

THE EUROPEAN ASSOCIATION OF  
RESEARCH & TECHNOLOGY ORGANISATIONS

# **IMPACT DELIVERED**

## **TECHNOLOGY FOR A BETTER WORLD**



# Foreword



By the time this year's edition of Impact Delivered reaches you, the launch of the new EU Innovation Programme, Horizon 2020, will be just a few weeks away.

Those of us, like RTOs, who see ourselves as innovation organisations are looking forward to the new programme with great anticipation. Its focus on tackling societal challenges and supporting economic competitiveness reflects perfectly RTOs' core business.

In a grim global economic context where there is a widespread feeling in Europe that we are being out-challenged on global markets, Horizon 2020 should be key to Europe's competitiveness by bringing our industries further helping them to develop innovative products & solutions to today's problems and keeping jobs in Europe. Today, EARTO Members are clearly on the starting blocks, ready to support the European Commission in making this programme a success!

For the European Commission the challenge will be to manage Horizon 2020 operationally in such a way that it stays firmly focussed on producing practical innovation outcomes, not just excellent science or clever technology.

But how can we make sure that the new innovation programme succeeds? Several things seem critical.

First, an approach to programme management that prioritises the objective of achieving concrete innovation outcomes. There is a double emphasis here, on 'prioritises' and on 'innovation outcomes'. The range of subjects and potential innovations that might be targeted under practically any of the societal challenge themes is almost endless, but the available resources are not. So choices will have to be made - and made to stick. The approach needs to be similar to how industry apports its limited R&D resources:

it's not about the science, it's about the potential impact.

Second, and following on from the first, a more objective-driven approach than previously in the management of research themes and projects, including for example a willingness to employ industrial-style techniques, such as stage-gating, to kill off less promising projects and avenues of research.

Third, of course, the need to ensure that industry participates widely in Horizon 2020, but also that RTOs are able to contribute fully their considerable and highly relevant skills. Indeed, RTOs should play a major role in the new programme, for they bring together a rare and proven array of innovation capabilities and activities - from basic and applied research to advanced engineering, design and development, measurement, testing, prototyping, demonstrating, and more besides. Particularly important for the new programme is RTOs' long experience of networking public and private actors across the innovation value chain and of building and managing large-scale innovation programmes and projects.

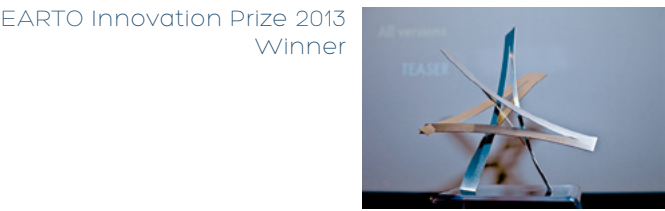
Underpinning all that RTOs do is a pragmatic focus on solving real-world problems and delivering innovations that have real-world value. That is what this publication illustrates and it is why RTOs have so much to contribute to Horizon 2020 and to helping it succeed as the innovation programme for jobs and growth that Europe so badly needs.

Hoping that you will enjoy the reading,

J.H.J. Mengelers M.Sc.  
President of the Netherlands Organisation for  
Applied Scientific Research - TNO  
President of EARTO



# A new generation of allergy vaccines



Next-generation allergy vaccines enabled by new gene technology have the potential to transform the quality of life of hundreds of millions of allergy sufferers worldwide. By modifying the structure of proteins responsible for allergies so that they cause fewer symptoms while remaining effective in desensitisation therapy, the technology paves the way for the ‘epidemic of the 21<sup>st</sup> century’ to be treated more precisely, safely and permanently than ever before. This innovation was developed by VTT Technical Research Centre of Finland.

Allergies have doubled over the last 20 years and there are now 80 million sufferers in Europe and close to 70 million in the US alone. Classified by the World Health Organisation as the fourth most chronic disease across the globe, allergy encompasses everything from unpleasant and debilitating responses to allergens such as pollen and cat hair to life-threatening reactions to foods and chemicals, causing symptoms in the respiratory and digestive systems or skin.

Over 80% of sufferers say their disease considerably affects their daily lives, with secondary effects such as depression, anxiety and sleep disorders adding to primary symptoms including breathing problems,

Trends indicate that half of all Europeans will suffer from allergies by 2015

but they also have a significant cost to society. In fact, allergy now belongs to the top five most costly disease groups in terms of work absence and healthcare costs.

