu/content/civitas-case-study-low-emission-zone-aalborg

4.7 RECOMMENDATIONS

The experiences of the CIVITAS Plus cities that implemented goods distribution measures reveal some general recommendations.

Urban freight transport involves a complex network of activities and stakeholders with different, often conflicting, interests. It requires a participatory approach that should:

- cover all key stakeholders (including citizens);
- be used as a basis for conducting feasibility studies;
- lead to the recognition of shared problems and to community building;
- tap collective knowledge in the exploration of alternative solutions; and
- support the implementation, monitoring and evaluation of measures.

Stakeholder involvement should be maximised from the planning stage, as partnerships underpin the success of sustainable logistics measures.

Stakeholder collaboration can be encouraged through the acknowledgement of real issues and the provision of incentives, which might include the opportunity to negotiate for improved delivery access. Time needs to be invested in building collaborative partnerships (such as FQPs) to ensure that information can be shared and potential problems identified.

Strategies need to be implemented gradually and communicated widely using a range of media outlets (local media channels, leaflets, posters and the Internet) to maximise dissemination. Any changes made to the local road network need to be communicated effectively through the use of clear signage to ensure that freight is redirected along appropriate routes.

Regulatory measures need to be enforced in order to ensure that the planned benefits can be achieved.

5 CLEAN FUELS AND VEHICLES

Most CIVITAS Plus cities include the use of clean vehicles and clean fuels in their integrated strategies to encourage cleaner and better transport. Clean vehicles lower air pollution, reduce the harmful effects of vehicle emissions and improve the quality of urban life.

Examples of measures implemented include the modification or replacement of vehicles, the provision of alternative fuels, the influencing of attitudes and behaviour, and optimisation and strategy development.

In the future, urban transport will continue to include dependency on the private car, since the complexity of personal trip patterns is unlikely to change substantially in the short to medium term. At the same time, the modal share of buses is likely to increase, and, regardless of new developments in manufacturing, goods vehicles will continue to play a significant role in supporting business activities in city centres throughout Europe. The deployment of cleaner vehicles and fuels remains a key activity within the CIVITAS Initiative.

5.1 A CLOSER LOOK

The implementation of harmonised European rules with respect to alternative fuels would create a cleaner urban fleet. Air pollution is estimated to be responsible for 420,000 premature deaths in Europe[73]. The use of alternative fuels would improve air quality and contribute to reducing GHG emissions in urban areas.

Measures related to clean vehicles and fuels in CIVITAS Plus cities involved the introduction of new or modified vehicles; and qualitative measures aimed at bringing about behavioural changes. New fleets included fully electric vehicles, hybrids powered by electricity and conventional fuels, or vehicles operating on compressed natural gas (CNG). Biomass-based fuels with higher blend ratios, such as E10, B30 or biogas, were also used. Other measures focused on users' behaviour and attitudes, or on the development of optimised techniques and strategies for the future provision and use of alternative fuels.

The measures were driven by local authorities and aimed to provide not only operational benefits, in terms of lower costs and increased fuel efficiency and patronage, but also greater awareness and understanding of the environmental issues surrounding the use of fossil fuels. However, the Europe-wide economic downturn has had a particularly strong impact on support from businesses, thus a number of measures were scaled down from their original implementation plans.

5.2 THE EU CONTEXT

In the 2011 White Paper on transport[74], the EU pledged to cut emissions from conventionally fuelled vehicles by 60 percent by the year 2030, with a view to phasing them out in cities by 2050. However, fuelling and charging infrastructure for electric vehicles has not been deployed uniformly in EU member states, which has had an impact on sales of clean vehicles.

To foster market up-take, in 2013 the EC put forward a proposal for a directive on the deployment of alternative fuel infrastructure[75]. The Clean Power for Transport Strategy[76] looks at all energy sources for fuelling transport, and at electricity in particular. The strategy sets targets for a minimum number of publicly accessible charging points in urban areas across the EU. Agreed in early 2014, harmonised rules for recharging and refuelling stations are designed to encourage the deployment of cleaner vehicles at more competitive prices.

5.3 CHALLENGES FACED

Shifting the transport paradigm towards clean fuels and vehicles often requires large investments and an adequate policy and legislative framework at national level.

A stable regulatory framework, along with a consistent political and legislative framework, are important for the successful deployment of alternative fuelling infrastructure and the introduction of clean public transport fleets. Utrecht (the Netherlands), for example, was forced to abandon its measure on discounted parking fees for clean vehicles[77]. In order to improve the city's air quality, the mayor had offered to incentivise the use of cleaner vehicles by differentiating parking tariffs according to fuel type. However, due to political changes at local and national level, the measure was never implemented since the necessary regulations never came into force.

Limited finances for planned improvements and new local fuel supply stations also played a role. Some measures, including those planned in Funchal[78] (Portugal), were either curtailed or significantly amended for this reason. Technological expertise and financial and institutional know-how are the most common obstacles to the deployment of

alternative fuels and their infrastructure. The development of alternative fuels in Coimbra[79] (Portugal), for example, was hampered by insufficient knowledge of daily operation routines. The city planned a gradual increase in the biodiesel blend up to 50 percent and conducted tests prior to scaling up. During the testing phase, two buses had to be removed from the trial when problems arose with their diesel engines.

5.4 LESSONS LEARNED

The relative attractiveness of alternative fuels depends on the overall regulatory issues of taxation, legislation and regulation; supply reliability; and general technical and operational competence.

Public participation in campaigns to promote the increased use of alternative fuels and cleaner vehicles has been generally low. The number of registered users was far lower than envisaged in the electric vehicle charging scheme[80] implemented in Brighton & Hove (UK). In addition, although public transport users generally considered environmental issues to be important, they did not seem to take these issues into account when deciding which mode to use.

The retrofitting of buses to use dual fuel was found to be a cost-effective way of extending the life of buses currently in service, while at the same time lowering emissions. This was demonstrated by the "Clean buses for the public transport network" measure[81] implemented in Zagreb (Croatia).

As part of a wider mobility management approach (see Chapter 7), eco-driving training was found to be effective in reducing fuel consumption in the short term. Longer-term analyses, however, indicate that the impact of such training is reduced over time.

Lightweight shuttle bus in Porto, Portugal

Before CIVITAS, the city of Porto had made no significant efforts to make its public transport fleet cleaner. With the support of CIVITAS, the city developed and tested a lightweight shuttle bus. An innovative construction technology was used in order to reduce vehicle weight and product costs, cut CO_2 emissions, and promote a shift towards cleaner modes of transport.

A total of 14,000 passengers were transported by the lightweight bus, and CO_2 emissions were between 7 and 36 percent lower due to the weight reduction of 16 percent (380 kilograms). The CIVITAS shuttle bus service attracted 27 percent new passengers. The CIVITAS measure in Porto demonstrated that if there is a good public transport service, citizens will use it.

For more information: http://civitas.eu/content/light-weight-bus-shuttle

5.5 MOVING FORWARD

The use of more environmentally friendly fuels can be scaled up and transferred in most situations. However, there are limits imposed by operating conditions; implementation costs; operational and performance characteristics; fuel availability; and the extent to which the fuel used meets environmental objectives.

Generally, measures involving the modification or replacement of vehicles are transferable to other cities. This is especially true where the modal share of public transport is high and fleets are in need of major maintenance and/or replacement. However, a number of issues need to be addressed.

Experience shows that technological expertise and related knowledge must be available. The measure "Renewable energy production to feed buses with low environmental impact"[82], which was implemented in Brescia (Italy), demonstrated how an agreement with experienced installers was central to the measure's success.

The modification and replacement of vehicles requires substantial investment, and the existence of well-defined maintenance plans is an important factor in the success of such measures.

Looking to the future, the general potential for alternative fuels requires research in order to adapt new technologies and products. The measures implemented in Gdansk[83] (Poland) and Tallinn[84] (Estonia) showed that political will to carry out studies, and the involvement of partners with the appropriate knowledge, are prerequisites for success.

In general, it is not easy to transfer this kind of measure to other cities if user attitudes and behaviour are not geared towards alternative fuels. Politicians should have a real belief in alternative and clean vehicles and fuels. It is also important that, in the case of fleets, reliable equipment is available to monitor results. The sufficient availability of alternative fuels is another prerequisite, and national standards should be in place.

Strategy development is a core requirement when developing cleaner transport, and there has to be support at the strategic level in terms of both decision making and execution. Decision makers in Brescia (Italy) relied partly on the support of the public transport operator for training[85]. The city purchased new clean-powered vehicles, and the local public transport operator provided training for drivers on how to handle the new 18-metre CNG and hybrid buses.

5.6 RESULTS/IMPACTS

Overall, CIVITAS Plus contributed to the introduction of 460 biodiesel vehicles (new or modified), 176 CNG vehicles, 73 minibuses or buses running on liquefied petroleum gas (LPG), 46 hybrid buses, 29 electric vehicles and 31 enhanced environmentally friendly vehicles (EEVs) in bus fleets. In addition, 70 trams

Energy-efficient fleet management in Ghent, Belgium

In an effort to address the level of emissions from its municipal vehicle fleet, the city of Ghent took a number of bold steps. These included reducing the number of vehicles in the fleet and implementing a procurement strategy to ensure that cleaner vehicles were purchased. A fleet management group was established to carry out the main activities, which helped greatly in achieving lasting change.

