Chapter 9
Integrating Transport Programmes for Sustainable Reduction in Urban Road Congestion—Best Practise Examples from Local Authorities Working with SUITS

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Abstract This chapter highlights selected sustainable transport measures that were implemented in nine partner cities during the SUITS project and discusses outcomes and learnings. Mutual exchanges, either in workshops or focussed meetings between the cities, provided inspiration for planning and implementing sustainable transport

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measures. For the project team, such exchanges provided insights into challenges the cities faced on a day-to-day basis which were used to develop training material and further understand the organisational process. During the project, cities worked on transport measures in five broad topic areas: clean fuels and low emission vehicles, collective passenger transport, vulnerable road users, safety and security and intelligent transport systems and services. Here, we present a selection to illustrate the scope of the undertaking and, how the project was able to enhance the implementation of each initiative.

9.1 Introduction

During the SUITS project, the partner cities Alba Iulia, Kalamaria, Rome, Turin, Valencia, Coventry and the West Midlands Combined Authority and the 'follower' cities Palanga, Stuttgart and Dachau worked on a variety of different transport measures. Within the project, we used the term 'transport measures' to refer to any initiatives undertaken by the city partners affecting all forms of transport and urban mobility, from public transport to private transport and active travel such as walking and cycling, along with programmes to reduce congestion and traffic emissions.

In following the cities, we have been able to understand the challenges they face and have offered concrete support to city teams. Transport and mobility planning is a complex task and of course the cities have a very good understanding of the necessary procedures. However, it is a major concern of the EU that cities, and especially small- to medium-sized cities, should place an even greater focus on aspects of sustainability when developing future transport programmes. This chapter outlines best practise examples that show how the SUITS partner cities implemented plans and strategies towards the goal of more sustainable mobility. Some of these were initiated during SUITS, while others had already started. Case studies of best practise were brought as 'shared experience', with local authority delegates collaborating, with SUITS guidance, to help their cities develop into 'learning organisations'. The strategic transport measures which the cities worked on can be grouped under the following themes, each reflecting important aspects of sustainable mobility:

(1) *Clean fuels and low emission vehicles.* Clean air is a basic requirement for human health and wellbeing. Studies by the World Health Organisation 2016 [1], have shown that ambient air pollution contributes to 7.6% of all deaths. Road traffic affects citizens' quality of life as well as their health. According to the EEA Environmental Indicator Report 2018, key EU air quality standards for the protection of human health were not being met in large parts of the EU, mainly attributed to emissions from road traffic and residential combustion in urban areas [2]. Therefore, local authorities are faced with challenging agendas in their regions to achieve these targets and to demonstrate their engagement to support citizens' health and well-being. The best practise examples we want to outline in this chapter are the implementation of urban goods freight distribution

with clean vehicles as shown in Turin, the clean air programme in Stuttgart and the provision of public electric charging points and electric vehicle sharing in Palanga.

(2) *Collective passenger transport*. This area focusses on the continuous development of a modern and energy-efficient public transport system as a driver for reducing car traffic and thus decreasing traffic congestion and air pollution. SUITS worked with the cities on innovative ways to maximise the potential for local public transport through an accessible service that is a fast and convenient alternative to the use of a private car. Best practise examples include Stuttgart's ambitious goals, with a suite of measures started before SUITS in 2015, shared with SUITS partners during workshops and continued during the SUITS project, the implementation of traffic light priority by Rome and the new plans developed by Turin on intermodality around new rail interchanges, including car-sharing services, shared taxi apps, bike-sharing schemes and e-scooter sharing. In addition, we show how Alba Iulia utilised innovative procurement and financing methods to purchase electric buses with numerous features to encourage wider use and to facilitate other sustainability goals for the city.

(3) *Vulnerable Road Users*. In the global assessment of road safety, the WHO 2018 demonstrated that just over half of the estimated 1.35 million fatalities occurring each year on the world's roads concern vulnerable road users, (pedestrians, cyclists and motor cyclists). Road traffic injuries are the leading cause of death for children and young adults [3]. Vulnerable road users are defined in the European Union Intelligent Transport Systems Directive as 'non-motorised road users, such as pedestrians and cyclists as well as motorcyclists and persons with disabilities or reduced mobility and orientation' [4].

The SUMP Guidelines quote statistics for 2017, stating that 70% of those killed on urban roads in the EU were vulnerable road users—39% pedestrians, 12% cyclists and 19% motor cyclists [5, p. 14]. Pedestrians, pedal cyclists, and motorcyclists are all considered as vulnerable since they benefit from little or no external protective devices that would absorb energy in a collision. In SUMPs, vulnerable road users intersect with 'vulnerable groups', such as children, disabled people and older people whose needs must be considered when planning and developing safe and sustainable transport systems [4, 5]. Best practise examples to enhance the safety of vulnerable road users are provided by the city of Rome in establishing road safety-speed zones and a safety campaign aimed at school students (DesiRe training initiative) and from Coventry (West Midlands, UK), implementing a neighbourhood speed safety zones awareness scheme.

(4) *Safety and Security*. Enhancing safety and security in all transport modes is a key objective of the European Commission. In the 2011 "Roadmap to a Single European Transport Area—Towards a competitive and resource-efficient transport system", the European Commission stated that by 2050, Europe should become a world leader in safety and security of transport in all transport modes [6]. In thinking about safety and security, our cities focussed on the safety of

pedestrians and cyclists. We highlight this key area by providing best practise examples from Rome, becoming a more walkable and cycle-able city; from Valencia, promoting a bike culture and thus developing a cycling infrastructure; and Dachau, using innovative citizen participation methods to develop its mobility vision which includes more cycling and improved safety and security.

(5) *Intelligent Transport Systems and Services.* Intelligent transport systems and Services (ITS), also called smart mobility, include the integration of smarter information and communications technology with transport infrastructure, vehicles and users. By enabling the sharing of vital information on roads, supply chains and public transport services, ITS allow for a more efficient use of the transport network. In addition, safety can be increased, and the environmental impact can be reduced. We will highlight the benefits of intelligent transport systems and services with examples from Kalamaria, implementing an intelligent waste collection system and using a real-time traffic information system to optimise vehicle travel time, and from the West Midlands, developing a testbed for connected and autonomous vehicles on public roads. Additionally, we also highlight an example from Coventry featuring implementation of an intelligent variable message system (iVMS) with the trial of an interactive App to improve traffic flow.

9.2 The Cities: Background Information

While we focus on transport measures that have the potential to be adopted by other small- and medium sized cities, it is important to always be aware of the specific needs of each city to allow measures to be implemented successfully (e.g., macro-environment such as number of cars, inhabitants, region; and micro-environment, such as the size of the local authority and its traditions, structures and processes). This has a major influence on which measures are implemented to ensure a sustainable reduction of congestion and how this is done. There is no magic formula for solving mobility problems; measures must be tailored to local circumstances to be effective. In the following, we revisit the earlier description of the SUITS cities (see also Chap. 4) focussing this time on the challenges they wished to overcome.

9.2.1 Alba Iulia, Romania

Alba Iulia is a city of 74,000 inhabitants and capital of Alba County in the Central Region of Romania. Public transport in Alba Iulia is considered one of most efficient in the country, but at the beginning of the SUITS project, transport in the city was mostly car-centred, with accompanying high pollution, and problems with parking and traffic management. This presented major challenges to Alba Iulia Municipality

regarding the achievement of sustainable mobility. Moreover, the different departments at municipal level found it challenging to cooperate efficiently in the area of mobility and lacked a clear vision on how to improve the situation.

However, the municipality has been highly active in attracting EU funds. In the period 2007–2019 over 200 million Euros from EU funding were used for local development and overall, the municipality represents a good practise at national level in terms of projects implemented through non-reimbursable funds.

We outline the city's use of innovative procurement and finance to support enhancements to its public transport fleet and other sustainability measures.

9.2.2 Dachau, Germany

Dachau is a small German city, with 50,000 inhabitants located in the metropolitan region of Munich. The car is the number one form of transport in Munich's surrounding region. During peak traffic hours, Dachau struggles with traffic jams, especially because a busy main road runs right through the middle of the city. Dachau also wants to strengthen cycling and introduced a new cycling concept in 2019, within which 10% of Dachau's citizens are expected to switch to the bicycle in the foreseeable future. In recent years, Dachau has placed great emphasis on citizen participation. Improving the quality of life is at the top of the agenda. Dachau was a 'follower' city in the SUITS project. We describe how a vision and guidelines for the future development of Dachau were drawn up in cooperation with the citizens.

9.2.3 Kalamaria, Greece

Kalamaria, with a population of 92,000 (2019), is one of the largest municipalities in Greece's second largest city, Thessaloniki. As a residential and recreational area for Thessaloniki, Kalamaria is facing severe environmental pressure due to rapid urbanisation [7]. The municipality receives transit traffic from Thessaloniki's centre, airport and the ring road, and some main roads have heavy traffic throughout the day. Internal targets are aimed at improving safety levels for citizens, decreasing accidents, increasing citizens' awareness and acceptance of sustainable mobility measures such as new pedestrian footpaths and bike lanes and also a focus on use of innovative technologies such as renewable energy. We describe Kalamaria's introduction of innovative pedestrian crossings with solar power and the city's trial and adoption of an innovative technology traffic management system.

9.2.4 Palanga, Lithuania

Palanga is a seaside resort town in western Lithuania, on the shore of the Baltic Sea with a population of just over 15,000 people (but during the summer the number of inhabitants including tourists exceeds 120,000). The most popular mode of travel is by private car. Because Palanga is a resort city, synergy with nature is considered particularly important and the city aims to ensure 'city comfort' not only for the resort visitors but for the locals as well. The city's SUMP was approved in 2017.

Palanga is a 'follower' city of the SUITS project. We will describe how it has focussed its activity on deploying car sharing points, and developing an electric vehicle charging network, while increasing the local population's awareness about sustainable mobility.

9.2.5 Rome, Italy

Rome has 2,873,000 residents. In 2015 the city approved the Traffic Masterplan for Rome which formulated a new understanding of mobility. In common with many Italian cities, Rome has implemented restricted driving zones where only freight and passenger vehicles with permits can enter at certain times, known as'*Zona a Traffico Limitato'* or limited traffic zones (LTZ).[1]

Rome was facing challenges regarding road safety and a need to increase sustainable mobility in general, including an increase in active travel modes. Building trust with citizens and including them in the planning, played a key role in the city's approach to preparing its SUMP. In late 2017, a public consultation campaign via a web portal was launched and enjoyed lively participation. This was part of a concerted effort to bring about a cultural change in the city to raise awareness of mobility, discourage a car-centred attitude and become a cycle-able and walkable city. In this chapter, we will discuss Rome's transport measures that focussed on improving public transport to increase its usage, extending the bicycle lane network, promoting bike sharing and improving bicycle parking.

