THE ISSUE

Traffic Health Environment

Intelligent Solutions for Sustaining Urban Economies

nereus

network of european regions using space technologies

SPACE AND ICT APPLICATIONS SUPPORTING SMART, GREEN, INTEGRATED TRANSPORT AND URBAN MOBILITY

SEVENTH FRAMEWORK PROGRAMME

Project funded under the Regions of Knowledge

European Commission

PREFACE

This publication **"Space and ICT Applications supporting Smart, Green, Integrated Transport and Urban Mobility"** has been produced through THE ISSUE project in collaboration with NEREUS. It is a collection of 40 short case studies that illustrate the emerging role of new technologies in providing viable and sustainable solutions to many high priority problems that urban and regional transport authorities currently face.

The collection establishes the growing impact of new technologies, especially from the fields of Information and Communication Technologies (ICT) and Space Data Products and Services, in urban traffic management and urban mobility, including environmental and health impacts. The publication will serve as a key reference source on these topics for politicians, policy makers, CEOs in advanced technology companies and planners, alike.

ICT technology is a common theme in the research and development approach in over 80% of these case studies. Downstream space products and services are needed in over 50% of the studies to deliver the required solutions.

The collection is organised around six "Societal Challenge" themes which together address some of the highest priority objectives in traffic management and urban mobility, globally and particularly for THE ISSUE and NEREUS regional networks. New research and innovation through application of ICT and space technologies to these Societal Challenges will make major contributions towards delivering Smart, Green, Integrated Transport and socio-economic benefits of growth, jobs and quality of life to Europe's cities and regions.

The collaboration between THE ISSUE and NEREUS on this publication has several objectives; how to raise awareness of the potential of ICT and space data products and services from Galileo and Copernicus for positive impact in transport and urban and regional economies; how to provide a reference source of information to underpin regional, national and European policy decisions concerning transport and urban mobility for Urban Europe; how to mobilise public understanding and engagement of citizens with Europe's Horizon 2020 Smart, Green, Integrated Transport agenda. Hopefully, you will find many positive responses among the articles in **"Space and ICT Applications supporting Smart, Green, Integrated Transport and Urban Mobility".**

We hope you find this collection useful and informative

Yours sincerely,

Professor Alan Wells
Scientific Adviser THE ISSUE Project

Alain Bénéteau
NEREUS President

Supporting Remarks

"Looking ahead to Leicester's future, it is clear that making better use of the road network and improving air quality are both priorities for the city as a whole. This publication includes a number of interesting case studies from Leicester, which demonstrate the tremendous range of expertise which can be found here. They also provide evidence of the growing impact these emerging new technologies are playing in helping us to deliver on our priorities in traffic management, air quality and urban mobility".

Sir Peter Soulsby, City Mayor Leicester.

"Mazowieckie voivodship self-government is actively involved in the development of space technologies as one of the key sectors of development of innovation in the EU. Mazovia is one of the main founders of NEREUS. THE ISSUE project, which aims at integrating areas of transport, health and environment, has entered into the next stage of the dissemination of intelligent solutions for the transport system. This project provides an excellent example of cooperation between regions and creating a better future by scientific and research institutes, and by companies from Mazovia".

Adam Struzik, Marshal of the Mazowieckie Voivodeship.

"Aerospace Valley covers a territory that brings together the entire value chain of Space sector; from big players of satellite industry to a multitude of SMEs specialized in services and applications using space data as images or positioning signals. In this context, Intelligent Transport Systems and THEISSUE related challenges become a key field of activity for Midi-Pyrénées and Aquitaine regions since it represents a major development driver for the regional Space expertise".

Agnès Paillard, President of Aerospace Valley, Midi-Pyrénées / Aquitaine regions.

"The applications for space data are of growing importance in many economic sectors, including transport and urban mobility, producing important social and economic benefits. The industry sector is already active as a service provider to many users. We anticipate an important role for the downstream space industry, as a partner in THE ISSUE project, to develop innovative and cost effective operational solutions to the Societal Challenges that THE ISSUE project is focusing on".

Marcello Maranesi, Chief Executive Office, e-GEOS, S.p.A, Rome.

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INTRODUCTION

TRAFFIC, HEALTH, ENVIRONMENT: INTELLIGENT SOLUTIONS SUSTAINING URBAN ECONOMIES

Application of ICT and downstream space data and services for transport and urban mobility; a thematic signature of THE ISSUE project

THE ISSUE Project
THE ISSUE is a 3-year European Commission Regions of Knowledge project, funded through FP7, launched in January 2012.

THE ISSUE sets out to integrate, co-ordinate and exploit Research, Technology Development and Innovation (RTDI) across regions in Europe via a consortium of research clusters in the East Midlands in the UK, the Midi-Pyrénées and Aquitaine Regions in France, the Molise Region in Italy and the Mazovia Region in Poland. The research clusters are Triple Helix partnerships involving collaborations between business, academia and local/regional authorities. THE ISSUE partnership is already expanding with the involvement of eight other region; Andalusia (SP), Basque Country (SP), Calabria (IT), Attica (GR), North-West Region of Romania (RO), Northern Ireland (UK), Primorje-Gorski (HR) and Uusimaa (FI), who have joined as project associates as a step towards building their own research clusters.

The challenge
THE ISSUE has developed a "Model Programme for 2014-2020" for Research, Technology Development and Innovation (RTDI) for Traffic, Health and Environmental applications in urban and regional economies.
The Model Programme is a coordinated response to a number of global Societal Challenges in transport and urban mobility. It draws on expertise in the Triple Helix clusters of THE ISSUE partners and identifies new viable and sustainable solutions to many high priority problems that urban and regional transport authorities currently face.

Implications
The Model Programme concentrates on Societal Challenges within the Horizon 2020 theme of Smart, Green and Intelligent Transport. Six "Societal Challenges" have been chosen which address some of the highest priority objectives, globally, and especially for THE ISSUE regional network, where ICT and space technologies may provide added value to the smart, green integrated transport, agenda and the associated socio-economic objectives.

"The case studies featured in this joint publication with NEREUS provide clear evidence of the diverse and advanced research and technological developments in the field of traffic, health and environment that we have identified in the regions of THE ISSUE partnership".
Steve Dibnah, THE ISSUE Project Coordinator

THE ISSUE
Traffic Health Environment
Intelligent Solutions for Sustaining Urban Economies

The Societal Challenges being addressed are defined as follows:

• Intelligent traffic management systems addressing traffic congestion and its associated impacts on air quality, infrastructure and urban and regional environments;

• Monitoring and forecasting urban air quality and greenhouse gas emissions;

• Utilization, planning and optimization of urban and regional road networks;

• Urban transport, mobility, modal shift and interoperability;

• Transport safety, security and health in urban communities;

• Disruptive innovation for sustainable urban mobility.

An RTD Action Plan has been set out for each Challenge area. The Action Plan will deliver operational solutions to urban and regional end-users based on proven innovative solutions and RTD within THE ISSUE partnership. Close academic-industry partnerships and alignment with the transport strategies of city and local authority ensure a strong regional focus. Project activities are planned that will raise readiness levels of the core technologies through pilot studies and demonstration programmes.
Thus pre-operational roll-out will be delivered as key step to market readiness.

State of the Art
This publication is a collection of 40 case studies of research, development and innovation in action addressing transport and urban mobility issues. Each case study relates to one or more of the Societal Challenges and discusses current work and potential solutions available within the current technological and industrial landscape.

The case studies are grouped according to their relevance to the Societal Challenge definitions. ICT technology is a common theme in the research and development approach in over 80% of the case studies. Downstream space products and services are required, directly or indirectly, in 50% of the studies to deliver the required solutions. The contributions are geographically diverse, and spread between contributors from the industry, SMEs, research institutes, universities and regional development authorities.

Outlook to the future
THE ISSUE Model Programme, together with the associated Joint Action Plan, is designed to become a major contributor to the European Commission's Horizon 2020 programme under the "Smart, Green and Integrated Transport" Agenda. Economic growth and job creation at regional and local levels are key objectives and the Model Programme is the means of delivery.

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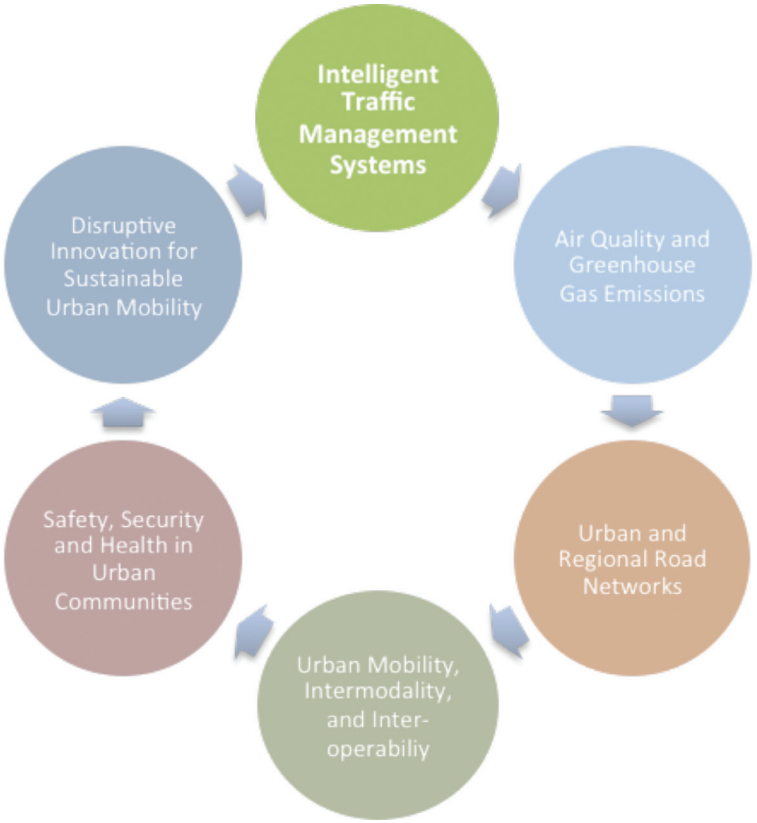
Societal Challenge 1



INTELLIGENT TRAFFIC MANAGEMENT SYSTEMS

The challenge:

Transport infrastructure is reaching capacity in many cities and regions. Management of demand requires better use of the existing infrastructure. Systems that deliver positive environmental impacts and facilitate urban mobility for users will be of particular value. ITS technology is an enabling technology capable of adding value to urban and infrastructure planning and contributing to safety and security of citizens.

The Response:

Research direction is to deploy ITS solutions to better manage existing urban networks and balance the impact of increasing demand. Areas of high RTD priority include:

- Advanced Urban Traffic Management and Control addressing congestion and traffic induced air pollution;
- Intelligent Traffic Systems for Safety and Incident Management;
- Intelligent Traffic Systems in Transport Planning.

cete du Sud-Ouest

Midi-Pyrénées/Aquitaine France

IMPROVING TRAFFIC CONDITIONS WITH A PRO-ACTIVE INCIDENT MANAGEMENT SYSTEM

Incident-related delays account for between 50 and 60 percent of total congestion delays

The challenge
Incident management is defined as the systematic, planned, and coordinated use of human, institutional, mechanical, and technical resources to reduce the duration and impact of incidents, and improve the safety of motorists, crash victims, and incident responders. These resources are also used to increase the operating efficiency, safety, and mobility by systematically reducing the time to detect and verify an incident occurrence; implement the appropriate response; and safely clear the incident, while managing the affected flow until full capacity is restored.

In most metropolitan areas, incident-related delay accounts for between 50 and 60 percent of total congestion delay.
In smaller urban areas, it can account for an even larger proportion.

The magnitude of incident-related congestion can be quantified by considering the total amount of non-recurring congestion.

Nowadays, research and development can directly bring technological solutions in terms of sensing and communications.

Implications
Many actors and stakeholders should be involved in such a project: Ministries of Transport and Ecology in France, local authorities, transport operators, notified bodies.

Figure 1: In most metropolitan areas, incident-related delay accounts for between 50 and 60 percent of total congestion delay

In France, and in Toulouse particularly, urban fast lanes around the city are managed by three different entities and the communication is far from easy.

For the moment, institutional and communication assistance are the weakest links of the chain. Some technical or non technical solutions are existing (CCTV surveillance, deployment of staff on the field), but these represent sparse solutions without any integration at a city level. Integration in a common project of the different actors (mayors, police forces, engineers, scientists, technical tools) is the goal to reach.

THE ISSUE solution
Research and development can directly bring technological solutions in terms of sensing (with telematic imaging, automated crash detection or wireless sensors for instance) and communications (machine to machine communications, wireless networks etc…).

Systems of incident management aim at proposing Pro-active Integrated Systems for Security Management by Technological, Institutional and Communication Assistance.

Existing methodology
Several partners within THE ISSUE project have the expertise to carry out such research. The technical component of the project uses a variety of tools to aid the automatic detection of a range of events. Additionally, the project will survey and assess best practice in prevention techniques and security management amongst European operators.

Incidents types
It is clear that mitigating incident impacts is critical to improving traveler and responder safety, transportation system efficiency and, indirectly, economic competitiveness. In order to understand how to minimize incident impacts, an understanding of incident types is helpful.

Incident management activities
Incident management entails an identifiable series of activities, which may be carried out by personnel from a variety of response agencies and organizations.
These activities are not necessarily performed sequentially.
For instance, motorist information is continually updated and typically disseminated throughout the duration of the incident while other incident management functions, such as clearance, takes place.
In any case, the incident management process can be characterized as a set of activities that fall into the following seven categories: detection, verification, information (to motorist for instance), response, traffic management, clearance.

The transportation solutions discussed within THE ISSUE project allow to cost effectively monitor and improve the operations, enhance safety, and rapidly respond to real-time conditions and emergency situations.

Outlook to the future
The stakes are very high in terms of lost time, safety, pollution, energy consumption, health of citizens The benefit is for the whole society. In the future we could plan to have, at a city level like Toulouse for instance, Advanced Traffic Management Systems and Intelligent Transportation Systems, Integrated transit control and information management system, advanced traffic management software.
The challenge for the future is to build up a system architecture, fully integrated without developing additional technological elements which are already existing.
Another challenge is also to develop a generic system which could be suitable to every city in Europe.
A demonstration project on one or several European cities (Toulouse is candidate for a first trial) to evaluate the global system should take place.

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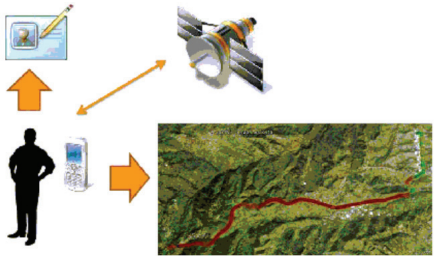
IMPLEMENTATION OF A COOPERATIVE ROAD FOR TRAFFIC SAFETY INFORMATION SYSTEM

A personal device, based on standard smartphones, has been developed, in order to improve the road traffic safety



The challenge

Safety in transport is a very topical issue, given the large number (millions) of deaths that occur each year in accidents involving all modes of transport. The social cost of road accidents in particular is therefore very high, both in terms of direct impacts on the people involved, and in general terms on the community.

Costs, in fact, can be measured in terms of health care and also by the impact produced by incidents on users of the road system and the external environment, expressed in terms of temporary deterioration of traffic flow conditions and increased travel times.

The safety of the system is, in fact, an attribute of the quality of the functional and economic transport service and is defined as the risk of incurring an accident of gravity assigned per unit of traffic.

Every effort must be done, in order to improve the road traffic safety.

Implications

The concept of social network can be applied to the management of traffic safety. The basic idea is to involve the user (drivers) in the process of referencing of the quality of transport services by road. In this way, through the use of a mobile phone, user can inform other users about quality of the service and dysfunctions. This information, appropriately conveyed through one or more platforms, may be available to various levels of managers and decision makers (road infrastructure managers, local authorities, law enforcement, vehicle manufacturers, fleet operators, infomobility services, and so on) and, subject to elaboration, to the same users, in order to disseminate static and dynamic information about levels of road network safety and possible management strategies (short and long term) aimed to reduce the impacts of road transport system on safety and environment.

"Provide for safe, reliable, and efficient movement of people and goods is the core mission of transportation systems and services".
Konstadinos G. Goulias, University of California, Santa Barbara, United States

THE ISSUE solution

The Project M2M - Mobile to Mobility, was funded by the Italian National Operational Programme Research and Competitiveness 2007-2013; the Project has developed four systems for acquisition, treatment and dissemination of data:

Personal Assistant Device Driver.

A dedicated software for commercial smartphone has been implemented, which carries out three different functions:

• assistance in navigation through the real-time communication of emergency situations and/or road sections with high accident rates (with an indication of the predominant risk factors);

• logging of data obtained from the user motion and/or activation of notifications in case of an accident;

• acquisition (on stationary vehicle or by foot) of risk scenarios.

Vehicle Device Monitor. Communication protocols for transmitting data from smartphone to a central system via the web in real time have been implemented; the system allows the acquisition of kinematic parameters and performance of the vehicle aimed at improving the road-vehicle interaction.

Dynamic Data Analysis. An open Database, accessible via the Web, populated by the data collected through the smartphone and other sources, supports many functions:

• analysis of user-vehicle interaction as a function of road environment;

• definition of driver behavioural profiles associated with the use of mobile information systems;

• development and validation of information relating to the quality of infrastructure;

• development and validation of cinematic-functional parameters related to driving conditions and road environment.

Interoperability Network Free Operated System. This system is devoted to the dissemination of free information for the end user on multi-channel mobile platforms (smartphone, mobile, etc.); web platforms (portals, blogs, etc.), social networks, etc.

Outlook to the future

In order to reduce accidents, networks congestion levels and atmospheric pollution, the mobility demand must be oriented towards sustainable transportation systems; an augmented share of collective transport in the mobility market constituting an efficient solution.

The application of ITS in the public transport sector allows the solution of various categories of decision problems, such as vehicle routing and scheduling, crew scheduling, fare collecting, and so on. The Mobile To Mobility (M2M) project may evolve toward Mobile To Transit (M2T) project, based on the use of cellular devices to understand the user desiderate, and offer transportation services tailored on the single user's needs.

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DE MONTFORT UNIVERSITY LEICESTER

East Midlands United Kingdom

APPLICATION OF NEURAL NETWORKS IN AIRPORT NOISE EVALUATION

Using measured local data from airports, we applied neural networks to evaluate noise distribution around airports

The challenge
Standard noise simulation tools cannot reflect the influence of certain local conditions that are not considered in a standard model.

Implications
As transportation hubs, airports comprise of many transport modes, including air and surface transport operations.
Changes in the magnitude of these operations tend to lead, directly or indirectly, to corresponding social and environmental changes, not least of which are employment opportunities and adverse environmental impacts. Therefore, it is important to know the likely scale and significance of environmental impacts if any operational changes are planned or proposed. However, it is not feasible to monitor each impacted location around an airport and the interactions

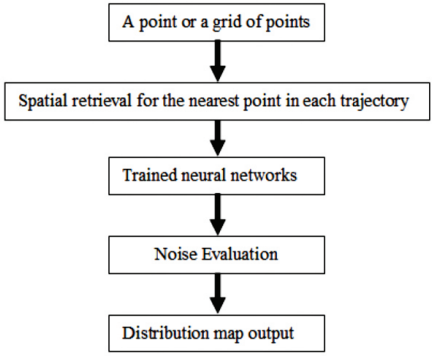

Figure 1: Neural networks for noise distribution in GIS environment

between the key factors are too complicated to enable reliable mathematical models to be developed. The standard models like INM are very useful in simulation analysis at a general level, but they do not incorporate specific local conditions, and thus the reliability of their results are subject to standardised assumptions regarding geographical and weather conditions. From this point of view, a location-specific model established with data from that site is likely to yield more realistic results although its generality is likely to be poor when compared with the laboratory model.
As part of our work on a decision support system for sustainable airport development, we applied neural networks as a mapping tool to establish the impact

"This approach to modelling noise offers a radically new way of thinking about and representing the effects of aircraft noise around airports".
David Gillingwater, Loughborough University

User Application: Multimodal Transport Planning Solutions

of aircraft noise in a GIS environment. A neural network trained with local data could potentially give better reflection of the local truth in noise distribution. It helps to reduce the potential conflicts between airport managers and local residents and has the potential to improve the operation at airports.