Car sharing was also widely promoted and a group of 54 employees were able to reduce their fuel consumption through eco-driving training.

The revised sustainable procurement strategy included environmental scores for vehicles as a selection criterion, resulting in the purchase of lower-emission vehicles for the city fleet. During CIVITAS Plus, 13 electric cars were purchased, as well as one hybrid lorry.

The use of electric bikes among staff was promoted, and car sharing was used to increase fleet efficiency. The emphasis on car sharing led to the integration of Cambio shared cars into the municipal fleet.

In total, the measures resulted in a 24 percent reduction in fuel consumption. The eco-driving training programme alone saw fuel consumption fall by 7 percent. A 30 percent reduction in the number of kilometres driven by the fleet was also registered.

In terms of implementation, data collection and dissemination, a total of EUR 282,000 was spent, with EUR 31,000 allocated to research and development activities.

For more information: http://civitas.eu/content/civitas-case-study-energy-efficient-fleet-management-ghent

were fitted with an energy recovery system and 35 methane converter kits were given to residents of Perugia (Italy).

The implemented measures contributed to the continued growth in public and private purchases of cleaner vehicles and influenced citizens' attitudes towards alternative fuels and cleaner vehicles. Further progress in this area could help to stimulate the regional market for such vehicles.

Testing biofuels in Coimbra, Portugal

Faced with rising oil prices and increasing traffic pollution, the municipality of Coimbra decided to explore the use of biofuel as an alternative for its public transport fleet. The local public transport operator SMTUC tested different blends of biofuel in four buses under real operating conditions. This provided information on energy consumption, atmospheric pollution caused by emissions, and the percentage of biofuel tolerated by the conventional engines.

The trial phase was divided into three stages, with the first test involving the use of a 30 percent blend (B30). The level was increased by 10 percent at each subsequent stage, reaching a maximum of 50 percent (B50).

Average operating costs for the four buses tested with B30 and B50 biofuel blends turned out to be lower than the average operating costs of similar vehicles running on diesel in the same period. It was estimated that the introduction of B30 fuel in the entire public transport fleet would result in a saving of EUR 420,000 per year in operating costs.

It was also found that average emissions of carbon monoxide and particulates decreased for all blends tested. In the case of B30 alone, average emissions fell by about 9 percent overall.

Based on these results, SMTUC is considering introducing biofuel in other municipal vehicles, such as waste collection and delivery vehicles.

For more information: http://civitas.eu/content/civitas-case-study-testing-biofuel-pt-fleet-coimbra

Many of the measures reported the economic implications of using alternative fuels (including capital and ongoing operating costs, and savings as a result of reduced fuel consumption), as well as the environmental impacts of alternative fuel use on GHG emissions. Results differed according to the (bio)fuel used or the investigated parameter. In Ljubljana (Slovenia), fuel costs for the CNG buses[86] fell by 14 percent (since CNG is cheaper than diesel). The cost-benefit analysis showed that the net present value will be positive two years earlier than for conventional diesel buses. However, it should be noted that there are uncertainties regarding maintenance costs and overall GHG emissions once the CNG fuel supply chain is taken into account.

Changes in fuel consumption are calculated either at fleet level (where a small number of vehicles have been adapted or renewed), or at vehicle level. Over 40 vehicles were tested in nine locations. Fuel consumption was generally lower in hybrid vehicles, due to the advantages of their regenerative braking systems. The cost of hybrid vehicles, and of buses in particular, was higher than that of the diesel equivalent, which may restrict future growth in the public transport market, although there were no cost implications for adapting the existing infrastructure.

Following the introduction of CNG buses, a reduction in fuel costs compared to the original fleet and a reduction in energy consumption were observed. The reduction in GHG emissions varied according to the location and the type of GHG measured. Although reductions in emissions of carbon monoxide (CO) and mono-nitrogen oxides (NOx) varied, the use of biofuel blends resulted in a slight reduction in CO_2 emissions. Similar conclusions were drawn from the monitoring of LPG buses.

Public participation in awareness-raising campaigns was generally low. However, there are indications that the take-up of incentivised parking for clean vehicles[87] increased during the closing months of the measure in Bologna (Italy).

5.7 RECOMMENDATIONS

The successful implementation of a measure, or package of measures, in a given city should provide grounds for transferring the experience to other cities if the following recommendations are followed.

National and international standards for biofuels are needed in order to instil confidence among users and providers and to promote alternative fuel consumption. Without such standards, it will be difficult to ensure consistent supplies. Contractual quality conditions are necessary in order to overcome barriers associated with fuel provision.

The widespread deployment of alternative fuels requires coherent taxation and legislative approaches for the different fuel types at regional and EU level, as well as local political and management support.

Stakeholder involvement is necessary in the switch towards clean vehicles and fuels. As governments adjust regulations, through exchange and debate users will become better informed and more likely to accept the changes. Additional expertise is needed both to develop effective awareness campaigns and to identify solutions to overcome the slow uptake of incentive schemes.

Policies, incentives and technologies should be developed to encourage eco-driving. An important element in this is the organisation of refresher courses to ensure that short-term benefits continue in the long run.

Retrofitting older municipal and public vehicles to run on alternative fuels can offer a cost-effective short- to medium-term solution that allows current fleets to continue to be used beyond their current lifespan (in terms of Euro standards).

Cities wishing to deploy more sustainable vehicle fleets should have access to relevant technical and operational expertise to help select, operate and maintain their fleets. Such expertise is often outside the scope of the traditional competences of their staff. The costs of hybrid vehicles remain higher than the costs of conventional vehicles, thus the sustainability benefits should be promoted.

Reductions in GHG emissions and improvements in air quality should be complemented by the promotion of emission-free mobility. Affordable parking alternatives outside the city centre should be created, and footpaths provided. Overall, this would help to reduce the number of vehicles entering the city centre.

6 DEMAND MANAGEMENT STRATEGIES

CIVITAS Plus cities experimented with a range of demand management measures in order to investigate the merits of different initiatives and to share lessons learned. The measures included access restrictions and road pricing and parking policies. Demand management strategies can reduce traffic by means of a variety of economic incentives, regulatory measures and modern communication technologies.

Pricing strategies can work as powerful incentives to encourage people to use more sustainable means of transport and to challenge the appeal of the private car.

Among the incentives tested by CIVITAS Plus cities were special parking tariffs for low-emission vehicles, financial rewards for avoiding peak times, and so-called mobility credits that assign a financial value to emissions limits.

In addition to pricing, the measures undertaken within CIVITAS Plus involved strategies to reallocate priority to specific transport modes (priority lanes for public transport or bicycles; bicycle parking) or to reshape the urban environment. This included the definition of dedicated zones via access management and the introduction of limited traffic zones (LTZs).

6.1 A CLOSER LOOK

Demand management is receiving greater attention from policy makers — thanks, in part, to the many measures introduced during the 12 years of the CIVITAS Initiative. From the CIVITAS Plus perspective alone, the ability to manage demand has been witnessed in several measures.

Demand management strategies are related to three main areas of intervention to incentivise alternative mobility. Firstly, they focus on reducing road use either by raising awareness of traffic problems or by assessing suitable congestion charging options.

Secondly, they shape demand by giving priority to sustainable transport modes. The development of priority lanes for public transport and the designing of priority signals at intersections are two examples tested by CIVITAS Plus cities.

Thirdly, the development of priority zones incentivises soft modes of transport by reducing or preventing the circulation of traffic in designated areas. Access to pedestrian zones and historic city centres, for example, can be controlled by automatic number plate recognition systems. Limited traffic zones, parking pricing and enforcement policies and "clear zones" further regulate mobility in cities.

This chapter does not provide a thorough overview of the measures, as they were diverse and varied according to the specific local contexts. The CIVITAS website[88] contains a section dedicated to specific examples. The intention here is to provide case studies that highlight relevant patterns, underline key challenges, and share lessons learned so that appropriate recommendations can be formulated.

6.2   THE EU CONTEXT

According to the section on smarter urban access regulations and road user charging in the EC's Urban Mobility Package[89], urban vehicle access regulations help to optimise urban access, improve air quality and contribute to the goal of phasing out conventionally fuelled cars in cities by 2050.

The sustainable urban mobility plan (SUMP) guidelines[90] identify demand management strategies (such as access restrictions, environmental zones, congestion charging) as measures to reduce climate change–related emissions.

With Action 3.2 of its White Paper on transport[91], the EC seeks to achieve "an EU framework for urban road user charging, including a legal and validated operational and technical framework covering vehicle and infrastructure applications."

The CIVITAS Plus measures followed these guidelines to design appropriate demand management in European cities.