9.2.6 Stuttgart, Germany

Stuttgart is the state capital of the federal state of Baden-Wurttemberg. While the city has only 620,000 inhabitants, it is the centre of a metropolitan region with more than 5.3 million inhabitants. As part of an important economic zone within the European Union and located in one of the densest conurbations in Germany, Stuttgart has to cope with a very high volume of traffic. Every day, around 800,000 cars enter and leave the city and are major contributors of traffic congestion and air pollution.

[1] These are variously referred to as ZTL, or LTZ, in this chapter we will use LTZ.

Due to its location in a basin, Stuttgart suffers from particularly severe urban climatic problems, with low rate of exchange of air in the valley, relatively high average annual temperatures, and low precipitation. This can lead to strong inversion weather conditions in which the air pollution generated by industry, households and traffic is concentrated in the city for a particularly long time.

Stuttgart was a 'follower' city in the SUITS project, and we describe how it is implementing a programme of integrated transport measures to bring about change in travel behaviour.

9.2.7 Turin, Italy

Turin is a city of about 887,000 inhabitants located in the north-western part of Italy and surrounded by a metropolitan area of about 2,000,000 inhabitants. Turin adopted its SUMP in 2010 and through its participation in several European and National projects, it has become a leading city in Italy for sustainable urban logistics. The PUMAS project (started 2013) consisted of a pilot for the delivery of goods in the limited traffic zone (LTZ) in the central area of the city. The results provided an impetus for the collection of traffic data, enabling a holistic picture of goods delivery in urban areas for the first time in Italy.

It also led to the signature of a Memorandum of Understanding between the city, the Chamber of Commerce, Transport and Commerce Associations, and the creation of a Freight Quality Partnership, which included the definition of incentives or so-called 'pull' measures in an innovative approach.

Turin continued those activities through the project H2020 NOVELOG, which started in 2015 and focussed on gaining knowledge about freight distribution and service trips for implementing effective and sustainable policies and measures. The involvement of the city of Turin on these themes continues through active participation in the ongoing projects SOLEZ, SUMPS-UP and SUITS. We outline how Turin has implemented more sustainable freight delivery with incentives for acquisition of clean vehicles, and how it plans for intermodality and sharing schemes around its new rail interchanges.

9.2.8 Valencia, Spain

The city of Valencia is the third largest city in Spain, with a population of around 787,000 inhabitants in the municipality. Valencia has experienced similar issues to many cities in its wider urban area: private car dependency, poor public space usage, low use of cycling and lack of bike lane connectivity, high vehicle speeds, air pollution and traffic accident casualties. This was despite a state-of-the-art traffic control centre

and a good intermodality between walking and public transport. Valencia adopted its SUMP in 2013, but it was not until 2015 that changes in local government provided the political endorsement needed to promote a sustainable mobility approach. We feature Valencia's work with the SUITS project to promote a bike culture, improve cycling infrastructure and implement a 30 km/h speed zone within the city centre.

9.2.9 Coventry and the West Midlands Region, UK

Coventry, with a growing population of approximately 363,000 is a small-to-medium sized city and a regional and industrial centre in the UK's West Midlands region, with a very strong link to the automotive sector. Across the region, Coventry is considered as the leader in transport innovation, with extensive connections with the motor industry and a history of innovative project collaborations. Nonetheless, it is similar to many other cities of its size, with a heavy dependence on commuting by car. This may be reflected in its modal share of commuter transport, with 77% of morning peak trips being by car and 22.7% by public transport (2015 figures, [8]).

Coventry has been involved in the SUITS project since its inception, and here, we share two examples of best practise from the city in speed safety zones, and an intelligent variable message system (iVMS).

The West Midlands region encompasses three cities (Birmingham, Coventry and Wolverhampton) together with post-industrial towns and suburban areas, and 2.8 million residents. The area is characterised by the diversity of both its population and urban landscape. In line with many urban regions across the world, the region faces a number of transport challenges: poor air quality (the health effects of which are increasingly well known), congestion (which causes delays to driving and bus journeys) and safety (where the need to reduce harms resulting from use of the transport system are recognised).

The West Midlands Combined Authority (WMCA) was created in 2016 as a partnership between the seven local authorities in the West Midlands region, including Coventry City Council, and has worked to bring powers from central government to regional level. Transport for West Midlands (TfWM) is part of WMCA and took over the responsibilities of the transport authority covering the West Midlands region. As TfWM developed, it was well positioned to commence new projects, building on the experience of its member Coventry City Council in the field of connected and autonomous vehicles (CAV), and to bid for projects to stay at the forefront of development in CAV technology. The Midlands Future Mobility CAV Testbed project is described as a best practise example in the next section.

9.3 Best Practise Examples

9.3.1 Clean Fuels and Low Emission Vehicles (Turin, Stuttgart and Palanga)

Turin—Strategic Programme: Urban Goods Freight Distribution with Clean Vehicles

Turin proposed a set of transport measures for the SUITS project connected with improving freight distribution with clean vehicles. Since April 2014, the city has had extensive involvement in urban logistic freight monitoring and delivery. It has developed a set of transport measures dealing with restrictions (with penalties or 'push' programmes) and incentives (rewards known as 'pull' programmes) for logistics operators delivering their operations under the Freight Quality Partnership (FQP) Agreement. Despite this, increasing commercial traffic had continued to affect traffic flow and burden the environment. Turin's goal for its new transport measures was to reorganise the loading and unloading of goods within the limited traffic zone (LTZ), while enhancing the loading/unloading parking areas, in the city centre. This would be achieved by granting LTZ privileges to operators using only methane or electric engine vans, with tracking through GPS by the city traffic management centre, to provide data that will help to improve loading/parking efficiency.

One of the main points of interest for local authorities while dealing with urban freight delivery lies in the location and the use of loading/unloading bays. The central area of Turin is a LTZ, which in this case consists of a 3 km^2 area that contains a large proportion of mobility attractors, including shops, business districts, and public offices. This area is characterised by a significant number of traffic flows, mainly during peak hours.

In terms of delivery vehicles, the municipality is encouraging progressive substitution of the most polluting vehicles commonly owned by operators. Moreover, the city is moving towards the use of logistic platforms and vehicles that meet a set of minimum requirements for the distribution of goods in the urban area. These actions are supported by special incentives for the movement of 'accredited vehicles'.

In May 2018, a 'Memorandum of Understanding' was made between the Turin municipality and the leading logistics operators. The latter would benefit from special permissions to enter the central area LTZ, conditional on using vans with only methane or electric engines and being tracked through GPS by the city traffic management centre run by 5 T (5 T manages the traffic control room of the Turin metropolitan area and is the owner of data collected from traffic sensors). The memorandum applies to most sectors of goods distribution excluding a few specific categories (e.g. drugs, newspapers and fuels), and those requiring special vehicles.

As a result, specific conditions and benefits have been granted to a selected additional group of vehicles (classified 'Euro 5', up to a specified maximum weight, and equipped with an 'on-board unit' linked to the Turin traffic operation centre). The operators taking part in the agreement and accepting the requests have free access to

the LTZ and can use the bus lanes outside the LTZ zones providing faster access to the city centre. At the same time, these vehicles have exclusive use of loading/parking areas.

The 'on-board units' provide data for analysis. Studying trends in this data can help with planning corridors for the delivery of goods and learning which places are used most by delivery vehicles. This information can be exploited to arrange the creation of loading/unloading parking areas that can be used effectively.

Thanks to this experimentation, the city has tested 'V2I—Vehicles to Infrastructure' connection systems and has collected a significant amount of data. The analysis of those datasets helps in demonstrating an increase in the operators' commercial production and speed, together with a decreased emission of pollutants per delivery.

Challenges and Lessons Learned

One of the main problems the municipality faced in implementing this transport measure was the lack of specialised staff for data analysis, which is a common issue for smaller cities. For Turin this absence was covered through support from the SUITS project partners, mostly through assistance provide by staff from Politecnico di Torino. Recognising this issue, the material developed within the SUITS framework was focussed on developing the knowledge of local staff to raise their awareness of tools and data, such as what data might be needed and what skills to be developed or sourced elsewhere. Resources from the SUITS CBT will remain available to support Turin and other cities in future activities (see the discussion of the MyPolis tool in Chap. 12). Transport departments may be limited in their day-to-day activities, but they have learned there is scope to have additional analysis from experts and what these skills can provide. This is an example of how a city administration can grow into a 'learning organisation'—gaining new awareness of what is needed, how it can be done and what kind of internal skills or external help they may need in future.

One of the key results of the SUITS project was to create specific cost effective, scalable, and easy to use tools that could help the cities in facing such challenges. (See Chap. 12 for more information and associated publications, [9, 10]).

The experience gained by Turin's team through participating in the project revealed that sustainable urban mobility solutions are increasingly the result of a mix of technological and policy innovation. The value of participating in European projects was also demonstrated, through interacting with other entities that can give valuable support in activities that otherwise would not be possible.

Outcome and Impact

The measures put in place by Turin to provide faster access to the city for less polluting delivery vehicles, have shown positive results. Faster access to the city centre and exclusive access to loading/unloading bays enabled more goods to be delivered in a faster time, resulting in an overall increase of 20% in the commercial productivity rate for all logistics operators taking part.

At the same time, there was an important reduction of PM10 emissions due to the use of the new low emission vehicles. The proven increase in delivery efficiency and

fall in emissions, have made it easier to demonstrate to operators that it pays to invest in technologies and vehicles with lower emissions, because they can take advantage of these city access measures with their associated benefits.

The main achievement of these transport measures was the stimulation provided to the logistics operators to renew their fleet of delivery vehicles by adopting less polluting ones and phasing out older diesel engines, which required considerable cost and commitment from operators. The user-specific transport measures that Turin introduced demonstrated to operators that this cost was worthwhile, in return for increased productivity and to reduce the environmental impact of urban freight. The feedback from operators is good and the municipality plans to renew the agreement in 2020, a good result thanks in part to the input from SUITS' team, and an important legacy of the results produced in the project.

In addition to the greater use of clean vehicles, the city-wide pilot in urban freight logistics allowed Turin to understand critical aspects of the new management system focussed on the use of ITS. On the data side, GPS traces were analysed by SUITS partners from Politecnico di Torino, to define both a disaggregated congestion Key Performance Indicator (KPI) [9] and a method to identify the most critical freight loading/unloading points in the city [10]. The congestion KPI can be used to evaluate the most critical routes for given travel purposes, such as parcel services, so that it is possible to assess the effective use of traffic lanes. At the same time, information can be extracted about the most congested areas influencing the travel time of vehicles: so that here, it is possible to propose the creation of new reserved lanes to ensure an efficient travelling time for those vehicles.

In an additional exercise, a specific survey was conducted in the Turin LTZ to collect information on the dynamics of freight deliveries (and pickups) at these locations. This included which operators usually deliver in the selected areas and where the vehicles are parked, to check the exploitation of the available loading/unloading areas. Moreover, the survey also checked the duration of stops, the number and dimension of packs delivered and the final destination of such deliveries, together with courier collection and deliveries. The analysis of this data helped in understanding the effective use of loading bays and access to restricted areas in the Turin LTZ [10].