THE ISSUE solution
Neural networks approach such complicated functions by means of learning from data. Hence it is an applicable tool when training data are available. At those airports where awareness of the significance of environmental impacts like aircraft noise is increasing, more and more environmental data are monitored but collected only from a very limited number of geographical locations. These data can provide a basis for the application of neural networks. Traditional interpolation methods in GIS are not very helpful because of the spatial distribution of the very limited number of monitoring stations. Therefore, using a neural network is a better candidate in this case. The operation of neural networks in deriving the noisy distribution in a GIS environment is shown in Figure 1. For a trained neural network with data from a single aircraft type, output for some virtual flight trajectories is shown in Figure 2. The network was trained using

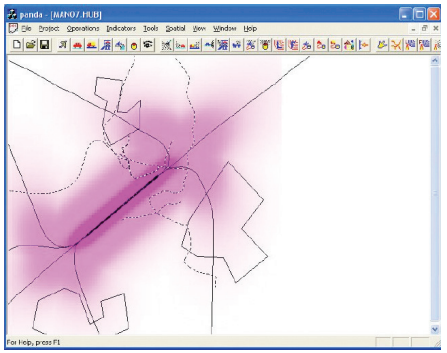

Figure 2: Noise distribution derived from neural networks

monitoring data from a large UK international airport right highlights residential areas subject to noise disturbance by this aircraft.

Outlook to the future
Computational intelligence has much more to contribute to sustainable transportation planning and management. Our research has successfully applied neural networks in airport noise evaluation, and we are going to extend this into transportation related emission and traffic volume evaluation and management under multiple modes where aviation, rail and road transport are considered together, especially for transportation hubs like airports. This work was undertaken at Loughborough University with Dr. David Gillingwater and Prof. Chris Hinde.

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ROMA TRE

Molise Italy

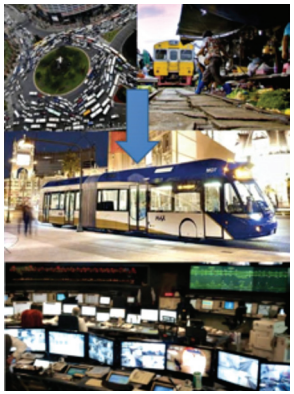
PUBLIC TRANSPORT PLANNING AND MANAGEMENT

Development of innovative tools to support planning and management of public transport services

The challenge

High social costs result from continuous growth in the use of private cars for urban mobility. Safety and health problems are linked to this transport mode. Shifting the modal split towards wider use of public transport makes better use of land, air and energy resources than individual transport modes based on cars. Opportunities exists to control the rising social cost of individual transport by introducing management policies and design frameworks that support modal shift actions. Design methodologies need to find optimal configurations for the public transport network in order to minimize the total costs of people mobility.

This challenge deals with design problems of the public transport services network and consists of determining optimal network configurations in terms of routes and service frequencies. Meta heuristics algorithms are used to minimize the total costs of the multimodal transport system consisting of: 1) travel costs for both private and public transport users; 2) operational costs of public transport services.



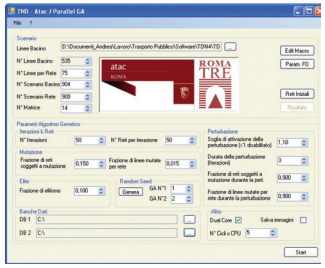
The solution is defined explicitly taking into account the variation of the urban modal split due to changes of public transport services.

Implications

According to the Green Paper on urban mobility (Toward a new culture for urban mobility, EC September 2007), quality of life in urban areas should be as high as possible, rethinking the question of urban mobility. There is no single solution to reducing congestion, however, alternatives to private car use, such as collective transport should be made attractive and safe. Responding to this challenge offers an opportunity to optimize the transport service capacity, respecting security, safety and costs and minimizing impacts on environment and population. Moreover, ensuring a competitive public transport industry results in benefits for transport users and providers and better value for money from transport spending.

"When the bus you are on is late, the bus you want to transfer is on time".
Murphy's law

User Application: Public Transport Information Systems



Graphical user interface for the transit network design tool

THE ISSUE solution

The first objective is the development of a procedure that simultaneously generates routes and frequencies of the public transport services in a real size area, characterized by (a) the actual complex road network topology, (not simply represented by radial or grid networks); (b) a multimodal public transport system (rapid rail transit, buses and tramways); and (c) a multi-modal transit demand. The design criteria are to develop an intensive rather than extensive network in order to improve efficiency, with integration of direct routes and effective transfer points. Service quality and journey experience are important selection criteria. As outputs, the tool provides a set of routes and their associated frequencies. This approach should also provide an innovative tool to test ways to increase efficiency and effectiveness of public transport supply in terms of service management. This is possible by evaluating the introduction of new service provisions such as cadenced timetable or time transfer systems. The evolution of operational research and greater capacity of computer technology together have created the opportunity of transferring innovation and new technologies to the public transport planning and operations industry. The software to implement this challenge is almost completed and a successful application has been carried out for the mobility agency of the city of Rome. The model application shows an increase of public transport services performance, with a reduction of operational costs of 20% and an increase of modal split of 2.5%.

Outlook to the future

For the future growth of the applications of the solutions presented, there is a need for development of cooperative tools for solving simultaneously planning and management problems. Such an approach offers a means of satisfying users needs for basic mobility and for providing more flexible transport solutions to respond to societal challenges. An additional effort has to be made from operators to increase the use of ICT and other technologies already available (automatic location systems, smart cards and ticketing systems). Important impacts are expected by the implementation of all innovations proposed but two main barriers have to be faced: a) the resistance to adoption of strong innovation to replace the standard transport solutions usually adopted; b) the greater interest, usually observed in the society, for investment in technology giving less importance to the planning of public transport service.

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PRIMO
THE WORLD'S FIRST MULTI-CONSTELLATION SATELLITE NAVIGATION RECEIVER

The challenge

Nottingham Scientific Ltd. (NSL) specialise in Global Navigation Satellite Systems (GNSS) applications development. GNSS facilitates improved safety of transport through the provision of accurate position and speed information of planes, vessels, trains and vehicles. The company needed to manage the hardware and software components of their products to ensure continuity of service, the ability to control the development and reduce manufacturing cost.

The challenge was to design a satellite navigation receiver capable of receiving data from all available SatNav constellations, including GPS (USA), GALILEO (Europe), GLONASS (Russia), COMPASS (China), as well emerging systems from other countries. The receiver must also be able to capture data from all Satellite Based Augmentation Systems (SBAS) that transmit corrections to SatNav data, including the European EGNOS system.

As all these SatNav systems have agreed to adopt a common standard, the task

Figure 1: PRIMO Hardware

was much simplified. However the objective was to create a device that could operate over a wide range of frequencies, ranging from the military SatNav signals available at 1227 Mhz, through the publicly available signals for GPS & GALILEO at 1575, and up to the Russian data which is found at 1602 MHz. Also as there are emerging systems, the design team had to design an electronic platform that could be easily upgraded to capture new data sources, by a simple software upload. Therefore the traditional approach of using a fixed frequency radio receiver was not an option.

Implications

The economic impact of this success story continues. As a direct result of this collaboration between NSL and DMU, and after just 12 months, the company secured substantial contract work to

"The KTP offers a unique opportunity for SMEs to access the state- of-the-art facilities that exist in UK universities. Put simply, the average SME cannot afford to invest in these facilities in terms of capital and training costs". **Mark Dumville,** General Manager

support further development work in the aerospace and info-mobility sectors valued in the region of £390k. Another year on and NSL are now in a position to sell the products developed during the project. Further benefits are:

• Annual turnover increased by £300k.

• A new spin out company is forming to exploit the new technology, creating jobs in the East Midlands.

• Won the prestigious Lord Stafford Award for Innovation in the East Midlands.

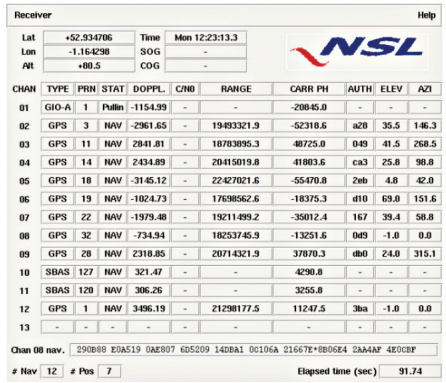

Figure 2: Data captured from PRIMO http://www.tech.dmu.ac.uk/~eg/GALILEO/

THE ISSUE solution

A collaborative partnership was set up between NSL Ltd and DMU, using a UK Government scheme known as a Knowledge Transfer Partnership (KTP). Using Software Defined Radio (SDR) a programmable GNSS receiver was developed capable of capturing data from all GNSS constellations conforming to the CDMA standard. The first prototype pictured here successfully captured data from GPS, GALILEO and SBAS systems.
The main advantage of using SDR is that system upgrades can be achieved by a software update.

Outlook to the future

NSL was the first, and as a result has continued to expand its business. Other companies are now marketing multi-constellation receivers, which will increase the commercial exploitation of data from the European GALILEO GNSS constellation.
Of particular technical interest is the use of SDR to provide the computational analysis to derive data from the raw satellite navigation data. GNSS is an expanding market, and we expect at least 4 constellations to become fully operational over the next decade. In addition new systems are planned by other countries, and there are also advances in Space Based Augmentation Systems, which provide corrections to GNSS data. Using SDR as opposed to analogue receivers means that devices can be adapted to receive emerging GNSS & SBAS data by means of software update. Thus the hardware design is protected from obsolescence.

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DE MONTFORT UNIVERSITY LEICESTER

East Midlands United Kingdom

COMPUTATIONAL INTELLIGENCE TO IMPROVE AIR QUALITY AND TRAFFIC MANAGEMENT

Computational Intelligence (CI) techniques are strong, efficient and capable of enhancing current traffic and air quality management systems

The challenge
Many cities face challenges with congestion and its associated impacts on air quality. Innovative solutions are required in order to overcome these challenges.

Implications
CI techniques, such as Artificial Neural Networks (ANN) and Evolutionary Computing (EC), enable systems to learn, adapt, and optimise even without any a-priori knowledge of the underlying system. Applying CI to the challenge of traffic congestion and its related impacts on air quality has substantial benefits. Rather than using a traditional reactive approach to traffic management, CI can predict and thus deliver solutions to most levels one hour in advance to the Airviro modelled data.

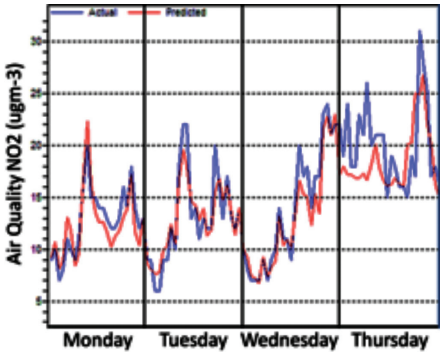

Figure 1: CI based forecast of NO_2 levels one hour in advance, compared to Airviro modelled

Predicted traffic and air quality values are then used by an EC algorithm to deliver optimised traffic management strategies. Improvements in traffic congestion will have large benefits on quality of life and the economy through reduced time and fuel consumption. In addition, reduced fuel consumption also lowers its related emissions of carbon dioxide and other pollutants. The related improvements in air quality will impact the health related problems such as respiratory problems which will be beneficial from a societal perspective, but also from a health expenditure perspective. The environmental benefits of improving traffic flow and its associated emissions are also substantial.
The political benefits of this come from working towards meeting the European targets for air quality and transport related carbon emissions. The regional transport policies of THE ISSUE partner regions all indicate a need for improvements in congestion and its associated effects on air quality.

Priorities for the partner regions include:
- Optimisation of existing networks
- Reduction of transport emissions
- Reducing impact of transport induced air and carbon emissions on health
- Improvement of the air quality.

Applying computational intelligence to congestion and air quality management will work towards meeting the regional and overall European priorities for mobility and air quality.

THE ISSUE solution
The use of CI in traffic management has been explored using the THE-ISSUE's triple helix approach. A consortium of universities, authorities, and a commercial prime has been formed to study and eventually exploit an Integrated Traffic Management and Air Quality Control System - iTRAQ.
A European Space Agency funded feasibility study was conducted in which the operational and commercial feasibility of this novel technology was demonstrated.
A prototype was implemented, shown to be capable of fusing existing data sources, forecasting traffic and air quality, and delivering solutions to emerging congestion problems before they formed (Fig. 2).
The project is currently in the process of being brought to market, delivering a fully integrated traffic management and air quality control system to users.

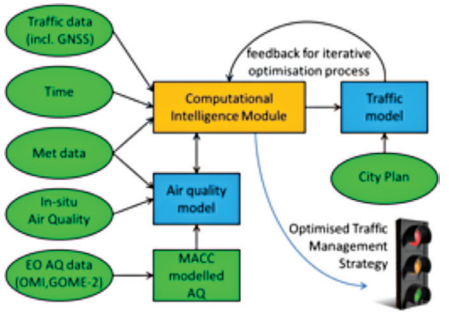

Figure 2: Overview of the dynamic iTRAQ system including the CI core and Earth Observation data feeds

Outlook to the future
CI provides advanced techniques that can solve a wide variety of problems. The next years will bring new "Big Data" based systems that combine existing data sets to provide better and completely new services such as personalised integrated multi-modal travel planners. CI will often be at the core of such advanced new systems.

"Computational Intelligence powered systems such as iTRAQ may well solve some of our most urgent problems we are facing in ITS".
Steve Dibnah, THE ISSUE Project, Leicester City Council

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CE-Traffic

Mazovia Poland

TRAFFIC INFORMATION FOR MASSES

Challenges and implication of implementation of RDS-TMC real-time traffic service in Poland

The challenge

Providing drivers with “on-trip” real-time, personalized traffic information is one of the key pillars of ITS. A driver who is well informed about traffic activity on his route, better adjusts his behaviour to road conditions and makes a positive impact on a general road user safety and comfort. Equal-opportunity in access to such services is generally provided to all road-users by the state, but this is not the case in Poland. CE-Traffic which is a regional, real-time traffic information provider for traffic management and high-end navigation systems decided to address this ISSUE and build an affordable RDS-TMC solution which could be used by drivers from all social-economic groups.

Implications

The TMC (Traffic Message Channel) standard allows the transfer of real-time traffic services to navigation systems over FM radio channels which is considered to be the most affordable means and therefore more accessible to users.

Although the technology has been in use for over a decade all over the world, the services are often not exploiting the full potential of the RDS channel.

The challenge of implementing the service was significant as public decision makers in Poland often underestimate the role of personal traveller information systems as part of ITS infrastructure. First of all there is no publicly available TMC Location Table, which is a reference system for traffic information. Secondly journalistic data generated by road authorities are neither standardized nor broadcasted in easily accessible way. Finally there is no publicly available information about traffic congestions.

“We looked at TMC solution with all its limitations and asked ourselves: how we can get more out of the technology that has been around for more than a decade”. **Jiří Novobilský,** CEO of CE-Traffic

THE ISSUE solution

In order to build the RDS-TMC which would bring true value to road users CE-Traffic optimized each component of TMC standard, starting with a new Location Table. It was designed to consider not only all major interconnecting roads and urban streets but also lower category roads commonly used by drivers e.g. shortcuts or alternative routes.

The second step was an implementation of a solution to capture, join and standardize journalistic data published by central and local road authorities.

The solution is coding every road event into the ALERT-C standard which allows for further broadcasting of the data. In order to deal with the limited bandwidth of the RDS channel the coverage of territory of Poland was divided in to 9 zones in order to deliver only geographically relevant data. The coded journalistic data is smartly fused with precise congestion data coming from a Floating Car Data system operated by CE-Traffic. Finally upgrading RDS infrastructure together with local radio partner allowed a solution to be created which broadcasts a high number of traffic messages country wide.

Outlook to the future

Personal traveller information services are an important part of ITS infrastructure, which have a significant potential to improve safety on the roads. Such systems should be an integrated component of ITS provided by the state with implemented standards of exchange of road data.

At the end the new RDS-TMC service has given large group of drivers in Poland equal opportunity to access CE-Traffic real-time services which was the aim of the project.

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ROMA TRE

Molise
Italy

DEVELOPMENT OF INTEGRATED SYSTEM TO MANAGE ROAD TRAFFIC AND ENVIRONMENTAL PROBLEMS BASED ON DTA MODEL

The challenge

Road vehicle emissions are an important aspect of the life quality and sustainability. The increase of congestion leads to an increase of pollutant emissions and, moreover, emissions are sensitive to different drivers behaviour. In this context, it is possible to reduce vehicle pollutant emissions, decreasing congestion with traffic planning policies and on-line operations. The aim of this challenge is to achieve reliable values of pollutant emissions in a wide urban network, taking into account the within-day variations of traffic conditions and parameters related to the different state of vehicles. This topic provides an opportunity for the implementation of an innovative management tool based on traffic simulation created to assess the pollutant emissions and to analyse impacts of different management policies and traffic operations.

Implications

This challenge is to reduce traffic congestion and thus air pollutant emissions. Such objectives respond to national and local priorities about the measures and the abatement of air pollution.

Moreover, from the social and economic point of view, the impacts will be to contribute:

- to build a balanced, dynamic and low-carbon economy by encouraging active and sustainable travel;
- to put more power into the hands of transport users by giving them the information they need to induce government and transport providers to account for;
- to reduce social and economic costs of transport to public health, caused by air quality impacts;
- to minimize the impacts of transport on heritage and landscape and seek solutions that deliver long term environmental benefits.

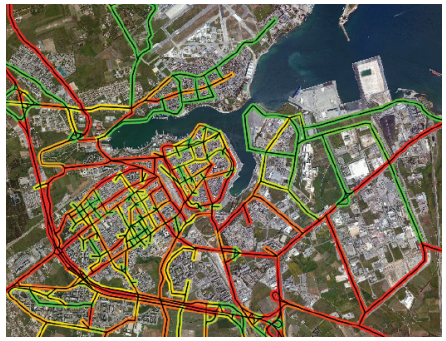

Figure 1: CO emissions simulation in Brindisi road network

From technical point of view the main implications are the development of a specific tool/software for large urban network and data collection of traffic flows and air pollution concentrations.

"In rebus quibuscumque difficilioribus non expectandum, ut quis simul, et serat, et metat, sed praeparatione opus est, ut per gradus maturescant".
Francis Bacon

User Application: Urban and Regional Road Networks

THE ISSUE solution

In order to estimate emissions, three different approaches have been defined in the last years of research: macroscopic, microscopic and mesoscopic. The macroscopic approach is based on the knowledge of aggregate variables and it is possible to estimate the emissions of all the network links. However the estimation accuracy is low. The microscopic approach can substantially improve the emission estimation, because it is based on the knowledge of parameters about the drive cycles of vehicles and related to the different traffic flow conditions. However, it can be applied only for small networks because of the huge data input needed. The developed dynamic mesoscopic emission model, based on a dynamic traffic assignment (DTA), provides reliable values of pollutant emissions in a wide network, taking into account the within-day variations of traffic conditions and parameters related to the different state of vehicles. These reliable estimations create the opportunity to develop an integrated system to manage road traffic, taking into account both the environmental problems and traffic congestion. In such a context, it is possible to reduce vehicle pollutants emissions, reducing congestion with traffic planning measures and on-line operations. According to the technology readiness level of relevant technologies for the system, the traffic simulation project successfully completed a first test simulation in two real life urban areas in Italy (Brindisi and Rome, see Figure 1 for example). Other technologies related to traffic sensors, GNSS application for mapping urban areas and remote sensing techniques for measures of air quality are at disposal and they have to be used in combination with the traffic simulation project to improve quality and usefulness of results.

Specifically, the adoption of this management system, at an operational level, is limited by the lack of a validation phase based on real data due to the modest presence of air quality sensors.

Outlook to the future

The potential benefits are for the whole society. About the future evolution of the research field, this could be involved in the implementation of best practices, of wide exchanging data between different platforms and the creation of specific tool for user information about air quality and impacts of local traffic policies. Moreover, the application field could be extended to the suburban network and to the specific network involving freight traffic. The major stakeholders could be the road network management companies as the regional and local authorities, who could be involved by widely dissemining information about the negative impacts of the air pollution and the growing constraining regulations governing air quality.

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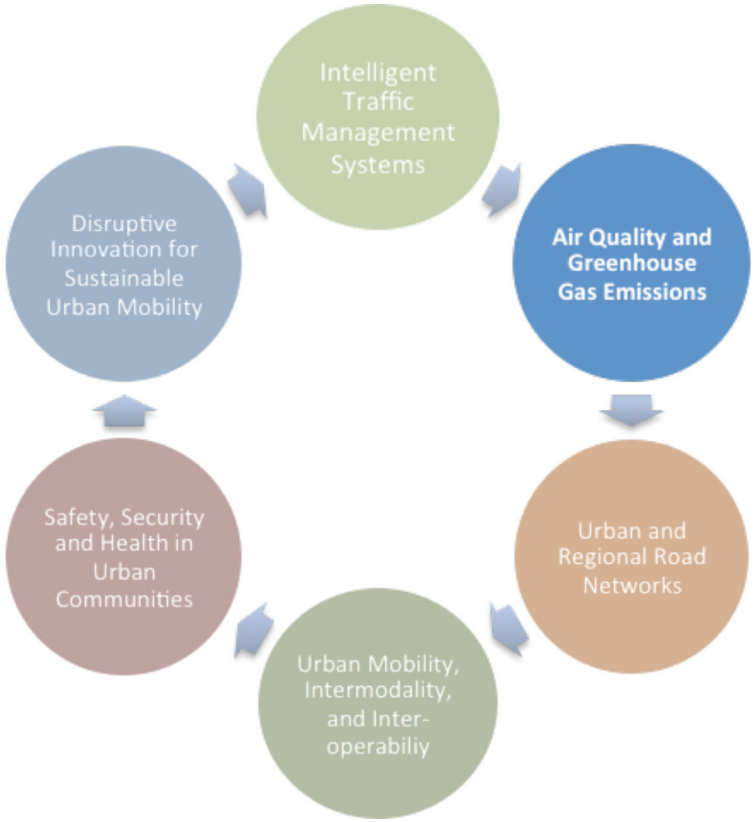
Societal Challenge 2



URBAN AIR QUALITY AND GREENHOUSE GAS EMISSIONS

The challenge:

Regional authorities and national organizations need local management strategies and technological solutions to meet EU directives and government regulations for air quality standards and greenhouse gas emissions.
Air pollution has very localized and adverse effects on human health, as well as flora and fauna ecosystems. Emissions from long distance HGV transport and urban traffic in congested towns and cities are major contributors of air pollution.
Climate change is linked to atmospheric greenhouse gases (GHGs), e.g. carbon dioxide (CO_2) and methane (CH_4), but traffic emissions account for 25% of GHG emissions across urban Europe. Whereas air pollution from traffic emissions is local and presents relatively short term problems which could be tackled through short term mitigation strategies, the climate change impacts are generally thought of as global and long term.