6.3   CHALLENGES FACED

The underlying challenge in demand management lies in adapting spatial constraints to the policy landscape. Gaining public acceptance of land-use and transport changes in cities is crucial for the successful implementation of demand management strategies. Cycling in Usti nad Labem (Czech Republic), for instance, had been perceived as a leisure activity before it was promoted as a valid mobility mode[92].

Rewards and charges as demand management tools tend to have low levels of acceptance initially, and the help of appropriately trained personnel may be required to improve the situation. In the Spanish city of Vitoria-Gasteiz, the measure "Superblocks concept for access restrictions"[93] faced strong opposition from key stakeholders based on political and strategic motives during the period immediately prior to local elections. The first phase in defining the dedicated zone was delayed as a result.

When designing dedicated zones, technological challenges were encountered with respect to system operation. The above measure in Vitoria-Gasteiz limited access to certain categories of vehicles (emergency vehicles, vehicles owned by residents of the area etc.). The automatic system recognised authorised vehicles, and training and knowledge were required to set the appropriate algorithm.

Feasibility studies for congestion zones require extensive data gathering, which can cause delays. The University of Zagreb, Croatia, conducted a study to assess the feasibility of congestion charging in the city centre prior to suggesting an eco-zone to tackle poor air quality and congestion[94].

New traffic and organisation strategy in Gorna Oryahovitsa, Bulgaria

Car ownership in the city of Gorna Oryahovitsa has skyrocketed in recent years, up more than 300 percent from before the CIVITAS Plus period. In addition, the creation of new industrial areas has resulted in increased road traffic and noise and air pollution. To address this, a new traffic organisation scheme was implemented to reduce road traffic and establish traffic-restricted areas, and a feasibility study was carried out for a bypass to remove heavy goods vehicles from urban areas.

The first stage of implementation involved defining the main traffic flows and conflict sections, before developing and testing a mathematical model to take into account possible ways to divert traffic. This was followed by the development of a new route network and proposals for pedestrian areas.

The second stage was the development of an updated parking management scheme, and the third stage was the identification of dedicated routes for heavy goods vehicles. Problem sections were identified and variants were tested for diverting or prohibiting heavy vehicles in these sections.

These three stages led to the elaboration of an optimised traffic management scheme, which was officially proposed to the municipal council.

The measures have already achieved impressive results, including improved traffic conditions in the city; a reduction in the number of traffic-related accidents; the removal of heavy vehicles from the downtown area; and a reduction in air and noise pollution.

For more information: http://civitas.eu/content/civitas-case-study-new-traffic-organisation-and-strategy-gorna-oryahovitsa

The designation of specific lanes can be hampered by spatial and infrastructure challenges. Weather conditions can delay the delivery of cycle lanes, for example. Aalborg (Denmark) had to interrupt the construction of its cycle highway between November 2010 and March 2011 due to unexpected extreme weather conditions[95].

New public transport network in Vitoria-Gasteiz, Spain

The public transport network in Vitoria-Gasteiz was completely transformed with the aim of making it more efficient, accessible, comprehensive and simple, and in order to reverse the upward trend in private car use.

A transit scheme was created in keeping with Spain's "superblocks" philosophy, according to which private cars and public transport are kept outside residential superblocks, while the inner streets are redesigned for use mainly by pedestrians.

As part of the changes, the city's bus network was reduced from 17 lines to nine, with new itineraries and timetables and improved frequencies. This involved creating 146 bus stops in new locations, and providing more resources and updated information at these stops. The implementation of the new public transport network is one of the main outcomes of the Public Space and Sustainable Mobility Plan of Vitoria-Gasteiz.

The reorganisation resulted in an increase in speed from 10.77 to 12.73 km/h, an improvement of 18.2 percent. Bus frequency rose from every 20 to every 10 minutes, while average fuel consumption dropped from 56.56 to 53.03 litres/100 kilometres (an improvement of 6.24 percent). Emissions of CO_2 were reduced by 421 tonnes per year and the number of accidents decreased by 36.9 percent. There was also an increase in the number of public transport users.

For more information: http://civitas.eu/content/civitas-case-study-new-public-transport-network-vitoria-gasteiz

6.4   LESSONS LEARNED

Road pricing, while a very important and powerful tool, is an aspect of demand management for which it is difficult to gain public or political support. However, with the appropriate participation of stakeholders and citizens at local, regional and national level, as was the case in Ljubljana[96] (Slovenia), more citizens will give their support. Public support can also be encouraged by linking road pricing with other environmental goals, as in Zagreb's proposal for an eco-zone in the historical city centre[97].

The designation of specific lanes for sustainable transport needs political support. The political drive in Iasi (Romania), for example, came from the municipality's commitment to improve traffic flow in general, and for public transport in particular[98]. This example highlights how, in the case of cycle lanes, proper planning, sufficient involvement and good organisation are essential in getting the measure started.

The definition of dedicated zones follows a similar logic, with strong reliance on political, institutional and organisational drivers to launch a successful measure. It has been shown that measures are more readily accepted by the public when they are part of a broader urban mobility plan.

6.5   MOVING FORWARD

The lessons learned by CIVITAS Plus cities can be transferred to other cities as long as the spatial, infrastructural and — to a certain extent — financial constraints are specifically addressed. Experience shows that there may be strong opposition to measures involving user charges. It is therefore necessary to organise targeted communications campaigns when demand management strategies are rolled out.

Access management measures show the value of good design, consultation and enforcement. In Vitoria-Gasteiz (Spain), the superblock approach shifted residents' mobility patterns by combining access restrictions and public communications. During the consultation phase, the number of individual vehicles entering the area decreased as a result of a well-thought-out information campaign.

The transferability of access management and LTZ measures is limited. If a measure aims to introduce a price system to enforce access restrictions, it will face stiff opposition from the general public and politicians. Important conditions for success are

political support and clear dialogue and communication with the public. If the measure aims to introduce camera or other surveillance systems, it is clear that well-functioning technology is important. Moreover, the feasibility of this approach is, to a large extent, dependent on local and national laws, such as privacy legislation regarding the use of cameras and data. European legislation must also be taken into account at this point.

Road user charging measures are not easy to transfer. Measures based on rewards and trip avoidance rather than on charging are more transferable. However, both types of measures demand strong political support and experienced partners to operate the supporting technologies.

The transferability of measures addressing public transport priority is limited, for a number of reasons. Many cities lack the physical space, or their institutional and planning regulations hinder the reallocation of space. Transferability is greater when more technical solutions are involved, such as the synchronisation of traffic lights. However, once again the quality of the technical applications plays an important role and the appropriate expertise is essential. Above all, it should be borne in mind that giving priority to public transport is often not a popular measure, so political will and power are essential.

6.6   RESULTS/IMPACTS

Each demand management measure implemented by the CIVITAS Plus cities led to reductions in the number of private car journeys. However, a comprehensive approach seems the most suitable way to tackle demand management.

In Bologna (Italy), the measure "Road pricing policies"[99] restricted vehicle circulation between 7 a.m. and 8 p.m. However, travellers' interests were safeguarded and mobility was guaranteed through a wider offer of sustainable options. Circulation was maintained, as was the equilibrium of parking supply and demand. Bologna reported a 69 percent reduction in vehicle access within its semi-pedestrianised area between 2006 and 2012.

Utrecht (the Netherlands) sought to reward drivers[100] for avoiding peak hours during a period of massive infrastructural developments around key traffic arteries. From 2007, extensive infrastructural changes in the west of the city caused a temporary reduction in traffic capacity on some roads. The minister of traffic proposed a national road pricing system and invested EUR 100 million in pilot projects.

This measure aimed to achieve both national and local objectives by reducing traffic in the Utrecht-West area during morning peak hours (6 a.m. to 10 a.m.) by giving a cash incentive of EUR 4 to car drivers for using alternative routes or other transport modes, or for not travelling during peak hours. A reduction of 1,000 cars on these roads was sufficient to prevent congestion during the morning rush hour.

Access restrictions and bus priority measures in Iasi, Romania

Public transport, slowed down by dense traffic, had gained a reputation for being late in the Romanian city of Iasi. The high numbers of vehicles on the roads made it impossible for public transport buses to adhere to their timetables. In addition, noise pollution and emissions were increasing in the city centre, spoiling its attractiveness.

To address these problems, and to reduce travel times and make public transportation a more attractive option, Iasi defined priority routes for public transport vehicles and implemented a green light priority system, as well as an access control scheme within the CIVITAS corridor in the historic city centre.

A control scheme was adopted in order to improve the quality of the city centre by restricting access by private cars. This was followed by promoting the use of soft modes (cycling and walking).

The measures had a positive impact on public transport reliability and led to increased satisfaction among public transport passengers. As a direct result of the measures, public transport punctuality rose from 78 percent in 2010 to 88 percent in 2011, and average speeds also improved.

Restricting access to the historic centre lowered dissatisfaction among residents of the area from 75 percent in 2009 to 52 percent in 2012. The public transport priority measures can be successfully replicated in other cities across the country.