Turin's experience shows that a range of city-level policy actions related to freight delivery can be informed through understanding the effectiveness and impact of delivery operations in critical areas of the city. Moreover, the additional activities have shown that by focussing at the micro level, for example on deliveries in a particular street and on retailers' and shops' exploitation of express courier services, new actions can be identified that local authorities could make to improve urban freight policies at specific locations.

Stuttgart—Strategic Programme: Working Together for a Human-Centred Mobility, Less Pollution, and Less Noise

Stuttgart was a 'follower' city in the SUITS project and is implementing a programme of integrated transport measures to bring about changes in travel behaviour.

With the Mobility Plan 2030, Stuttgart defines primary objectives to reduce emissions, noise and congestion and to improve quality of life in the city. This plan is regarded as the overall SUMP for the municipality and includes an action plan on sustainable mobility in Stuttgart. This action plan has a short-to medium-term life, as it is revised and updated by the political authorities of Stuttgart every two years. The action plan includes goals to improve conditions of public transport, pedestrians, and cyclists as well as a reduction of the modal share of motorised individual transport. In addition, the topics of reachability and accessibility are given high priority.

Before the SUITS project, Stuttgart had actively participated in projects at a European level, coordinating two EU projects 2MOVE2 and CARAVEL and participating in several other European projects (Go Pedelec, Active Access, SUMPA MED). In 2MOVE2[2] [11], the main objective was to improve urban mobility by advancing or creating sustainable, energy-efficient integrated urban transport systems in participating cities. CARAVEL[3] [12], aimed to improve quality of life in the participating cities by tackling urban mobility issues through public–private partnerships, stakeholder consultations, awareness-raising activities and research.

To reduce air pollution, Stuttgart has introduced numerous transport measures and launched different initiatives in the transport and mobility sector. An overview of Stuttgart's traffic management measures is provided here. In a later section we will outline the enhancement of the public transport network and its attractiveness.

Since 2008, Stuttgart has implemented a low emission zone in the entire city (with a few exceptions), i.e. driving and parking is prohibited for vehicles that do not have a green environmental sticker (vehicles with emission classes lower than Euro 2 and vehicles without a regulated catalytic converter). In 2019, the traffic bans were extended to vehicles with emission classes below Euro 5, and in 2020, the diesel traffic ban was further extended to vehicles with diesel engines of emission class Euro 5 and lower on certain routes through the city centre.

In addition, bans on the passage of trucks on certain routes have been in force since 2010. To support this, a truck route recommendation network was developed, which recommends optimal routes through Stuttgart and at the same time displays routes that are closed to truck traffic.

Environmentally sensitive dynamic speed adaptation has been implemented on some main urban routes. This system regulates traffic depending on the weather and traffic situation, thus improving traffic flow, and reducing stop-and-go situations. Furthermore, continuous improvements are being made to the parking guidance system and parking management. This on the one hand leads to a reduction in traffic from vehicles searching for parking spaces, and on the other hand creates incentives for the use of Park and Ride car parks and public transport because of the comparably high parking fees in the city centre.

From 2016 to 2020, the 'particulate matter alert' was introduced and used as an instrument for air pollution control. If air quality falls below the designated limit, citizens are called on not to use their cars in the city if possible and to switch to

[2] https://civitas.eu/project/2move2.

[3] https://civitas.eu/content/caravel.

environmentally friendly alternatives or to form carpools. In the domestic setting, the operation of comfort chimneys, i.e. chimneys which do not serve basic needs, are also prohibited on these days according to a regulation of the state government.

Since 2015 Stuttgart has actively promoted a campaign called 'Stuttgart steigt um' (Stuttgart is changing), to encourage citizens to avoid using the car and to use other modes of transport.

In addition, there are a number of other transport programmes aimed at environmental protection and pollution reduction. These include: comprehensive funding programmes for e-mobility in the commercial sector, e.g. through support for the purchase of new vehicles with high emission standards or support for the purchase of e-cargo bikes; a programme to increase the modal share of cycling, which includes the expansion and improvement of the cycle path network (e.g. creation of special cycle routes through the city centre), programmes for environmental protection in companies; intensification of the greening of roads and light train rails; a ban on combustion (solid fuels and green waste) in the city, restrictions on dust-intensive operations and construction sites on days with high air pollution and subsidies for further expansion of car and bike sharing services in the city.

Challenges and Lessons Learned

The introduction of Stuttgart's' transport measures posed several challenges. Cities need to consider that during the planning and implementation of transport measures, changes are likely to happen in different areas, all of which need to be managed. These can be, for example changes in political leadership or changing regulatory framework conditions, but also unforeseen problems such as delays in the implementation of projects as well as social developments that lead to changes in mobility needs. The municipal bodies/technical departments need to have both patience and determination; they must be empowered and motivated at the political level to be courageous when it comes to the design and implementation of transport measures. Cities have to increase the visibility of their transport programmes, enhancing transparency and enabling citizen participation. Programmes must be consistent with the longer-term strategic objectives of the municipality (Sustainable Urban Mobility Plans). To avoid an abrupt end of transport measures it is essential to build up strong political support (Mayor and City Council) and create a broad network of local actors that support the deployment of sustainable transport measures in the city.

Outcomes and Impact

The example of Stuttgart clearly shows the complexity of urban pollution problems and that a bundle of coordinated transport measures is needed to improve it in a long-term and sustainable manner. In addition, a well-developed public transport system is required, which is further discussed in the next section.

Stuttgart has developed exploitable results in 2MOVE2 and other national and European projects which can become integral parts of the overall mobility strategy of the municipality. By developing a dynamic 'Action Plan for Sustainable Mobility', Stuttgart has gained a living SUMP instrument that focuses not only on planning but also on the implementation of concrete actions. The various transport measures have

contributed to better air quality, with no limits being exceeded since 2018. The air in the city has become cleaner and subsequently the particulate matter alarm was ended in April 2020. It has led to people in Stuttgart and the region actively developing awareness on the issue of air pollution control.

Palanga—Strategic Programme: Developing an Electric Vehicle Charging Network and Car Sharing Points

Palanga is a small coastal town in Lithuania and the issue of mobility poses challenges particularly in the summer months due to the huge influx of tourists. The city's SUMP was approved early in 2017, and its full implementation is expected by 2030. The SUMP is focussed on the implementation of universal design principles in the transport system (including mobility on its sandy beach) and infrastructure modifications to improve and promote bicycle and pedestrian mobility.

In the framework of SUITS, Palanga focussed on the challenges of citizen participation as well as on developing interaction and cooperation with business partners. The Palanga team wanted to broaden their understanding of the principles of sustainable mobility, as well as increase their capacity and agility in these areas. Since both the city administration and the citizens had limited experience with citizen participation, some quite elementary questions arose in the beginning. This is regarded as typical for smaller cities, where there is often simply a lack of capacity, both in terms of personnel and experience, to initiate and moderate processes for citizen participation. The initial question for Palanga was how to get its rather conservative population to participate at all. An important prerequisite for active participation is information. Only if citizens are informed about strategies and planned projects can they engage with issues, develop their own opinions, and participate.

Hence, it was necessary to educate and explain the benefits of sustainable transport and the essence of the innovations to the local population, to gain acceptance and support. Before that, the local administration had to build up its own knowledge in this area, which, as Palanga has impressively shown, is possible if the will and the appropriate support is there, such as that provided by the SUITS project.

As a resort city with a population heavily dependent on car use, Palanga focussed its attention on increasing the use of clean vehicles as a first step towards more sustainable mobility in the city. Palanga has attracted the biggest car sharing service provider in Lithuania (CityBee) and implemented several car-sharing points at regional level. In addition, an electric charging network was implemented consisting of seven charging posts, one of them state-owned, the others privately funded.

Key success factors include the communication and cooperation with business partners (setting the location of the parking and pick-up spots in the city), and involvement of local politicians to gain the necessary support and consultations with citizens in order to take their requirements into account during planning and ensure acceptance. A bike sharing system is in the planning stage, which will also be implemented in cooperation with the car-sharing provider. However, this project poses great challenges, as there are numerous private bicycle rental companies in the city already.

Challenges and Lessons Learned

Sustainable mobility was a very new concept for Palanga and its citizens. It was a concern that Palanga's generally conservative population would be reluctant to accept any kind of innovative transport measure. Hence, it was necessary to educate and explain the essence of the innovations to local citizens, to gain their acceptance and support.

This represented a big challenge for the Palanga local authority, as the municipality is very small, and few people are involved in mobility planning. National policies and political agendas provide the underlying context within which city initiatives must be constructed and introduced. With SUITS support, the city has developed a vision for future developments in the mobility sector and prepared relevant strategic documents. These are being used as the foundation for communicating its strategy for sustainable mobility within the local authority, to high-level management and to the wider city population.

Outcome and Impact

With SUITS project help, Palanga has moved forward considerably from its starting position, of being a city and population with very little knowledge about sustainable transport, or experience of introducing it and with relatively low resources in terms of the size of its team. The implementation of the charging points and developing partnerships with relevant businesses has been a successful first step, with accompanying political support for car sharing services. Charging points are a highly visible indicator, to both citizens and visitors, of the city's commitment to sustainable mobility. It is planned to renew Palanga's SUMP and add more mutually integrated transport measures focussing on sustainability. The city also plans to evaluate the social impact for all the transport measures.

In line with the approach advocated by SUITS, the Palanga local authority is exploring how to involve citizens and business partners more closely in the decision-making process about appropriate transport measures, to ensure that all stakeholders remain satisfied, that they make the best choice from the alternatives available and that local concerns about maintaining Palanga's status as a 'resort city' are fully considered.

9.3.2 Collective Passenger Transport (Alba Iulia, Rome, Turin and Stuttgart)

Providing fast and convenient public transport is vital in enabling cities to reduce car traffic and provide a clean, safe and appealing urban environment. First, we will show how Alba Iulia used innovative procurement methods to finance new buses to improve public transport. Then we discuss Rome's focus on bus lanes, traffic light priority and measuring passenger experience, followed by Turin's development of inter-modality around new rail interchanges, such as car-sharing services, shared taxi

apps, bike sharing and e-scooter sharing. Finally, we revisit Stuttgart, where many integrated transport measures were developed as part of the Public Transport Pact 2015 and continued through the SUITS period.

Alba Iulia—Strategic Programme: Using Innovative Procurement and Financing Methods to Enhance Public Transport and Work Towards 'Smart City' Goals

During the SUITS project, the municipality of Alba Iulia was involved in an innovative pilot project testing the three Guidelines developed within the project: Guidelines on Innovative Procurement, Innovative Financing and New Business Models.[4] These were used to enhance the development of a sustainable mobility policy for the city, with an emphasis on strengthening public transport.

