From collaborative research projects to market deployment:

12 success stories

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INTRODUCTION

The European Framework Programmes have been important mechanisms to achieve European transport policy goals related to mobility, energy efficiency, safety, emission reduction, economic growth and competitiveness. Thousands of projects have been carried out with funding from European programmes. A major target of co-funded RTD projects is the creation of technologies, methodologies and processes, and their implementation as successful innovations. The added value and benefit of the European Commission's financial support is tremendous, though impossible to quantify.

This collection of factsheets gives a snapshot of European road transport innovations using 12 success stories that represent the wide range of RTD in this sector carried out in collaborative projects.

This report has been produced by the FP7 project "FOSTER-ROAD - Future Surface Road Transport Research", the support action for the European Technology Platform ERTRAC.

www.ertrac.org

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Advanced Driver Assistance Systems

To enhance the safety of the vehicle occupants and other road users, vehicle manufacturers, including FCA, have introduced a range of features either as standard or as optional on new vehicles.

In particular over the past years, a series of EU research projects have focused on the development of so-called Advance Driver Assistance Systems (ADAS), which facilitate the driver with the task of manoeuvring the vehicle in difficult or critical situations.

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The numerous ADAS features which have been introduced recently by FCA or another European vehicle manufacturer, and which can be linked to at least one previous EU project, include:

- Adaptive Cruise Control
- Blind spot monitoring
- Lane departure warning
- Lane change asssitance
- Front collision warning
- Autonomous emergency braking
- Driver monitoring
- Pedestrian detection
- Intelligent speed adaption/advice
- Night vision support
- Adapative light control
- Traffic sign recognition
- Automatic Parking

ADAS Example:

1. Blind-Spot Monitoring

Blind-Spot Monitoring uses ultra broadband radar sensors to assist the driver during lane changes, indicating the presence of other vehicles in blind spots by lighting up icons on the door mirrors and activating an acoustic signal chosen by the driver.

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LACOS: Lateral Control Support

1998-2000

Validation of autonomous systems capable of providing driver assistance for Anti-collision purposes along the lateral axis of the vehicle integrating "Lane Warning Support" and "Lane Change Support".

http://cordis.europa.eu/projects/rcn/45556_en.html

RESPONSE II: Advanced Driver Assistance Systems

2002 - 2004

Identification of enabling and disabling factors for ADAS market deployment; definition of Code of Practice on ADAS design specifications and validation

http://cordis.europa.eu/project/rcn/45559_en.html

PReVENT: Preventive and active safety applications

2004 - 2008

Development of Safe Speed and Safe Following, Lateral Support and Driver Monitoring, Intersection Safety, and Vulnerable Road Users and Collision Mitigation.

http://cordis.europa.eu/project/rcn/74668_en.html

2. Lane Departure Warning

Lane Departure Warning (LDW) is a mechanism designed to warn a driver when the vehicle begins to move out of its lane on freeways and arterial roads, using a camera/optical sensor to establish the road position of the vehicle with respect to the horizontal markings present on the road surface. As the car deviates and approaches the lane marking, the driver receives a warning: a visual alert plus either an audible tone, a vibration in the steering wheel sent via the electric power steering (EPS), or a vibration in the seat. If the driver does not react promptly, the system issues a second visual alert. Instead if the turn signal is on, it is assumed that the driver is intentionally crossing over the lane.

SAVE: System for effective Assessment of driver state & Vehicle control in Emergency situations

1998-2000

Development of an integrated system to monitor the condition of drivers and undertake emergency handling prior to and during emergency situations (e.g. drunk-driving and fatigue)

http://cordis.europa.eu/project/rcn/32177_en.html

PReVENT: Preventive and active safety applications

2004-2008

Development of Safe Speed and Safe Following, Lateral Support and Driver Monitoring, Intersection Safety, and Vulnerable Road Users and Collision Mitigation.

http://cordis.europa.eu/project/rcn/74668_en.html

interactIVe: accident avoidance by active intervention for Intelligent Vehicles

2010 - 2013

Introduction of advanced safety systems that autonomously brake and steer

http://www.interactive-ip.eu/

3. Front Collision Warning

Front Collision Warning (FCW) utilises radar and video sensors to detect whether the vehicle is approaching another vehicle or large obstacle in its path too rapidly and warn or assist the driver in avoiding/mitigating the incident.