For more information: http://civitas.eu/content/civitas-case-study-access-restriction-and-bus-priority-iasi

Access to priority lanes had no direct impact on the volume of public transport passengers, although the quality of services significantly improved. CIVITAS cities reported better adherence to timetables, as shown in Chapter 1. In Craiova (Romania), a 25 percent improvement in punctuality was achieved[101].

The four LTZ measures improved knowledge about the design and management of LTZs. Perugia (Italy) started an LTZ from scratch in an area outside the city centre that was suffering from oversubscription for parking[102]. Bologna[103] (Italy) and Funchal[104] (Portugal) used new technologies for saving costs as well as for better enforcement. Brighton & Hove[105] (UK) harnessed behavioural research to develop a new style of LTZ in which the design of the street altered traffic and made it possible to give priority to pedestrians.

6.7   RECOMMENDATIONS

The experiences of the CIVITAS Plus cities that implemented demand management strategies led to the recommendations outlined below.

Citizens and stakeholders must be kept informed and considered as part of the solution, not as part of the problem. However, measure approval should not be based on citizens' support alone — at least not initially. Support may increase after implementation, as citizens experience the benefits. Trial schemes are desirable — on a large scale, rather than small technology demonstrations.

Utrecht's successful measure of paying drivers not to drive at peak times should be trialled more widely elsewhere in order to see a general impact. The typical reaction of motorists to charges for the use of existing roads is that they are being asked to pay for something that they have already paid for. Paying motorists not to drive at certain times or in certain places would seem to be more acceptable — although funding is certainly a challenge.

Public transport priority measures are effective and should be considered as a high priority in European cities. Along with reducing traffic congestion and improving air quality, they tend to have positive impacts on the quality of the public transport service.

The development of a sustainable parking policy requires wide support, so it is critical to engage all stakeholders. In Ghent[106] (Belgium), a detailed survey of parking occupancy before and after the measure was helpful in making the measure a success.

New parking charges may be more positively received if a "soft" LTZ is introduced rather than a more comprehensive solution. This proved to be successful in Perugia[107] (Italy), where the compromise was part of a response to a shortage of parking spaces, but also a response to a genuine demand for local parking in a specific area.

Intelligent transport systems should be used where they are cost-effective and practical. Although ITS may appear attractive, such solutions sometimes take up scarce resources that could be better used on pedestrianisation, bus lanes or other environmental or traffic improvements. Some schemes introduced variable message sign directions to car parks with lower demand. Despite attracting genuine support from drivers, these measures had no significant impact on traffic.

7 MOBILITY MANAGEMENT

According to the European Platform on Mobility Management (EPOMM)[108], mobility management "is a concept to promote sustainable transport and manage the demand for car use by changing travellers' attitudes and behaviour. At the core of mobility management are 'soft' measures, such as information and communication, organising services and coordinating the activities of different partners."

Soft measures typically enhance the effectiveness of hard measures within urban transport. Hard measures might take the form of new tram lines, new roads or new bike lanes, for example. Mobility management measures, in contrast to hard measures, do not necessarily require large financial investments and may have a good benefit-cost ratio.

7.1 A CLOSER LOOK

Mobility management continues to be a growing area in sustainable transport planning in cities. This trend is reflected by the high number of measures implemented in this category in CIVITAS Plus cities. Of the 25 cities participating in CIVITAS Plus, 22 implemented mobility management measures.

Several measures constitute mobility management policies. These measures influence travel behaviour and modal choice via the provision of accurate travel information by mobility centres. Individual customised mobility plans, either for certain areas or routes or for certain user groups, can also contribute to mobility management.

Mobility marketing comprises educational and promotional programmes that facilitate comprehensive mobility dialogue. The aim is to improve citizens' awareness of their contribution to sustainable and liveable cities and to further improve their mobility behaviour.

Demand management is the application of strategies to reduce private vehicle use. Incentives (rewards) and pricing policies are discussed in Chapter 6.

7.2 THE EU CONTEXT

Mobility management is not currently reflected among EU policy priorities, although the mobility management approach is genuinely European. According to the subsidiarity principle, most mobility management measures come under local competences, although the EU supports mobility management research and innovation projects, as well as EU networking.

Local authorities can find motivation for engagement in mobility management measures in EU legislation and policy objectives. The EC has set a target to improve air quality in European cities[109], while at the same time developing a high-quality transport system. Mobility management approaches can ensure that European cities are able to tackle mobility challenges such as air pollution, congestion, travelling costs, accidents and noise pollution.

Local authorities in general, and CIVITAS Plus cities in particular, are the most competent entities in tackling these challenges. Targeted mobility management strategies not only address environmental challenges, but also promote a competitive, resource-efficient European transport system.

7.3 CHALLENGES FACED

Depending on the particular mobility management measure, several challenges were identified by the CIVITAS Plus cities.

First and foremost, quantitative analyses remain difficult, as it can be challenging to measure the effects of mobility management interventions. Without support for longer-term evaluation, it is hard to assess real impacts, as these are often manifested long after the end of a project timeline.

Some cities experienced technical difficulties. In Brighton & Hove (UK), for example, the local wireless connection was insufficiently flexible for use without extensive adaptation[110]. This hampered the sharing of real-time information for journey planners and route timetables.

The elaboration of customised mobility plans faced primarily organisational challenges. Porto (Portugal), for example, sought to launch a participatory planning process for a new intermodal

Mobility improvements in Usti nad Labem, Czech Republic

Before CIVITAS, most of the access routes in the centre of Usti nad Labem were already barrier free, but more vulnerable pedestrians were not aware of these routes. CIVITAS helped to create a web portal highlighting the routes to a far wider public.

Issues connected to accessible routes in the city were discussed with associations of disabled people in the Usti region, and with local schools and other representatives of the public. The measure was integrated into the SUMP that the city drafted during the CIVITAS project.

The city resolved to keep updating and improving the web portal after the end of the CIVITAS project. It also recognised the need to continue adjusting public spaces and public transport stops in order to fulfil the conditions for barrier-free routes, based on the findings of the CIVITAS project.

For more information: http://civitas.eu/content/mobility-improvements

interchange, but the measure was hampered by poor dialogue between stakeholders and the city[111].

Information and communication technology plays a crucial role in establishing mobility agencies and encouraging public transport use. Challenges related to ICT are connected with organisational issues and may be experienced during the preparation phase of a measure. Technical challenges are more likely to be faced in the course of implementation.

Stakeholder involvement and cultural issues have an impact on the development of mobility marketing campaigns. In Tallinn (Estonia), for example, cars were regarded as status symbols[112]. Combined with the lack of a dedicated sustainable transport marketing plan and delays in the creation of marketing guidelines, this compromised the success of measure implementation.

Eco-driving measures proved that communication efforts and awareness raising are key to improving drivers' performance. The Tallinn Bus Company introduced a training programme that was deemed very useful for drivers[113]. One of the main challenges was to find fair rewards for improved eco-driving. In Vitoria-Gasteiz (Spain), a training programme was offered to citizens to help them save fuel[114]. Despite considerable communication efforts, attendance figures were low.

Cities faced diverse challenges when promoting behavioural change, which are explored in detail in Chapter 9.

7.4 LESSONS LEARNED

Perhaps the most fundamental lesson learned from these measures is that the likelihood of success increases when mobility management is used to support a more comprehensive urban mobility plan.

In relation to mobility centres, experience shows that organisational aspects, together with political will, play an important role. In the successful creation of an integrated mobility centre in the city of Brno (Czech Republic), the local government provided extra funding and supported cooperation between the partners[115].

The measure "Mobility management plan for the university campus"[116], implemented in Donostia–San Sebastian (Spain), offered customised mobility planning as part of the overall strategy to promote sustainable mobility in the city. The measure resulted in a growing awareness of environmental issues

within the university community, and CIVITAS Plus activities proved to be a very important stimulus for the development of mobility plans.

Mobility marketing initiatives demonstrated the central role of stakeholders and the importance of political support. The measure "Info mobility centre and mobility marketing"[117] in Coimbra (Portugal) successfully combined the efforts of the municipality and the local public transport company.

Integrating mobility plans with other measures is apparently more effective than presenting planning as a stand-alone measure. The success of personalised travel planning in Brighton & Hove (UK) lay in the fact that the first personalised plan ran for three years, allowing CIVITAS Plus activities to benefit from lessons already learned[118]. The measure built on the experience gained in order to respond appropriately to commuters' needs.

In relation to eco-driving, it was found that a shared understanding of measure objectives can lead to close and effective involvement and cooperation. In Tallinn (Estonia), a measure to integrate eco-driving into the existing training programme of the city's bus company followed this approach[119].

7.5   MOVING FORWARD

Most mobility management measures can theoretically be transferred among European cities, as long as they place emphasis on awareness raising, involving the target group, and using appropriate technologies. Nevertheless, unsuitable local conditions and a lack of human and financial resources can frustrate well-intended mobility management efforts.

Theoretically, mobility centres can be established anywhere. However, the CIVITAS Plus measures showed that it is not always easy in practice, due to time constraints and the need for investments in human resources, awareness raising and technology. Such investments are only possible with support from politicians and stakeholders.