The transport measures tested by Alba Iulia during the SUITS pilot project included:

- Organising an innovative public tender with the Ministry of Development for the acquisition of electric buses for Alba Iulia together with several other municipalities—the first public tender of its type both at national level and in the mobility field.
- Novel criteria for public procurement contracts in transportation: these were highly innovative and a 'first' at national level. Although some of the criteria introduced were considered somewhat restrictive, the majority were approved by the national authorities for public procurement, and thus can be seen as innovative. For example, buses would have free Wi-Fi, GPS navigation with real-time monitoring in stations, video surveillance in buses, account-based ticketing, an emergency situation management system and part of the fleet would use biofuels.
- Developing the new public parking policy with support from EU technical assistance facility JASPERS [13] which provided the necessary expertise to develop an efficient and novel parking policy.
- Implementation of the pilot project, 'Alba Iulia Smart City'—with several smart and innovative transport measures in the mobility area such as smart parking using intelligent parking sensors and mobile apps, monitoring air quality in the city through air quality sensors installed on buses, smart cameras installed at the busiest intersections in the city and installing free Wi-Fi and other enhancements in buses.

Challenges and Lessons Learned

The municipality was the first of its kind in the country to attempt to issue municipal green bonds—a financing instrument usually used solely by governments; however, due to some legislative drawbacks the opportunity for issuing green bonds has been temporarily postponed but will be tried as soon as an opportunity arises.

[4] https://cbt.suits-project.sboing.net/guidelines.

Outcome and Impact

There was a strong emphasis in these transport measures on enhancing public transport provision, by procuring new buses with superior facilities that would encourage people to use them. The public transport company for the metropolitan area covers the municipality of Alba Iulia and the surrounding eight villages. Now, with one simple SMS, any citizen can pay for a bus ticket and go anywhere in the city. In addition, the buses were adapted for people with disabilities, and Alba Iulia's public transport was one of the first in the country to provide free Wi-Fi and air conditioning in its buses. The 15 newly purchased buses have air quality monitors, which are used to measure the level of pollutants at the city level.

The municipality went through a process of systemic change during the SUITS project. The departments that work on mobility issues were involved in a series of workshops and training sessions. This resulted in them starting to actively cooperate in a more integrated way not only in transportation and mobility, but also in other fields of activity.

Last but not least, during the SUITS project Alba Iulia Municipality developed and submitted three large projects on transport/mobility, funded under ERDF (Regional Operational Programme), of which two were successful. After implementation, these will drastically change the face of mobility for the city [14].

Rome—Strategic Programme: Public Transport Improvements

Rome was facing challenges regarding a need to increase sustainable mobility, through better public transport, active travel and road safety. In this section, we outline enhancements in public transport in particular.

The Municipal Assembly of Rome adopted its SUMP-Sustainable Urban Mobility Plan ('PUMS' in Italian) on August 2, 2019, under the coordination of the Rome Mobility Agency (RSM), (during the period of participation in the SUITS project). Rome's SUMP is based on EC Guidelines for SUMP, adopted by the Italian Ministry of Transport (MIT) in 2017 in line with the mission of the National Guidelines for SUMP in Italian Cities.

It is a strategic plan that defines and develops infrastructures for mobility services on a medium-term basis (10 years). It promotes safety, accessibility for all and implements smart technologies towards a connected vehicle-infrastructure-pedestrian environment and intelligent transportation system. The urban transport system has been designed to:

- guarantee all citizens transport options to access key destinations and services.
- improve safety conditions.
- reduce air and noise pollution, greenhouse gas emissions and energy consumption.
- increase the efficiency of transport flows of people and goods.

SUITS partner Rome Mobility Agency (RSM) supported the municipality of Rome in preparing its SUMP and advocated a participatory approach according to the SUITS development process and discussions at early SUITS workshops in 2016.

Following the SUITS model, RSM acted as 'Change Agents' to accompany and support the city in cultural change, in terms of working approach and the development of tools to improve understanding and integrate aspects concerning mobility.

From 2017 RSM worked with the city to develop an effective 'communication strategy' to carry out research and engage broader public participation. This process involved public meetings, research interviews and online media. The communication strategy also included the launch of a SUMP website in September 2017, the 'pumsroma.it' Fig. 9.1. This website portal[5] hosted a large-scale online participatory process to collect proposals from citizens to inform preparation of the SUMP, and this gained impressive results in terms of participation, [15]. At the end of a 4-month period, over 1,600 citizens had registered to participate in the SUMP consultation; over 2,600 citizen proposals were published; 50,000 visits had been made to the portal and over 20,000 votes made.[6]

A follow-on 'listening phase' took place in July 2018, consisting of two separate investigations: a survey of 2,000 telephone interviews with a representative sample of citizens, and an online questionnaire through the PUMS web portal (with 4,800 usable responses). This provided clear opinions for input to the preparation of Rome's SUMP. Residents identified Rome's main mobility issues as: reduce the accident rate (improve safety), reduce congestion, improve air quality, promote urban cycling, and strengthen the public transport infrastructure, [16].[7]

In respect of public transport, during the period of engagement with the SUITS project, Rome implemented a range of measures focussed on increasing the use of public transport in order to decrease private car use. In addition to renewal of the bus fleet to reduce its environmental impact, improvements to the service were implemented by the creation of dedicated bus lanes; the implementation of traffic light priority for public transport to increase performance and the analysis of user satisfaction in public transport, outlined below.

Renewal of the Bus Fleet

Rome's plan is to renew the surface fleet by replacing older vehicles with low and zero-emission vehicles by 2030—there have already been 682 new vehicles in 2020. In addition, 60 electric buses will be renovated within the next 3 years.

E-mobility is supported by 118 electric vehicle charging stations, a number that is predicted to increase to 300 in the near future.[8]

[5] https://www.pumsroma.it/ (accessed 27/10/2020).

[6] More can be found about Rome's participatory approach at: https://www.eltis.org/resources/case-studies/giving-people-what-they-want-romes-sump-and-its-participatory-co-creation (accessed 26/01/2021).

[7] Information provided by RSM and also from presentation at POLIS 2019 https://www.polisnetwork.eu/wp-content/uploads/2019/11/3G-Fabio-Nussio.pdf [16].

[8] As above.

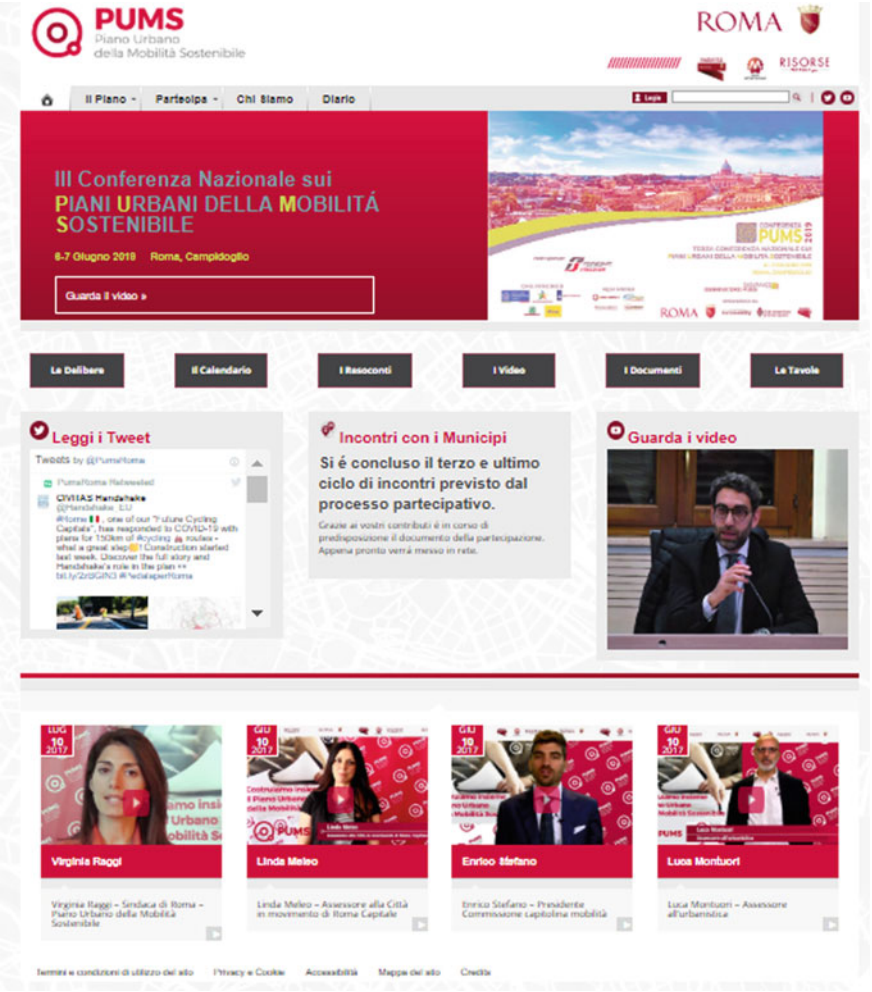

Fig. 9.1 The PUMSRoma website. *Source* www.pumsroma.it (accessed 27/10/20)

Dedicated Bus Lanes

Dedicated (protected) bus lanes increase the speed of public transport. By extending the protected bus lane network, Rome shortened journey times, making public transport more attractive. Two routes were completed by 2020, one in a densely populated commercial road (2 km, both directions) the other along a safeguarded archaeological site (0.5 km), and further routes are being implemented.

Traffic Light Priority

Implementing traffic light priority for various main public transport routes has increased the performance of the public transport network. Traffic light priority is planned on all tramway lines (about 50 km) and along six bus lanes.

Measurement of Quality of Public Transport Experience

In line with its participatory approach, in 2019 the Rome Mobility Agency carried out a customer satisfaction survey into public and private transport, to evaluate public transport experience and the safety and security of vulnerable road users. Evaluation of satisfaction related to surface public transport, metro lines and other services such as interchange parking, traffic lights systems and road parking fees. In total, over 18,600 interviews took place in 2019. The results indicated a need for improvement to the reliability and efficiency of the Rome surface public transport bus service, which was losing appeal with the public. In 2020, public transport was also subject to 'pandemic effect' with reduction of capacity due to the need for social distancing. Consequently, further improvements to public transport are planned for the coming years, even if the 'pandemic measures' in the public transport system are generating less revenues and increased costs for public transport operators.

Challenges and Lessons Learned

Rome adopted a 'guiding coalition' approach towards leading the SUMP activities, in line with SUITS recommendations on organisational approach. (See Chap. 6 for more information about this approach). Several different groups, each with specific skills, came together early on, to form a 'guiding coalition' to progress Rome's SUMP. These consisted of the Interdepartmental Working Group, and Technical Secretariat, with coordination by RSM's Expert Steering Committee. These groups worked together to build integrated plans and act until the conclusion of the SUMP process.

Rome's participatory approach towards preparation of its SUMP consisting of multiple interactions with stakeholders and citizens and planned 'listening' phases, played a key role, firstly in preparing the SUMP and then post-implementation in the surveys that followed—for example to monitor the effects of public transport improvements.

This participatory process was an important step in seeking to bring about a culture change in the city to raise awareness of sustainable mobility, encourage sustainable travel behaviour, discourage a car-centred approach and become a cycle-able and walkable city. Rome shared this example with other SUITS cities as an example of 'best practice'.