RADARNET: Multifunctional Automotive Radar Network

2000-2003

Development of multifunctional radar network integrating precisely synchronised near-distance and far-distance sensors http://cordis.europa.eu/project/rcn/56917_en.html

ROADSENSE: Road awareness for driving via a strategy that evaluates numerous systems

2001 - 2004

Definition of industry codes of practice in the field of Vehicle Safety and especially in Human Vehicle Interactions (HVI).

http://cordis.europa.eu/projects/rcn/56917_en.html

ReVENT: Preventive and active safety applications

2004 - 2008

Development of Safe Speed and Safe Following, Lateral Support and Driver Monitoring, Intersection Safety, and Vulnerable Road Users and Collision Mitigation.

http://cordis.europa.eu/project/rcn/74668_en.html

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Automotive Micro Electro Mechanical System Sensors

Robert Bosch is the global number one in the development and production of high quality Micro Electro Mechanical System (MEMS) sensors. With the aid of MEMS, electronic products can be applied in a much more versatile, simple and intelligent way to various applications.

- For automotive vehicles, Robert Bosch manufactures around 400 Mio MEMS sensors every year, which are used for electronic stability control, airbag systems, seat-belt tensioners and many more applications.
- More than one billion units are produced for consumer electronics.
- The overall market for MEMS in 2015 was around 20 billion units.

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In addition to comprehensive in-house RTD, various EU-funded, collaborative RTD projects contributed to the development of MEMS systems at Bosch.

In 2007, Bosch scientists Franz Laermer and Andrea Urban were awarded 'European inventor of the year' for their process of manufacturing MEMS

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SI-Gyro - Silicon surface micromachined gyroscope for mass market applications,

http://cordis.europa.eu/project/rcn/31535_en.html

SUMICAP - Surface micro-machined encapsulation on wafer level,

http://cordis.europa.eu/project/rcn/54467_en.html

MAXIMA - Multi-axial integrated monolithic accelerometer,

http://cordis.europa.eu/project/rcn/8966_en.html

I-SPEEDER - Imagine
a system and processing equipment for deep etching with a double etch rate,

http://cordis.europa.eu/project/rcn/54477_en.html

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Crash Test Dummies

The FP7 projects "THORAX" and "ADSEAT" significantly contributed to the development of state-of-the-art crash test dummies.

The ADSEAT project focused on whiplash injuries, the most commonly reported injuries in motor vehicle crashes. Crash statistics show that females have a higher risk of sustaining whiplash injuries than males. One reason: The only available model for assessing seat designs aimed at protecting against whiplash was that of an average male. Consequently, ADSEAT developed "EvaRID", the first dummy model for rear impact testing, which represents the weight and size of an average female. Together with the male model "BioRID", the virtual and hardware models made it possible, for the first time in history of crash testing, to address occupant protection for both an average female and an average male. The models are used as research tools for assessing the safety performance of car seats in order to reduce the risk of soft tissue neck injuries. ADSEAT results caught the attention of policy makers in the area of consumer testing, as well as in the industry developing vehicles and safety systems. Today the EvaRID model is commercially available.

Adaptive Seat to Reduce Neck Injuries for Female and Male Occupants

http://www.adseat.eu

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THORAX – Thoracic Injury assessment for improved vehicle safety

www.thorax-project.eu

Thoracic injuries are one of the dominant causes for fatalities and injuries in car crashes. The THORAX project proposed advanced thorax injury criteria with the associated injury risk curves in order to improve the performance of the "THOR" dummy in frontal impacts. One of the project results, the "Combined Deflection Injury Predictor" metric, is today THE candidate to be incorporated into United States NHTSA regulation for use on a THOR dummy. In addition, the car industry uses the prototype thorax instrumentation based on strain gauges as an R&D tool, because it provides valuable information all along the crash pulse and therefore allows a better understanding of the interaction between the dummy and the vehicle interior.

"The outcomes of this project are now successfully used by the car industry as a research tool to design safer cars"

Dr. Anne Guillaume, Director of the Laboratory of Accidentology, Biomechanics and human behavior (GIE PSA Peugeot Citroën - Renault)

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Development of SiWIM Bridge Weigh-in-Motion technology

The ability to accurately weigh vehicles while they are moving at full speed allows informed decisions to be made with respect to the design and maintenance of road infrastructure, while also providing the long term potential for enforcing legal weight limits for trucks. Bridge Weigh-in-Motion (B-WIM) technology measures the structural response of a bridge as a truck passes over it, using sensors attached to the underside. The measured response is then used to calculate the axle weights and the gross weight of the truck.

One of the major outputs of the EU projects was the development of the SiWIM B-WIM system, which is now a leading commercial product, marketed by the Slovenian company Cestel. The SiWIM system has been used by road managers in a number of countries around the world and is a world leading product in the field of B-WIM. More than 1000 installations have taken place worldwide and the system is now being exported from Europe into the US, where the concept was first developed.