In general, there was significant awareness of customised mobility plans. In some cases, such as Ghent (Belgium), car usage decreased among employees in participating companies[120]. It should be stated, however, that the economic downturn may also have affected these figures.

To a great extent, mobility marketing measures were aimed at changing travel behaviour by raising awareness and providing travel information. Such measures can readily be transferred to other cities. However, it should be borne in mind that such services will have to be "sold" to the public and other stakeholders. Information must be provided in simple and user-friendly ways. The inclusion of new channels, such as social media, can reach new audiences not accessible via traditional media, although traditional channels should not be abandoned.

Eco-driving measures are apparently easy to transfer to other cities. However, this also requires support at

Campaigns to promote public transport and cycling in Szczecinek, Poland

The Polish city of Szczecinek carried out a comprehensive communications campaign to encourage people away from the car towards more sustainable means of transport.

The city also aimed to make residents aware of new public transport options, such as the water trams and water taxis, the public bike rental service, and the improved bike lane network.

Events to promote road safety, cycling and public transport were organised, focusing on the involvement of young people. These events included a cycle tour, competitions and games for children. Specific target groups were identified, along with the best ways to address them. Several buses were also branded with the CIVITAS logo, and flags, roll-ups and banners were used to promote the Initiative. A campaign steering group was created, which included representatives of all relevant partners in the city. Its main responsibilities were to coordinate activities and to monitor progress.

Media involvement was intense, with CIVITAS promoted on local television, via the Internet, and in local, regional and national print media.

Awareness levels rose significantly as a result of the events. A survey carried out following the activities showed that over 89 percent agreed with the statement that public transport or bicycles should be used instead of private cars — a notable increase.

For more information: http://civitas.eu/content/civitas-case-study-campaigns-promote-public-transport-and-cycling-szczecinek

a strategic level within companies and/or within the municipality. The presence of frontrunners that lead by good example is extremely important. Effective technical support can further help bus drivers to improve their behaviour. In Tallinn, for example, new drivers found it hard to master the additional eco-driving tasks while controlling their vehicles.

Keeping the city centre accessible in Utrecht, the Netherlands

To limit the negative impacts of roadworks and further stimulate the use of public transport, Utrecht formed the unique public-private entity Platform Utrecht Bereikbaar, which aimed to keep Utrecht accessible during a period of extensive public works. The project was initially planned to last only two to three years, but is now in its fifth year.

Extensive infrastructure adaptations in and around Utrecht temporarily reduced road capacity on some of the city's most important access routes. In order to keep the city accessible and limit economic losses, it was estimated that rush-hour traffic needed to be reduced by between 2,000 and 4,000 cars.

Private businesses also acknowledged the situation and recognised the need to act. In conjunction with the Dutch authorities, several companies purchased the Utrecht Accessible public transport pass for their employees, giving them access to the entire public transport network in Utrecht, as well as to public bicycles, park-and-ride facilities and some train lines. Employers were able to purchase the pass tax free as part of a wider national agreement.

The estimated impact of the pass was 1,125 fewer car trips per day during peak hours on roads in the south-west of Utrecht. The number of trips completed on public bikes by pass owners also showed a significant increase, from about 1,400 in January 2010 to 12,100 in September 2012.

For more information: http://civitas.eu/content/civitas-case-study-keeping-city-centre-accessible-utrecht

7.6   RESULTS/IMPACTS

Mobility management schemes trialled during CIVITAS Plus had a significant and measurable impact on cities and citizens.

Mobility centres achieved a significant increase in awareness of sustainable transport issues and associated behavioural changes. Twenty-one percent of the general public interviewed in Porto (Portugal) stated that they had used private cars less frequently since the launch of the MOVE-ME[121] application. This well-designed app is an information management system that provides real-time information from a number of different operators in the city and region.

Hands-on initiatives, such as electric bikes in Aalborg (Denmark), generated high levels of awareness of mobility plans among employees[122], whereas information campaigns alone may have a limited impact on travel behaviour. Campaigns organised by the employees themselves can create peer pressure that motivates colleagues to join (the so-called nudge factor).

The two implemented eco-driving measures were very successful, resulting in significant short-term savings. In the case of the Tallinn Bus Company, the accident rate dropped by 22 percent. The techniques developed during CIVITAS Plus will become part of the formal drivers' training programme, and will thus have long-term effects.

7.7 RECOMMENDATIONS

Measures in the field of mobility management are generally successful in reducing the number of private car trips, particularly when they target specific groups.

In the long term, sustainability will be achieved by a mixture of measures. Mobility management largely focuses on reducing demand and changing the modal split in favour of more sustainable transport. It is important that measure objectives are very clearly defined. Sustainability targets may be met in the future by new vehicle technologies.

Mobility marketing campaigns are best organised by specialised marketing companies — in close cooperation with the municipality — and need to have

a clear message. People should be approached in a personal way or as members of a well-defined group: peer pressure is more effective than general information provided online or on paper.

A scheme's full impact on travel behaviour may not be measurable within the project. Ideally, measurements of impacts should continue in the long term, and funding should be available for this if the full impacts are to be captured.

Eco-driving is effective and should be included in national driver training standards, as well as in training programmes. As the public transport operator will save money as a result, some of the savings can be returned to drivers as an incentive to employ eco-driving techniques.

8   TRANSPORT TELEMATICS

Modern transport telematics systems offer opportunities to make urban transport more efficient.

Communication technology can help to better coordinate traffic flows via satellite-based applications, GPS, wireless data transmission, automated traffic counting devices and high-resolution cameras.

These technologies make it possible to give priority to public transport, improve parking management and better enforce road rules. They can also provide passengers with real-time travel information and mobile transport guidance.

Telematics systems enable the better collection, coordination and use of data for traffic management. They offer tools to evaluate, visualise and warehouse information in order to remove bottlenecks and address unsafe situations. They can help to coordinate traffic flows and support traffic operations through the prioritisation of sustainable modes (particularly public transport). CIVITAS Plus cities implemented measures on monitoring and control; public transport information; and access and parking management systems.

8.1   A CLOSER LOOK

Transport telematics can lead to the better understanding and management of urban traffic. Through ICT, cities can give priority to public transport, improve parking management and better enforce road rules. This contributes to ensuring that the most appropriate solutions are chosen to reduce urban congestion. In general, transport telematics applications can be grouped under three main fields.

Traffic management and control play an essential role in urban transport systems, with the aim of maximising the potential of the road network and improving safety.

There are a variety of systems that provide public transport information, including real-time passenger information services (on-board, via SMS and/or Bluetooth, or on electronic display panels at stops) and online route planners. Information can also be targeted to specific groups, such as visually impaired passengers.

Alongside conceptual and policy innovations, access and parking management can also be improved by new technologies. Intelligent transport systems for enhanced parking management can enable the implementation of parking restrictions. When deployed for parking and access management, such technologies can address a number of issues, from the measurement of parking patterns prior to a change in policy, to enabling payment and information provision. They can also contribute to the efficiency of enforcement.

8.2   THE EU CONTEXT

An EC directive on ITS[123] was adopted in July 2010 to provide a framework for the deployment of innovative technologies for road transport. The directive defines priority areas and actions, which include the optimal use of road, traffic and travel data; freight management; ITS for road safety and security applications; and links between vehicle and transport infrastructure.

Acknowledging the need to provide a general framework to meet specific requirements, the EC initiated action plans on both ITS and urban mobility in order to assist cities to reach their urban policy goals. The ITS Action Plan[124] created a collaboration platform to promote local ITS initiatives, while the Urban Mobility Action Plan focuses specifically on guidelines for achieving cleaner and better mobility in urban areas[125]. In addition, urban ITS expert groups[126] supply the EC with information on multi-modal solutions, smart ticketing, traffic management and best practices. This legislative framework provides cities with the necessary insight into using transport telematics for improved mobility.

8.3   CHALLENGES FACED

Depending on the particular measure implemented in the transport telematics category, the following challenges were identified by the CIVITAS Plus cities.

In terms of traffic management, the installation of monitoring tools and displays and real-time passenger information services were hampered by technological challenges and local constraints. This was particularly true in Szczecinek (Poland). The city identified corridors and defined test parameters prior to establishing an information collection system in order to implement a control system for traffic management[127]. Difficulties arose due to the lack of space at the municipal police headquarters to store the information collected.

Parking measures are generally unpopular, and this was the experience of CIVITAS Plus cities, leading in a number of cases to a low level of political commitment. However, when commitment was made, it proved to be a very powerful driver of change. The city of Perugia (Italy), for example, used ITS to improve parking efficiency in the urban area through a measure to implement a city parking strategy[128].

Public transport information and ticketing measures faced challenges in relation to the homogenisation of some payment systems. Introducing highly complex systems without the benefit of past experience also posed difficulties, as was the case in Donostia–San Sebastián[129] (Spain). In the case of Aalborg (Denmark), difficulties were also encountered with the integration of two IT systems, which set back the implementation of the measure[130].

8.4   LESSONS LEARNED

A number of conclusions can be drawn from the numerous transport telematics measures implemented by CIVITAS Plus cities.