Outcome and Impact

The 2019 surveys showed a general increase in satisfaction with all the services investigated, with substantial peaks compared to 2018 for: 'Traffic light systems' (+10 points), 'Mobility Information Systems' (+8 points), 'Individual Transport for the Disabled' (+6 points), 'Metro lines' (+5 points) and Variable Message System

'iVMS' (+4 points). Only 'Public Transport Surface Lines' showed decreased satisfaction, losing 4.5 points. This latter decrease in satisfaction was despite shortened bus journey times, so will need further investigation.

As further improvements are made, the culture of engaging with citizens will allow Rome to continue to monitor satisfaction with its transport measures—and react accordingly. Rome's engagement of citizens on a large scale from the outset may well have encouraged long-term engagement with sustainability [17].

Rome's web portal continues with a high level of citizen engagement, communicating ideas and concepts regarding sustainable transport measures. Sustainable mobility has become the responsible norm as a strategic planning instrument for the wellbeing and improvement of citizens' daily lives.

Turin—Strategic Programme: Developing Intermodality Around Public Transport Infrastructure

Through the period of engagement with the SUITS project, Turin has been seeking to achieve intermodality around new interchanges for its underground and regional railway system (in addition to the extensive transport measures with clean vehicles, mentioned earlier in this chapter). The transport measures outlined here consist of infrastructural development projects aimed at completing the regional railway system within the city, designed to include new car-sharing services, shared taxi apps, free-floating shared bikes and e-scooters/mopeds.

Challenges and Lessons Learned

During the initial phases, it was realised that the main obstacle to achieving intermodality was the lack of an integrated ticketing system. A solution is being investigated from the Piedmont region aimed at transforming the current public transport smartcards into a MaaS platform, that will enable the purchase and use of integrated tickets for all regional transport services through smartphone apps on a 'pay per use' basis [18]. Turin municipality has been working with the operators of the different mobility services to make them aware of the MaaS concept and gain their support.

Outcome and Impact

The initial feedback from the mobility service operators is positive and the city plans to introduce the system in 2021. This is a clear example of a city following the approach recommended by SUITS: recognising barriers to change, searching for innovative solutions and working with multiple partners to achieve goals.

Stuttgart—Strategic Programme: Integrated Measures for Public Transport

As mentioned earlier, another goal of Stuttgart's Action Plan, which fits very well with similar goals of other SUITS partner cities, focusses on the improvement of conditions for public transport, pedestrians and cyclists as well as a reduction of the modal share of motorized personal transport. Since 2015, the city has been implementing a programme of several transport measures to achieve this goal.

Public Transport

Stuttgart has implemented a set of integrated transport measures to enhance public transport in the city. In 2015, the Public Transport Pact was adopted, which aims to increase the efficiency of public transport, especially bus and rail, enabling at least 20 percent more people to use it by 2025. The public transport measures include the following:

- Expansion and enhancement of the light rail and suburban railway network
- Expansion of Park and Ride and Bike and Ride spaces along the urban railway lines
- Use of express buses to close gaps in local transport, for example to connect one of the most populous city districts with the city centre. A separate bus lane can be used on a congested route, thus by-passing traffic jams. Two other lines connect city districts with the airport and the exhibition centre, by-passing the city centre.
- Increasing transport capacity through more frequent services to cope with increasing numbers of passengers and the purchase of new cleaner buses (hybrid and diesel with high emission standards) and buses with higher passenger capacity
- In the long term, it is planned to only purchase hybrid buses that recover energy during braking. This reduces diesel consumption by almost 7 L per 100 kms, resulting in a CO_2 saving of 30 percent
- Intermodal connection of different transport modes

Mobility Management

These improvements were accompanied by a number of transport measures to improve 'mobility management' to achieve simpler, more efficient, and thus more attractive use of public transport and to reduce road traffic:

- More intensive use of new information and communication technologies to improve user-friendliness (e.g. regarding passenger information or ticketing)
- 'Jobticket' Initiative: For employees of the city administration and for employees in participating companies—a subsidy of public transport fares provides incentives for commuting by public transport
- POLYGO Card: a smartcard for the use of public transport, which also enables simple access to car and bike sharing services and the use of e-charging stations
- Public transport interchange car park—the parking ticket can be used as a public transport ticket at the same time
- Streamlining of the fare zone system. More than 50 fare zones (so far) will be turned into five 'ring zones', making the fare system simpler, clearer, and also cheaper for many passengers, especially for the numerous commuters.
- Implementation of a special mobility guidance programme for new citizens.

In addition, Stuttgart implemented numerous mobility awareness campaigns (posters, radio advertising, videos, Facebook posts, interviews and newsletters) aimed at increasing the population's awareness of poor air quality and triggering changes

in citizens' mobility behaviour towards the use of the well-equipped public transport system. These initiatives are for example: 'Stuttgart is changing'; 'Together for clean air' (increasing the use of public transport) and 'Together towards the goal' (promotion of carpooling and car sharing).

Challenges and Lessons Learned

The example of Stuttgart, working with SUITS as a 'follower' city, and sharing its goals and experiences, clearly shows that a well-developed public transport network and services are prerequisites for encouraging people to switch to public transport. It also shows how closely the different areas are interlinked and that impacts on air quality should be considered at every point.

An important learning point from Stuttgart's experience is that it takes patience and perseverance to achieve the desired change in transport. Many integrated transport measures are needed, which must have an overall objective and be applied in a wide range of areas.

Outcome and Impact

In recent years, the local public transport system in Stuttgart has developed positively. Stuttgart offers its citizens one of the densest local transport networks in Germany. On average, around half a million people travel by public transport in the metropolitan region every day. The city's goal is to ensure that even more people use public transport in future, which will further reduce the volume of traffic and improve air quality and thus improve the quality of life. The corresponding transport measures to achieve this are described in the Transport Development Concept 2030, [19].

9.3.3 Vulnerable Road Users (Rome, Kalamaria and Coventry)

All the SUITS partner cities introduced transport measures for increasing safety and security for road users and promoting active travel through cycling and walking. Vulnerable road users include pedestrians, cyclists, children and young people, people with disabilities, older people and others with reduced mobility or cognitive ability. Here, we describe transport measures from Rome, Kalamaria and Coventry, which addressed issues affecting these groups in particular.

Rome—Strategic Programme: Vulnerable Road Users in Road Safety-Speed Zones, with a Safety And Security Campaign

Rome has established a number of transport measures to improve the situation for vulnerable road users. These include 'environmental islands' where cycling and walking is safer, together with a safety and security campaign aimed at young people, to raise awareness and improve future road use.

Environmental Islands

'Environmental Islands' are portions of land bounded by the mesh of the trunk road network, and supported by the chamber of commerce, freight transport associations and the local trade operators. The scheme identified protected pedestrian routes and pedestrian spaces; other interventions concern temporary and permanent extensions to existing pedestrian areas, and the creation of new ones. These zones guarantee a low vehicle speed where cycling and walking is safer and vehicle emissions reduced thus encouraging more active travel at the same time as providing greater safety for more vulnerable users.

In addition, within the SUMP framework, an initiative 'Vialibera' was established to incentivize car-free mobility—once a month, cars are banned from 15 km of streets around the city centre so that citizens can use the areas for different activities such as walking, cycling, parties and other events. This initiative arose from a proposal made during the public consultation phase.

Safety and Security Campaign

While working with the SUITS project, a new safety awareness campaign was initiated to underpin cultural change efforts. Safety awareness campaigns are mainly aimed at young people. They raise awareness about road safety issues and are widely advocated as an effective way to guarantee good behaviour from future road users [20]. A new and extensive training initiative was launched during the period of participation in SUITS, in 2017/2018, 'De.Si.Re. – La città che vorrei' (the city I dream of), with a focus on road safety and sustainable mobility, aimed at the primary school age group. The initiative involved 14 primary schools and 4,300 pupils in the 2017/2018 school year.

Challenges and Lessons Learned

It is not always easy for organisations from different sectors, with sometimes conflicting interests, (for example cyclists and motorists) to work together, but this was achieved successfully for the safety campaign 'De.Si.Re'. The campaign was promoted by Rome Municipality, with the Rome Mobility Agency (RSM) acting as coordinator, with additional collaboration from the Italian Automobile Club of Rome, the Italian Cyclist Federation, and the local police.

Outcome and Impact

Before these measures there was a lack of citizen engagement in Rome regarding sustainable mobility. The road safety awareness campaign and the customer satisfaction exercise followed-on from Rome's initial engagement with citizens through the 'PUMSRoma' web portal, when preparing the SUMP. A perceived outcome has been a growing engagement by citizens and greater public participation regarding sustainable transport measures. With measures like these, Rome is following the *Vision Zero* of the European Union [21] and is initiating a series of steps aimed at reducing the number of accidents, on the one hand through infrastructural transport measures, and on the other, by creating awareness of the issue amongst citizens, and thus improving safety on Rome's roads in the long term.

Fig. 9.2 Example of a 3-D crossing.[9] *Credit* iStock.com/olaser

Kalamaria—Strategic Programme: Smart Solar-Powered Pedestrian Crossings Near Schools

Working with the SUITS project, Kalamaria developed internal targets aimed at improving safety levels for citizens and decreasing accidents. In addition, the city aimed to increase citizens' awareness and acceptance of sustainable transport measures such as new pedestrian footpaths and bike lanes and particularly of innovative technologies such as renewable energy.

Smart pedestrian crossings using sustainable solar-powered technology were identified by Kalamaria as combining an increase in safety, with high visibility to the public. Kalamaria implemented these near different schools resulting in an increased level of safety and a reduction of injuries and fatalities at the new crossings.

The next step is to implement additional crossings which will be new '3D' smart pedestrian crossings, also sited near schools to achieve higher road safety; in addition, one is planned on a commercial road near the commercial centre.

These 3D crossings are painted on the road surface in a way that they appear to 'float' in 3D form and are much more effective than 2D crossings in visually compelling motorists to stop. They will also be highly visible to the public as an innovation (Fig. 9.2).

Challenges and Lessons Learned

[9] See also an article about use of these in Valencia: https://www.themayor.eu/en/a/view/a-3d-zebra-crossing-to-be-painted-in-almussafes-in-the-valencia-region-988.

Implementation requirements included securing the budget and establishing the need for and acceptance of the technologies. Participation in European Mobility Week, encouraged by SUITS involvement, helped to raise the profile of safety and sustainability with citizens.

The municipality is also aiming to promote renewable solar power energy resources as part of this transport measure. Although the installation of the crossings was delayed due to the coronavirus pandemic crisis, the scheme gained the support of the new Mayor and it was expected that two smart pedestrian crossings (one ordinary and one 3D), would be completed in the first months of 2021.

Outcome and Impact

Kalamaria was able to combine a focus on safety for vulnerable groups with its goal of raising public visibility of road safety and sustainability. There was an increased level of safety and a reduction of injuries/fatalities at the new crossings. The innovative solar powered beacons are very visible, as they are sited near the crossings, so will promote innovation in sustainability and urban mobility to the public. The pedestrian crossings initiative shows a valuable combination of citizen participation, public visibility of transport measures and promotion of innovation in sustainability. It is hoped their public visibility alongside support from the new Mayor will in turn lead to a higher probability for widening this transport measure.