Further developments in the SiWIM system have taken place as part of the BridgeMon (2012-2014) FP7 project, which was funded under the Research for the Benefit of SMEs scheme. BridgeMon developed a second generation B-WIM system and further increased the accuracy of SiWIM by implementing the latest research developments in the field. Results of field testing showed excellent improvements in accuracy and long-term stability of results. The B-WIM concept was extended from road to railway bridges to calculate the weights of trains for the first time, thereby providing access to a new market. In addition, BridgeMon extended the B-WIM concept to carry out structural health monitoring for both road and railway bridges, allowing both traffic loading and bridge resistance to be monitored at the same time.

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"The Slovenian Infrastructure Agency has continuously supported implementation of SiWIM® system, which research was supported by a number of EC research projects. As a result, for more than a decade the agency have been using the SiWIM results for monitoring axle loads on state roads, for heavy traffic surveillance and for determining the degree of overloading on the Slovene national road network. The results are used to optimise decisions related to infrastructure maintenance. Increased heavy (overloaded) traffic can significantly shorten the expected lifetime of roads and bridges. SiWIM® data have not only provided key information to support decision making processes related to pavements and bridges, but have also allowed to set the road damage remediation fees and to share the renewal costs between all parties involved. Finally, regular use of SiWIM as a pre-selection tool for overloaded vehicles has efficiently decreased the number of violators which has a positive impact on durability of infrastructure and on the safety of road users."

Ljiljana Herga,
Head of Roads Maintenance and Safety Division
at Slovenian Infrastructure Agency

COST Action 323 - Weighing in motion of road vehicles

ARCHES - Assessment and Rehabilitation of Central European Highway Structures

http://arches.fehrl.org

BRIDGE-MON - Bridge Safety Monitoring

http://bridgemon.zag.si

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Diesel Exhaust Aftertreatment

Vehicles powered by diesel engines require sophisticated exhaust after treatment technologies to meet the levels for NOx and particulate matter emission legislation. The DEXA cluster consisted of three RTD projects from the FP5 programme, directly contributing to the Diesel Particulate Filter (DPF) technology, which is nowadays dominating the market, available in mass production for a broad field of applications. These are catalytically-coated filters which are regenerated in phases of engine operation under particular operating conditions.

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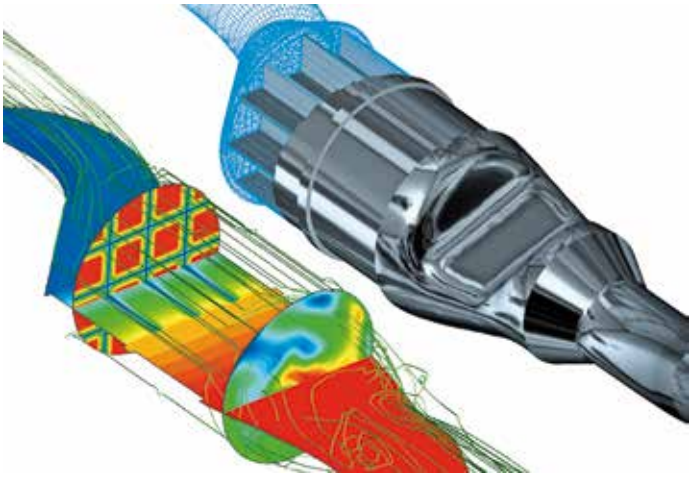

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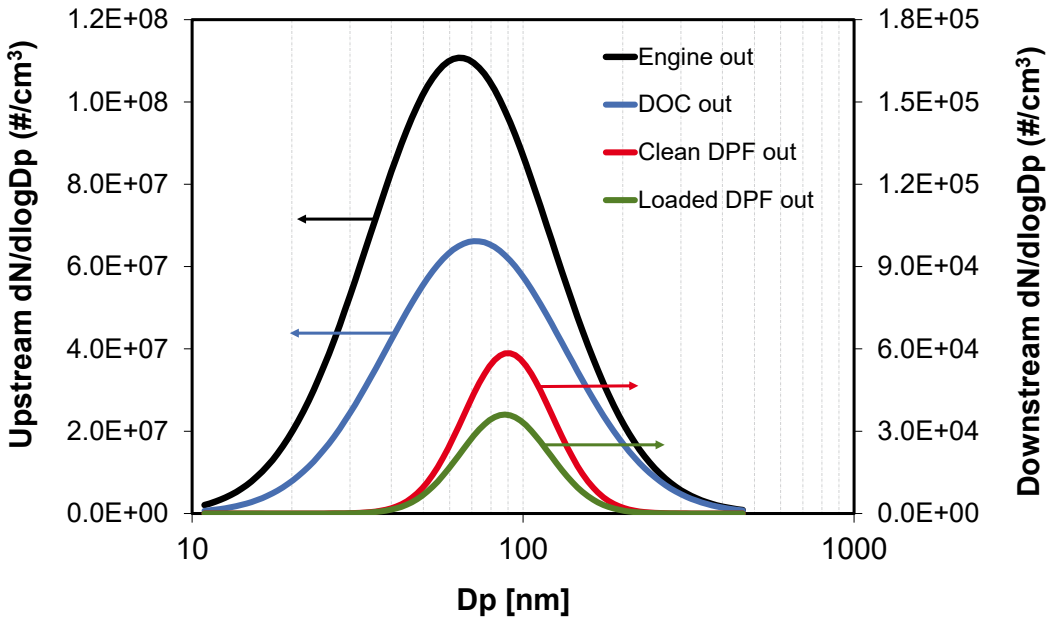