In traffic management measures, political contribution and commitment were frequently mentioned as being crucial to success. In Monza (Italy), for example, strong political commitment on the part of the deputy mayor for mobility helped to push through a measure to improve the capacity of the road network[131].

Good design, comprehensive consultation and effective enforcement are key aspects in measures related to parking. In most cases, new traffic management and signage, along with new enforcement systems, are able to overcome access violations.

Automatic vehicle location and real-time passenger information at bus stops in Skopje, the former Yugoslav Republic of Macedonia

At the start of the CIVITAS project, the public transport system in Skopje was outdated, with an ageing bus fleet, low reliability and poor passenger information. With the support of CIVITAS, real-time arrival times were displayed at 10 bus stops based on GPS devices in 30 buses and a monitoring centre with new software. This was the country's first automatic vehicle location and real-time information system.

The city promoted the measure through several channels, with an emphasis on television and radio, national newspapers, and the city website. The measure was closely related to other innovative actions for improving public transport in Skopje, as outlined in the city's new SUMP. Public support for the measure was very strong.

The CIVITAS measure gave rise to a public-private partnership that will increase the number of real-time information displays from 10 to 80, while the number of GPS-equipped buses will increase from 30 to 400.

For more information: http://civitas.eu/content/introduction-avl-system-and-real-time-passenger-information-bus-stops

In the context of complex traffic management systems, an important lesson learned is not to go it alone. Exchanging experiences with colleagues can be very valuable. In accession countries, the principles developed and shared in CIVITAS cities in relation to deploying new traffic management systems were applied with excellent results.

Public transport information for blind and partially sighted people in Brighton & Hove, United Kingdom

To improve accessibility and public transport provision for blind or partially sighted passengers, the city of Brighton & Hove added audio devices, known as react units, to bus stops. When activated, the devices verbalise the information displayed on the bus signs, which includes details of which services are due and where they are going. Users have a battery-operated key fob that alerts them when they are near one of the "talking bus stops". The fobs are issued to relevant bodies representing blind and partially sighted people and to public transport users who apply for them.

Feedback indicates that the introduction of the technology has led to greater confidence and independence for blind and partially sighted bus passengers. The bus stops have won several national awards for innovation and for the promotion of accessibility, and there are now 42 of them in the city. Seventy-eight percent of survey respondents had found it difficult or very difficult to obtain bus information prior to the introduction of the talking bus stops, but this share had fallen to zero by the end of the CIVITAS intervention. Seventy percent of respondents said that the new system is their primary source of bus information.

The level of satisfaction with the service is high, with 100 percent of respondents requesting that it be rolled out to further locations in the city and beyond. The combined project costs for the implementation of this measure came to EUR 49,916.

For more information: http://civitas.eu/content/civitas-case-study-public-transport-information-blind-and-partially-sighting-persons

Transport telematics have an important role to play when it comes to public transport information and ticketing. In encouraging the use of collective transport, experience shows that technology is vital to success. Skopje (Former Yugoslav Republic of Macedonia) recognised the technological potential of real-time information systems for passengers at bus stops[132] and was the first city in the country to implement the system, leading the way for other Macedonian cities.

8.5   MOVING FORWARD

Overall, CIVITAS measures in the field of transport telematics can be transferred to other cities. While most of the ITS-related measures are transferable, local circumstances in terms of legal and spatial constraints may delay or modify the process. In general, appropriate technical expertise and strong political will are prerequisites for the transferability of these measures.

Monitoring and control measures have great potential for transferability. However, this depends on local and national circumstances. Laws on privacy in relation to the use of cameras and the collection of personal data should be borne in mind, including those at European level.

Parking-related ITS measures have reasonable transferability potential, although implementation proved that a wide range of local challenges can crop up. However, if there is strong political support for parking management, access to technology and expertise can ensure the use of telematics in this sector.

Public transport information and ticketing measures using telematics can easily be transferred as long as the devices function well and the systems are integrated. Success will depend on extensive research, cooperation between stakeholders, and realistic financial and time planning within a stable organisation.

8.6   RESULTS/IMPACTS

Overall, the use of IT in transport monitoring and control proved to be effective. Relevant measures included the introduction of adaptive traffic light controls to give priority to public transport and dynamic traffic information displays.

A number of transport monitoring and control measures, such as urban traffic centres, have effectively improved traffic performance by reducing travel time, accidents and fuel consumption. However, because of the diversity of cities, public transport measures have to be adapted to existing conditions. The development of an optimal traffic management strategy using ITS technologies in the "Strategic traffic management"[133] measure in Usti nad Labem (Czech Republic) was seen to be the most effective in tackling urban traffic. It resulted in efficient traffic management in the city, and a reduction in congestion.

The efficient management of public parking spaces and the provision of real-time information to redirect drivers to available car spaces in Brno (Czech Republic) led to the optimisation of parking capacity while minimising transport emissions and the time needed to locate vacant spaces[134]. This also led to smoother private car transport and (indirectly) public transport in the city, especially during morning peak hours when a relatively high number of drivers tended to look for vacant spaces, creating unnecessary congestion.

Real-time information systems and services have become a necessity in public transport. Passengers appreciate information about timetables and connections at bus stops and on-board vehicles as much as via websites and smartphone applications. As demonstrated in Ljubljana (Slovenia), equipping stops and vehicles with electronic real-time information displays improved the punctuality of public transport arrivals and departures by 3.4 and 23.3 percent respectively[135].

8.7   RECOMMENDATIONS

From the experiences of the CIVITAS Plus cities that implemented measures in the transport telematics area, some general recommendations emerge for other cities.

Real-time information services for motorists, including speed-monitoring alerts, public transit messaging, warnings about children on pedestrian crossings etc., have substantial impacts on driving behaviour. Delivering dynamic traffic messages to drivers via LED displays or other means should be considered a key priority in traffic monitoring and control measures.

Transport telematics are usually combined in a package of integrated measures. Some transport management and control measures are set within a more comprehensive urban mobility plan. It is

Public transport priority and urban traffic control in Monza, Italy

As an important node connecting cities in Switzerland and Italy, and as a hub for small and medium-sized enterprises, the Italian city of Monza suffers from high levels of traffic and congestion. Through CIVITAS, Monza set up an urban mobility system to encourage sustainable modes of transport. The city made a commitment to increase public transport use by making it more attractive to citizens, and by optimising the flow of buses thanks to the application of ITS technology in conjunction with more systematic transport thinking.

Monza managed to achieve significant results by using ITS in conjunction with an automatic vehicle location/automatic vehicle monitoring (AVL/AVM) system and an urban traffic control (UTC) system. These systems make it possible to identify the position, and delay, of each bus operating in the city in real time.

The systems also allow decisions to be made as to which buses need priority action. A decision-making module then decides which actions are more appropriate for resolving potential conflicts. If two delayed buses are approaching the same intersection from opposite directions, for example, a decision will be made as to which bus needs right of way. The UTC system then changes the traffic lights as requested.

The implementation of the new systems resulted in a 5 percent increase in traffic flow and a 20 percent reduction in traffic density. The shorter traffic light times decreased waiting times for pedestrians and cyclists.

For more information: http://civitas.eu/content/civitas-case-study-public-transport-priority-and-traffic-control-monza

recommended that a detailed and focused evaluation be carried out for telematics systems, so that their effectiveness can be better assessed.

The chief recommendation in terms of parking strategies is to carry out a full evaluation of the needs of the area and to discuss the findings with politicians and local stakeholders before implementing any activities. CIVITAS Plus revealed examples of evaluations and consultations that led to schemes being strengthened and refined over time. In Ghent (Belgium) the "Parking and public space management"[136] measure was shaped according to the demands of both businesses and residents. Where a lack of civic agreement existed, schemes were cancelled: in Donostia–San Sebastian (Spain), for example, part of the "Changing parking behaviour"[137] measure was first postponed, then abandoned.

Two sets of recommendations can be drawn from the CIVITAS Plus experience in relation to public transport information and ticketing, and fleet management. Firstly, it is important to ensure compatibility between different technological systems, such as GPS data outputs, communication systems, driver communication, ticketing, positioning and real-time passenger information. It is recommended that the expert planning and management system be installed on a server so that it can be used from any computer. Secondly, as some European countries have limited experience with the latest technologies in public transport services, the sharing of experience can be very helpful. The initiative led by Brno (Czech Republic) on developing a network of European CIVITAS Plus partners to highlight best practices in intermodal infrastructure is an example of effective knowledge sharing[138].

9 BEHAVIOURAL CHANGE AND MOBILITY CAMPAIGNS

One particular issue recurs throughout the eight CIVITAS measure categories elaborated above — behavioural change. In order to create sustainable mobility within cities it is not enough to provide infrastructure and public transport systems. There must also be a cultural shift that encourages city residents to actually choose and use sustainable mobility. Integrated mobility programmes such as CIVITAS should therefore include measures on behavioural change.

Understanding of behavioural change has risen significantly in recent years. The present publication provides some theoretical background, as well as concrete examples of how behavioural change processes can be planned and managed.