Coventry—Strategic Programme: Community Speedwatch

High vehicle speeds in urban areas pose a safety hazard to vulnerable road users, but speed limits need to be actively enforced and drivers' awareness raised to ensure compliance. Community Speedwatch (CSW) is a national initiative in the UK where active members of local communities join together, supported by the police, to monitor speeds of vehicles using speed detection devices such as speed guns, speed cameras and tablets. Vehicles exceeding the speed limit are referred to the police with the aim of educating drivers to reduce their speeds. In cases where education is blatantly ignored and evidence of repeat or excessive offences is collated, enforcement and prosecution follow.

In Coventry, the scheme has been implemented alongside safety and security awareness campaigns and speed zones strategies and is further enhanced using state-of-the-art technology for better accuracy. The CSW online platform[10] provides CSW groups and local police with training and a range of tools for making community involvement more efficient. It also produces a range of feedback notifications and collates statistics useful to both the police and neighbourhood groups. The statistics cover case status, live offence rate and volume reports of repeat and excessive speeding. Amongst many other functions, it also keeps track of operator accuracy and interactively engages practitioners in online training to increase their efficiency.

Challenges and Lessons Learned

[10] https://www.communityspeedwatch.org/,(accessed 07/09/2020).

Some input from Coventry City Council staff was initially required to disseminate and promote the scheme, but no extra staff were needed. There was some initial opposition from vehicle drivers, but despite this, public acceptance overall was high, and citizens were extremely positive about the scheme, making continuous requests to extend the scheme to more areas within the city [22].

Outcome and Impact

The benefits in fewer accidents, reduced fatalities, improved quality of life and public awareness, balance well against the relatively small funding cost and fast implementation. This is a community-led project that is scalable to larger or smaller cities and was shared within the SUITS project as a good practise. Funding came from local funds and only three months is needed from traffic zone planning to equipment purchase, training and implementation. It has created a framework of cooperation between the local authority, police and the public, which can lead to future cooperation.

9.3.4 Safety and Security (Rome, Valencia and Dachau)

Promoting safety and security for all was a constant theme in the SUMPs of our partner cities and many of the transport measures implemented during the SUITS project. In the previous section we outlined some examples showing an increased focus on providing safety for 'vulnerable road users' in particular pedestrians, including older people and children, through traffic calming and pedestrian areas. In this section we explore examples which focussed on a broader theme of road safety, especially for cyclists, and on providing an infrastructure to promote the safety and security of cycling and make it more attractive. There is some overlap with the themes in the previous section. Here, we focus on three examples from Rome, Valencia and Dachau. With the COVID-19 pandemic, 'safety' gained a new meaning, in terms of providing less crowded city space, discussed here in the Rome example.

Rome—Strategic Programme: Improving the Bicycle Network for Safer Cycling

In all corners of Europe, cities face alarming levels of congestion and air pollution and a scarcity of public space, whilst urban environments remain dangerous for vulnerable road users. Cycling is a powerful way to address these challenges and steer cities away from dominance of private cars and towards being more sustainable, equitable and economically prosperous places for citizens. Rome's SUMP includes actions to increase active mobility as well as to better integrate these transport modes with public transport.

As a consequence, Rome's SUMP includes key initiatives to promote cycling, bike sharing and bike parking, partly developed through the lifetime of the SUITS project.

Rome extended the city bicycle lane network, two bike lanes were completed along major routes (3.6 km opened June 2019, and 2.2 km planned during first

half of 2020) with another of 5.8 km still under construction. The SUMP reference scenario (interventions already financed) expects 91 km of new cycling routes in the next three years, while the SUMP scenario plan (a 10-year plan not yet financed) includes a further 304 km of new cycling routes.

Education campaigns and activities took place to raise awareness about road safety and cycling, particularly aimed at young people. Standards and incentives have been developed for parking bicycles in common spaces and the creation of local cycling networks, together with continuous repair and development of the main cycle network. In addition, 2,600 parking stalls for bikes have been installed.

Intermodality will be promoted by combining cycling with public transport in multi-modal hubs, providing integrated facilities enabling users to organise modal exchange between private cars, public transport and bikes or electric vehicles, with bicycle parking in exchange nodes; bike sharing and transporting bikes on public transport. The hubs are planned (for example a 69-hub bike park) but not yet implemented at time of writing, dependent on budget availability.

An Uber service for bike sharing with 2,700 electronically assisted bikes (e-bikes) began at the end of 2019. Due to COVID-19, the operation of this has not yet been assessed. A five percent modal share for cycling is estimated for 2022 [17].

Challenges and Lessons Learned

With the COVID-19 emergency, the Rome Administration is focussing even more on 'intermodality', as travelling by private car may be perceived by citizens to be 'safer' than public transport during the pandemic. The challenge is to minimise the use of cars with a set of innovative measures, like the extension of sharing systems, launch of new micro-mobility services, large use of smart working, different regulation of city hours, opening times and related duration of activities to avoid the typical 'rush hours', avoid crowding and enable implementation of social distancing. These measures are complemented by another special set of implementations to encourage cycling and walking:

- Implementation of emergency cycle lanes of 150 km based on SUMP bike plan.
- Local measure to promote active modes, especially for movements below 5 km.
- Incentives for the purchase of electric bikes.

The establishment and construction of these new routes on the main streets of the city and on other 'strategic' itineraries will encourage safe, active and sustainable mobility in the later phases of the health emergency, and beyond.

Outcome and Impact

The new cycling infrastructure developed during the period of Rome's engagement with the SUITS project encourages more sustainable active mobility along with numerous health benefits associated with less pollution and increased physical activity in walking and cycling. Rome was already aware of these benefits through its earlier involvement in specific projects such as PASTA [23]. The new cycle routes offer a viable alternative to the use of private cars, especially for short journeys

less than 5 km, and they will be integrated with public transport, by creating a network of cycle lanes mainly on the right-hand side of the roadway that is both inter-connected—and safe.

Valencia—Strategic Programmes: promoting Safety Through a 'Bike Culture' and 'City 30'

Since 2015, when changes in local government provided political endorsement to begin implementing its 2013 SUMP, Valencia has developed many activities directed towards creating a city with more active travel and sustainable transport. This included many activities to raise public awareness, creating participatory instruments such as the 'Mobility Round-table', new cycling lanes, creation of a better cycling network or 'cycling ring', reclaiming public space through pedestrianisation in specific areas, calming down transit, communication campaigns, workshops and collaboration with stakeholders. These measures were particularly focussed on improving safety in the city for pedestrians and cyclists. The measures described here were carried out with support from the SUITS project and feature initiatives to create a 'bike culture' and the implementation of 'City 30' speed limits.

A specific communication strategy was developed, communicating the SUMP sustainability plans and new regulations to citizens through two people-centric and user-friendly documents: a short booklet with key points about the SUMP, 'Towards a sustainable mobility in València. Policies and objectives in the area of mobility and public space of the City Council of Valencia', [24]; and also, a booklet providing the new Mobility Regulations in a friendly format "Keys to the sustainable mobility ordinance for living and co-living in the city of València", [25]. Encouraging cycling is an important part of the new transport measures and the city has created a special department called the 'Bike Agency' (*Agencia de la Bicicleta*) which plays a key role in communicating and promoting a 'bike culture' and providing information to citizens about the cycling network, [26].

An important milestone for the city and the Sustainable Mobility Service was the 'Valencia City 30' transport measure. This introduced a 30 km/h speed limit on streets with single carriageways in both directions, with taxi/bus lanes as additional lanes. In this way, practically all the streets in the inner-city neighbourhoods, or 64% of the city, are now safer and calmer with drivers respecting a maximum traffic speed of 30 km/h. Higher speeds are only permitted in the larger avenues, with two or more lanes in each direction, where up to 50 km/h is allowed but drivers are encouraged to give priority to pedestrians and drive with necessary caution to avoid accidents. This is one of the main innovations introduced by the new regulatory standard with a view to reinforcing road safety and quality of life in the city.

Challenges and Lessons Learned

In implementing these measures, and working within the SUITS approach, the Valencia team learned that planning and coordination are key when implementing sustainable transport measures, which often have inter-dependencies.

Many groups were involved in the road safety consultations, involving meetings with different entities such as the Local Police, the Municipal Transport Company (EMT), Ferrocarriles de la Generalitat Valenciana (FGV), as well as neighbourhood associations and other areas of the City Council de València. The outcome was a new Road Safety Master Plan 2018–2023, which outlines eight strategic directions to alleviate deficiencies and reach common mobility objectives.

The eight strategic directions seek to improve safety conditions in pedestrian mobility, cyclist mobility, improve the urban road network and calm traffic, improve control and monitoring of road discipline, as well as management mechanisms, education and training, promoting participation and dissemination in road safety and promoting the use of sustainable transport.

A change of mind-set from both government and citizens was required in order to implement City 30. Communication and citizen engagement were essential, to avoid potential opposition and misunderstanding, while there were additional challenges such as lack of budget, human resources and dealing with bureaucracy.

Outcome and Impact

The development of an improved cycling infrastructure has helped to calm traffic, improving road safety for all, while the cycling ring has had a multiplicative effect in promoting the adoption of cycling as a feasible alternative. City 30 is expected to reduce accidents and limit severe casualties with an ultimate aim of reducing fatalities to zero during the coming years.

The Road Safety Master Plan for the city of Valencia 2018–2023 has played an important role in this strategy and consolidates the efforts to make Valencia a safer and more sustainable city for its citizens. This plan was drawn up in line with the EU objective to halve the total number of fatalities on the roads of the European Union by 2020, with the aim of zero road deaths in line with 'Vision Zero' [21].

Valencia continues to work on many projects including improving the cycling network, pedestrianisation of Valencia City Council Square and redesign of the main commercial ring road, [26].

Dachau—Strategic Programme: 'Dachau Thinks Ahead'—Citizen-Oriented Urban Planning/Using Participation Techniques To Gain Citizen Engagement

Dachau was a 'follower' city in the SUITS project, and therefore not obliged to participate in any of the project work, although taking part in the benefits of attending at workshops and receiving information produced by the project. Like many small-to-medium-sized cities, Dachau struggles with traffic congestion, especially because a busy main road runs right through the middle of the city. In the transport/mobility area, Dachau's goals are to achieve improved safety and security for road users, and to improve the cycling network.

In this case study, we show how Dachau used citizen participation techniques to engage citizens in these goals, as part of a wider 'urban planning' initiative. While this example has a wide focus of which 'safety' was only a part, we have included it here, because it highlights how a small city can use participation techniques successfully to harness citizen buy-in for sustainable mobility measures.

The city has been focussing on citizen participation in its urban planning for several years and the 'Dachau thinks ahead' programme was launched in 2018 with concepts very much in line with SUITS' approach to citizen participation. The aim of the programme is to involve citizens at an early stage in the considerations of future urban development and to jointly develop a vision for the city. Citizens are called upon to actively participate in the development of a model and the planning of concrete transport measures through suggestions and ideas for improvement.