Effect of the Diesel Oxidation Catalyst (DOC) and the Diesel Particle Filter (DPF) on soot particle size distributions.

Source: Aerosol & Particle Technology Laboratory CERTH/CPERI

SI-Gyro - Silicon surface ART-DEXA - Advanced regeneration technologies for diesel exhaust particulate aftertreatment, micromachined gyroscope for mass market applications,

http://cordis.europa.eu/project/rcn/51342_en.html

PSICO-DEXA - Particulate size and composition measurements for diesel exhaust after treatment,

http://cordis.europa.eu/project/rcn/51391_en.html

SYLOC-DEXA - System level optimisation and control tools for diesel exhaust aftertreatment,

http://cordis.europa.eu/project/rcn/51992_en.html

The ART-DEXA project investigated experimentally the effective operating conditions of DPF technologies.

The required measurement techniques for particle analysis were analysed and investigated in detail in the PSICO-DEXA project. Additional results provided details about the particle generation during various engine operations (composition, mass and size distribution).

SYLOC-DEXA focused on the generation of simulation software for DPF layout and development. These simulation models and methodologies served as a basis for numerical simulation tools now applied in industrial RTD projects.

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European Bus System of the Future

EBSF was aimed at developing a new generation of urban bus systems adapted to the specificities of European cities. As a result of joint collaboration between different stakeholders categories and also competitive industries under the coordination of UITP, new technologies on vehicles and infrastructure combined with operational best practices were tested in real operational scenario. Many of these innovations achieved a market uptake.

Success factors:

- All relevant categories of stakeholders involved
- Ensuring that solutions are what is really needed
- Global thinking / systems approach
- EBSF as an efficient and open platform for dialogue between all urban bus transport stakeholders throughout Europe
- Open Dialogue not limited by commercial relations
- First time that big OEMs join forces for pre-competitive research
- Outputs are the result of the collaboration of many bus system actors representing all stakeholder categories
- Close link to the sector strategy (PTx2)

IT Bus Platform & EN13934:

- Standard for bus equipment communication based on plug-and-play architecture. Ensure interoperability between solutions and independency from single supplier
- ITxPT Association developed for promotion, maintenance and evolution of the standard.

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© ITxPT

First tenders (Turin, Geneva) and implementation (Sweden)

IT Bus Platform & EN13934:

- Standard for bus equipment communication based on plug-and-play architecture. Ensure interoperability between solutions and independency from single supplier
- ITxPT Association developed for promotion, maintenance

New Driver Workplace on last IVECO, DAIMLER, IRIZAR, CONTINENTAL:

- New concepts for driver workplace design (space, pedals, seat) developed in a code of practices applicable to all existing standards. Implemented in the last urban buses of IVECO, DAIMLER.


© EVOBUS

Implemented by CONTINENTAL and in the last electric bus from IRIZAR

- Last commercial products have driver workplace designed in accordance

MAN LION GLS 5 Doors:

- Five-door urban bus developed by MAN by implementing one of the solutions for better accessibility and passenger flow developed, simulated and tested in operation in EBSF
- Commercial product awarded Bus of the Year 2015

Bus stop:

- Principles for designing bus stop integrating different functionalities and services that is attractive to the


© RATP

passenger. Prototype tested in Paris, Bd Diderot (Gare de Lyon) since 2012: planned to be dismantled end 2012, has prolonged its service until 2015 due to great success.

- Paris bus stop prototype has been used as living laboratory and baseline for the bus stop tender assigned late 2014 (to the same designer than the EBSF one)

Bus passenger area design tool:

- Simulation tool for the design of bus interiors (in terms of seating arrangements, handrails, spaces, doors) focused on improving accessibility andpassenger flow and reducing the waiting time.
- Simulators adopted for the design of the MAN 5 doors and the VOLVO central driver / wide front-door. Today it is a tool of interest for supporting PTO/PTA in the definition of the bus requirements

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EBSF_2 continues the work for more efficient and attractive urban bus systems.