The Response:

Integrating new technologies from space, airborne and in situ sensors can improve identification of emission sources and provide new tools to support regulation of emission levels, such as:

- Integrated systems to monitor air quality and identify sources of emissions in urban environments;
- Satellite technology to determine greenhouse gas emissions;
- Sensor monitoring and model forecasting of emission levels.

Mapping Air Quality over Urban Areas

Advances in monitoring and management of urban air quality using ground-based scanners

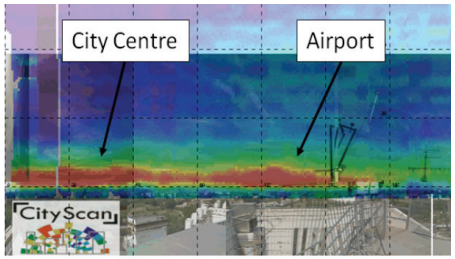


Figure 1: Data from the CityScan instrument, showing pollution above the City Centre and Airport in Bologna in June 2013

The challenge

Air quality is an international issue which has been the subject of several European directives[1] on pollution levels as, at high concentrations, atmospheric pollutants can have significant effects on human health, ecosystems and the climate.

As these effects can occur over a wide range of geographical dimensions, from the regional to global scale, air quality can be considered a truly transnational issue. In the UK, the main sources of air pollutants such as NO_X (NO_2 and NO), CO, VOC_S and particulate matter are motor vehicles and power generation[2].

It is becoming increasingly important to measure emissions and concentrations of these air pollutants, particularly in urban environments where particularly high concentrations are expected.

Implications

By improving knowledge of the emissions, transport and spatial variability of pollution within urban environments effectiveness and implementation of policies relating to air quality can be improved. Air quality policies must take the spatial and temporal variability of air pollutant into consideration. Models for emission sources and transport mechanisms are required to implement adequate air quality improvement measures. If individual emission sources can be identified, and their effect on areas downwind quantified, air quality reduction measures can be more focused.

THE ISSUE solution

Researchers at The University of Leicester have developed a novel technique for the measurement of air quality and specifically of nitrogen dioxide. This measuring instrumentation, called CityScan, offers unparalleled information on the spatial extent of nitrogen dioxide concentrations within urban environments. CityScan bridges the spatial gap between point source measurements and satellite air quality measurements, offering additional information on emissions, transport and the chemical cycle of More information regarding the CityScan technique can be found at http://www.leos.le.ac.uk/aq/cityscan.html.

Based on measuring scattered sunlight, CityScan records nitrogen dioxide concentrations over a full hemisphere every six minutes. Full hemisphere, high-rate measurements are best suited for emission and transport monitoring of air pollutants over city-wide scales. Using a single instrument, the structure of the urban boundary layer can be investigated, with valuable information on aerosol and NO_2 dispersion. Using multiple instruments, there is the potential for tomographic retrievals which could deliver 3D concentration information on air quality parameters down to 50m resolution. Such information would be a substantia CityScan has been deployed in both London (UK) and Bologna (Italy) during 2012. The London deployment took place as part of the large NERC funded ClearfLo project in January and July/August. CityScan was deployed in Bologna in June as part of the large EU project PEGASOS. Analysis of the results obtained from both campaigns will be used to obtain unprecedented spatial information about air quality, focusing in particular on differences between a relatively isolated mega city and a smaller city situated in a highly polluted region, in this case the Po Valley.

"Improving air quality is a top priority for us, and we would welcome the opportunity to meet with [the CityScan team] and talk some more about the project". **Rory Palmer,** Deputy City Mayor, Leicester

Figure 2: The CityScan Instrument installed in london during the Olympics in July 2013

Outlook to the future

CityScan instruments are currently deployed in Leicester and London, and data from these instruments will be used to develop new services for local authorities. Near-term developments will incorporate novel methods for data assimilation into 3D dispersion models, and use of such models in urban air quality management systems. Furthermore, the application of CityScan to detailed investigations of discrete major emission sources and downwind exposures is anticipated in the next 5 years.

References

[1] Directive2008/50/EC of The European Parliament and Council on ambient air quality and cleaner air for Europe (2008).

[2] AEA Technology for DEFRA, Air Pollution in the UK 2009 (2010).

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England's East Midlands

East Midlands United Kingdom

MONITORING AIR QUALITY TO ASSESS RUSH HOUR IMPACT ON SCHOOLS

Air quality sensors to measure pollution levels in school playgrounds and commuting zones

The challenge

Local Authorities are responsible for ensuring the air quality in cities, thus they must monitor and report levels of pollutants. Regular pollutant exceedances such as NO_2 are still common in many European cities[1] (EEA), and some communities will be more vulnerable to high concentrations from busy roads.

There are many primary schools in the most populated areas that are more exposed to busy roads. Focusing on some of these schools highlights the pollution these children are exposed to every day. Measurements at rush hour showed how high NO_2 was during the times when children were walking to and from school (up to 3 times higher than during the middle of the day).

The recent move from petrol to diesel cars and the fact that catalytic and particle filters are less efficient for short journeys means that our inner cities are still considerably polluted, particularly at rush hour.

Figure 1: European cities road traffic produces high NO_2 levels as well as other particulate pollution

Implications

Raising awareness of the health implications of cars and living near particularly busy roads will make the children more aware of the effects of traffic on air quality and health. A BBC Inside Out East Midlands report on the effect of NO_2 on children, links with asthma and links between car engines and emissions was filmed in a local primary school where we were measuring NO2. This was aired on the local BBC news and caused an increased dialogue between the University of Leicester, the Air Quality monitoring division of Leicester City Council and the general public.

The media coverage highlighted that Leicester City Council is working hard to combat this issue and that research on air pollution in the city is a hot topic. It is just the right time to be promoting outreach activities of this kind in schools.

"There is high educational value in encouraging students to contribute their own pollution data, combine results and draw conclusions in thiscollaborative approach". **Lee Page,** Royal Society of Chemistry.

User Application: Education and Public Awareness

Figure 2: University of Leicester students demostrating air pollution experiments in the classroom of Shenton Primary School. The BBC is seen filming here for the local News

THE ISSUE solution

The Royal Society of Chemistry will fund a project that tests and uses data from low cost sensors to be used in school playgrounds. It will host a website that will present data from hourly sensor measurements that will be monitoring at various schools around the UK. This will help scientists and school children to assess the geographical distribution of detrimental air quality and the extent to which rush hour impacts on the pollution levels they are exposed to.

The study will begin in September 2013 and will expand across the UK in 2014 It will be linked in with the outreach activities of the JOAQUIN project[2], to educate local school children and their parents and also provide a guide for local authorities to assess and respond to highly localised pollution effects.

The air quality monitoring represents an exciting opportunity for students to directly measure air pollution at their school.

Outlook to the future

Several new cutting edge low cost pollution sensors will be purchased through outreach funding and the University of Leicester will lead this national project to monitor selected atmospheric pollutants near to schools around the UK. Outreach materials will be supplied to the schools to get all age ranges involved with the measurements and to think about the causes and implications of pollution in their cities.

This scheme represents an innovative way to source data, at the same time contributing to the scientific education for children through learning about the air pollution in their daily lives.

Further information:

[1]http://www.eea.europa.eu/

[2]http://www.joaquin.eu/

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GREENHOUSE GAS EMISSIONS MEASUREMENT SERVICE

New direct measurement approach for more accurate GHG emission monitoring

The challenge

Greenhouse gas (GHG) emissions are a driver of global climate change, arguably the most significant challenge of modern times, already with huge economic and social implications. As part of attempts to tackle this issue, countries around the world have set targets to reduce their GHG emissions. It is important to distinguish between 'air quality' and 'climate change'. GHGs are drivers of global climate change of which important examples are CO_2, CH_4 and CO, whilst those pollutants that contribute most to 'air quality' issues include NO_2, NO_X and particulates.

The monitoring of GHG emissions targets has been achieved, to date, through budgeting systems known as 'inventory methods', which allocate estimated emissions values to different activities such as transport, energy usage, burning of fossil fuels etc. In this way, a country's overall emissions profile is built up with very little or no actual measurement of emissions. The error in estimating emissions in this way can be very large with estimates also based on historical information so that, at the time of reporting, information to policy makers can already be out of date by up to two years.

Implications

The effects of global climate change are many and varied, with evidence in relation to the extent and severity of these effects also varied. However, the scientific consensus is that global climate change is occurring and that the implications extend to multiple physical impacts, examples of which include:

- Increased frequency, length and intensity of heat waves.
- More intense and prolonged droughts for regions such as southern and central Europe
- Increases in heavy rainfall with more severe occurrences of localised flooding
- Glacial retreat with increased risks in seasonal water availabilities as a result
- Sea level rise due to the combined effects of thermal expansion and melting of land-based ice resulting increased risks of coastal flooding.

Currently the major contributors to GHG emissions, at the sector level, are (in order of priority) energy, transport and industry. However, the expectation is that, given trends towards cleaner sources of energy, it is the transport sector that will emerge as the largest emitter over the next decades.

"The Astrium service provides near real-time GHG emissions at city scale. It has the potential to inform policy makers about which initiatives are working more quickly, and provide a check for calculated emissions levels". **Burston,** Centre for Carbon Management

THE ISSUE solution

Leading European service providers have therefore teamed up to create a new service concept which complements the current inventory methods of compiling emissions, while radically reducing the error estimations, by using direct measurements of CO_2, CH_4 and CO from the ground, aircraft and space.

This distinctive approach provides information on all distance scales allowing improved modelling of atmospheric transport of GHGs as the scale of monitoring moves from cities, to regions, to nations and, eventually, available globally.

Figure 1: GHG emissions measurement service

Considering the importance of the transport sector in current emission trends, and the extent to which urban vehicular emissions contribute to these, initial trials for the service have focused on dense urban centres, where congestion-driven GHG emissions are a major problem. The concept was successfully trialled during the London 2012 Olympics. Monitoring activities were based on information provided from four ground stations, a modified London bus (to capture in situ observations around London), observations from aircraft as well as data captured from space. The primary goal of establishing feasibility of the service was achieved, along with important insights into the practicalities of running such a service on a citywide scale. Further development at this scale will be undertaken during the upcoming CarboCount City project in 2013 - 2014, where similar demonstrations will take place in both Rotterdam and Paris.

Outlook to the future

The GHG emissions measurement service has clear operational ambitions and as such is being developed as a service for customers, to be paid for by customers.

To further assist with realising this commercial success, a demonstration stage project is being proposed through the European Space Agency's Integrated Applications Programme to provide an opportunity to test/showcase the regional monitoring potential of the service. Calls for user participation have already been distributed. Collaboration between regions participating in THE ISSUE is already anticipated.

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LEICESTER BUS EMISSIONS STUDY FOR TRANSPORT POLICY

Contribution of buses to emissions and impact of bus measures to improve air quality locally and city wide

The DEFRA funded study by LCC and TRL aims to establish a bus emissions baseline for the following pollutants; NOx, PM_{10} and CO_2.

The challenge
Road vehicles are the main source of air pollution in Leicester. Leicester City Council (LCC) has declared an Air Quality Management Area (AQMA) Fig.1 for NO_2 covering the city center as a whole, with 'ribbons' extending along the main radial and peripheral roads. The city's first Air Quality Action Plan (AQAP) was published in 2004. An updated plan was incorporated into the Council's 3rd Local Transport Plan to cover the period 2011-16. The plan focuses on improving transport systems such as city center bus improvements, expanding parking controls and running campaigns to encourage cycling and walking.

Figure 1: Air Quality Management Area in Leicester

Implications and benefits for citizens

- Identifying options for a long-term package of public transport emissions reduction measures that are specific to conditions in Leicester.
- Establishing the contributions of nitrogen oxides (NO_x) and particulate (PM10) emissions from buses and their subsequent impact on air pollution on four key corridors.
- Identifying and assess relevant measures to reduce bus emissions and improve air quality that are applicable locally and city-wide.

"Novel and innovative ways of reducing bus emissions are critical to dealing with Air Quality – LeicsteBest is leading the way".
Paul Monks, University of Leicester

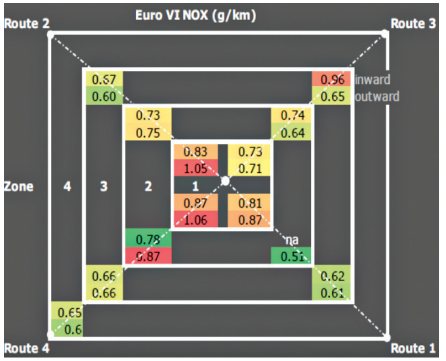

Figure 2: Baseline ZIM for fleet weighted bus NO_x emissions

THE ISSUE solution
Automatic Number Plate Recognition (APNR) cameras were used to ascertain detailed characteristics of vehicles on the four test corridors. Post processing analyses of these data were used to understand the likely emissions standards of these vehicles.

Driving cycles - Global position (GPS) of individual bus/car journeys was recorded in order to evaluate instantaneous speed at any given location along the entire test route.

Air pollution modelling - Baseline and applied to an air dispersion model to intervention emissions results were used to estimate the impact on air quality at selected roadside receptors.

Emissions modelling - Both ANPR and driving cycle results were used in combination with other input data to estimate baseline and intervention emissions. The study developed bespoke processing techniques and applied state of the art modelling.

Outlook to the future
An important element of the project was to discern whether bus related emissions can be characterized within similar morphological zones. The result of this exercise was to produce a series of 'zoned impact maps' (ZIMs) (See Fig. 2). The result of the study suggests that Leicester should be looking towards Euro VI to reduce NO_x and PM emissions. However, given the reduced running cost of hybrids and the ability to spatially manage exhaust emissions it is likely that these might be an attractive option to operators and hence a close alternative to the emissions saving.

Acknowledgements
The project is funded by DEFRA (Department for Environment, Food and Rural Affairs).

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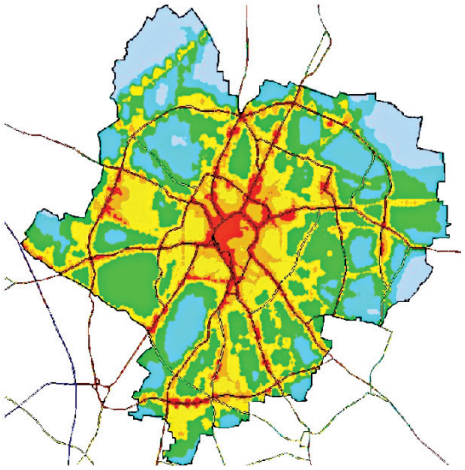
LESTAir THE LOW EMISSION STRATEGIES FOR TRANSPORT PROJECT

Development of a business case for a 'Low Emission Zone'/ Environmental Zone in Leicester

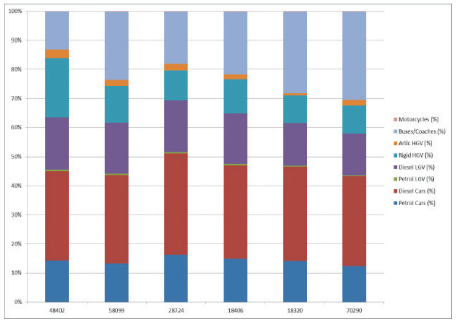


The challenge
A solution entailing a high regulation burden on local stakeholders and businesses is likely to be perceived nationally and locally as politically unacceptable, and be excessively costly in relation to benefits.

Implications
The Project will therefore focus on stakeholder engagement, as opposed to regulation and a viable, time-based mobilisation plan as part of the Business Plan, as opposed to theoretical reporting. Also identification of existing sources of funding and operational savings, as opposed to unrealisable, socio-economic opportunity costs, including a clear evidence base for the cost-benefits of the measures needs to be identified. An integrated approach to air quality and carbon, to maximize the cost-benefits of the measures.

Project Outcomes
The principal deliverable will be a Report by 31st March 2014, detailing a Business Case for a Low Emission Strategy for Leicester City Council. This document will include: a package of measures for implementation and clear success criteria for the project.

"The project gives both stakeholders and air-quality practitioners a chance to re-examine priorities in the light of both rapidly evolving vehicle technologies and continuing issues with NOx and fine particulate levels".
Paul Goodman, Newcastle University



Estimated NOx pollution on inner ring roads 2013

• An evidence base for quantifying the costs and benefits of the measures selected in terms of their Air Quality and Climate Change effects, as well as health, social and economic impacts.

• A replicable methodology for identifying and appraising the said measures.

• A detailed, time-based and prioritised Mobilisation Plan for implementation of the measures identified in the Business Case; this will be suitable for incorporation in the revision of the Council's statutory Air Quality Action Plan.

• A Road Map summarising the project, which will facilitate knowledge transfer to DEFRA, other UK Local Authorities and local stakeholders.

Outlook to the future
The success criteria of the Project to be monitored include:

• Successful identification of multiple measures which can be implemented in 2014-2015 onwards, with Benefits-Costs Ratio of 2 or greater.

• This to include at least one measure for each of the HGV and Bus emissions sectors in Leicester which can deliver at least 10% reduction in concentrations or emissions of the specified pollutants.

• Finance, grants and operational savings to support these measures.

• Successful engagement of senior management in key emitting sectors in the task of air pollution reduction through cost effective measures.

• Dissemination of the results of the project to the stakeholders.

Acknowledgements
The project is funded by DEFRA (Department for Environment, Food and Rural Affairs).

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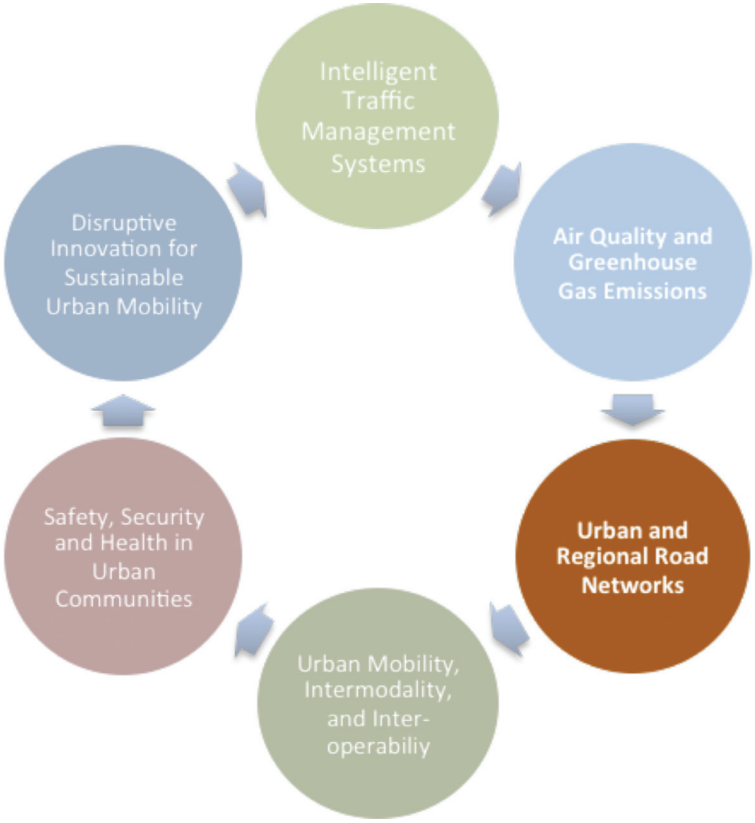
Societal Challenge 3



URBAN AND REGIONAL ROAD NETWORKS - UTILIZATION, PLANNING AND OPTIMIZATION

The challenge:

Regional authorities and national organizations need local management strategies and The European Environment Agency forecasts that by 2020 80% of European citizens will live in urban areas. Such increases create new problems of urban sprawl, traffic congestion, overloaded infrastructure, noise and air pollution. Chaotic and unplanned development of urban infrastructure offers very low economic and social effectiveness, unprofitable development and high cost of maintenance of public transport. These effects are serious barriers to sustainable development of many European cities.