9.1 WHAT IS BEHIND BEHAVIOURAL CHANGE?

People will only change their behaviour if they have the opportunity, ability and motivation to do so. Change is initiated by a trigger, such as a CIVITAS measure. This is illustrated by the so-called triad model[139].

MOTIVATION

ABILITY   **OPPORTUNITY**
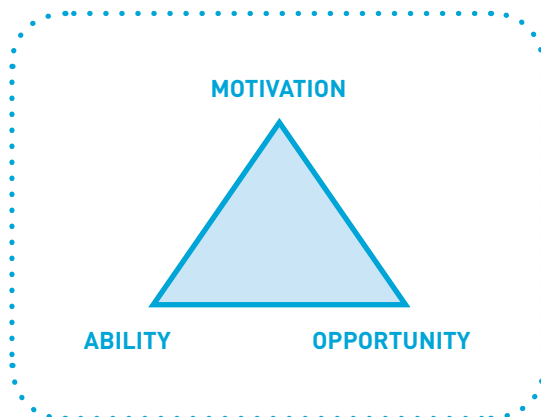
Poiesz's triad model

For a commuter to change from travelling to work by car to going by bike, the person's office or workplace needs to be within a certain radius (opportunity); the person needs to be able to ride a bicycle and know the route (ability); and there must be a reason for them to make the change, such as cutting their journey time, improving their health through physical activity, or reducing their environmental impact (motivation).

Many CIVITAS Plus measures were designed in the form of information and promotional campaigns. A good campaign can both boost knowledge, thus adding the ability element; and serve as a source of motivation for urban citizens. One such example is the "Mobility for the elderly"[140] measure in Zagreb (Croatia), which provided information to elderly passengers on how to use the buses (ability) and on why public transport is good for overall mobility in the city (motivation).

This specific motivation — that is, *knowing* that the requested behaviour is good — is only part of the cluster of motivational aspects. Recent research in behavioural economics[141] shows how new behaviour is derived from a combination of personal values, previous experience and the sort of emotional reaction expected to the new behaviour. People change their behaviour if it makes them feel good, and only if it fits with their identity. Campaigns should therefore focus on citizens' core motivations.

9.2 INGREDIENTS FOR REAL CHANGE

Campaigns have only limited power to persuade. Behavioural change is a long-term process and in order to inspire change, more is required than one-shot interventions.

In the UK, the government created a behavioural insight team, often referred to as the Nudge Unit, to apply insights gained from academic research into behavioural economics and psychology in the activities of British public policy and services.

In addition to working with almost all government departments, the team helps local authorities, charities, NGOs, private-sector partners and foreign governments to develop proposals, which are then tested empirically across the full spectrum of government policy.

The team has defined three essential aspects for the effective "nudging" of behaviour:

- understanding;
- interventions (influence); and
- results (measurement, evaluation, interpretation).

Understanding means that a measure can only be effective if there is sufficient insight in advance about the current and desired behaviour. This means knowledge of the target group and its characteristics. These insights are helpful when it comes to selecting potential measures, and ican also contribute to the removal of resistance and the lowering of thresholds. Understanding is the first step in designing an optimal behavioural influence strategy for specific situations — the actual *interventions*. Monitoring and evaluation are then used to find out whether the strategy yields the promised *results*, and to identify what lessons are to be learned from the process and what the side effects might be.

This approach has also been used by the Dutch Government in relation to more than 100 national behavioural change projects, as documented in the report *Grip on Behaviour*[142]. The report concludes that, although many interventions have been completed in recent years, little attention has been given to understanding and monitoring. This may be one of the reasons why not all CIVITAS activities related to behavioural change are easily transferable to other cities.

9.3 UNDERSTANDING BEHAVIOUR

A number of measures in CIVITAS Plus focused on understanding citizens' behaviour. Understanding means trying to determine the reasons for behaviour, rather than simply trying to solve problems though (behavioural) interventions.

In Zagreb (Croatia), discussion of mobility issues was mostly limited to professionals. It did not actively involve members of the public, who typically reacted only after decisions had been implemented. Change was needed in order to reduce dissatisfaction, spread responsibility and increase the number of citizens taking part in the decision-making process. As a vital part of communication and dialogue with citizens, a series of public events known as "Wednesdays in the tram"[143] were held at the Info-Point. The events targeted citizens, especially public transport users, cyclists, car owners and pedestrians interested in improving mobility conditions. Traffic experts and the media were also involved. Topics included cycling, car pooling, freight delivery, congestion charging, the planned intermodal passenger terminal and a new train station. As a result of listening to citizens, new interventions were developed. By using this model, the local authority and public transport operator were able to profit from the diversity of views held by members of the public and from their different attitudes to mobility in the city.

Analysing and understanding the behaviour of tourists helped the municipality of Funchal (Portugal) to promote its new Green Line bus service, which was introduced in order to raise the quality and environmental standard of public transport[144]. In an ambitious marketing approach, the Tourist Kit was specially developed to make public transport more attractive to visitors. Originally conceived as a support activity for the Green Line, the Tourist Kit turned out to be a success in its own right.

Tourists were given a brochure about the most exciting places to visit by public transport, as well as a public transport ticket. Stickers on the tickets depicted the participating hotels, which began offering them as free souvenirs. The ultimate goal of the strategy was to encourage hotel receptionists to persuade tourists to take the bus into the city centre rather than the complementary hotel shuttles that were contributing to congestion. Receptionists were given a small commission depending on the total number of tickets sold, thus they were able to benefit from their efforts while acting as ambassadors. People tend to return a favour, which explains the pervasiveness of free samples in marketing. In Funchal, guests receive free tickets for public transport from hotels. These are an essential part of the Tourist Kit. Robert Cialdini calls this the principle of reciprocity in his work on the principles of persuasion[143]. The kit also creates a "feel-good" experience for those staying at the hotel. As a result, public transport and the hospitality industry both win.

In Bologna (Italy), the municipality recognised a need to integrate a set of instruments for traffic planning, control and monitoring. The solution was an integrated platform in the distributed environment of the Cisium traffic control centre[146]. This platform connects and integrates the municipality's ITS. It controls the majority of the traffic lights in the city and influences traffic communications throughout the metropolitan area in order to achieve optimal real-time traffic management. A vital step was to include citizens in the decision-making process. The municipality had to take into consideration the cultural and social acceptance of the proposed mobility policies and ITS. Essentially, discussion was needed between different interest groups to ensure maximum impact. This, along with political support, is decisive for the success of the measures. Ensuring participation in a measure's design and implementation process is a good way to ensure that behaviour is understood, allowing the right triggers for change to be activated.

9.4 DESIGNING SUCCESSFUL INTERVENTIONS

Successfully implemented interventions follow five key stages, which slot into the theoretical framework described above.

The CIVITAS Plus measures that really stand out all followed these five steps when developing interventions to tackle particular behaviour. It is also noticeable that campaigns were often successful when linked with other changes taking place.

Looking once more at Zagreb, there was a focus on removing obstacles in order to improve accessibility to public transport among elderly people, thus picking up on step two of the approach outlined above. Corresponding to a trend observed in many European cities, Zagreb has begun to see a steep growth in its ageing population. In 2001, people over the age of 65 made up 14.9 percent of the population, while census data from 2011 indicate that their share had increased to 17 percent[144]. It was clear in Zagreb that greater attention should be paid to this group and to their safety, particularly in traffic, as they are one of the most vulnerable groups of public transport users in the city.

A group of elderly citizens were given the opportunity to talk to bus and tram drivers working for the local public transport operator ZET. Traffic police representatives also participated and gave advice to senior citizens about traffic risks, particularly when crossing at junctions. Many proposals, objections

and recommendations were collected and referred to the relevant authorities. Four workshops were held on safety for senior citizens, drawing bus and tram drivers' attention to senior citizens' needs in public transport. More than 160 drivers participated in the discussions.

Another example of the removal of obstacles was the "Public transport information" measure implemented in Porto[145] (Portugal). Porto aimed to develop a decision-making tool for public transport to help people plan their trips. It was to be based on real-time information provided by a host of different operators. This information is now available through smartphones and other geo-referenced mobile equipment, allowing users to select the best combination of transportation from their place of departure. The information is also available on LCD displays in institutions such as hospitals and university departments, as well as public transport stations. The provision of information removes some of the insecurity that might be associated with routes and timing, which could be perceived as a barrier to public transport use.

In Gdansk[146] (Poland), the municipality managed to encourage changes in behaviour and exploit the social context to the fullest. Before the city's involvement in CIVITAS, Gdansk's public transport stops had commonly been used by members of the public for posting small leaflets and adverts. The untidy papers stuck to the bus shelters spoiled their appearance and attracted further acts of vandalism. This had a negative impact on people's perceptions of safety and security on public transport generally.

During CIVITAS, at the heart of Gdansk's approach was the belief that the solution lay in a shift of attitude. Following a group evaluation by the different institutions responsible for public transport (shelter maintenance teams, municipal guards, police and transport operators), the social campaign "Clean public transport stops" was launched to improve perceptions of safety and security among service users. The ambitious campaign, launched in September 2011, was expanded in 2012. Initially, 72 special advertisement boards were installed at bus and tram stops in the centre of Gdansk. A broad media campaign then encouraged citizens to feel a sense of ownership and responsibility for the stops.