More info: www.ebsf2.eu

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Heavy Duty Hybrid Drive System

Volvo commercialised its heavy duty hybrid drive system in 2010. Since then, about 1850 units have been sold.

Technical specifications:

- A parallel hybrid system

It is available on the market in these models/applications:

- Hybrid
- Electric Hybrid
- Electric

Zone management:

- High-power charging stations (HPC)
- Zero-Emission & Silent Zones

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Various EU-funded, collaborative RTD projects contributed to the heavy duty hybrid drive innovations of Volvo. They addressed the research and technical development of driveline technologies, hybrid energy strategies, battery system developments, etc. Some of the FP projects carried out in recent years were:

HAVE-IT - Highly Automated Vehicles for intelligent transport

http://www.haveit-eu.org

HELIOS - High energy Li-ion storage solutions

http://www.helios-eu.org/

HCV - Hybrid Commercial Vehicle

http://www.hcv-project.eu

AMELIE - Advanced fluorinated materials for high safety, energy and calendar life Li-ion batteries.

http://amelie-green-car-project.fr/

ASTOR - Assessment and testing of advanced energy storage systems for propulsion

http://cordis.europa.eu/project/rcn/55359_en.html

LIBERAL - Lithium battery evaluation and research – accelerated life test direction

http://cordis.europa.eu/project/rcn/64856_en.html

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Integrated Fare Management

The IFM-PROJECT (2008-2010) proved the possible coexistence of multiple ticketing applications on the same platform and the possibility to load a ticketing application to non-transport related media (such as a near field communication (NFC) phone, a contactless payment card, etc.) and proposed a way forward for an increased interoperability of ticketing systems.

The IFM project united representatives from the national schemes in the UK and Germany, and the many local and regional CALYPSO-based schemes.

The IFM-Forum, a UITP "mirror group" of further stakeholders, enabled many others to participate, altogether representing 21 countries.

The IFM-Forum of May 2010 showed that ITSO, VDV and CALYPSO could adapt their applications to be downloaded onto and co-exist with, one multi-application card/medium.

The project ended successfully in June 2010 with consensus on a first step towards customer delivery: to use their own medium eTicketing at their destination by downloading the local application on compatible media.

IFM partners agreed on a common vision and set up an IFM-Alliance as the backbone of the EU-IFM system architecture.

The extended EU-IFM model, including media owner/retailer roles, has been integrated into the new ISO/IEC IFM 24014-3 standard. This standard complements the set of standards used in fare/ticketing management applications. In addition, ISO/TR 24014-3:2013 describes how to implement Interoperable Fare Management (IFM) applications in a multi-application environment, and the additional roles and use cases that appear.

http://www.iso.org/iso/catalogue_detail.htm?csnumber=62354

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A Smart Ticketing Alliance (STA) with IFM-PROJECT partners was set up in 2014 to define the customer media and ticketing application qualification process:

http://www.uitp.org/smart-ticketing-alliance-creating-seamless-ticketing-across-borders

STA Specifications are widely used as the underlying smart ticketing specification for Horizon 2020 projects and are widely copied by other regions and countries outside Europe.

The STA approach received endorsement from a wide range of stakeholders including UITP, EMTA, EPF, EPTO, UIC/CER, and has recently received endorsement from the European Parliament as supporting open Smarter Travel.

STA specifications and related work is closely aligned with journey planning and real-time information with the aim of providing the traveller with an integrated package of smarter travel tools.

UITP and STA are partners of the IT2RAIL project (2015-2017), preparing the work of the Innovation Programme (IP4) entitled 'Seamless Attractive Railway Transport System' of the SHIFT2RAIL Joint Undertaking.

http://www.it2rail.eu

STA is working closely with mobile network operators (through the GSM Association), handset manufacturers (through the near field communication Forum) and the European Standards Body (CEN-CENELEC) to specify the use cases and requirements for public transport applications on NFC-enabled devices and ensure the harmonisation of standards and provision of a common certification.

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Personal Rapid Transport London Heathrow

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On 16th September 2011, London Heathrow launched the unique Heathrow pod system, which took six years to develop at a cost of £30 million. The system consists of 21 low energy, battery powered, driverless, zero emission vehicles capable of carrying four passengers and their luggage along a dedicated 3.8 km guide way. The pods carry passengers travelling between the Terminal 5 Business Car Park and the main terminal. The journey is on-demand and non-stop from start to destination at the touch of a computer screen and the pods even recharge themselves at battery points when not in use so they are always ready to go. The Heathrow pods use 70%less energy than it takes to power a car, and 50% less than a bus.