Transport system solutions directed at sustainable development of existing and planned road networks can provide conditions for safe and efficient transport of people and goods, ensure priority of public transport and counterbalance the prevailing urban sprawl.

The Response:

Sustainable urban development requires coherent urban planning based on intelligent traffic management technology, data fusion from many separate sources, ease of access to data and information for planners, technology providers and public and commercial users. Transport system solutions directed at sustainable development of existing and planned road networks include:

- Integrated planning techniques;
- Innovative data gathering, processing and providing for transport and physical planning;
- Satellite and airborne-based technologies and GIS for transport and physical planning;
- Sensor monitoring and model forecasting of emission levels.

URBAN AND REGIONAL ROAD NETWORK SYSTEMS

Synergy of spatial planning and road system improvement through utilisation of ITS technology

The challenge

The European Environment Agency forecasts that by 2020 80% of European citizens will live in urban areas. Such significant increases in numbers of cities' inhabitants brings with it disturbance of spatial order, urban sprawl, traffic congestion, over-loading the capacity of the infrastructure, noise and air pollution. These effects represent serious barriers for sustainable development of many European cities. The mobility problems resulting from urbanization are the effect of lack of balance between supply and demand. Consideration of the demand for mobility usually leads to solutions that increase the capacity of the road network, e.g. new road construction, more lanes or replacing crossroads with junctions. Such behaviour often fails to match the aim of sustainable development which is to keep a balance between the realization of transport, economic, social and environmental objectives. Adapting cities and metropolitan areas to changes in transport mobility requires the coordination of spatial and urban policy to manage transport services and balance demand between public, private and commercial transport needs. Spatial planning needs more support from modern technologies to incorporate intelligent management systems into the road network. Increasing traffic throughput in corridors well served by public transport, prioritising public transport, improving functional attractiveness of inner-city areas, are all important. Modern transport solutions need to provide controlled access to specific urban areas, manage traffic flow, and provide traffic information and fast response for emergency situations.

Figure 1: Integrated Traffic Management System web portal (http://www.zszr.zdm.waw.pl)

Implications

System solutions are required to develop the use, planning and optimizion of existing and planned road networks in cities and regions. A systems approach is necessary to implement sustainable development strategies for urban areas in order to create conditions for safe and efficient transport of people and goods while ensuring the priority for public transport. The consequence of chaotic and extensive built up areas is a very low economic and social effectiveness of infrastructure investment and unprofitable development and maintenance of public transport. The systems approach is essential for urban development of coherently built areas and control of urban sprawl. It is worth noting that a proper road sub-system is an element of an intelligent transport system structure that will function well if integrated into the wider the city/regional structure. From the user point of view, the consequence of road system improvement will be decreases in noise and air pollution, improvement of life quality as well as increase of transport efficiency. Improvement to the transport network using new technologies will bring financial benefits in the long term by increasing the transport efficiency and profitability, subject to availability of the necessary capital investment. Expenditure by the local authorities for the system development therefore remains the critical problem.

"Efficient road infrastructure is an indicator of the progress and the civilization development. The extent to which the needs are met and challenges overcome is one of the main criteria of evaluation of economic systems and the governments". **Sławomir Heller,** Heller Consult Director

THE ISSUE solution

Integrated Traffic Management System is the one of the innovative solutions which exists in Warsaw. Its main purpose is to organize and control current traffic in the supervised area. It can give the priority to public transport, and inform the road users about traffic incidents. The system includes 37 junctions, however, its expansion to 152 is foreseen.

Figure 2: Real-time camera view (http://www.zszr.zdm.waw.pl)

Through the visualisation and monitoring of the specific locations in real time the system permits planning, controlling, forecasting, responding to traffic incidents and transmitting information to users. This information is also available through a web portal. The system facilitates users to make decisions on route selection and means of transport. This system may serve as a good example for THE ISSUE solutions for utilisation, planning and optimisation of urban and regional road network.

Outlook to the future

The challenges and solutions presented have the potential to significantly influence the development and functioning of cities and regions and of people mobility. Intelligent management systems can make the road networks more user friendly, provided they are wisely planned, considering spatial planning requirements and incorporating modern technologies into the road systems.

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INTEGRATION OF CLIMATE AND INFRASTRUCTURE DATA TO REDUCE TRAFFIC CONGESTION

Novel and innovative data integration systems support engineers in assessing the climate change impact on road infrastructure and traffic congestion

The challenge

One of the major problems we are facing in this century is the climate change. This represents new challenges for authorities that are responsible for road infrastructure and effective traffic management. The short and long-term impact of the global warming and extreme weather on the road infrastructure, road construction technology and traffic management must be therefore taken into account. Moreover road authorities should have the possibility to integrate the climate and weather data with the road and traffic data in order to define response scenarios for the future.

Implications

The influence of the climate change on the road network and traffic flow can be

Figure 1: Pavement rutting observed on provincial road W719 in Warsaw, Poland

observed more and more often. One of the most spectacular examples has been observed in 2010 in Germany where the A29 motorway was closed for days in order to repair several concrete slabs, which collapsed due to high temperatures. Surface rutting caused by high temperatures over long periods of time has also been observed in the road network of Mazovia, Poland. Heavy rainfalls impact road safety by increasing the probability of aquaplaning which can be responsible for serious accidents. Such events always contribute to traffic congestion. The socio-economical consequences of such events are invaluable in relation to human life and health but entail precisely quantifiable costs of transportation delays or road and infrastructure repairs and renovation. Not less important are the environmental and social consequences of re-routing traffic to alternative routes.

"Promoting the use of the Information Providing System leads to the improvement of the road administration staff's qualifications".

Grażyna Lendzion, Director of Warsaw Municipal Roads Administration

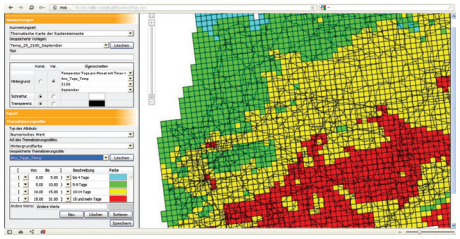

Figure 2: Example of the climate forecast data integration with road condition data for an advanced analysis of weather influence on the condition of bridges

THE ISSUE solution

The solution addressing these new challenges has already been defined. It can be characterised by two keywords: information and integration. "Information" comprises all possible data relevant for road and traffic management: road network, pavement condition, network junctions, traffic flow as well as data concerning the weather conditions and the climate. The keyword "integration" stands for visualising all the data sources in conjunction in the form of Information Providing Systems. Thus, data that could not be merged in the past, can now be presented on an integrated digital map with thematic layers that provide different information on demand. This innovative way of data intersection has a great potential as an integrated system for analysis and forecasting of road traffic due to the climate and environmental changes. Numerous examples of application of the system as a crisis management tool and road safety assessment tool kit can be given. For example, the integration of weather forecast data with the road infrastructure information can be used to prepare traffic congestion management scenarios in the case of road closures due to heavy rain or snowfall. Furthermore, long-term climate forecast data can be used for assessing the change in road maintenance costs resulting from the evolving weather conditions. In addition, the interdisciplinary data broaden the knowledge and information spectrum used for the adjustment and development of the standards and procedures of roads engineering taking the climate change into account. The successful application of a Internet browser-based Information Providing System for the federal roads authority in Germany utilising the described solution has demonstrated the system's potential in road maintenance planning taking into account the climate information.

Outlook to the future

Our system developed in cooperation within the HELLER Group companies from Mazovia, Poland and Hesse, Germany regions, enables engineers to adopt road traffic management methods to the new environmental problems. We are convinced that the integration of climate data into traffic management will have a great impact on the future planning and management of roads. Therefore, in close collaboration with the users of the system, we are developing it while sharing our experience and knowledge with new communities.

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AN OPEN GIS CASE STUDY OPEN STREET MAP FOR GREAT BRITAIN (OSM-GB)

Open Street Map is the world's largest volunteer collaborative map database.
The OSM-GB Project makes it professional-friendly

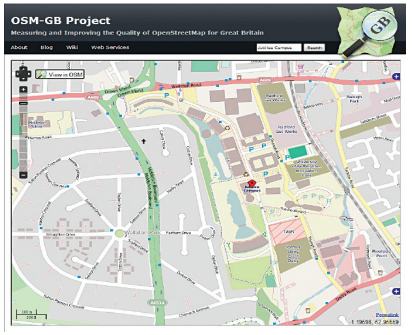

Figure 1: The OSMGB project website (http://www.osmgb.org.uk)

The challenge
Smart cities and intelligent transport systems are facilitated by unfettered access to up-to-date map data. Founded by Steve Coast in 2004, OpenStreetMap (OSM) is a collaborative project to achieve this creating world-wide free and editable mapping by the citizen, for the citizen.
The initial stimulus was the restriction on availability and use of map information and the advent of inexpensive portable satellite navigation devices. It was inspired by the success of Wikipedia. OSM registered users have now grown to over one million around the world who collect data using GPS devices, aerial photography and other copyright free sources.

Implications
This citizen-led approach to mapping has developed in parallel to government-led initiatives. Chief amongst these are spatial data infrastructure programmes such as the UK Location Framework and the EU INSPIRE directive. While initiatives such as INSPIRE tend towards a top-down process of harmonising established government data models and services the OSM approach is more informal and shaped by individuals in terms of what data is captured and how that data is described. National Mapping Agencies such as the Ordinance Survey of Great Britain provide professionally surveyed map data with published specifications and standards driven mainly by government needs. In contrast, OSM mapping relies on the availability of usually local mapping enthusiasts to capture changes.
Its more informal structure tends to lead to the capture of a broader range of features of interest to diverse sub-communities such as cyclists and walkers and because of the local interest will often be kept more up-to-date.

"Surrey Heath has long been an advocate of OpenStreetMap and the inception of the OSM-GB project has enabled us to use OSM data in both our intranet GIS and Qgis desktop GIS systems".
James Rutter, GIS Manager, Surrey Heath Borough Council, UK

User Application: Urban and Regional Road Mapping

OSM data provides an alternative to national mapping for many uses but combining the two in an open source OSM data

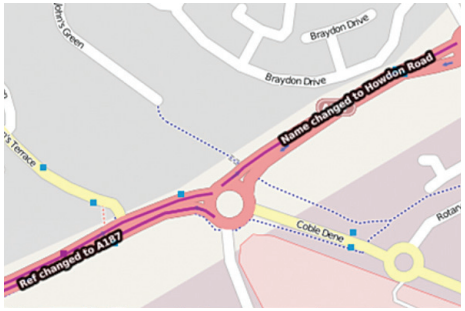

Figure 2: A sample of quality checks in comparing OSM with national maps

provides an alternative to national mapping for many uses but combining the two in an open source.

The ISSUE solution
Initiated at The University of Nottingham Geospatial Institute (NGI), the OSM-GB project (Figure 1) is a collaborative research programme with 1Spatial and KnowWhere. The research goals are to develop the automated methods needed to quality check, edit and redeliver the improved map data back to the OSM database. The OSM-GB objectives are to enable the OSM maps delivered in different thematic layers, open standard formats and national reference systems to be usa ble by citizen and professional alike and on a free and open source basis. With the exponential growth of crowd-sourced data such as OSM, local authorities and transport planners can have access to a new data source for a wealth of future citizen-focussed requirements. OSM-GB Project outputs include the development of Web Services based on the internationally agreed Open Geospatial Consortium Standards. The data can be in many different formats and reference systems including British National Grid. A key element in achieving this is the development of a rules-based catalogue for checking and improving the geometry and attribution consistency of the data as input by the volunteers (Figure 2). The project also aims to promote the use and uptake of OSM mapping and to supply data and comments regarding data quality back to the OSM community.

Summary
The availability of free and open source map data and geographic information systems (GIS) software has made it increasingly possible for government and volunteer organizations and even individuals to make use of GIS tools for both professional and leisure purposes. The OSM-GB project has been mostly built using Open Source GIS components including database administration, cartography tools, web services and web interfaces.
It brings together Open data, Open Source Software and Open standards facilitating intelligent transportation and many other services of tomorrows Smart City.

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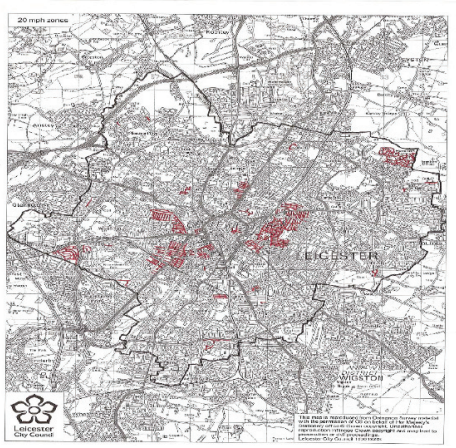
TRANSPORT SCHEME TOOLKIT FOR 20mph ZONES

Development of “a Ready Reckoner” tool, which can assist in the improvement of areas to be designated as 20mph zones

The challenge
This DEFRA-funded study will be completed by the end of March 2014 and it is hoped that it will inform future transport management schemes. The project Brief agreed with DEFRA encompasses a wide-ranging identification and cost-benefit appraisal of available options, for taking action to deal with the pollutants NO_2 and CO_2.

Benefits to citizens
Leicester City Council recognises the impacts of road traffic on the poor air quality in parts of its area and the need for improvements from this source of emissions. For this project Leicester City Council will work with the London Borough of Hillingdon and Transport Research Laboratory Ltd (TRL) to populate and develop the database of the Ready Reckoner with real-world traffic management schemes for use in both areas.
Both authorities are committed to an extensive roll-out of 20 mph zones as part of a common vision for improving the quality of life for its residents However, little work has been done to assess the local impact of these types of interventions in terms of adverse air quality, or indeed carbon emissions in the local context.
Transport Research Laboratory Ltd was appointed to further develop the Ready Reckoner transport tool.

“This elegant solution will give in depth knowledge of the AQ impact of 20mph zones”. **Jolanta Obszynska,** Leicester City Council



20mph zones, base plan, Leicester

The solution
The aim of this tool is the identification and quantification of potential detrimental impacts on air quality from a range of proposed 20mph traffic management schemes (i.e. speed humps and chicanes).
This tool will identify optimal solutions, in terms of emissions and cost-benefits and introduce the concept of offsetting mitigation measures due to an expected increase in poor air quality.
The project will be monitored via completion of the key milestones by the set dates. The tendering process will ensure that sub-tasks will also be given defined timelines. The lead authority, London Borough of Hillingdon, will be responsible for project monitoring in close collaboration with Leicester City Council.

Outlook to the future
Establishment of an extended database of local traffic intervention measures evaluated for their impact on emissions;

Update of the desktop Ready Reckoner for use by traffic practitioners to ensure traffic management schemes include an assessment of emissions;

Provision of evidence base to support a case to be established for the use of low emissions management schemes in areas of poor air quality;

Transferability of the methodology and development of a consistent approach to evaluation of traffic management measures in terms of emissions and effective roll-out of the project to transport engineers across the two local authorities and beyond.

Acknowledgements
The project is funded by DEFRA (Department for Environment, Food and Rural Affairs).

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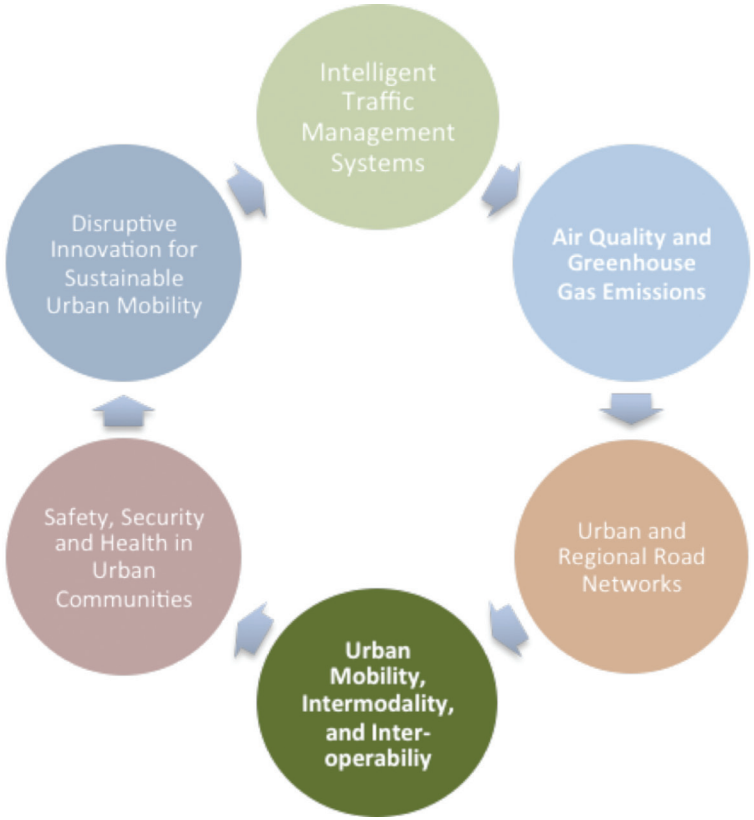
Societal Challenge 4



URBAN TRANSPORT, MOBILITY, INTERMODALITY AND INTEROPERABILITY

The challenge:

Improvements in the cost effectiveness and attractiveness of public and soft transport modes (e.g. cycles) are necessary for providing efficient seamless travel in the urban environment for all categories of persons, especially young people, elderly, disadvantaged and less able persons. Modal shift towards public and soft transport modes benefits citizens by reducing stress and journey time. It also contributes to reduction of carbon footprint, noise, and congestion, thereby enhancing the quality of urban life.

The Response:

Innovative data processing and new information systems can help to optimize travel experience, such as:

- Localization based services for mobile citizens;
- Tracking services for freight transport;
- Predicting and managing the behaviours of crowds;
- Innovative travel planning tools based on GIS Technologies;
- Smart ticketing.

LUTB TRANSPORT & MOBILITY SYSTEMS

Lyon France

NEW APPROACH FOR URBAN LOGISTICS: DELIVERY AREA BOOKING

A system for reserving Delivery Areas and adjusting the reservation during the delivery journey

The challenge

Delivery Areas were created to facilitate freight delivery to professional and private customers. To avoid improper use of these areas we have designed a system which is able to provision Delivery Area Booking. As sketched in Fig. 1, the working process allows freight operators to create delivery rounds taking into account the Delivery Areas availability prior to the delivery round and adjusting the reservation in event of unexpected circumstances (traffic jam, absence of client) disrupting the delivery process.

Implications

In urban areas, goods deliveries for professional and private customers generate a large flow of vehicles, from small vans (for express deliveries) to trucks (to supply larger stores). Delivery services are increasing due to just-in-time management, the development of e-commerce and the emergence of new customer behaviour

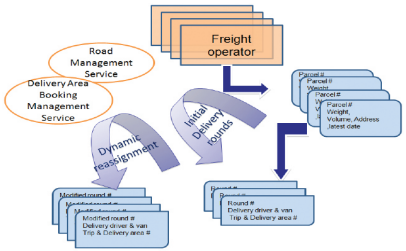


Figure 1: working process of a Delivery Area

(such as home delivery and delivery into lockers). All of this makes the transport of goods complicated, particularly in town centres, with negative effects on private and public transport flow causing traffic jams, for instance.

In European cities, and specifically in France, a large percentage (from 70 to 80%) are double-parked deliveries. Such behaviour creates congestion, pollution and conflicts between road users.

THE ISSUE solution

After receiving the main functional requirements from all potential actors (freight operators, drivers-deliverers, city administrators, etc.), we proposed a new approach in which delivery operators can book delivery areas for a limited period in advance, using a common ICT reservation system based on three modules:

1. SyGAL, an Interactive system for Delivery Areas booking management, a web based system able to manage delivery

"The solutions developed in the ALF project are innovative and tempting; I look forward to see the first returns of experience of their use and upscale in a real environment".

Diana Diziain, Freight & Logistics Project Manager, Grand Lyon

area reservations and to deliver this information in a mobile and distributed way to different actors (static: logistician or dynamic: delivery driver). Dissemination of this information to in-lorry integrated devices and/or personal devices (Smartphone, Internet tab, etc.) is technologically possible.

2. Guided CESNA, a multi-agent based system organising a computational process with distributed negotiation, allowing static delivery round preparation and dynamic adjustments, if necessary.

3. CEMAVIL, an in-the-field information system that collects occupancy information by in-road sensors, and allows different users (delivery professionals, private drivers, etc.) to receive occupancy information.

To complement our approach we have developed a list of additional services (energy delivery, manipulation equipment, shared lockers, etc.). This could increase professionalization of the Delivery Areas and prevent non-authorised vehicles from occupying them.