## Accelerating advances

With the incidence of allergy increasing and the financial cost of anti-allergy drugs which are almost exclusively concerned with symptoms set to exceed \$14.7 billion in the US alone by 2015, pressure is mounting to find real cures that get to the root cause. While some treatments do exist to alter the underlying disease process, by gradually desensitising the body to natural allergen extracts, they remain very lengthy, high risk and highly variable.

VTT took up the challenge of accelerating advances in desensitisation, or immunotherapy, by focusing on the antibody at the heart of the allergic reaction: immunoglobulin E (IgE). Working with the University of Eastern Finland and Helsinki University Central

In 2004, the annual direct and indirect costs of allergies in Europe amount to €29 billion

Hospital Skin and Allergy Hospital, VTT discovered how an IgE antibody binds to an allergen, a protein causing allergy, to form a complex capable of launching inflammatory reactions and then detailed for the first time the 3D structure of this complex.

## Supporting nature

This knowledge opened the door to genetic modification of these structures so they no longer bind with IgE and trigger the release of histamines and other substances causing adverse reactions but can still trigger the production of immunoglobulin G (IgG). As IgG protects from allergic symptoms by preventing the release of histamine, the modified allergens will continue to allow the development of natural immunity through desensitisation therapy.

VTT’s discoveries allow the development of an entirely new kind of safer, faster-acting, more reliable and efficient desensitisation product, or vaccine, based on a rational design rather than the previous trial and



error-based approach. The new vaccines will allow the patient’s body to develop a natural immunity against each type of allergy they are vaccinated for.

VTT spin-off Desentum has been set up to develop, produce and, with partners, sell the new vaccines. It is initially planning to develop a product line of 20 to 25 new hypoallergens which could be used as vaccines for some of the most important allergies, including pollens such as birch and hay, allergens from pets and proteins associated with food allergies including fish and nuts. It also foresees the development of a general platform for the manufacture of products against new allergens too.

## Making a difference

Desentum has secured funding to carry out the production and non-clinical testing of the first set of vaccines and clinical trials will begin next year in collaboration with larger pharmaceutical partners. With the new vaccine costing an estimated €0.5-1.0 per portion and predicted to lead to a jump in the 4% annual global growth rate of allergy vaccine sales – currently valued at \$642 million a year – Desentum is destined to have a positive impact on allergy costs – and patients’ lives – into the future.

‘Anti-histamines are not the solution because they only inhibit or lessen the allergy, so you still have the allergy. We believe that curing allergies is about changing or modifying the genetic structure of the allergen molecules, so we want to eliminate the cause of the allergy, instead of removing symptoms’ Professor Juha Rouvinen, University of Eastern Finland

Conventional immunotherapy has less than a 5% market share as the gradual immunisation process requires vaccine administration by a healthcare professional, can take three years or more and brings with it the potential risk of side effects



By defining the structure of the allergen-IgE antibody complex which triggers the body’s allergic response, VTT has opened up the opportunity to develop safe, fast-acting vaccines in the form of simple self-administered pills or drops

VTT Technical Research Centre of Finland is the biggest multi-technological Research and Technology Organisation in Northern Europe. With its staff of 3000, its unique research facilities and extensive global co-operation networks, it provides leading-edge technology solutions and innovation services. VTT works to enhance its customers’ competitiveness and competence, creating the prerequisites for society’s sustainable development, employment and wellbeing. [www.vtt.fi](http://www.vtt.fi)





# A new frontier in precision watchmaking

EARTO member CSEM has developed groundbreaking methods of working with silicon that have led to the holy grail of mechanical watchmaking: unprecedented accuracy and reliability with less maintenance. Just as quartz crystal resonators revolutionised timepiece design 40 years ago, so silicon micro-components produced through wafer-level fabrication are distinguishing a new generation of high-performance watches and rejuvenating the European watch industry.

Switzerland's watch industry is the world's number one, making over 30 million timepieces a year, producing 95% of watches in the €800+ market and exporting €17 billion worth of watches annually.<sup>1</sup>

The balance springs of 40% of the winners of the last Concours International de Chronométrie, the annual showcase for mechanical watchmaking excellence, were made from silicon

Helping such a key industry maintain its competitive advantage has, in recent times, centred on improving the tried and tested internal mechanism, or movement, where troublesome factors such as magnetic fields, the clogging effects of deteriorating lubrication and general knocks and wear can lead to loss of accuracy and efficiency. While silicon has

been seen as the industry's 'silver bullet' for many years because it is light, shock resistant, non-corrosive, anti-magnetic and almost friction-free, pioneers have so far failed to industrialise its production.