Operating statistics of the PRT service show that:

- Mean passenger waiting time is 19 seconds
- About 70% of passengers do not wait at all, since a vehicle is waiting for them.
- 94% of passengers wait for less than one minute.
- Mean travel time delay was 24 seconds beyond the scheduled minimum run time
- Service reliability was 98.7% (99.7% if one long break in service is omitted).
- PRT emits only about half the CO_2 per passenger-km emitted by the previous transfer buses.

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"The Heathrow pods offer a personal, comfortable and reliable ride that is free of emissions. That is why our excitement for this pioneering British technology is being shared by town planners, architects, other airports, business parks, campuses, retail and residential destinations from the US, Europe, India, Mexico and the UK, who believe that this system could revolutionise transport in urban environments."

John Holland-Kaye, commercial director at Heathrow

CityMobil

The PRT system was implemented by BAA (British Airport Authorities), among others, based on the recommendations of the FP6 CityMobil project, implementing in total 20 pods to run autonomously on a guided track between a car park and terminal 5.

The PRT would otherwise have been realised, but specific research activities which were part of the CityMobil project proved important in order to better understand specific implementation issues for such systems within an urban environment.

© ULTRA PRT

"We have been listening carefully to our passengers as part of our plan to make every journey better at Heathrow. Passenger feedback has been amazing and positive Twitter comments abound. We love watching people's reactions when they see the pods for the first time and then again when they step off just five minutes later at their destination."

John Holland-Kaye, Commercial Director at Heathrow

More info:

http://www.citymobil-project.eu/

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Traffic Management Key Performance Indicators and Decision Support Tool

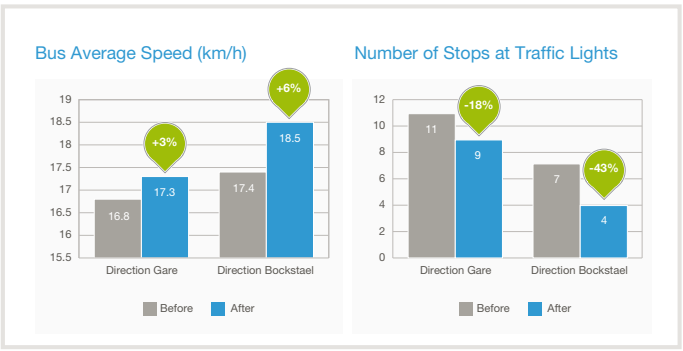
With the aim of achieving a common and more holistic approach to the assessment of ITS and traffic management measures in urban areas, the FP7 CONDUITS project (2009 – 2011) defined a set of key performance indicators (KPIs). A total of 13 KPIs were defined across the main policy areas of traffic efficiency, pollution reduction, road safety, social inclusion and land use. Selected KPIs were then tested in Paris, Rome, Munich, Tel Aviv and Ingolstadt.

Building on the KPIs, a decision support tool (CONDUITS-DST) was developed after the project ended, with financial support from Kapsch TrafficCom and coordinated by Polis.

CONDUITS-DST is designed to help decision-makers understand what will be the likely wider impact(s) of a particular measure. The tool has been developed in several stages: a first version covering pollution reduction was developed in 2012 and expanded in 2013 to encompass two traffic efficiency KPIs: reliability and mobility. In 2015, the road safety module was integrated into the CONDUITS-DST.

The CONDUITS KPIs can now be used for ex-ante and ex-post assessment of a traffic management measure.

CONDUITS_DST uses data from the traffic model and emissions profiles. and/or the KPIs.



From collaborative research projects to market deployment

A major target of European co-funded RTD projects is the creation of technologies, methodologies and processes, and their implementation as successful innovations. This factsheet is one example of a successful collaborative RTD project and is part of a series of 12 success stories collected by the FP7 project FOSTER-ROAD, the support action for the European Technology Platform ERTRAC. **www.ertrac.org**