Outlook to the future

The next step in our work is a prospective observation and formulation of suggestions of legislation evolution. Another

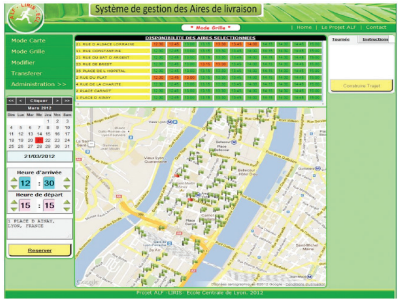


Figure 2: SyGAL

contribution will be the design of a serious game allowing professionals (logisticians and drivers-deliverers), the general public and decision makers to learn, understand appropriate behaviours and master the foreseen proposed user interface.

Several aspects of pooling are also considered for study such as pooling of Delivery Areas with taxi or private parking according to a schedule (during the day only, in the morning only, working days), pooling of distribution by segmentation and delegation by zone with a limited number of delivery operators and creation of Urban Logistics Spaces, and choice of treatment of the last Km by a soft means (tri-car, bicycle, etc.) thorough management of traceability. Although a prototype of this system is currently in operation, a demonstration in medium-sized cities is yet to be carried out. The originality and innovation of our solution lies on a better use of Delivery Areas by reservation and its adjustment in real time.

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North-West Region Romania

IT&C TECHNOLOGIES USED IN TICKETING FOR MODERNISING URBAN TRANSPORT

Modernising public transport in Cluj-Napoca by means of an automated ticketing system based on IT&C technologies

The challenge
Increasing amenity of public transport in the city of Cluj-Napoca aims to increase the satisfaction of existing passengers and attract a new ones in larger numbers.

Implications
Population mobility is an important issue in the city of Cluj-Napoca and has to respond to new challenges because the city's population is expected to increase according to recent statistics. Using a large number of private cars for daily travels has dramatic effects on air quality, the duration of a travel and the fuel consumption. The public transport can provide population mobility but must satisfy the expectations of key stakeholders;
Passengers expectations: the public transport system should provide predictability, timeliness, access to information, modern charging systems, safety, comfort.
Expectations of communities and

authorities: to minimise chemical pollutant and noise for residents, in order to protect the health of the citizens. Studies indicate that 70% of urban pollution is due to transport and public transport is responsible for a part of it.
Regional, national, European expectations: to be more energy efficient to reduce fuel consumption and cost of exploitation. The priority for the City Hall of Cluj-Napoca and the Passenger Urban Transport Autonomous Company (RATUC) is the development of services according to the expectations of the passengers, extending these services in the Metropolitan Area (that includes a number of localities in the vicinity of Cluj-Napoca) and multiplying the experience in other cities in the North-West Region of Romania. An integrated system for ticketing is already implemented in the region, in the city of Oradea, where an e-ticketing system is under development in the framework of a European project: Attractive Urban Transport for Accessible Cities (ATTAC) funded byThe South East Europe Transnational Cooperation Programme.

"Our motto is: <we are moving the city>, so innovation in the transport titles usage will encourage more passengers to come beside us".
Niculae Dobos, head of Technical Department, RATUC

User Application: Integrated Ticketing

THE ISSUE solution
In 2011, the study on the implementation of a modern ticketing system was completed in Cluj-Napoca, this study was the basis of a European Regional Development Fund (ERDF) (2007-2013) funded project under implementation at this moment. The objective is to replace the old system that relies on paper tickets.
The automated system for issuing travel titles is a complex system, based on information and communications technology (IT&C) and on the contactless technology. The travel titles are recorded on a MIFARE type contactless card, the transfer of information being done by presenting the card to the equipment at a distance up to 10 cm. The cards can be purchased and recharged from automatic ticket release machines placed in 60 stations and the journey can be validated by simply presenting the card to a validator located in the transport vehicle or in the station. The journey validation in the stations capitalizes the waiting time, increases the boarding speed of passengers, implicitly decreasing the run time and overall travel duration. This is a novelty element in the charging systems for surface transport, adapted to the needs of our city.
The hardware elements of the system are: 61 automatic card machines, 136 validators in stations, 327 validators on board the transport, 327 board computers, 9 data transfer points, 74 LED boards in stations for displaying the run time, 1 central location for the operational management containing servers, PCs, software, dedicated applications required for the management of the entire system. The system is integrated for all transport modes (bus, trolleybus, tram).

Outlook to the future
The implementation of this system will increase by 5.7% the number of passengers, from 230000 up to 243000 and a 2.3% reduction will be registered in the average duration of a travel in town, from 15.59 minutes down to 15.24 minutes.
Additionally, the data provided by the system will be used to develop an integrated urban transport management system.

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DEVELOPMENT OF INNOVATIVE MOBILITY AND TRAVEL APPLICATIONS

Traveller information, journey planning or smart ticketing: the next issue for innovative mobility

Figure 1: Multimodality is one of the main issues of the future of mobility

The challenge

The evolution of mobility, linked partly to the new regulatory and social context, deeply modifies the traditional perception of "journey". Alternative transportation modes have to progressively replace the individual car model.

This evolution, well identified in transport policies, may complicate the journey planning for the traveller, who generally wants to travel ever faster, ever further, ever cheaper and ever easier. That is why the evolution of mobility has to be accompanied by the development of innovative tools and travel applications that minimize its potential inconvenience. Travellers need transportation systems that are, by design, easy to use, with a good quality information.

Implications

In principle, the user should want to shift from his individual car to a different transport mode like public transport. But this latter has to be comfortable, fast and easy to use. The development of solutions that makes multimodal travel stress-free and efficient is one of the challenges for the success of these transport policies. Easy access to real-time, seamless, reliable, multimodal and personal information makes travels more enjoyable and encourages the traveller to use public transportation. In the same way, the development of smart ticketing, and in particular of unique ticketing for different means of transportation (train, bus, tram, metro, river buses, public bike systems), simplifies the journey for the traveller who does not have to buy different tickets at each node of the travel and is provided with a clear vision of the total cost. Smart ticketing can also improve the efficiency and image of public transport, may impact the charging policy and allow sharing of global usage statistics between separate operators.

User Application: Multimodal Transport

THE ISSUE solution

Traveller information and multimodal journey planning

The development of data acquisition technologies (congestion peak detection, indoor and outdoor positioning systems) improves data quality and quantity at the beginning of the chain. Data transmission solutions (machine to machine communications, wireless networks) improve the transfer speed and the accessibility of the real-time information.

Journey planning tools deal with the information processing. Methods and models are developed by companies and public authorities. In order to solve problems of integration, comparison and accessibility, the development of standards (NEPTUNE standard for the theoretical multimodal supply, SIRI for the real time information…) could be used as tools allowing transport actors to share, visualize, validate and manage real and multimodal information. Direct or indirect collaborative methods, with the potential intervention of all users, can also be envisaged. Information display technologies, from variable message signs to smartphone applications, allow the diffusion of real time and multimodal information (Mobiville project, Coovia application).

Smart or unique ticketing

A lot of technologies linked to smart ticketing exist: smartphones applications, QR codes, smartcards, NFC, car-sharing vehicles via mobile contactless smartphones (Autopartage project), and common ticketing solution for different transportation actors (Pastel Card).

Further developments are required for a generalization of their use in all territories. In particular, the technological solutions have to be adapted and tested in the local context and local acceptability of users established.

Outlook to the future

These applications will impact all transport systems and will change the vision of multimodal journeys. In the future, after the resolution of partnership, standardization and technological issues, any travel (from urban travel to interregional journey) will not be made only with a car, but with a combination of several means of transport identified at the beginning of the travel (for instance from a smartphone application) that provide the quickest, cheapest, easier and least polluting journey.

Throughout the journey, the traveller will be able to send anonymous information to transport providers and easily receive updated multimodal information necessary for the optimization of his journey. The journey breaks will be as easy and as quick as possible. The payment process will be totally transparent.

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USING SATELLITE TECHNOLOGY IN PUBLIC TRANSPORT

GNSS integration into public transport significantly improves network working, the quality of the service and quality of life in our cities by making it more fluid and efficient. The more attractive and efficient public transport becomes the more it is used, thus contributing to cleaner and less polluted cities

The challenge
The challenge is to improve the global quality of public transport. By making it more punctual, safer, more comfortable and more attractive, we help to increase its use and in this contribute to creating cleaner and less congested cities.

Implications
Information from GNSS satellites is becoming more widely used to improve the functioning of urban and interurban public transport. As a consequence, journeys become more reliable for users and help to increase access to public transport for everybody, allowing the young and those that do not have private mean to use public transport to reach their destination.

Figure 1: NAVOCAP is a French manufacturer, and provider of SIV/SAEIV. For 24 years, we have been a reference on the market

For the cities, investing in intelligent management of the transport network is also a strong societal and environmental signal. By integrating GNSS into public transport services, the city helps to reduce greenhouse gas emissions on two accounts. On the one hand it promotes public transport, on the other hand it improves energy efficiency and leads to greener, safer and more accessible cities.

THE ISSUE solution
The solutions provided through use of GNSS information are numerous.

"Thanks to the satellite information, we make public transport more fluid, more efficient and more attractive". **Edgard ANTOINE,** President NAVOCAP

Figure 2: Our systems and components are almost fully made in France

Precise timetables
First of all, real-time precise information is provided to the user concerning bus timetables, frequency, and punctuality.

This aspect is extremely important as it allows the user to know precisely the situation and to plan accordingly. It is an in-depth and reliable system that gives confidence to the user and also contributes to total integration of urban and interurban public transport.

Traffic Light priority
Traffic lights priority is a useful application that links the geo-location of the vehicle by GNSS with other geographic data to control the operation of traffic lights.
In this way, when the bus comes closer to the red light we can switch it to the green in order to give priority to the bus. This has interesting implications for both users and operators. First, delays can be reduced. Smoother and more economical driving results reducing fuel consumption and brake wear. Finally, smoother journeys, with fewer red light stops means more security and comfort, particularly for elderly travelers, the disabled or persons travelling with children.

The security
The satellite guidance and the real-time geo-localization help to make transport safer, because they allow reacting faster in case of need, especially in breakdown or attack cases.

Outlook to the future
Nowadays, NAVOCAP invests 20% from its turnover for the Research & Development. If we have made this choice it is because we believe that the intelligent and adapted use of the satellite technology is improving significantly the life quality of the citizens. But we also want to maintain the European level of excellence regarding technological intelligence and high quality research.

We are now the actors in the world of tomorrow.

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IMPROVING EFFICIENCY OF TRAFFIC MOVEMENT FOR HGV'S IN CONGESTED URBAN ENVIRONMENTS

Using GIS and GMES data to add value to static maps of recommended travel routes for HGV's through Leicester City

The challenge

Local Authorities are responsible for ensuring effective route communication for HGV (Heavy Goods Vehicles) drivers within city boundaries. Leicester City's current data of preferred HGV movement is inflexible and not easily accessible once travel has commenced. To provide ease of access to HGV preferred routing, an electronic map application was developed for mobile hands free devices.
This new application will provide easy access to approved routing that minimises congestion and air pollution.

Implications

Increasingly, the well-being and security of future generations are dependent upon the actions and decisions made by local authorities and key stakeholders. Air pollution generated by heavily congested city 'freight routes' and increased motor traffic accidents (Fig. 1) have

Figure 1: Hazard of insufficient information on suitable access routes for HGV drivers

societal implications for citizens living in close proximity to major transport corridors. A higher incidence of asthma and respiratory related conditions has been recorded along these transport corridors. In 2010, freight in excess of 139 billion tonnes per kilometre was moved by road. With increases in both domestic and overseas hauliers operating in the UK, the number of vehicles hauling freight via road makes a considerable contribution to road congestion and air pollution. In-cab monitoring (including GPS, Sat Nav and automatic height/width setting) provide generic vehicle and route information to the driver. However, the city approved HGV delivery routes are not present on these systems. The result is excessive congestion on unapproved roads (shown as the 'shortest route' by Sat Nav) and lower air quality along trunk routes.
Congestion increase is also caused by vehicles using roads with unanticipated height and weight restrictions.

"The G-STEP project can help businesses save time and money, reducing congestion whilst improving air quality. A win-win situation".
Garry Scott, Leicester City Council

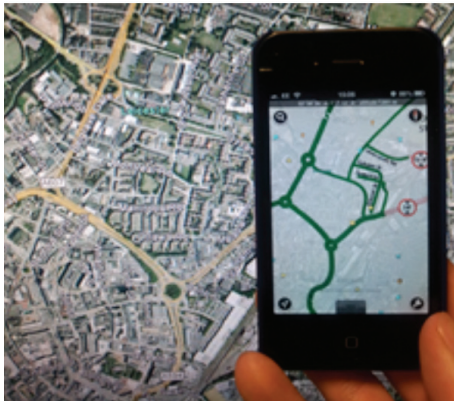

Figure 2: Mobile device access for pilot interactive HGV map application

THE ISSUE solution

Leicester City Council (LCC) holds data on preferred routing for HGV's in the form of a single static map. The G-STEP project at the University of Leicester was approached to investigate the possibility of a more flexible, user friendly version of the data and to add additional material in response to driver's needs. G-STEP (co-funded by the ERDF and the University of Leicester) has research expertise in GIS and GMES solutions. After consultation with both LCC and a consortium of HGV related companies, it was concluded that there was a need for an improvement in data accessibility by developing bespoke data for a range of hands free mobile devices.

G-STEP, using GIS technologies, georeferenced the existing data, added novel material in response to requested needs, and developed algorithms for use on a range of mobile devices. The application now incorporates several mapping layers to allow drivers to select parameters relating to height, width and weight. This is spatially registered to approved traffic corridors that avoid predominantly residential areas, schools and roads with known access problems (pinch points, weak bridges etc.) and indicates why apparently safe alternatives should be avoided. The original app formatting and supporting data structure supplies this critical information, as well as providing ease of access to update key queries in response to Leicester City traffic routing changes.
By applying GIS technologies, this novel application delivers up-to-date, reliable data of approved routes for HGV movement in and around the City of Leicester.

Outlook to the future

The HGV Leicester City app is designed to provide a single accessible entry point for HGV drivers using the city roads. The success of this initiative has generated interest with other city councils and it is intended that similar GIS mapping applications be built. There is scope for unification of this application across UK cities.

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KIUNSYS

Pisa Italy

SMART AND SUSTAINABLE URBAN MOBILITY SOLUTIONS

Smart mobility and parking solutions for more socially, environmentally and economically sustainable cities

Figure 1: Kiunsys' portfolio of smart urban mobility & parking solutions: web applications, electronic passes, sensors, mobile apps, gates, PDAs

The challenge

Road safety, energy efficiency and traffic congestion have been already identified as the main challenges currently being faced by cities all over the world. A city with a Sustainable Urban Mobility Plan is not a place with just a "green" sustainable agenda.

In fact, mobility has had an increasing impact on economic and social development of the cities, worldwide, over several decades. However, current levels of road traffic and expected levels in the future are increasing congestion, road fatalities and transportation pollution (air and acoustic).

Over time many cities in the world have tried many ways to solve these problems, introducing Intelligent Transport Systems based upon different strategies and adopting available state of the art technologies. This has generally produced poorly integrated systems and fragmented components. Today, advances in sensor and ICT technologies provide us with the unique possibility to offer a comprehensive approach to respond to several needs of a city, addressing the requirements of both public authorities and citizens.

Implications

Kiunsys designs, develops and realizes concrete solutions for Urban Mobility, in line with the EU transport policies (2010/40/UE Directive (2010), Commis-sion Delegated Regulation (EU) No. 305/2013 (2012)), which aim a reducing travel time in urban areas, increasing the capacity of the road network, reducing congestion, reducing pollutants, reducing energy consumption.

THE ISSUE solution

Kiunsys' scope is to realize hardware and software solutions which are concrete, solid, useful, close to the needs of clients and citizens, and which take into account the sustainability constraint. Public Authorities, Mobility& Traffic Managers and Parking Companies are offered products and devices specifically conceived, designed and developed for urban mobility, smart parking and tracking of goods, vehicles and people for City Logistics, all of which can contribute to improving the quality of urban life. In the following, current outcomes from the introduction of Kiunsys solutions, as measured and provided by our customers, include:

"Thanks to the innovative solutions provided by Kiunsys, we have reduced by 60% the citizens' attendance at the counters and significantly reduced also the disputes with citizens". **A. Fiorindi,** Pisamo SpA Director

User Application: **Smart Mobility and Parking**

Figure 2: The Kiunsys' Mobility Pass (winner of the 2009 RFID Italian Award) is a solution for the counterfeiting of parking permits and offers several key benefits for the management of urban mobility and parking

a) Parking management systems.

Reduction of Km/vehicle travelled in finding a parking bay (qualitative);

• 60% reduction of Km/citizen travelled to visit the Parking Authorities offices, (based on number of citizens at the counter);

• 80% reduction of paper for permits and parking payments (based on the number of processed documents);

• 80% reduction of disputes with citizens, according to the number of civil actions;

• 10% increase in parking control efficiency, according to the number of fines issued by Law Enforcement Officers;

• 10% increase in productivity of desk officers, (based on the number of practices performed by employees);

• A general increase in perceived welfare by all citizens, through the introduction of mobility and parking services and the electronic European Parking Card for people with disabilities.

b) Tracking and control system for City Logistics.

Reduction of travelled Km per freight vehicle and increased compliance of urban delivery vehicles with city transport rules (still qualitative).

Outlook to the future

Encouraged by the positive market response, Kiunsys is planning to develop new services for urban mobility, further exploiting the ITS trends, services for intermodal mobility, parking reservation, predictive services and new platforms for urban mobility.

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INNOVATIVE TICKETING SYSTEM SOLUTIONS FOR WARSAW PUBLIC TRANSPORT

Improving the quality of public transport in Warsaw-ticketing system development

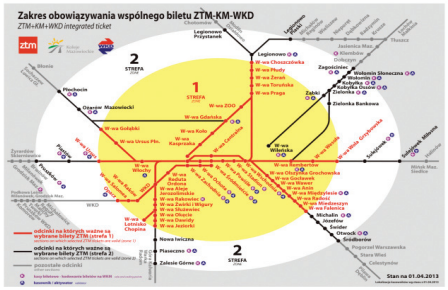

Figure 1: The scope of the ZTM+KM+WKD integrated ticket - http://www.ztm.waw.pl

The challenge

As the major cities expand, keeping citizens mobile is becoming a major challenge for municipal authorities. Road traffic is still increasing, leading to growing congestion and pollution in city centres. Public transport is one of the most economical and environment friendly policies for solving congestion problems in urban areas. Modern fare collection systems are one of the factors supporting attractiveness and accessibility of multimodal public transport. Innovative ticketing system, however, should not be considered as a simple replacement for traditional paper or magnetic ticketing. An important step is identifying which features and functionalities of innovative ticketing systems can be adopted and how they will integrate with the customers' wider mobility requirements. The introduction of an innovative ticketing system is also an opportunity to reconsider current fare policies and to offer alternative fare possibilities to customers. Integrated ticketing and tariff policies between different public transport operators on various levels (local, regional, national) should be offered to make tickets valid for all public transport modes and for a whole region.

Implications

Warsaw has an extensive network for public transport ticket distribution; there are over 1,400 traditional sales points. Passengers can also use vending machines, a ticket-selling system for mobile phones and on-line ticket sales. However, stationary points are still the most popular form for providing standard tickets and electronic urban cards. Nevertheless, lately the use of stationary and mobile ticket vending machines (placed in vehicles) are growing in popularity as these ticket machines make the purchase faster, with no necessity to search for the point of sale or stand in a queue and with 24 hour availability. At present more than 25% of short-term tickets are bought this way. Buying tickets via mobile phone (mPay, SkyCash, moBilet) has been available since 2008 and is slowly coming into broad usage (0.42% of ticket sales so far). This solution is popular mostly among younger generation familiar with innovative technologies.

THE ISSUE solution

New Information and communications technologies (ICT) can contribute to increase the awareness of car users of the accessibility of mobile applications that allow quick purchase of public transport tickets and simultaneously, contribute to the decrease of the congestion by leaving cars at home and use the Park & Ride system (P&R). Dissemination through THE ISSUE project can assist with the take up of these solutions.

Outlook to the future

Innovative ticketing systems can contribute to the overall improvement of the public transport network level of services, image, and accessibility, with the main aim to facilitate and increase the use of public transport and so contribute to the overall political goal of developing a sustainable transport policy.

The ticket system development strategy is aimed at creating better access to public transport and simplify tickets purchase procedures. Actions will be aimed at enlarging the number of electronic tickets users (urban travel card) and forms of electronic purchase.

Technological solutions will tend to adjust sales systems to the new electronic equipment, tele-communications services used by the transport system users, the use of the Internet and wireless communication, safety insurance i.e. personal data and money transfer protection.

E-ticketing systems do not focus only on the payment methods, but also process a huge amount of data, which can be used, managed and controlled by the public transport managers as well as contributes to public transport planning. They also give opportunities to introduce an integrated pricing structure that is not easy to implement with the use of traditional payment methods.