## Focusing on accuracy

CSEM worked with the watchmaking industry<sup>2</sup> to overcome the challenges involved with industrialising silicon for use in watches, notably its fragility and the difficulties of machining and assembly. With CSEM providing the tools, techniques, facilities and know-how to work with silicon, the project resulted in the development of Silinvar®, which uses a vacuum oxidation process to negate silicon's susceptibility to temperature fluctuations. As changes in temperature can change the elasticity of the balance spring, leading to timekeeping errors, this new thermal stability represents a significant breakthrough. Silinvar®

can also be manufactured using CSEM's deep reactive-ion etching (DRIE) technology, which involves stripping layers of atoms from a block of silicon, enabling the creation of extremely complex shapes to the almost perfect degree of exactitude required for watchmaking.

Patek Philippe intends to expand its use of silicon to about 90% of its annual output, from a fifth, within 10 years<sup>4</sup>

## Transforming timepieces

Silinvar® components are changing the rules of the game. They have up to five times the accuracy of conventionally manufactured steel components.<sup>3</sup> They have also allowed watchmakers to produce component designs that were simply not possible before. Girard Perregaux's revolutionary new Constant Escapement mechanism, which has a novel and extremely thin blade to ensure a constant energy return for timekeeping accuracy, could not have been made without Silinvar®. Patek Philippe has also introduced Silinvar® innovations, including the GyromaxSi balance which increases the power reserve, the Spiromax

'CSEM helped us develop the silicon balance springs used in our high quality watches. This in turn allowed us to increase the robustness and precision of these timepieces' Pierre-André Bühler, President ETA SA, Member of Executive Group Management Board Swatch Group



<sup>1</sup> For reference: this information comes from [http://www.fhs.ch/statistics/watchmaking\\_2012.pdf](http://www.fhs.ch/statistics/watchmaking_2012.pdf) and [www.wthejournal.com/en/pages/swiss-watch-industry-figures](http://www.wthejournal.com/en/pages/swiss-watch-industry-figures)

<sup>2</sup> For further information see The Financial Times article published 9 September 2011 entitled: 'Silicon: Patek takes big dose of watch wonder drug'

balance spring to improve isochronisms and the Pulsomax escape wheel and lever which boost efficiency and long-term reliability. Swatch Group, meanwhile, pioneered silicon components in its high-end range and has since extended them to a range of mid-market watches which, as a result, come with a four year warranty.

The new silicon micro-components mean watches no longer lose precision through exposure to magnetic fields, temperature extremes, shocks or lubricant deterioration

## Influencing the future

The technology behind these developments is helping to protect the European watchmaking industry from global competition and economic crisis. Its wide uptake by luxury watchmakers has led to a prediction that the export potential for high-end watches with Silinvar® components represents 10% of the total - valued at €6.5 billion. As silicon is already acknowledged to have a very positive impact on brand perceptions, a wider range of watchmakers is expected to follow the quality names along this path, enabled by the imminent generation of new types of components, suggesting that silicon's influence on the watch industry has really only just begun.



'Girard-Perregaux has developed a new escapement for mechanical watches. The key component of this device, developed together with CSEM, is etched out of a single piece of silicon in their clean room and delivers minute increments of energy, driving a timepiece with unparalleled precision' Michele Sofisti, CEO SOWIND Group (Girard-Perregaux and JeanRichard)

'Our collaboration with CSEM provides us with access to state-of-the-art technology and know-how, and enables us to position our company at the technological forefront of watchmaking innovation. Additionally, in the medium term, CSEM ensures series production, enabling the rapid integration of technological developments into our watches' Jean-Pierre Musy, Technical Director, Patek Philippe

CSEM is a Swiss research and technology organisation specialising in micro and nanotechnology, information and communication technology and system integration, addressing also small series production when necessary for industry. CSEM creates a dynamic link between research and high-tech industry, and also collaborates with other innovation centres to provide appropriate solutions for cutting-edge products and applications.  
[www.csem.ch](http://www.csem.ch)





# Reconstruction system reveals hidden history

An automated virtual reconstruction system developed by EARTO member Fraunhofer IPK, which is the only technology in the world enabling the virtual restoration of torn or shredded documents, is able to solve what has been called 'the biggest puzzle in the world' - reassembling Stasi files destroyed after the fall of the Berlin Wall. One of the world's most sophisticated pattern-recognition machines, the ePuzzler's impact will extend beyond reconciliation authorities to public security, the entertainment industry, world cultural heritage and image processing.