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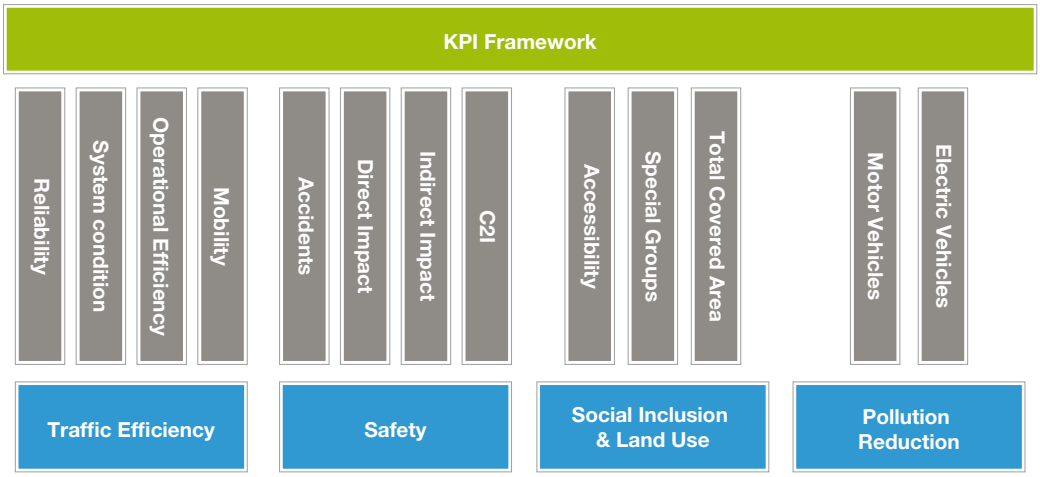
"KPIs as a basis for decision support tools contribute to better-informed investments in both urban and interurban traffic management solutions and knowing the expected benefits and impacts of ITS solutions. Not only public authorities and associations like POLIS representing cities and regions are interested in KPIs and tools that helpdecision-making prior to the deployment of ITS, but also foundations representing the private industry sector like IRF realise the necessity of these factors for a sustainable deployment of ITS."

Josef Czako,
Former Vice President International Business Development, Kapsch Traffi cCom



CONDUITS offers a holistic tool for assessing the wider impacts of traffic management measures both before and after implementation. CONDUITS_DST and KPIs are free of charge.

The CONDUITS-DST was tested in Brussels on part of a bus route which is being equipped with bus priority at traffic lights, in terms of efficiency, pollution and safety.

Besides Brussels, other cities, including Stuttgart, Tel Aviv and Haifa, have either adopted or are testing CONDUITS-DST and/or the KPIs.

A training for using the tool was given to cities in the context of the CIVITAS CAPITAL project. Several cities are now applying the CONDUITS-DST.

CONDUITS: conduits

http://www.polisnetwork.eu/conduits-city-pool

FOSTER-ROAD is funded by the 7th Framework Programme of the European Union

FACTSHEET

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Ultra High Performance Fibre Reinforced Concrete

Ultra High Performance Fibre Reinforced Concrete (UHPFRC) is characterised by a very low water/binder ratio, high binder content and an optimised fibrous reinforcement. This provides the structural engineer a unique combination of extremely low permeability, high strength and tensile strain hardening.

UHPFRC is perfectly suited to the rehabilitation of reinforced concrete structures in critical zones subjected to an aggressive environment and significant mechanical stresses, to provide long-term durability and thus avoid multiple interventions on structures during their service life.

With the use of UHPFRC, critical steps of the construction process, such as the application of waterproofing membranes, can be prevented. The construction process becomes simpler, quicker, and more robust with an optimal use of composite construction. The concept can be implemented on bridges, buildings, galleries, tunnels or retaining walls.

The waterproofing capabilities of the UHPFRC make it no longer necessary to apply a waterproofing membrane. Thus, the bituminous concrete can be applied after only seven days of moist curing of the UHPFRC. This means a very significant saving of time in comparison to the drying period of up to three weeks necessary prior to the application of a waterproofing membrane on a usual mortar or concrete.

The application of cast-on site UHPFRC was first validated during the FP5 SAMARIS project (2003-2006) in Switzerland. The FP6 ARCHES project (2006-2009) then showed that the implementation of this technology with local components in Slovenia and Poland was possible and fostered the use of cost-effective (ECO) UHPFRC mixes with reduced clinker content.

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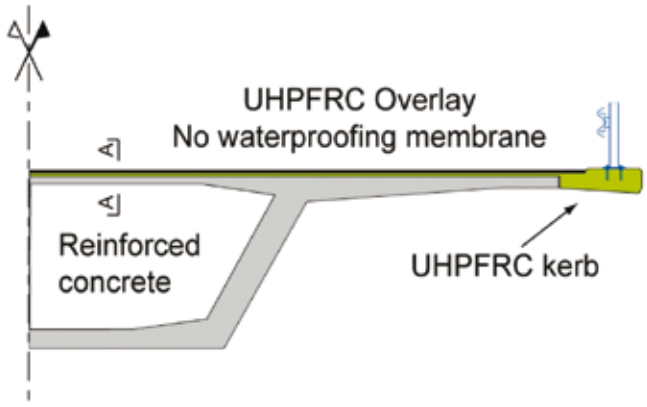