It is a crucial issue to promote new services and their advantages and to offer a wide range of other services to the public transport users to encourage city inhabitants to leave their cars and to use public transport to a higher extent.

"It is important to take into consideration and promote modern technological, organizational and applied solutions into communication".
Adam Struzik, The Marshal of the Mazowieckie Voivodeship

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SPRING - (SIMULATEUR DE PERFORMANCES D'UN RÉCEPTEUR INTÉGRANT LA NAVIGATION PAR GNSS)

A powerful 3D computing engine delivering urban canyon modelling

The challenge

Personal land navigation has become one of the most popular and frequently used Global Navigation Satellite Systems applications. In particular, vehicle and pedestrian navigation contributes widely to day to day life. However, navigation accuracy and precision depend on the type of environment such as the well known urban canyon effect. The drop of performance is due to poor visibility of GNSS satellites and thus the high influence of multipath errors. Therefore, recent technologies have been focused on the improvement of GNSS performances in constrained environments.

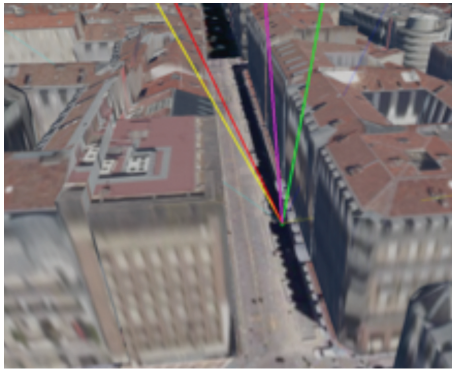
Implications

As a direct result of research activities, solving this challenge will provide a world competitive technology aiming at giving key information to GNSS industrial users and providers.

The implications for this technology are extremely important since it will help the industry to design services or systems with the knowledge of the behaviour of their product in constrained environments, such as urban canyons, where GNSS reception is still a major difficulty.

The implications for end-users (the citizens), are also significant since today no GNSS device gives precise positioning in urban environments. Current solutions are based on extrapolations, not on "true" positioning. Helping to understand the behaviour of GNSS signals in urban environments is the first step to ameliorate the quality of service in this environment.

"SPRING is a full software simulator aimed at providing a reliable assessment of the accuracy and availability of time, position and velocity of GNSS". **Thierry Chapuis,** GNSS Services Expert, CNES.



THE ISSUE solution

As a response to the need for reliable, accurate and precise navigation in urban environments especially the estimation of positioning accuracy in constrained environments Thales Services, in cooperation with the French Space Agency (CNES), is developing a GNSS simulator named SPRING (Simulateur de Performances d'un Récepteur Intégrant la Navigation par GNSS). Development of the simulator, which has started, consists of several components: The SPRING simulator allows the estimation of multipath errors by taking into account the nearby environment of the receiver, represented by 3D models. It extends the capabilities of a GNSS simulator with the performances obtained by using the most advanced Information Technologies.

Today, the system design is already well advanced, providing various key services to GNSS service providers, and GNSS equipment manufacturers. Indeed, the SPRING simulator allows users to analyse "real data" coming from a GNSS system.

From this data analysis, SPRING provides a performance analysis, for a punctual measure or for a complete trajectory in a constrained environment. It ultimately gives a simulation, in a local environment, of the signal propagation behaviour, including the influence of signal reflection resultant from multipath error.

Outlook to the future

The first version of SPRING will be released at the end of 2013, with new services added in 2014. Algorithms to enable the hybridisation of GNSS data with outputs from additional sensors will also be implemented. These new sensors will include barometric altimeters, accelerometers, gyroscopes and odometers.

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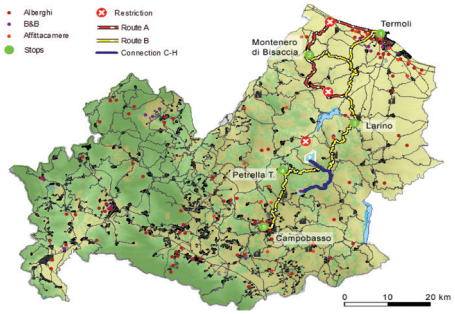
Molise Italy

TOWARDS SUSTAINABLE MOBILITY: A MULTISCALE INTEGRATED APPROACH

The research fosters GIS models integrating socio-economic, environmental and transport indicators



The challenge

The problem of mobility requires a complex approach, which considers the dependence of mobility solutions on the urban-regional structure and its evolution and also takes account of negative impacts on the environment, citizens' health, the artistic heritage, and the quality of life. The great challenge for both urban and rural areas thus consists of the ability to conceive complex patterns of mobility management, where transport and territorial development plans are integrated in order to satisfy the generated demand for individual mobility and to foster sustainable low-impact transport systems.

Implications

Transportation systems can be evaluated according to their external costs, borne by the whole community, including both users and non-users of the transport system. The external costs are sometimes called the social costs, since they impact on society in general and are generally considered to be external to the normal understanding of mobility. The main external contributions to the social costs include greenhouse gas emissions, air pollution, noise, accidents and congestion.

Some of these produce a significant reduction in the quality of life in urban areas; others generate high social impacts and long-term effects on climate.

Most of the Italian population, who live in large cities, is exposed to levels of air and noise pollution that exceed current statutory limits, but these problems also apply to some streets and zones of small and medium-sized towns.

It is worth noting that the risks from air pollution affect people in different ways; the groups most affected are the elderly and small children.

Congestion is another major problem for the population normally living or travelling into the city, with serious repercussions in terms of time wasted in traffic queues.

"The specific purpose of transportation is to fulfil a demand for mobility, since transportation can only exist if it moves people, freight and information around". **Jean-Paul Rodrigue,** Hofstra University

User Application: Urban and Regional Planning

The reduction of traffic congestion and the related pollution is therefore an important commitment for public authorities.

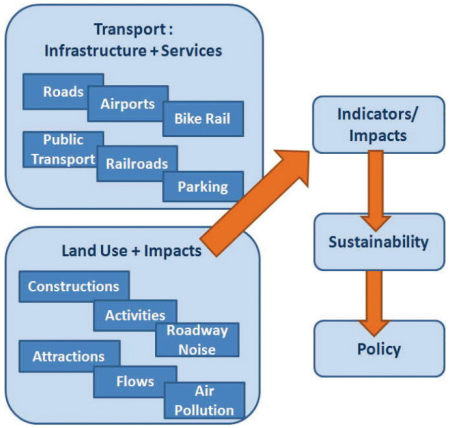
Undeniably, the negative impact from the increased demand for mobility on human health is important, whether it is expressed in terms of human damage due to poor road safety or the effects of environmental (air and noise) pollution caused by traffic.

THE ISSUE solution

In Molise a project has been started with the aim of integrating different data sources in a GIS environment. Several indicators regarding environmental, socio-economic and cultural dimensions have been selected in order to improve sustainable transport systems. Indicator values are derived, above all, from land-use and transport models.A comprehensive geo-database has been developed to integrate all data from those models and to provide further indicators that are useful to monitor and to study traffic impacts but also to forecast new models. The GIS database contains data about air quality, noise level, accessibility, land use and land cover and several sources are combined providing spatial information at various scales of analysis.

Furthermore, a road network model has been implemented to perform network-based spatial analyses integrated with social and economic aspects.

The integration of all data in a GIS is the precondition to study environmental impacts with transport models and to support sustainable mobility policy.



Thanks to this model data it becomes possible to use a single and integrated tool to monitor and manage all mobility aspects that have environmental, social and economic impacts.

Outlook to the future

The research is aimed at:

1. Developing an accessible open GIS on the system of regional mobility;
2. Providing a methodological basis for the suggestion and the assessment of policy options;
3. Building medium and long term scenarios in relation to mobility trends and their impacts.

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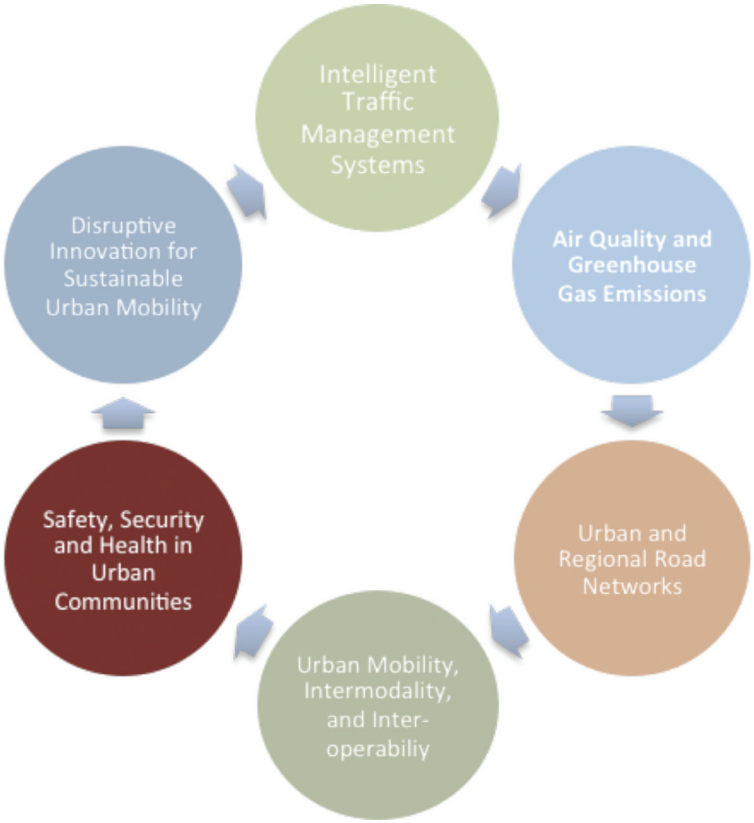
Societal Challenge 5



SAFETY, SECURITY AND HEALTH IN URBAN COMMUNITIES

The challenge:

Safety, Security & Health are at the heart of policies for Europe 2020, especially transport policies and projects that generate improvement to the quality of life of citizens and communities. Reducing accidents saves lives, makes the streets safer, reduces congestion and creates a better urban environment. Economic benefits accrue from reduction in workloads in health services in accident and emergency centres and reductions in traffic congestion arising from incidents.

The Response:

New monitoring and mapping systems have extended the amount and type of information that can be collected as input for road safety enhancement tools. Typical applications include:

- Design and quality of network to enhance road safety;
- Systems to control and manage the road network before, during and after incidents;
- Health of citizens;
- Security and information about freight road traffic.

ROMA TRE

Molise
Italy

INNOVATIVE TRAFFIC MANAGEMENT SYSTEMS BASED ON SPEED CONTROL AND DATA FUSION TECHNIQUES

Speed control for safety management and data fusion from forecasts from a traffic state model

The challenge

The development of safety management systems have become mandatory for all public agencies. One of the main causes of road accidents is the high speed of vehicles on highways. Moreover, road traffic is often characterized by high congestion levels that largely affect people from a social, environmental and economic viewpoint. Therefore, the capability to detect and/or forecast traffic condition is of utmost importance in management applications aiming at relieving congestion and reducing risks of high speed collisions. Recent advances in technology have made available numerous new monitoring systems so largely extending the amount and type of traffic measurements. These new possibilities have allowed two new tools to be developed. One leads to applications for forecasting traffic state in order to identify the most efficient management policy, while the other is a speed control system that also deals with information to users in order to decrease risk of incidents.

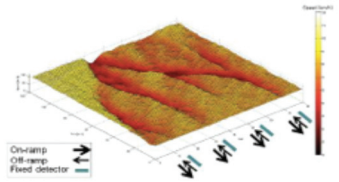


Figure 1: Ground Truth Speed map of a 40 km freeway stretch. Test simulation

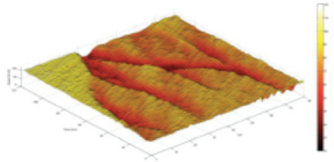


Figure 2: Estimated Speed map. Measurement data fusion

Implications

Road safety is considered by the European Commission as a major societal issue. Road safety will play an important role in the White Paper on transport policy 2010-2020, with the objective to reduce road users casualties, to improve the overall performance of the transport system and to meet citizens needs and expectations. According to the specific Molise priorities, one of the main objectives, in responding to this challenge, is to reduce the risk of death or injury due to transport accidents caused by high speed. From the social and economic point of view, sustaining a safer transport system and also decreasing congestion becomes a strategy to improve quality of life in local communities.

THE ISSUE solution

The availability of new technologies and new monitoring systems has largely extended the amount and type of traffic measurements. Examples of new data probes include GPS-based smartphones as well as vehicles equipped with Bluetooth devices or RFID transponders. So, the attention has to be focused on the fusion of data detected by different sensors in order to improve the forecast of traffic flow conditions. New sources of data probes in vehicles can provide data on location, mean speed and travel time, relative to road segments, and monitored in specific time intervals, and these can replace the traditional measurements of traffic volume, time and mean speed relative to a local section monitored continuously in time. All these detected data could be used in a forecast traffic model. Taking into account the technology readiness level of relevant technologies traffic forecast model has been successfully completed in a first test simulation on a freeway stretch. The information about traffic conditions provided by the forecast model permits vehicle speed identification.

Currently, in trying to reduce road accident rates, a Tutor system has been introduced on some Italian freeways. This is a speed detector system, based on identifying vehicle travel time between two sections. Nowadays this tool is used on closed network (toll highway systems), but it could be replicated, improved and expanded in order to be used on open road networks to provide better control, and supervision. Speed identification could be done from a single vehicle or from the traffic stream and used as a tool for speed control to operate on specific stretches of roads and potential black spots.

Outlook to the future

In the future increased use of data exchange between different platforms will increase. Moreover, the application could be extended to urban zones, where the congestion is higher and control is more complex due to the interferences between infrastructures and users. Furthermore, the approach leads towards more Advanced Traffic Management Systems using advanced software and data fusion from new sensors and data streams.

These tools can be of great interest for those who deal with management and safety in public administration, for commercial users customers and for enterprises engaged in innovative technologies.

"The car of the future will be faster than sound. So the driver will be in the hospital before starting the engine". **Henny Youngman**

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DE MONTFORT UNIVERSITY LEICESTER

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iCARE - A PLATFORM FOR INTER-OPERABILITY FOR MOBILE AND HOME TELECARE

The challenge

There are now more people aged over 60 than under 16 in the UK and much of Europe, and caring for our ageing population is a key UK & EU priority. Assisted Living (**AL**) is a generalised concept that refers to enabling older people to continue to choose living independently in their own homes; achieved by the use of mechanical adaptations and unobtrusive monitoring technology.

This includes devices to support mobility, such as vehicle trackers for mobility dial-a' rides and personal trackers for sufferers of dementia who may wander from home. **AL** products offer enhanced personal mobility opportunities for older people. Applying Intelligent Transport Systems (ITS) to this market creates opportunities for new services that aggregate data from different sources, such as buses and dial-a-ride services. In the absence of International or European standards for the data produced by **AL** devices, products and services have come to the market using in-house proprietary standards. These devices are unable to communicate with each-other due to lack of a common protocol; and new entrants into the market are restricted.

There are clear commercial benefits to companies that use such 'closed' systems. However the adoption of 'open' standards enables new ideas to gain traction, thus supporting innovation and cost reductions resulting from competition.

With an estimated 2.1 million people suffering from mild dementia in the UK alone, finding solutions to enable patients to be supported in their own homes is a major policy initiative for all European Governments. A number of companies now offer variations of GNSS based personal trackers for use by people reliant on assistive technology, many of which offering additional features such as fall sensors, voice, panic alarms and RF links to telecare sensors and systems.

Implications

AL mobility products offer a generic solution to enable older and vulnerable people to remain fully connected to society, by supporting access to the transport network. Thus iCARE and similar initiatives deliver substantial social impacts.

Economic impacts arise from enabling older people to continue to choose living independently in their own homes with the support of Assisted Living and Intelligent Mobility. It has been shown by more than one study that Assisted Living environments deliver better health outcomes, and lower health care costs.

"Since our involvement in iCARE we have landed a major customer in Europe, and have developed a portfolio of products and services for low-cost monitoring and alerting services for the wider market".

Simon Hussey, Intamac Systems

User Application: **Assisted Living**

THE ISSUE solution

iCARE is a solution that overcame the restrictions due to the use of 'closed' standards. iCARE is a platform for inter-operability for use with **AL** devices. iCARE is a UK Government funded programme set up to demonstrate that **AL** devices from different manufacturers are capable of inter-operability. This is achieved by defining "a platform for inter-operability" which is a communications layer that lies above the application software provided by different suppliers. This concept, which has been adopted for home automation, allows equipment manufacturers to maintain proprietary systems for the products, which inter-connect with other apparatus via a data gateway that carries lower level data in agreed standardised format. The advan- tage being that existing products can in- ter-connect by the addition of an iCARE gateway. The main barrier to the take-up of interoperability in this market is economic rather than technical, as major suppliers with a large market sector do not want to allow new suppliers entry to this market. Trials were undertaken with volunteer users, including personal trackers for sufferers of dementia, and they demonstrated that inter-operability is enabling care and health providers to provide better services, in terms of both health outcomes and cost reduction.

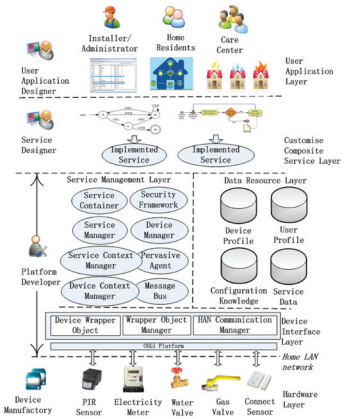

Figure 1: Autotxt hardware

The iCARE concept is now being examined by commercial partners with a view to taking the platform to market. DeMontfort are also working with developers of Intelligent Mobility and Mobile Telecare devices, to translate our design concepts for low power operation into commercial products.

Outlook to the future

The development of a platform for inter-operability that will connect **AL** devices with each-other and with devices in other sectors such as home automation and energy management is the key output. Extending interoperability to ITS is inevitable, and is identified as a key European technical objective in FP7.

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REMOTE SENSING AND GIS IN SUPPORT OF TRANSPORT-RELATED CIVIL CONTINGENCY STRATEGIES

Enhanced decision support capabilities for key actors in civil contingency scenarios

The challenge

During the last decade, the way in which civil protection work in the UK is approached has been the subject of a major review, with a new legislative Bill - the Civil Contingencies Act 2004 - being prepared and implemented as a result. The 2004 Act recognises key actors such as local authorities, government agencies and emergency services whose duties include assessment of local risks to inform emergency planning, implementing emergency plans, implementing Business Continuity Management arrangements and cooperation with local responders to enhance coordination and efficiency; and lesser actors such as utilities companies and transport operators who are expected to support key actor activities. The project concept focuses on key actors who must act quickly, effectively and safely, often in very difficult and complex scenarios. Visualisation, planning and strategic awareness therefore emerge as particular challenges faced by key actors in the context of civil contingency scenarios.

Implications

Throughout the UK, people enjoy a quality of life that is underpinned by many essential daily services that are accepted as being taken for granted such as utilities, transport networks, council activities and emergency services. These services are highly interdependent, and disruption to anyone can have serious knock-on implications for others. The disruption of these services can therefore threaten the well-being of communities and pose severe threats to industry, commerce and individuals, in particular those who are vulnerable. As a result it is extremely important that responses to civil contingency scenarios are well coordinated, efficient and supported by the best available planning capabilities – this in order to limit the scope and duration of any disruption that may result, as well as to minimise the risks to life and property of both citizens and civil contingency personnel.

THE ISSUE solution

Given the requirements for key actors to assess risk, implement emergency plans, implement Business Continuity arrangements and coordinate all involved activities with all involved responders it is considered that temporally frequent, weather independent, wide area observations from space, coupled with the analytical capabilities of GIS, have the potential to provide a highly valuable capability within the context of civil contingency strategies. For example, given a scenario in which major flooding has occurred in a particular region, both road and rail networks would be disrupted. The scale and extent of any disruption could be determined through the preparation of rapid flood extent maps from either radar or optical imagery.

These products could be combined with Ordinance Survey and National Rail GIS layers to enable the preparation of 'disruption maps' or 'disruption reports'. These could be updated as required, dependent on the nature of the response scenario. The products themselves could inform the key actor activities.

Figure 1: Flooding in the UK (2012)

Depending on the nature of the civil contingency scenario, it may also be possible to consider using the latest advances in Unmanned Aerial Vehicles (UAV) to support monitoring requirements within the response effort. UAV platform capabilities described as 'High Altitude Long Endurance', or HALE, have already successfully completed 14 day continuous flight trials with non-stop three month missions the ultimate goal. Such capabilities therefore offer the potential for continuous coverage for up to three month periods. Continuous coverage in this way would resolve any temporal resolution limitations associated with space-based platforms which would be particularly applicable for short duration, highly dynamic civil contingency scenarios, such as terrorist attacks, riots or major demonstrations. HALE platforms have been developed using space technologies, rather than aerial technologies, and are thus already able to support a wide range of useful instrumentation including multispectral optical, hyperspectral optical and LiDAR - with a wider range of monitoring capabilities as a result.