In the first participation module, citizens were asked to mark ideas, suggestions, criticisms, and possible solutions on various fields of action by using an interactive online map on the city's webpage. Within three months, almost 2100 entries were made, some of which were of very high quality. The results were assigned to the corresponding thematic fields: mobility, nature, urban design and public space, housing, economy and jobs, sport and leisure, urban technology, education and social infrastructure, culture and environment. Most of the contributions related to the broad topic area of transport/mobility (56%). Here, participants' suggestions focussed on improving public transport, reducing the high level of 'transit' traffic and improving conditions for cycling—in which safety plays a major role. (In second place with 13% was the thematic field 'nature'—which can be perceived as having broad links to sustainability and quality of life).

In addition, working groups were set up involving members of the city council, the city administration and various interest groups to develop the guiding principles of the city's vision. The presentation and discussion of the results with the citizens was accompanied by a large social event (workshops, music and childcare). At this citizens' workshop attended by almost 300 people, another 350 contributions were made by the participants on the various topic areas.

Challenges and Lessons Learned

The 'Dachau thinks ahead' public participation campaign was very different from the 'classic' participation approach, where schemes are presented, and citizens are asked to provide feedback and suggestions. Rather, the aim was to involve the citizens at an early stage, even before the concrete planning, and to take their problems and wishes into account in the development of overarching guiding principles for urban planning.

The organisation of such a participation process and communication with the public at different phases involves a huge amount of work for the local authority. The unlimited support of the city administration staff was an important factor, particularly as the public events took place mainly in the evenings or at weekends. Good moderation is important for the success of such events, as a big challenge is to guide participants and motivate them to contribute. The events were well received, and the citizens participated very actively in the different phases and events.

Besides the citizens, the involvement of different stakeholders (representatives of interest groups, associations, politicians, council members, planning experts, etc.), and their activities in different working groups was another key success factor. The early and active participation of interest groups in the development of guiding principles and concepts helped to enable a very broad consensus to be reached, which led

to a perception of less intense resistance to the implementation of concrete measures at a later stage. In the council decision-making meetings, in different situations, it became clear that many aspects had already been clarified and agreed during the campaign. Thus, excessive discussions on decisions and possible adjournments of council meetings could be avoided in many cases, enabling progress to be made.

One project that was inspired by the contributions of the citizens is the so-called 'Parklet', which was implemented as a fast way to collect feedback. The Parklet (see Fig. 9.3) is a mini-garden, replacing two parking spaces in the city centre and offering seating and additional parking facilities for bicycles. It has a feel-good factor that offers space for creative ideas, for example it contains an 'idea tree' where people can leave behind messages, about urban mobility issues. Citizens are encouraged to not only make suggestions but also to change their own mobility behaviour and to communicate this to other citizens, leaving messages on the tree [27]. At the same time, it should raise awareness of how much space a parking space takes up and how it can be used alternatively.

The Parklet was received very positively and resulted in a total of about 150 contributions—interestingly much of this feedback was received from children and young people—a group often left out of consultation but important as vulnerable road users, pedestrians and cyclists. Their large participation is mainly due to the location of the Parklet very centrally in the city and next to an ice cream shop. The Parklet is mobile and will be set up at other locations in future.

Outcome and Impact

The major outcome of the 'Dachau Thinks Ahead' initiative was the development of a vision paper, serving as the basis for the new land use plan, and which was unanimously approved by the city council at the end of 2019. In addition, a strategy

Fig. 9.3 Dachau's 'Parklet', *Photo* J Hoffmann

to promote more cycling was introduced through a new 'Cycling Concept' in 2019, within which 10% of Dachau's citizens are expected to switch to the bicycle in the foreseeable future.

Delegates from SUITS partner Technische Universität Ilmenau (TUIL) worked with the city, assisting with the initiatives, and contributing information on several mobility topics, including input to the planning of a car-reduced district with enhanced safety through fewer cars. The new residential quarter will feature reduced car traffic, residential garages (so less on-street parking), efficient urban freight delivery and greater pedestrianisation—moving towards a car independent lifestyle.

Particularly in this last example, the participation of citizens has enabled greater understanding of needs and issues, and an agreed solution, which will provide a concrete example of a pedestrian-safe environment, hopefully paving the way for further traffic reduction measures.

The results of the intensive participation were set up as an exhibition in the foyer of the town hall, while the ongoing process of engagement and feedback continues through such initiatives as 'The Parklet'. This participative approach can be targeted at further initiatives over time. Dachau's experience (although not directly connected to SUITS activities) aligns very clearly with SUITS' approach that even small cities with comparatively low capacities can initiate extensive participation procedures, which are ultimately supported to a high degree by the citizens – and that this brings benefits in helping to define and gain agreement of a vision for sustainable transport programmes.

9.3.5 Intelligent Transport Systems and Services (Kalamaria, WMCA and Coventry)

During the lifetime of the project, most SUITS partner cities were implementing transport measures to integrate smart information and communications technology with transport infrastructure, vehicles and users aiming to improve traffic flow and reduce 'churn' through smart parking. Common challenges include coordinating input from multiple partners with different skills, achieving 'buy-in' from both citizens and municipalities and long-term planning. These are seen in examples from Kalamaria, in smart parking management and steps to optimise vehicle travel time through a real-time traffic information system, and from the UK West Midlands region, developing a testbed for autonomous CAV on public roads. An additional example is included from Coventry with the trial of an iVMS 'smart tech' traffic flow system and a mobile App to connect with drivers.

Kalamaria—Strategic Programme: Smart Parking Management and a Real-Time Traffic Information System

One of Kalamaria's SUMP goals was to optimise vehicle travel time to reduce congestion. In line with this the city investigated innovative technology, in smart parking

management and implementing a real-time traffic information system, which began through being the test city for the MyPolis Live platform. We present the key points below.

Smart Parking Management

In line with its goal of investigating innovative technologies, Kalamaria is developing a sensor-controlled parking management system, to optimize usage of urban parking spaces and to reduce traffic churn generated by 'park search' driving.

Requiring coordination between several different groups of municipal staff and with European funding, the sensor-controlled parking system went through the planning stage and was put out to tender, extended to the end of 2020. The system is planned to consist of 150 smart parking spaces, planned for three roads in the commercial centre of the city, equipped with on-street sensors which measure the occupancy of the parking lots, and send this information to a system that can be used by drivers to find a vacant parking slot.

Using a Real-Time Traffic Management System for Intelligent Waste Collection

Collecting and using historical and real-time traffic data enables municipal staff and drivers to have access to intelligent features such as estimated arrival time and accurate routing allowing them to make informed transport assessment and planning decisions. However, the collection of this data can be a costly exercise.

Kalamaria participated in the pilot of the SUITS MyPolisLive platform,[11] (developed by SUITS partner SBOING), investigating the use of crowd sourcing as a low-cost solution for small-medium sized Local Authorities to capture, visualise and use traffic data and produce guidelines for implementation of such programmes, [28], (also see Chap. 12).

MyPolisLive was trialled in Kalamaria for four months from October 2018 until the end of January 2019, used by 50 assorted vehicles including city vehicles, taxis and company vehicles. The main target was the decrease of freight and passenger traffic with the optimization of the traffic flow. In addition, the platform can improve accessibility and economic development of the area by optimising the speed of distribution of goods, [29].

Challenges and Lessons Learned

Kalamaria's experience with innovative technologies has been one of incremental change. Initially, colleagues within the team were resistant to change, but this gradually declined as the programme progressed. A new municipality administration in September 2019 was a catalyst for getting new projects underway.

The parking scheme project required coordination between several different groups of municipal staff and also the use of innovative financing mechanisms. An early SUITS workshop held in Kalamaria indicated that participants from the trade transport sector had little awareness of the social and environmental impacts

[11] https://www.mypolislive.net/.

associated with the externalisation of freight transport. It was found that raising trade associations and citizens' awareness was important to overcome this [30].

In piloting the MyPolisLive crowd-sourced traffic management system, some issues were encountered with driver concerns and reassurance about data privacy, but once these were overcome, the pilot was very successful, providing data which enabled a reduction of traffic and in the number of trucks at peak times.

Outcome and Impact

The intelligent parking scheme showed a combination of visible benefits to drivers, through reduced driving time and a better driver experience, together with a better quality of life for all citizens through reduced traffic congestion, reduced emissions and better safety.

Following the successful MyPolisLive traffic management trial, Kalamaria is planning to use the system for its fleet of waste collection vehicles, developing a real-time information system for waste collection within the municipality. This will be used to control waste collection vehicle routes and to optimize travel times for the municipality's fleet of 127 vehicles (including waste collection trucks, construction vehicles, buses and municipal passenger cars).

Through using the platform, Kalamaria aims to reach the following goals:

- Reduction in operational costs
- Decrease in air pollution during peak traffic freight hours
- Optimization of waste collection in the municipality's boundaries
- Reduction in traffic nuisance
- Reduction of costs in vehicle maintenance through reduced mileage

Success will be monitored through measurement of travel time and optimization of travel routes. Discussions with the new municipality's administration are in progress regarding how to use and benefit further from the platform. Kalamaria ran an open international competition for the implementation of the real time information system during 2020 and announced a contractor in January 2021. The project is expected to complete by the end of 2021.

The trial of the MyPolisLive traffic platform helped all stakeholders to visualise, understand and manage traffic data. It is a cheap and cost-effective system for smaller municipalities to improve their traffic conditions, thereby reducing vehicle pollution and energy consumption and finally to improve their citizens' living standards.

Kalamaria's combined transport measures indicate how embracing new technologies can lead to realisable benefits on several levels, both for the municipality's own duties (such as in waste collection and fleet management) and in terms of raising public visibility of new technology and promoting the profile of sustainability to citizens, which we outlined in the earlier example of highly visible smart and solar powered crossings.

West Midlands—Strategic Programme: Testbed for Connected and Autonomous Vehicles (CAV) on Public Roads

There is a long history of mobility innovation in the UK West Midlands region, and the motor vehicle industry still forms an important part of the region's economy. The exciting and developing technology of Connected and Autonomous Vehicles (CAV) offers the opportunity to address the familiar challenges of poor air quality, congestion, and safety concerns in the West Midlands, and elsewhere, through more efficient and safer use of the road network. In the West Midlands region, it also helps to nurture a local industry to develop new technologies which can be exported around the world, driving economic growth.

Coventry City Council has experience in various innovation projects trialling connected and autonomous vehicles. The UK Autodrive[12] project, aimed to integrate connected and autonomous vehicles in a live real-world environment and involved trialling autonomous vehicles and electric autonomous 'pods' on live streets of Coventry. The trial included challenging areas of shared space environments. UK CITE[13] created a living lab environment for companies in the CAV industry to test how vehicles interact with V2V, V2X and V2I,[14] various modes of communications infrastructure on the roads of Coventry, Highways England roads and a Jaguar Land Rover test track.