By the end of 2014, more than 30 applications of cast-on site UHPFRC to protect or reinforce bridges or slabs in industrial buildings, alone or combined with reinforcing bars, have been performed successfully in Switzerland and one in Slovenia. The assessment of the Log Čezsoški bridge in Slovenia two years after its rehabilitation with the ECO-UHPFRC developed during the ARCHES project was very positive. The assessment after 10 years of the condition of the UHPFRC applied in 2004 on the bridge over the la Morge river in Switzerland showed extremely low chloride penetration from de-icing salts (values no more measurable after a few mm from the UHPFRC surface), confirming the excellent on-site protective properties of this material.

UHPFRC applications are rapidly spreading to road structures and buildings in Switzerland. Lately, this rehabilitation technology was transferred to offshore structures at sea with the reinforcement of a masonry signalisation turret in Brittany in 2013, with a 60 mm UHPFRC shield cast-in place by helicopter.

SAMARIS - Sustainable and Advanced Materials for Road Infrastructure

http://samaris.zag.si

ARCHES - Assessment and Rehabilitation of Central European Highway Structures

http://arches.fehrl.org

"Our community is committed to the promotion of sustainable development. A new approach to the rehabilitation of the bridge, presented today, is living proof that this can be achieved in all fields, including the construction industry. We are proud to be able to participate in the ARCHES project, which pioneered the use of a new generation of ultra-high performance fiber reinforced concrete. Above all, we are pleased that the development of this new material also helps to increase knowledge of our region. Indeed, a number of organisations and companies from Slovenia and especially from the northen Primorska region (ZAG, Salonit Anhovo, TKK Srpenica, CPG Nova Gorica and Primorje Ajdovščina) have been involved in the development and practical use of of this technology."

Daniel Krivec, the then mayor of Bovec Municipality, Slovenia at workshop organised after the application of UHPFRC on Log Čezsoški Bridge in Slovenia.

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Variable Valve Actuation

In internal combustion engines, the valves control the flow of intake and exhaust gases. Variable Valve Actuation (VVA) combines the benefits of Variable-Valve-Timing and Variable-Valve-Lift. Electro-hydraulic VVA has been under development by FCA since the late 1990s. This combined control results in better performance with reduced environmental impact: up to 10% CO_2 reduction, 40% less particulates and up to 60% NOx reduction.

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FCA's VVA system (Multiair®) uses a solenoid to control hydraulic fluid, allowing infinite variable control of Valve Lift and Timing. The system was commercially launched in 2009 on the FIRE 1.4 TC Multiair® engine; the engine went on to win the "Engine of the Year" award in 2010. Licenced by Schaeffler as the "Uniair" system, production has covered more than one million FCA engine units.

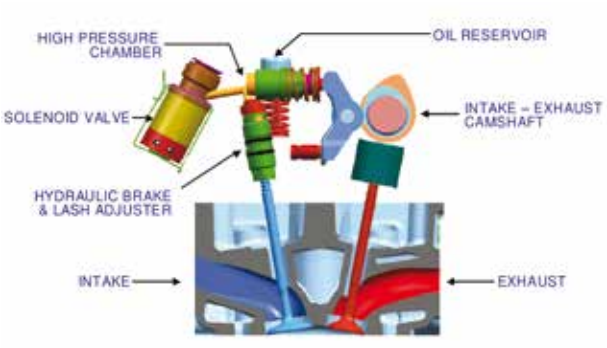
In the FP6 project "NICE – the New Integrated Combustion system for future passenger car Engines", Centro Ricerche Fiat investigated the optimisation of the mixture preparation using electro-hydraulic VVA.

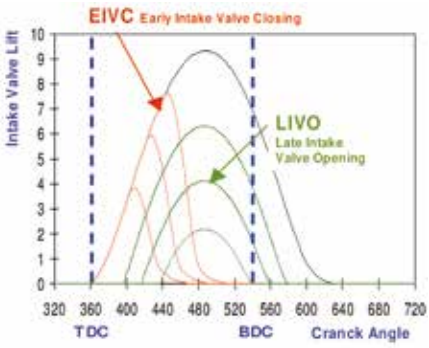
1.4 Fire Multiair TC – Euro 5 Alfa Romeo MiTo – September 2009

www.ertrac.org

0.9L Twin-Cylinder Multiair TC – Euro 5
Launched end 2010

The research activities successfully contributed to the development of the system control strategies to further improve the performance and flexibility of its application and use.





NICE - New Integrated Combustion system for future passenger car Engines,

http://bit.ly/1SUCv68

Source: NICE Publishable final activity report

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