Outlook to the future

Beyond the 2004 Act itself, such a capability would be expected to have private sector relevance too, with potential customers including insurance organisations, logistics companies, transport operators and any other organisations with supply chain considerations.

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LIVING CLOSE TO BUSY ROADS INFLUENCES THE EFFICIENCY OF RESPIRATORY SYSTEM

People living in the vicinities of busy roads have lower values of respiratory function parameters and higher risk of bronchial obstruction

The challenge

Dynamic growth of the road traffic density results in high levels nitrogen oxides, ozone or particulate matter, which contribute to one of the most serious problems of air quality in Europe today. In urban areas high levels of air pollutants are characteristic for the surroundings of busy main roads. In Warsaw (Poland) a study on the influence of traffic-related air pollutants on the health of people living close to busy roads has been conducted. 4985 people (smokers and non-smokers) from the city and selected rural areas were investigated in years 2008-2011. Results of pulmonary function tests are presented.

Implications

The non-smoking persons investigated showed regular average mean values for particular spirometric indicators, both among the city and rural areas inhabitants. However, statistically significant differences between the groups were noticed. Among city residents, mean values of key spirometry parameters such as FEV1, FEF50 and the pseudo-Tiffeneau factor (FEV1/FVC) have proved to be statistically significantly lower than for the

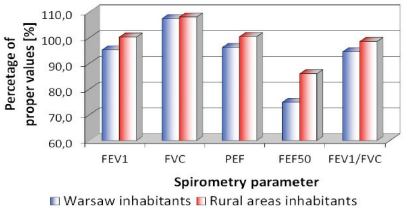

Figure 1: Mean values of crucial spirometry parameters among non-smoking inhabitants of the city and rural areas

control group (see Fig.1).

It was confirmed by the t-Student test (hypothesis on equality of average values of indicators was rejected at the level of $p<0.05$). This indicates that the average efficiency of the respiratory system of people living near busy streets of Warsaw is lower than in the control group (which consisted of residents of non-urban areas with statistically significantly lower concentrations of air pollutants). It can also prove that among the inhabitants of the city there is higher incidence of chronic airway inflammation and hyper-reactivity of small bronchi.

The percentages of people with bronchial obstruction symptoms were also calculated considering the degree of obstruction for each investigated group. Obstruction is diagnosed when the FEV1/FVC values are lower than 70%. Altogether obstruction was observed among 9.14% of the investigated inhabitants of Warsaw and amid 2.23% of people living in non-urban areas. This means that the occurrence of the problem of proper airflow through the bronchi is over 4-times more frequent among people living in close proximity to busy streets, compared with residents of non-urban clean areas. The conducted observations showed also a clear tendency among city inhabitants for rather moderate form of bronchial stricture,

so of FEV1 values lowered to the range of 50-79% (besides FEV1/FVC values lower than 70%) (in the control group such tendency has not been observed). This is a typical phenomenon for smokers suffering from COPD and not for people exposed to mainly environmental factors. The observation definitely needs further monitoring, also for economic reasons – with more advanced obstruction forms, costs of treatment are much higher but also the quality of life is dramatically lower, especially affecting people's professional activity.

The frequency of long-term pulmonary symptoms (present for at least 6 months), which indicate a dysfunction of the respiratory system, was also calculated. Among city residents the symptoms such as dyspnoea, cough with expectoration and wheezing were declared more often than in the control group (see Table and Fig.2).

Symptom	Warsaw [%]	Control [%]
Dyspnoea	18.3	14.3
Cough	13.2	10.7
Wheezing	6.9	4.5

Presented results demonstrate that there is a significant influence of road traffic and the air pollutants emission arising from traffic on the respiratory inefficiency and increased incidence of problems with proper function of the respiratory system among inhabitants of Warsaw in comparison with residents of rural areas.

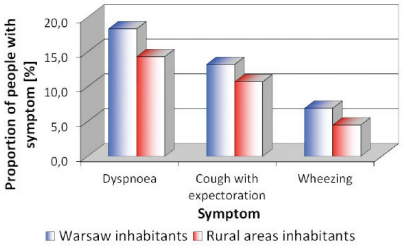

Figure 2: Proportions of people demonstrating the occurrence of pulmonary symptoms

THE ISSUE solution

Considering the WHO reports indicating that on a global scale, as a result of air pollution in cities, over 1.3 million people annually die prematurely and that a key part of the emissions of certain air pollutants arise from the transport sector, it is essential to take both corrective action and to implement such environmental management policies in the cities, which will limit the impact of road transport on the environment and health of inhabitants.

Outlook to the future

The results of the project will be presented to the authorities of Warsaw. A new action was also taken to develop the scope of the research on the impact of traffic-related air pollutants on the environment and human health. The effectiveness of different actions limiting this impact will be also investigated.

Acknowledgements

The project was financed from the Polish budget for science for 2008-2012.

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COOPERATIVE ROAD HOTSPOT WARNING SYSTEM (CRHWS)

The CRHWS aims to develop more intelligent and reliable solutions to improve transport safety at road hotspots

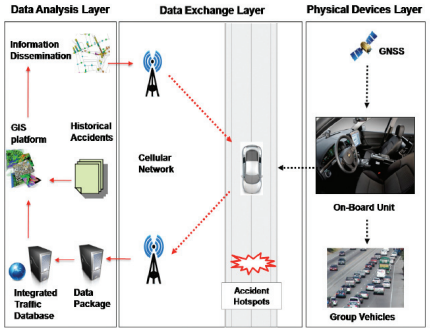

Figure 1: The system architecture and components design of the proposed system

The challenge

Road safety statistics reveal that the majority of road accidents have occurred cumulatively on specific sections of roadway network, which are often referred to as road hotspots. An effective approach for improving hotspot safety is to develop reliable and trustworthy notification to drivers, which informs them with better perception about potential dangers. However, current techniques, such as Online Traffic Information Platform (OTIP) and Roadside Traffic Signs (RTS), have many constraints. For instance, OTIP only can provide various road events or information to drivers when a driver plans their journey beforehand; the RTS are normally pre-defined based on prior knowledge and a single data source, fixed at the roadside. As a result, such a system has constraints on the consideration of various real-time traffic situations leading to accidents which are related to driver, vehicle, road and environment.

Implications

Given this context, various traffic data sources are less integrated and utilised, making the traditional hotspot notifications less convincing, and not particularly effective for individuals in different situations at hotspots. Developing a real-time Hotspot warning system is valuable both for transport managers such as traffic control agencies, and road users and commercial sectors such as drivers and automotive manufactures. The hotspot warning system is promising to build on existing mobile platforms as it can adopt already existed mobile and navigation data and generate new information.

In this system an application control centre is designed to capture and analyse real-time data stream from vehicles (e.g. via smart phone or navigation platform), and historical data from internet-based database. Based on the data, the system determine potential status of vehicle and

"This project with its aim of providing real-time road traffic injury risk information has the potential of not only improving road safety, but also extending the understanding on other real issues such as traffic flows and congestion". **Sanjay Rana,** www.road-injuries.info

User Application: ITS for Road Safety Enhancement

feedback warning to the drivers.

The technical approach proposed here is to develop a reliable hotspot notification system by integrating data sources from vehicle, traffic and environment. In order to achieve this goal, the project has designed a system architecture (see Fig. 1) and communication between a client vehicle and a remote control centre. This project developed a pair of prototype platforms to explore the feasibility of the system concept (see Fig. 2). By wirelessly connecting vehicles with cellular stations, the prototype platform was enabled with bi-directional communication between a client vehicle and a remote server.

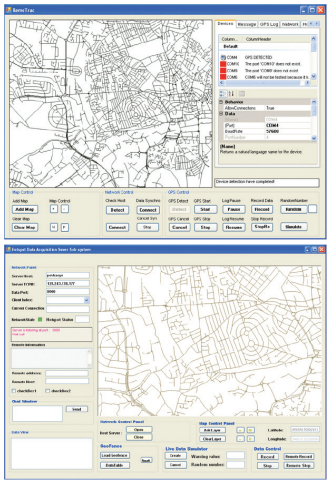

Figure 2: The software prototype systems developed for feasibility validation

The algorithm is designed to monitor real-time status of vehicle by collecting periodical messages from vehicles. Various potential possibility are identified about driver's risk by considering data from other internet-based traffic databases such as traffic and environment related databases. After analysis and decision-making by algorithm, the application server could inform the driver of danger warnings, in order to avoid risky driving or to re-enforce driver concentration.

To present, the system development is undergoing the proof of concept stage.

A few practical field experiments have been conducted to test the feasibility of early-stage prototype system.

Outlook to the future

The CRHWS is an initiative creating new opportunities for increasing driving safety at road hotspots. This project fosters the information cooperation between vehicles and infrastructure and it has been demonstrated to enable safer transport and better management for local transport operators. It could potentially contribute to future growth of automotive safety applications and the continuation of accident safety research. Successfully introducing the CRHWS vehicles will reduce accidents both at local and global levels. In addition, it will increase the driving safety perception, reduce economic loss due to accidents and greatly promote the quality of life on the road.

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A WAY TO IMPROVE THE DAILY LIFE & MOBILITY OF BLIND & VISUALLY IMPAIRED PEOPLE

Nowadays, 285 million people are affected by visual impairment worldwide. How can we improve their daily lives?

Figure 1:The world-unique hybrid GNSS for blind and visually impaired within its protective transport cover: the ANGEO Mobile device

The challenge

Helping and reassuring blind and visually impaired persons during their daily trips, especially in an urban environment, is a very ambitious challenge. GNSS technology offers a solution but urban canyon effects cause large positioning errors that can vary from five to dozens of meters in very constrained environments.

Implications

Currently blind and visually impaired people living in the city suburbs are largely dependent on taxis for their mobility. Despite good public transportation links, the fear of getting lost in public transport and multimodal platforms remains important. In this context, to solve the challenge of getting a precise positioning in an urban signals with other sources of information. Positioning information can then be corrected using inertial sensors, or geographical information from open data.

To be fully effective, such a concept implies a need for transport networks to open their data. In France, for the moment, the transport policies are not allowing publication of data about a city transport network as they fear that third party access could damage the data. Necessarily, transport policies have to change in order to give access to open data to help visually disabled people to travel safely and to reassure them to the maximum. The phenomenon of open data of transport networks is growing more and more after a slow take-off. This is an important trend transport authorities should encourage.

THE ISSUE solution

ANGEO Mobile is the result of 6 years of Research & Development in collaboration with the NCSS (National Centre for Space Studies), the FNCSR (French National Centre for Scientific Research), eye care professionals and blind instructors.

The ANGEO Mobile solution is a French patented device that was designed to help and reassure blind and visually impaired people moving on known or unknown routes. Thanks to the world's first hybrid combination between GNSS and inertial sensors that detects the movements of your hips, this device ensures a more reliable and accurate performance than any other GNSS devices for blind people with an accuracy of 5 meters compared with a 15 metres accuracy of other systems. The inertial sensors that are combined with the GNSS permit the user to have an efficient positioning even when the satellite signal is lost, especially in urban canyons. In this way, navigation instructions are always relayed and reliable. As another advantage, the device has a "transport mode" which is a mode for intermodal transport. This mode allows the user to be guided regardless of the type of transport he uses and even if he changes the mean of transport. It will automatically detect the type of transport being used.

The ANGEO Mobile solution also includes human assistance as it is possible for the user to call the assistance centre when he is lost during the navigation.

Finally, although the technical challenge is being solved, the access to additional open data remains difficult, but it is the way to improve the reliability of the ANGEO system and to diffuse this solution in order to improve the daily life of blind and visually impaired people.

"Today, only 5% of visually impaired are independent while they are travelling, they fear going through new routes. I hope ANGEO will be an opportunity to reintegrate them professionally and socially. We would be proud to contribute to this".

Edgard ANTOINE, CEO of NAVOCAP/ANGEO TECHNOLOGY

User Application: Mobility for Visually Impaired

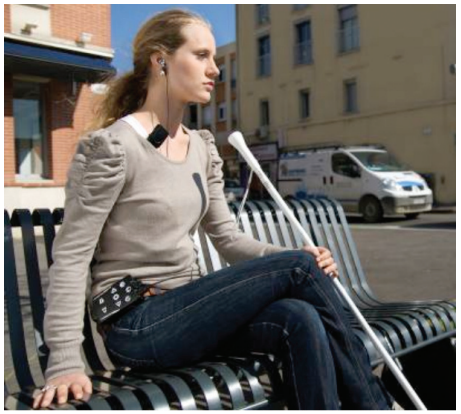

Figure 2: High reliability, intermodal transport mode, human assistance: the words that describe the solution

Outlook to the future

For the moment, the device only takes into account pedestrian/car/bus intermodal transport mode. But as for the future, we plan to extend it to the underground, especially with the support of Geographical Information Systems based on reliable and precise multimodal and open data.

This enhancement would have a major impact on the life of the users as it would enable them to go anywhere they want without fear and in turn make their trips safer and easier.

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ANAS RUMORE PROJECT

The challenge

The ANAS Rumore Project came from the need to respond to new European and Italian regulations governing issues of noise pollution. e-GEOS has supported the Italian National Road Agency (ANAS) in identifying the most critical acoustic areas where noise could harm the human environment or areas of natural value (e.g. national parks, nature reserves). These areas became the subject of dedicated airborne photogrammetric flights, from which 1:2,000 scale maps were produced and the main sources of passive noise (bumps, joints of bridges) and the main receptors (hospitals, schools, villages, etc.) were identified. On the basis of those results and field measurements of traffic and noise a model of noise propagation was produced to identify all the areas where noise exceeds the threshold levels prescribed by law. For these areas, noise abatement measures have been designed and implemented. The project has been undertaken by the Italian companies e-GEOS, TECNIC CONSULTING ENGINEERS S.p.A. and SIT - Servizi di Informazione Territoriale S.r.l.

Implications

ANAS manages more than 24,000 km of national roads and motorway network, directly or through Concessionaires, guaranteeing swift mobility in complex and inhospitable terrains, adapting and maintaining the network for efficiency, and safety, striving to provide optimal integration with other modes of transport, reducing environmental impact and improving quality of life.The data analysis and the project results are now available at ANAS as a Topographic Data Base and also in Google Earth 3D, which allows users to have a full vision of the interventions to be implemented (Figure 1).

Figure 1: Information on the buildings floors with a noise level (DB) out of the limits allowed by law (yellow)

The ANAS Rumore Project is aimed at processing aerial images with Digital Elevation (DEM) and 3D modelling techniques, integrated with in situ sensor and traffic data collection, analysis and simulation in order to evaluate urban traffic impact on citizens health. This integrated processing allows the definition of a Noise Mitigation Measurements Plan to identify areas potentially affected by traffic noise effect and to identify corrective measures over an area of about 10,000 sqKm.

THE ISSUE solution

The identified methodology requires the road network to be broken down into discrete elementary routes. Level of criticality and sensibility toward noise exposure is assigned to each identified elementary route depending on the density and typology of buildings along the routes, the urban morphology and the traffic flow density along the route. The analyses are performed by semi-automatic tools, exploiting the capabilities of the GIS system developed for the Project, with the following main functionalities:

- delineation of the built up areas extracted from the Corine Land Cover (CLC) 2001, updated using visual inspection methods and photo-interpretation;
- integration of ANAS competency routes information;
- integration of information on population density (from ISTAT 2001 sources);
- integration of the information on the critical paths already identified with the screening activities.

In order to fulfill the methods requirements, the project partners collected and homogenized data from many sources referenced with a unique reference frame.
The methodology adopted for the identification of the critical areas affected by traffic and noise is the following:
1) identification and extraction of the data of interest: after the data homogenization, the next step is the spatial intersection of the road graph, provided by ANAS with the information already included in the Project database, in order to extract only the set of information relevant to the analysis of critical paths.
2) The next step is aimed at update the Corine Land Cover database with information related to the built up areas within 500m of the ANAS road network extents. However, the adopted CLC2000 database was created using 2000 satellite imagery and ancillary data, so the information content related to the built up areas should be updated using aerial ortophotos and advanced photo interpretation techniques.
3) Then, after the identification of the updated built up areas, the evaluation of the population density and auxiliary data related to each area is provided, by the extraction of the following information:

- dwelling density;
- distance of the focal point of each built up area from the road axis;
- height of the focal point above the mean sea level.

Finally, the analysis and evaluation of traffic data on the ANAS road network is implemented, with a model calibration and identification of the critical paths.

Outlook to the future

The ANAS RumoreProject is a project implemented in compliance with the new European and Italian regulations governing issues of noise pollution, addressed to monitoring and reducing potential damages from noise pollution, improving quality of life. The methodologies implemented in this project are in line with THE ISSUE finalities, and they are available to be tested by THE ISSUE partners and available for any other test that is able to improve the correlation between geographical measure and traffic information. After consolidated test results it will be possible to organize a commercial strategy provide monitoring solutions related to regional authorities.

"ANAS Rumore Project is aimed at integrating different monitoring techniques in order to evaluate urban traffic impact on citizens health".
Fabio Volpe, Remote sensing manager, e-GEOS

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AUTOTXT - THE FIRST FACTORY FITTED VEHICLE IMMOBILISATION, LOCATION AND RECOVERY SYSTEM

Nowadays, 285 million people are affected by visual impairment worldwide.
How can we improve their daily lives?

The challenge
At the time of this development vehicle alarms were purchased and fitted by the car owner to their cars. Autotxt is different because it is a factory fitted unit that is designed to be an integral part of the vehicle's Engine Management. Autotxt also used the emerging technologies of data communications via mobile phones, and low cost GNSS receivers.
The challenge was to design an innovative product that delivered the key requirements of vehicle immobilisation, location and recovery; and was capable of being a Gateway to the vehicle's internal telematics systems. The final solution is a standardised electronic control unit (ECU), with a wide range of different telematic input & output devices, which can be configured for different vehicles and automotive applications.

Figure 1: Autotxt hardware

Implications
The most important impact is that Autotxt represented a major innovative step in vehicle security. The complete system when enabled includes driver authentication, tracking and remote immobilisation. The product went into volume production in the UK, creating skilled manufacturing jobs, as well as supporting an engineering design base.

THE ISSUE solution
Like similar products to be found today, Autotxt has a GPRS MODEM and a GNSS tracker. Its unique and innovative design difference is that it is integrated with the vehicles' data Local Area Network (LAN), and supports an RF LAN. It is more appropriate to consider the device to be a Gateway; linking a range of different networks to each-other. Thus Autotxt

User Application: Vehicles Security

enables inter-operability between different networks and different services.
The design approach was to develop an automotive quality Gateway to provide connectivity between the vehicles wired and wireless networks, and external wireless networks.
The original gateway design supports the following I/O:

- CAN Bus
- Blue tooth
- LPRF
- GSM covering Voice, SMS & GPRS
- GNSS including GPS and SBAS
- Serial
- Automotive I/O

The device was developed to be fitted either after-market, or track-side; track side fitting being more suitable for inter-operability with the vehicles wired network. An underlying suite of connectivity drivers were developed which are hardware specific; overlaying this hardware abstraction layer is a series of services and applications. Thus new services which are identified can be speedily incorporated into the system. More recent versions have added the flexibility of using Model Based design methodologies.
For example, driver authorisation can be achieved either by a standard 'key in' operation, via the private RF network to a traditional key fob, or by creating a Bluetooth connection to the driver's mobile phone. If Bluetooth is used then the mobile phone is paired to the vehicle, and the driver is required to enter a 4 digit PIN number to enable the car. However once the driver has been recognised, the 'authentication' process is independent of the hardware used.

Outlook to the future
Autotxt has now passed from research to become a wholly commercial product, where it continues to be developed to meet today's vehicle security needs. The legacy within the DIGITS research group is that it developed our capability to translate our skills in microelectronic design, satellite navigation applications, and embedded real-time systems.
These skills are now being deployed within emerging research projects.

Further opportunities are being explored to develop new commercial partnerships to create innovative solutions that use Satellite Navigation, Embedded Real-Time Software and Micro-Electronic design.