Other activities included an art competition for new "Stop vandalism" signage. The innovative approach of this anti-vandalism strategy was a direct result of the new positive and preventive, rather than repressive, approach to the problem. The advertisement boards allowed the city to combat the illegal behaviour in a constructive way by providing a legal alternative and a citizen-led approach. The concept included broad media information and promotion. People will do things that they see other people doing: this social evidence is also one of the key principles of persuasion according to Cialdini[147].

It is important to remember that achieving behavioural change is not simply about providing tools and information for citizens. There must be a good balance between the "carrot" and the "stick". In finding such a balance, SUMPs provide an integrated basis on which to develop strategies that satisfy the mobility needs of people and businesses.
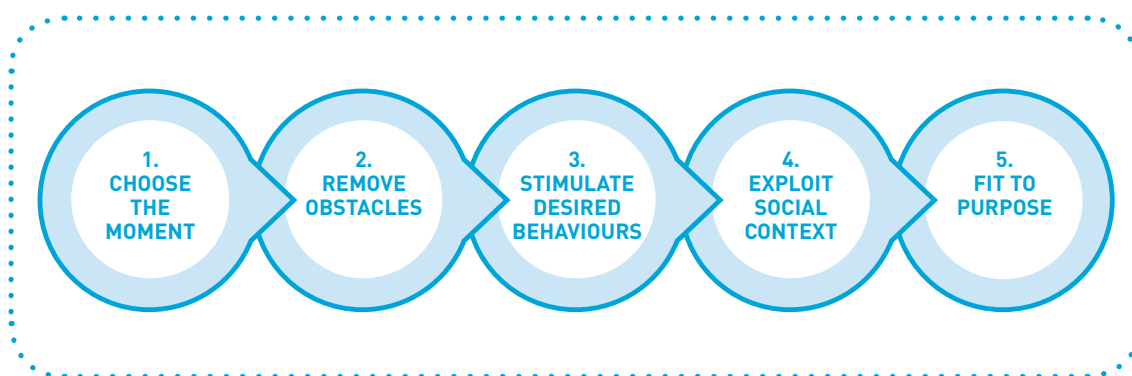
Five steps for designing successful behaviour-centred interventions
Adapted for this publication from XTNT et al. (2013)

These strategies are the result of an integrated planning approach and address all modes and forms of transport in cities and their surrounding areas[148]. A SUMP should create a balance between improved services, restrictions, an integrated vision and behavioural measures.

9.5 MEASURING THE RESULTS

Behavioural change is difficult to measure, but since CIVITAS is a living laboratory it is very important to see which measures worked and why. This is the only way behavioural measures can be scaled up and transferred to other cities. Identifying actual changes in behaviour makes it possible to adapt and improve measures in the future.

In Ghent (Belgium), the municipality managed to combine measure results in an Internet-based tool[149]. The decision-support system was created to manage all mobility information and to contribute to the organisation of holistic events management. The tool addressed questions related to mobility, and also provided advice on environmental issues. Local event organisers were persuaded to join the system through direct marketing. In a well-thought-out move ideally fitted to the purpose, the evaluation of campaigns to encourage event goers to opt for sustainable modes of transport, and the tools for organising these events, were combined. The tool was assessed positively by many of the participating cultural organisations.

Extensive infrastructural adaptations in and around Utrecht (the Netherlands) temporarily reduced road capacity on some of the city's most important entry and exit routes. The local authority and the national highways authority Rijkswaterstaat anticipated traffic delays and reduced accessibility in Utrecht because of the roadworks.

In order to keep the city accessible and limit economic losses, it was estimated that 2,000 to 4,000 cars would need to avoid rush hours. Utrecht put together a variety of measures in order to achieve this reduction. Private businesses acknowledged the situation and recognised the need to act. With the opportunity clearly there for the taking, the intervention "Rush hour avoidance" was created[150].

During this pilot, motorists were rewarded for avoiding early morning peak hours. The measure targeted daily users of the A2 highway by means of licence plate recognition. Of the 15,555 people invited to participate, 4,026 car owners eventually took part (26 percent). Participants earned an average of EUR 55 by not travelling during peak time. By following up on the pilot and seeing how the incentives resulted in long-term behavioural change, the measure has grown into one of the pillars of the Dutch "Better Utilisation" programme[151].

9.6 FINAL THOUGHTS ON CHANGE

Behavioural change is a difficult and long-term process, which makes it complex to implement in a pilot situation. Nevertheless, due to developments in technology and methodology, and to its relatively low cost compared to infrastructural measures or public transport services, behavioural change will continue to be an important aspect of policy in the domain of sustainable mobility.

The measures implemented during CIVITAS Plus show that a well-considered behavioural change strategy can be effective and can provide tools that are transferable to other contexts. By understanding behaviour, selecting the best interventions, measuring the results and continually refining the approach, cities can indeed make a difference for their citizens.

10 CONCLUSION

Local authorities that took part in CIVITAS made a commitment to deliver accessible, safe, smart and sustainable transport solutions to their citizens and visitors. In recent years we have witnessed a shift in urban transport planning. Former practices mainly consisted in handling private motorised traffic and providing a few public transport options. This approach resulted in poor air quality and degraded urban spaces.

Over the past 12 years, the CIVITAS Initiative has pioneered a new range of innovative transport measures to counteract traffic problems such as congestion and air pollution by offering alternatives to car use and improving mobility for all. Supporting the development of SUMPs supports improvements in quality of life. CIVITAS has helped numerous cities create better and cleaner environments.

ENSURE POLITICAL LEADERSHIP

Analysis shows the need for policy support and local leadership for successful measures. European cities have managed to implement sustainable measures thanks to strong political will to overcome transport congestion, ensure greater and more appropriate space sharing among means of transport, and provide increased safety and security for travellers. The popular appeal of a measure depends on the positive attitude of public authorities towards modifying urban transport planning.

INVOLVE STAKEHOLDERS AND OBTAIN PUBLIC SUPPORT

CIVITAS further recommends comprehensive communication and information tools to reach stakeholders. The opinions held by members of the public and transport users about proposed SUMP measures must be assessed in order to achieve greater acceptance and reach a better understanding of people's travel patterns and how transport planning can make a positive change in travel behaviour. Stakeholder involvement is also one of the recommended cornerstones of a SUMP. By involving users, it is more likely that behavioural change will be achieved, as demonstrated in numerous cities.

Two CIVITAS handbooks, *Involving Stakeholders*[152] and *Reaching the Citizen*[153], were published in June 2011 by CIVITAS VANGUARD, a support action for the coordination and dissemination of CIVITAS Plus. These toolkits are available as resource materials for those interested in stakeholder consultation and public communications.

IMPROVE TECHNICAL KNOWLEDGE AND EXPERTISE

Innovative measures relying on telematics have proven to be useful in the implementation of local transport policies. In several policy initiatives, ITS have been used to assess traffic flow, carry out remote surveillance and provide instant information to users. Knowledge and expertise in relation to ITS technology is vital in order to ensure the smooth implementation of a mobility plan. Experience has shown that third-party expertise can help. The success of ITS measures also requires compatibility in terms of hardware and software. Information technologies include digital and mobile applications to provide citizens with real-time information, ease the use of different transport modes, engage stakeholders in decision making, and actively involve them in campaigns and incentive programmes.

THINK SUMP

European cities possess the key to foster and improve their urban environment. Since the beginning of the CIVITAS Initiative in 2002, participating cities have led the way to sustainable mobility. Within CIVITAS Plus in particular, an increasing number of cities worked on the development or improvement of their own SUMPs, and the topic has become sufficiently important to merit a discussion group on integrated planning on the CIVITAS website[154]. In the years ahead, SUMPs will be an integral aspect of urban mobility planning.

With European citizens more concerned than ever about the negative impacts of motorised transport, and hopeful about the prospects for more sustainable alternatives[155], initiatives such as CIVITAS are part of the avant-garde — identifying solutions to tomorrow's mobility challenges today.

ABBREVIATIONS

AVL/AVM	Automatic vehicle location/automatic vehicle monitoring
CCTV	Closed-circuit television
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxide
EU	European Union
EC	European Commission
EP	European Parliament
EEV	Enhanced environmentally friendly vehicle
EPOMM	European Platform on Mobility Management
EUR	Euro
FQP	Freight quality partnership
GHG	Greenhouse gas
GPS	Global positioning system
ICT	Information and communication technology
IMC	Integrated mobility centre
IMS	Information management system
IT	Information technology
ITS	Intelligent transport system
LPG	Liquefied petroleum gas
NOx	Mono-nitrogen oxides
LTZ	Limited traffic zone
NPV	Net present value
PM	Particulate matter
SUMP	Sustainable urban mobility plan
UFCC	Urban freight consolidation centre
UK	United Kingdom
UTC	Urban traffic control

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