These projects enabled Coventry City Council to develop deep collaborations with a range of different parties in the industry, including local universities, vehicle manufacturers, technology suppliers and provided prior experience for the WMCA CAV Testbed project.

The Midlands Future Mobility CAV Testbed aims to provide a real-world environment for the testing of Connected and Autonomous Vehicles on public roads in the West Midlands, connecting Birmingham, Solihull and Coventry. The project has an overall budget of £25.3 m, made up of a mix of public sector funding from Innovate UK and private sector contributions from the project partners. Once the initial development is complete, the testbed will continue into an operational phase for 8 years.

The testbed covers 80 km of public road, representing the largest public road test facility for CAVs available in the UK and all phases of work were scheduled for completion in 2020. The physical infrastructure includes deployment of specific CCTV cameras to enable the monitoring of CAVs during on-road tests; roadside units to enable communication between test vehicles and road infrastructure; weather stations and global navigation satellite system (GNSS) correction equipment to provide accurate positioning information to users of the test facility.

Through its involvement in the project, Transport for West Midlands (TfWM) can give the project access to the required public assets, such as Urban Traffic Control systems. This also enables TfWM to be at the forefront of the development

[12] http://www.ukautodrive.com.

[13] https://ukcite.co.uk/.

[14] vehicle-to-vehicle, vehicle-to-everything, vehicle-to-Infrastructure.

of CAV technologies in the region and helps to ensure that the organisation addresses challenges relating to safety, air quality improvements and congestion reduction.

The project aims to:

- Make the West Midlands an attractive and internationally recognised destination of choice for companies looking to research, develop and trial CAVs and supporting technology.
- Accelerate development of SAE Level 4 + CAVs (those that can detect their surroundings and operate without user input).
- Offer insight to TfWM and other public sector agencies about the infrastructure change and investment required for future mobility services on roads.
- Offer insight in policy and regulation that may be required for CAV, ITS and mobility service provision

Challenges and Lessons Learned

On commencement of the WMCA CAV Testbed project, the requirement for a central data-hub was recognised, allowing for the storage, reception and distribution of desired datasets. One of the main challenges associated with the data-hub was the identification of relevant and desirable datasets and receiving them in a suitable format. An example of this is Traffic Regulation Order (TRO) data, which defines any regulations and restrictions on specific roads. Existing means of storing data vary widely across and within local authorities in the region, requiring standardisation to make this data useful to Testbed customers.

The project required extensive collaboration with a range of partners from across the public, private and academic sectors, sharing different areas of expertise and working together towards a common goal. To deliver a project such as this, local authorities need to establish and develop collaborative relationships and sustain these after individual projects have been completed. Local authorities are well placed to act as coordinators and facilitators of consortia, bringing a wide range of parties together.

The support of national government is also crucial for such a large project. The UK Government is committed to positioning the UK as a world leader in the field of CAVs, and as such Government funding has been made available to support projects in this field.

Outcome and Impact

The completion of this project will strengthen the West Midlands as a leader in the provision of innovative technology and infrastructure projects, creating economic growth within the region.

The Midlands Future Mobility consortium has been successful in winning a further £7.9 m of government funding to extend the CAV Testbed into rural and inter-urban roads. This extension will turn the testbed into a 300 km test environment offering vehicle manufacturers and technology providers the chance to test vehicles and technologies in a range of settings.

TfWM is also leading a consortium delivering the ConVEx project, (Connected Vehicle Data Exchange), funded by Innovate UK and running from 2019–21, which will deliver a facility for open and commercial sharing of data resources relevant to CAV development and deployment. This facility will offer data cleansing and analysis, will draw together relevant datasets and explore connections that generate further insights into CAV development, deployment and operation and enable organisations to monetise data resources that may have previously been left dormant.

In 2019, TfWM was awarded £22 m of government funding to act as the pathfinder Future Transport Zone in the UK. This broad programme will build on the legacy of experience in the projects detailed above and deliver a wide range of projects aimed at translating innovations into services that the general public can use. These include an autonomous vehicle trial, trials of demand-responsive transport and MaaS, and improvements to digital infrastructure, such as digitisation of traffic regulation orders that will support future developments of innovative transport services in the West Midlands, [31].

The learnings from the SUITS project have supported TfWM in being able to deliver this programme. For instance, TfWM is delivering a package of transport measures in Coventry in collaboration with private transport service providers such as car hire companies. Furthermore, the experience from the SUITS project in relation to data processing has informed the technology choices that TfWM has made, as it has developed 'big data' processing solutions in collaboration with Amazon Web Services.

Coventry—Strategic Programme: Intelligent Variable Messaging System (iVMS) Smart Tech Traffic Flow

Coventry, like many other cities, has invested substantially in traffic management systems over recent years, including seeking to utilise new technology. Nevertheless, there was little to no active interaction between travel management systems, and 'managed interventions' within travel systems (for example, to respond to major incidents). These tend to be highly reactive, and 'blanket' in communicating to all users in a non-targeted way and requiring high levels of human resource to intervene.

As part of its vision of Integrated Mobility, and alongside its involvement in SUITS, Coventry initiated a project to develop, demonstrate and test new traffic management systems, with innovative iVMS technology, on three main road routes into Coventry; and to demonstrate the potential for a reduction in congestion in one section of the city.

The aim of the project was to receive constant real time traffic and journey data from strategically placed street infrastructure (Automatic Number Plate Recognition, Bluetooth Radar, CCTV, etc.) and 'connected vehicles' (including, potentially, their drivers' / passengers' smartphones), and then to use this data stream to manage the traffic system as a whole through traffic prediction and simulation models, and to provide live in-journey information and guidance to travellers regarding journey conditions, routes and alternatives. The system aimed to enhance travellers'

decision-making, with the potential to tailor information to the needs of specific user groups such as freight, commuters, businesses, etc., ultimately leading to reduced congestion.

The key objectives of the iVMS project were to:

- increase the effectiveness of traffic management in Coventry, leading to reduced congestion and associated economic and social benefits.
- encourage behavioural change by individual travellers in support of congestion reduction.
- provide an enhanced testbed environment for future development of vehicle technologies and transport systems.

The project was coordinated by a consortium of partners from key corporate and academic institutions within the region [32].

A sustained period of upgrade and development provided new 'on-street' traffic signalling and communications equipment and capability (ANPR cameras, Bluetooth Radar sensors, loops detecting vehicles, cloud-based technology, etc.) and their integration with existing, and upgraded, communication systems in order to improve the level of communication between on-street devices and the existing Urban Traffic Control (UTC) system.

The system upgrade focussed on making real-time information available to drivers of vehicles and systems, on journeys through selected corridors—entry, exit, route, speed of travel, etc.,—and the capability to manage these [33].

A mobile phone app was developed as part of the project by partner SGIL and underwent a series of 'on-road' trials to ascertain the app's readiness and effectiveness to provide real time information to users during their journey. It was made available to download in November 2017, but due to a number of limitations related to the nature of the project and external factors, was not taken up or tested further.

Challenges and Lessons Learned

The project created the infrastructural capacity and the tool to encourage behavioural change. While the upgrade to infrastructure was a beneficial investment for the future, the iVMS app itself did not have the resource, expertise or time to be tested in a meaningful manner. The app failed to gain usage amongst its target set of drivers, mainly due to a lack of incentivisation and associated marketing. Factors limiting the take-up of the app included:

- the app was only available for Android phones (due to project resources)
- the app's journey planning features were limited to a suggested route and time of departure
- its emphasis on 'peak spreading' objectives acted as a disincentive to individual take-up
- the app was aimed primarily at commuters into Coventry, and the intended take-up incentives (such as prize draw rewards of free parking) were not secured such that the consequent behavioural change was underestimated by the project

- the emergence of other travel-planning apps in the region
- legal changes concerning the use of mobile devices whilst driving, also impacted upon the inclusion of incident reporting.

In conclusion, an app is in place which could change individual journey behaviour, but it has not been launched in a manner to fairly test its ability to do so, and its proposition of behavioural change through gamification and incentivisation remains untested with individual travellers.

Outcome and Impact

Although the behavioural change aspects of the app remain untested, the iVMS project has achieved an upgraded and better integrated traffic management platform that provides the infrastructure and capacity for targeted traffic management on the designated corridors. The capacity now exists, and has been tested, for traffic management strategies and operational decisions to be implemented, in real time, and with subsequent data feedback loops providing 'impact of decision' information—although these traffic management plans and strategies are yet to be written and implemented. Modelling has identified the relatively small scale of driver behavioural change required on the individual corridors to achieve congestion benefits—essentially small numbers of drivers slightly spreading their peak journeys—providing further clarity on the business case for, and desired travel outcomes sought, from any future traffic congestion intervention.

More broadly, the project has substantially informed greater knowledge and understanding of the costs and benefits of scaling the traffic management system to the whole of the city, including the infrastructure, technical and operational challenges of achieving such an outcome.

The most substantial achievement of the iVMS project has been to develop and extend the local test bed environment for vehicle technologies (and related smart city activity) across a number of dimensions. These include:

- An enhanced traffic management platform generated under iVMS as the catalyst, integrator and leverage point for new research and service developments.
- The availability of new data streams is enabling Coventry University's Institute for Future Transport and Cities to undertake 'near blue skies' research into driver behaviour.
- The development of (regional) research partnerships, supporting a deeper and diverse intelligent transport ecosystem for the whole region.
- Further consolidated recognition of Coventry City Council as sitting at the heart of new developments in intelligent transport systems, with involvement in projects such as UK CITE, UK Autodrive, CATCH!, SUITS, PARK-AV and Urban DNA.

Overall, the project has provided an innovative model for traffic management technologies for the city, and a 'test-bed' capacity for future trials of innovative technology, which can be expected to support further local economic benefit to the sectors, businesses, and citizens of Coventry.

9.4 Conclusions

In this chapter, we have tried to give a flavour of how the local authorities in the SUITS partner cities were able to improve their capacity to plan and implement sustainable transport measures using the support of the project team, and the skills and learnings shared within the project. For more about how cities overcame challenges and learned new ways of working, through the organisational change required to deliver projects effectively, see Chap. 6.

Working together with partners in the SUITS project resulted in much shared experience and lessons learned together. A few shared experiences stand out:

- the importance of thinking long-term and across integrated transport measures.
- success through public consultation
- including highly visible transport measures to maximise citizen awareness and acceptance of sustainable goals.
- the need to mix technology innovation with policy innovation.
- working with a range of partners from other sectors, industry, business and academia to maximise and supplement gaps in skills and capacity
- finding new ways of working, innovating financing and procurement
- maximising the use of data through intelligent and smart transport systems.

As a project team, SUITS partners supported the local administration teams with information and mutual exchange of experience. From this SUITS partners learned a lot about the skills and knowledge requirements of the cities/mobility planners, which we were able to take into account in the creation of the Capacity Building Toolbox. The capacity building toolset is introduced in Chap. 7 and can be found at https://cbt.suits-project.sboing.net/.

In Chap. 18 we will examine the Local Authority perspective further with some of the challenges faced while working on EU-funded collaborative projects and lessons learned for the future.

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