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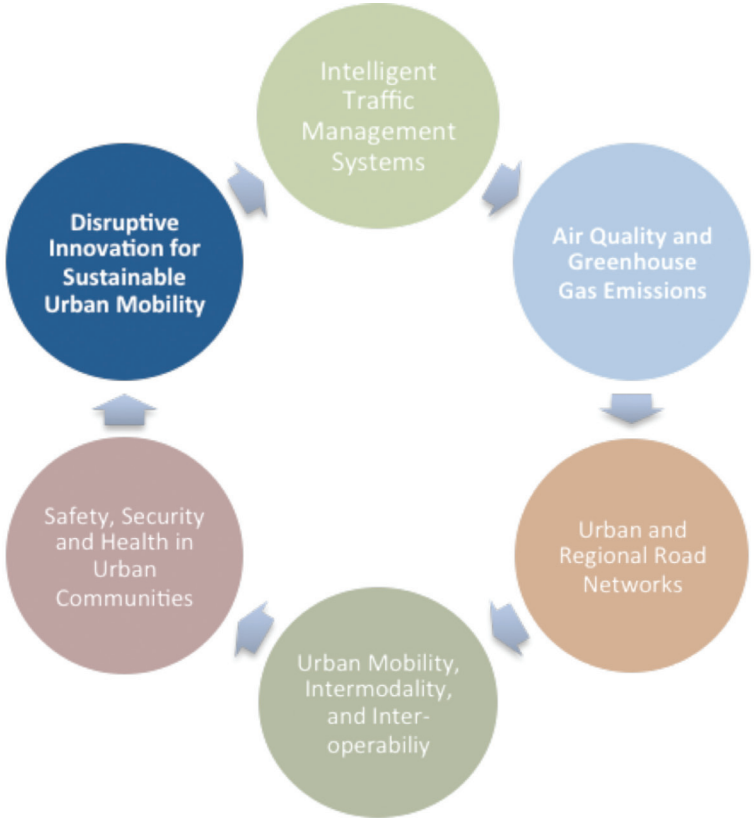
Societal Challenge 6



DISRUPTIVE INNOVATION FOR SUSTAINABLE URBAN MOBILITY

The challenge:

In many cities and regions implementing efficient and integrated urban transport systems has been a challenge for local authorities and transport organizations. For as long as urban transportation decisions are made vertically, without transverse collaboration between political decision makers, users and system providers, or where consultation between stakeholders is ineffective, transport planning will continue to suffer from technical incompatibility and compartmentalization of the different transport modes.
Methodologies for policy and planning for sustainable urban transport need a radical shift towards horizontal connectivity between stakeholders.

The Response:

In other fields, disruptive innovations have managed to displace existing markets and value networks. Disruptive technologies could impact significantly on current approaches to urban sustainability. Examples in this publication include:

- Triple helix actors fostering organizational collaborations;
- ITS for Changing User Behaviour;
- Uptake of Low Carbon Vehicle Technology.

PREDICTING AND MANAGING THE BEHAVIOURS OF CROWDS

A data based model of crowd behaviour to manage pedestrian flows and design safer public spaces

The challenge

As illustrated by the recent crowd disaster in Duisburg during the Love Parade in 2010, the understanding of pedestrian behaviour and crowd dynamics has become an important research area. Much fundamental research undertaken in this area is aiming to analyse the collective motion of crowds and their congestion formation mechanisms. The objective is then to design better exit routes for evacuation of large crowds and to adapt the environment for safe planning of mass events.

Implications

A new approach at the crossroads of social ethology and statistical physics seeks to understand the behavioural rules and interactions that govern collective behaviours in human crowds. The approach consists of using the methodology and tools developed to understand and model the collective behaviours of animal groups (ant colonies, fish schools sheep flocks) and their interactions with their environment whilst moving. The ambition is then to adapt these methods to extract the rules governing pedestrians behavior and to develop models based on these rules to understand and predict human crowds behaviours. Reducing pedestrian congestion in metro stations or optimizing the use of road networks are typical applications under consideration.

Figure 1: Automatic tracking of pedestrian groups motion on the Place of Capitole in Toulouse

THE ISSUE solution

The Dynactom (Complex dynamics and interaction networks in animal societies) research group at the ResearchCentre on Animal Cognition in Toulouse has

"One of the biggest advantages of this vision-based model is its versatility. It's relevant to a whole range of pedestrian situations, and that's what makes it more testable".

Michael Batty, University College London

gained a rich experience in the experimental investigation and modelling of numerous collective phenomena in animal and human groups and societies.
The team has developed new modelling approaches that incorporate the visual information that pedestrians use to navigate through crowds, and the manner in which the information is processed to adapt movement.
The motion of a pedestrian can be well described by two simple behavioural rules: suggesting that a pedestrian tries to minimize the visual coverage of his vision field and adjusts the walking speed to keep a certain safe distance from other people.
Numerical simulations of this model show that these two rules are sufficient to generate a large variety of collective behaviour that forecasts a transition from smooth flows to stop-and-go waves and crowd chaos.

This prediction agrees well with recent observations of crowd disasters that happened during the pilgrimage at Mecca. Furthermore, the model allows for the identification of zones where the occurrence of crowd accidents is likely.

Outlook to the future

This work opens the way for the elaboration of reliable risk management tools. The model could help urban planners to design better exit routes for evacuation of large crowds from buildings, reduce congestion on pedestrian flows and adapt the environment for a safer planning of mass events. The consequences will be a reduction of stress, travel time and economic cost due to congestion.

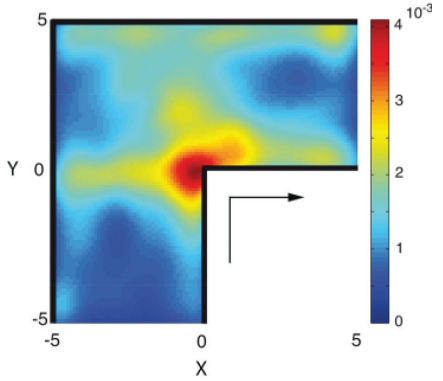


Figure 2: Simulation of a large crowd changing direction by 90°. The colour indicates the intensity of physical pressure experienced by individuals. Red areas indicate a high risk of crushing

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BARRIERS TO ADOPTION OF ELECTRIC VEHICLES

Innovation enablers, ICTs, and the co-creation of sustainable practices

The challenge

Research into the decision process of business actors undertaken between 2010 and 2013 in the plugged-in town of Milton Keynes suggests that national policies incentivizing the adoption of electric vehicles failed to address key concerns of pioneering adopters, and particularly those of business users. Companies represented the bulk of the market for EVs, and their major concerns could not be solved by deploying infrastructure, but required for the reassessment of business models, purchasing criteria and IT systems.

Implications

Organizational markets play an important role in the adoption of low emission vehicles. Business fleets are easily overlooked because company registered cars constitute only 8.3% of the car stock in the UK. However, 56% of all new cars and 75% of all EVs are purchased by companies. Company buyers shape the consumer market as cars move from the company fleets to the private market.

The barriers faced by business users have been largely unaddressed by national EV policy, which is based on financial incentives and infrastructure deployment. Policy documents show more concern with the needs of the industry than with those of adopters.

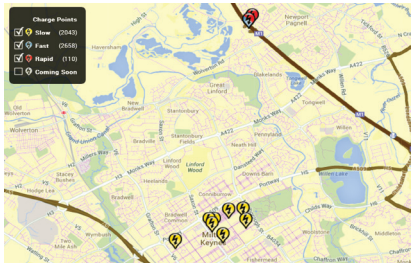

Figure 1: Slow charging points serve shoppers and commuters in Milton Keynes city centre. Rapid points along M1 enable long-distance travel

Interviews conducted in Milton Keynes as part of the PiP engagement indicate that a lack of knowledge about the fit between EVs and user behaviours, organizational practices and duty cycles constituted a barrier for adoption. Industry actors did not have the capability to provide support in that area during the early stages of the transition. In several cases, fleet experts declared that they did not have the capability to provide advice on the subject. Lack of data about operation, maintenance and repair costs was a concern, as was the lack of analytical and predictive tools. Organizational know-how did not keep pace with the rapid evolution of low-carbon strategies and developments, and governmental policies did little to foster the learning process or encourage the development of enabling technologies unless they were directly related to automotive performance or to the management of charging.

"It is our intention to adopt an open approach that encourages other parties to introduce new and alternative technologies and business models to the city". **Milton Keynes** Plugged-in Places application

User Application: Electric Vehicles Uptake

THE ISSUE solution

Some of the teething pains experienced by organizational user of EVS were solved as pioneers learned from their experience and shared their knowledge. In other cases, however, the problems were made persistent because the systems and models used by organizations had been designed around the old technologies.

In one of the cases studied, the manager of a 1,300 car fleet used industry standard tools to perform a whole life cost analysis and concluded that EV adoption was a money losing proposition. Upon realizing that key figures built-in into the software were based "business as usual" assumptions unrelated to the capabilities of the new technology and the business needs of his organization, a bespoke modelling tool was commissioned. This allowed for a re-evaluation of the ingrained models under different conditions (lease vs. buy, 4 year vs. 3 year life cycle, 80,000 vs. 100,000 miles a year). Figures generated with the new system demonstrated that EVs made financial sense for the company and the drivers, as long as EVs were not managed with systems and practices shaped by the needs of the internal combustion engine.

Figure 2: EV charging point in use at Milton Keynes city centre

Outlook to the future

Recent policy developments suggest growing interest by policy actors in the role of ITCs as part of the wider network of innovation enablers.

Innovation policy is evolving away from a model of product innovations pushed from the top-down, and towards a systemic approach in which innovative practices are co-created with the participation of a rich network of enablers. In this context ITCs become two-edged tools.

Unexamined, they can act asinvisible enforcers of entrenched procedures, but they also create opportunities for innovation as they look at the prevailing values, assumptions and models and create the possibility of challenging the status quo.

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MY ELECTRIC AVENUE

A system is being tested that prevents local electricity grids overloading when numerous electric vehicles recharge

The challenge

The advent of Electric Vehicles (EVs) necessitates an assessment of their potential impact on the grid. Clusters of EVs simultaneously recharging in the same neighbourhood, for example, risks of overloading the local electricity network. EA Technology's Esprit system can control the recharging of vehicles to avoid this and field trials of it are being carried out in the My Electric Avenue project.

The challenge is to implement a demand curtailment and scheduling system that does not inconvenience EV users, while also maintaining reliability of electricity supply. Simply increasing the capacity of the local grid is expensive and requires disruptive civil works. Instead, the Esprit system follows the 'smart grid' principle of 'doing more with less': i.e. adding intelligence, rather than on ever more capacity and redundancy.

In My Electric Avenue, researchers from De Montfort University are collecting and analysing data on EV users' behaviour and their attitudes to Esprit's intervention in the recharging of their vehicles.

Figure 1: Field trials of smart grid technology for electric vehicle recharging

Implications

Aimed initially at Distribution Network Operators (DNOs), Esprit allows them to manage local power demand, thus protecting their assets and ensuring reliable electricity supply and it must do so without any inconvenience, disruption or loss of service quality to end users. Esprit's success would also have wider implications for the creation of smart grids. While its intervention might be required on rare occasions by DNOs, a similar system would find regular application from utility companies. They don't own the network infrastructure, but must continuously balance the varying supply and demand of the energy that they buy and sell. The widespread application of demand response is therefore central to smart grid operations as it allows major penetrations of low carbon power generation (renewable energy, nuclear power or fossil fuelled

"This project will deliver a low carbon solution to benefit customers and the network". **Stewart Reid,** Scottish and Southern Energy

User Application: **Electric Vehicles**

Figure 2: Esprit can control clusters of electric vehicle recharging to prevent overloading local power networks

generators with carbon capture and storage) to be accommodated. Esprit could become a key enabling technology for the extensive demand response required in low carbon energy systems. This confounds the misapprehension that EVs will be a burden on the grid. Instead, they may be essential to establishing smart grids. In return, being powered from low carbon sources, smart grids enable the decarbonisation of the transport sector through the use of EVs and - for longer range, larger payloads and quicker refuelling - Fuel Cell Electric Vehicles (FCEVs). The latter are fuelled by hydrogen produced by electrolysis, which enables demand response at large-scales for smart grids. Technologies like Esprit therefore lie at the interface between the low-carbon power and transport sectors of the future, creating a powerfully symbiotic relationship that is critical to meeting climate change and energy security challenges.

THE ISSUE solution

Supported by Ofgem's Low Carbon Networks Fund, My Electric Avenue aims to test the effect on local electricity networks of recharging clusters of EVs and to provide a technological solution to avoid associated network overloads. It aims to deliver a cost-effective solution that reduces the need for network reinforcement and allows a faster uptake of EVs.

Esprit works by monitoring the load on a local electricity substation and, should it approach its maximum capacity, will temporarily switch off individual EV recharging units on the electricity feeder lines that are threatened with overload. Since this is done on a short-term, rolling basis, it is unlikely to have a significant impact on the overall charging rate of the EVs affected, particularly if they are on an overnight recharging schedule.

Outlook to the future

The basic functionality of Esprit is being tested in the My Electric Avenue trials, but following the success of these, greater sophistication will be built into the system. Initially, this will be in order to commercialise the product for application by DNOs in the cost-effective protection of their networks and the reliable delivery of electricity. However, the potential for broader implementation is tantalising, especially in facilitating widespread demand response in the operation of smart grids.

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INTERNET ENERGY: PILLAR OF THIRD INDUSTRIAL REVOLUTION

Shifting from traditional roles, a new paradigm is emerging where anyone can become an electricity producer or consumer. This adds significant complexity to the grid

The challenge
Decentralized energy production should be managed by decentralized decision making to allow each produced kilowatt to be consumed in its nearest location to minimise line loss. The Internet of Energy could be the answer.

Implications
Energy is clearly the challenge for upcoming decades. Political decisions and economical directions are stuck because of lack of references and solutions. Jobs opportunities, new businesses, GDP growth depend on our capacity to face the energy challenge.
Energy distribution is transitioning from heavy centralized energy production plants to highly distributed micro-plants through emerging technologies.

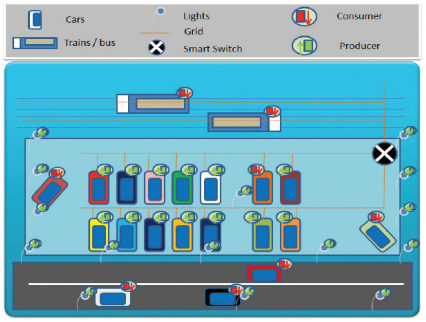

Figure 1: Production and distribution of energy modelled as data flows on internet

Smart grids are already deployed but actual design is dedicated to handle huge and predictable quantity of energy and not designed to handle part time tiny production with highly variable performances. On the other hand the Internet is really powerful in managing distributed resources and, in doing so, is creating new branches in the economy.
As stated by Jeremy RIFKIN in his book "Third Industrial Revolution" technology transfer between Internet and grid management may be the missing link. In such areas, sooner is better. Either each country can wait for solutions from overseas or work now to create its own and stay tuned to face the future. While parked or stopped a vehicle is an energy provider; on the move it becomes a consumer. Fig. 1 above illustrates this principle. But how to maximize each kilowatt in such a role is the challenge.

"Using Internet technology to transform the power grid of every continent into an energy sharing intergrid that acts just like the Internet".
Jeremy RIFKIN, president of the Foundation On Economic Trends

User Application: **Infrastructure**

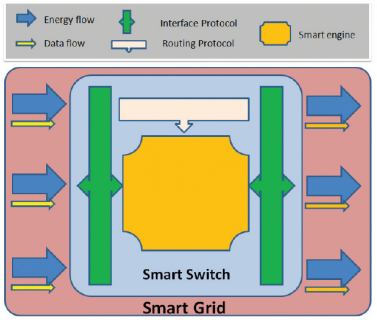

Figure 2: Smart Grid: Energy distribution network with routing protocols as in data networks

THE ISSUE solution
Proposed research will define and set up a model of a next generation of smart grids based on existing internet technologies.

Many protocols are used on the Internet. They allow networks to be reliable, efficient and route continuously growing amounts of complex data.

Transferring these technologies to power management will provide similar features with similar expected benefits. The above picture "Smart Grid" shows an energy distribution network with routing protocols like those used in data networks.

As far as kilowatts and bytes do not have so many common properties the Internet Energy should be deeply re-thought to provide appropriate features.

However, many dynamic routing protocols in the internet are of interest for routing kilowatts, such as Shortest Path (OSPF) Routing Discovery and Multicast (IGMP / PIM).

Predictive engines are used in many IT areas. Renewable energy sources (wind, sun) are by definition subject to short-term forecasting and predictive computation should help to increase efficiency in the grid. These distributed metrics should be managed by distributed decision-making nodes in order to comply with Just-In-Time production/consumption, low in-line loss, elimination of waste.
Target audiences range from energy providers to consumers also requiring equipment designers to embed these new protocols and metric management methods into products.

Outlook to the future
Once described and benchmarked, the Internet Energy should apply to any range of networks, from metropolitan (WAN network), to local (LAN networks).
Even tiny networks inside a car, a plane, or a house would also match, thanks to new generation of standards (RFC) as used on Internet.

New tenants may come to the market to manage and enable least-cost routing for electricity in the network.

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AUTONOMOUS, ELECTRIC, INTELLIGENT AND CONNECTED VEHICLES FOR URBAN ENVIRONMENTS OF THE FUTURE

Figure 1: An autonomous vehicle

The challenge

Revisiting cars usage in urban areas thanks to technology.

The electric, intelligent, connected and autonomous vehicle will provide safe, dual-mode, manual and automatic urban and social drive capacities. These innovations will help address challenges for future urban vehicles, so that they can find their place in real traffic, contributing to congestion reduction while improving the urban journey experience.

Implications

Sensitizing people to the mobility of tomorrow.

Beyond the state-of-the-art experiments of autonomous low-speed electric vehicles which are confined to small and calibrated spaces, new innovative vehicles will be able to demonstrate the feasibility of dual-mode and stand-alone vehicle operation for real urban roads. Demonstrators and showcases will allow the public to understand the abilities of these vehicles such as the use of increased detection and safe driving capabilities. This improved awareness should help prepare peoples' confidence for the future deployment of such vehicles.

One of the significant issues regarding the place of Man in the automated vehicle is related to the perception of the automation itself. Studies have shown that beyond a certain speed, passengers of automated vehicles feel some fear. We will have to increase information to allow people to perceive the cognitive abilities of automated vehicle reality: perception, analysis, action. The idea is to display augmented-reality detections and information about system decisions so that passengers feel safe.

These autonomous vehicles must be carefully thought out and designed for real traffic situations. We not only have to create intelligent vehicles but also much more relevant and smart users-oriented transport services.

Once electric autonomous vehicles are perceived as friendly and safe, their number will increase, hence directly impacting on emissions. In addition, optimization of the flow of these vehicles in existing traffic will reduce congestion. These autonomous vehicles are a chance for urban transport services to be more flexible and friendly for European citizens.

"Environmentally-friendly transport and particularly autonomous electric vehicles have a bright future in our new cities".
Benjamin CANS, Link & GO Project engineer - CRDTA

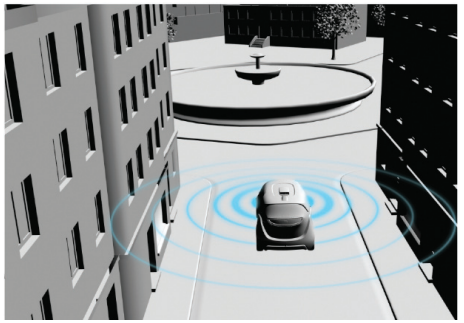

Figure 2: Ubiquitous connection and precise vehicle aero-localisation

THE ISSUE solution

These innovations, applicable to vehicles manufacturing itself as well as to their efficient inclusion in cities traffic, will require exploitation and combination of several technologies such as Open Data, Cloud computing and Global Navigation Systems-sourced (GNSS) information.

Innovations are in line with two of THE ISSUE's objectives; first promoting the uptake of new technologies from RTD programs in order to improve Intelligent Traffic Management. Secondly, exploiting the use of Galileo/GPS technology linked to existing traffic management systems for personal real-time public transport journey. To achieve operational demonstrators and highlight these innovative solutions for urban mobility, cooperation between technology providers, researchers, car manufacturers and regional and local authorities are crucial.

THE ISSUE can contribute to facilitating these exchanges and building the right environment to enter the market and answer citizen requirements regarding the deployment of efficient and user-friendly urban transport vehicles and services. NEREUS is contributing by promoting the application of space technologies in the transport and urban mobility sectors.

Outlook to the future

Projects promoting the development of autonomous electric intelligent vehicles will as such positively participate in the reduction of traffic congestion and emissions, and in the improvement of air quality in urban area.

These innovative solutions will clearly shorter journey times and sensitize people to multi-modal solutions in their public transport usage.

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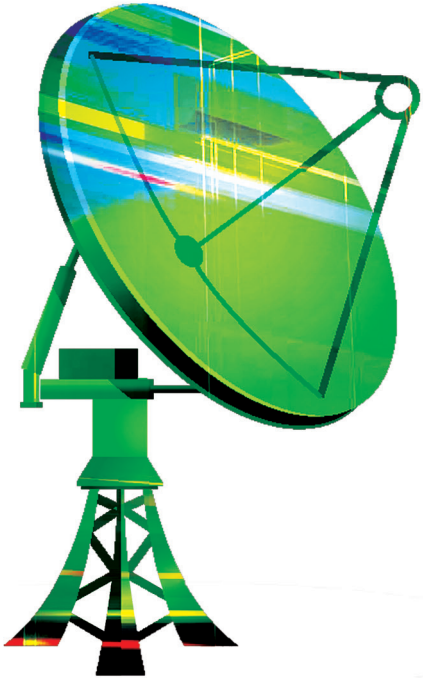

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