During the peaceful revolution of 1989, Stasi agents spent weeks shredding around 40 million sheets of paper by hand in a bid to destroy evidence of their activities. Determined to rescue documents of immense historic and personal importance, over the last 22 years the German government has employed up

Reconstructing 16,000 bags of shredded Stasi documents by hand would take around 400 to 800 years - the ePuzzler is able to complete the task in a few decades

existing system could handle this complex challenge, with scientific essays solely describing solutions dependent on pre-conditions such as black text on white paper, jigsaw-puzzle completeness and known document layouts.

## A good match

In 2007, Fraunhofer IPK was tasked by the German government with implementing a system for automated virtual document reconstruction. The pilot phase of the project aimed to develop reconstruction software and adapt digitisation hardware to build a system that would then be used to virtually reconstruct selected bags of the torn documents. The system is to be continually developed in a way that will make the processing of the remaining 15,500 bags possible within a timeframe of 10 to 15 years. With each of the

16,000 bags of documents requiring billions of outline comparisons, the technical challenge extends beyond simply developing faster algorithms to creating an entirely new reconstruction methodology. What Fraunhofer IPK has developed so far are intelligent pattern recognition, image processing and workflow filter techniques which enable the fragments to be matched using colour, texture, shape, tear patterns and handwriting and fonts to compose digitised images of entire document sheets.

The basic idea behind the ePuzzler is similar to the human method of solving jigsaw puzzles, first clustering together those pieces with 'low level' similarities such as paper colour, to reduce the number of potential reconstruction candidates, then examining 'higher level' similarities such as text lines

## An important task

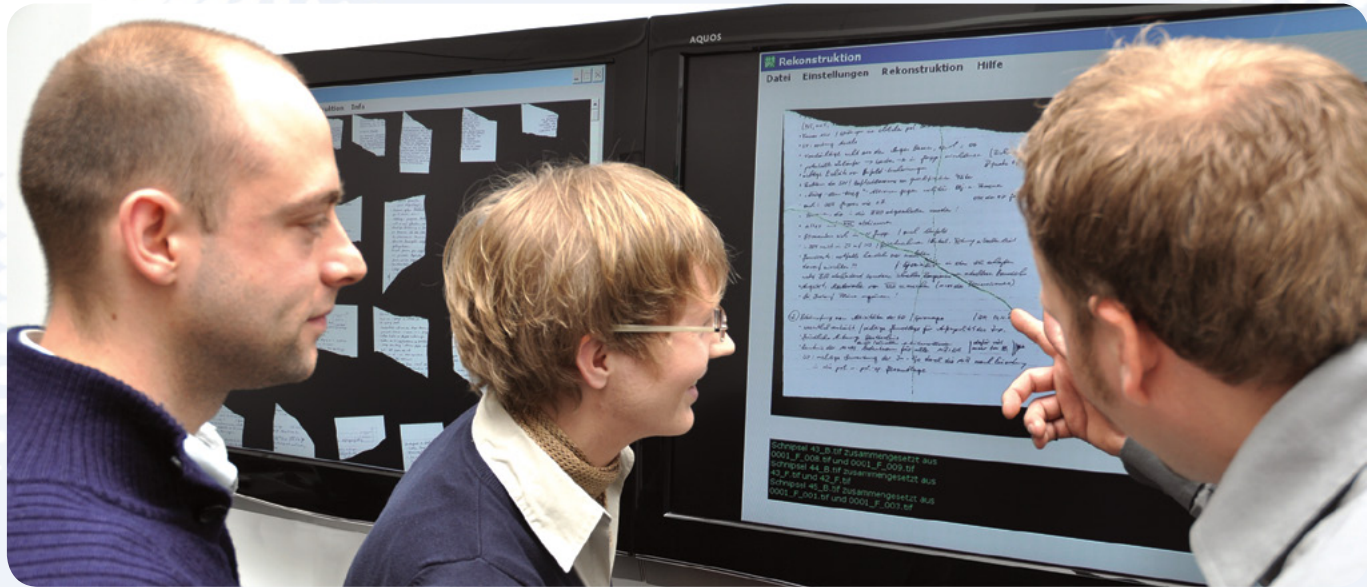
The system, named ePuzzler, will be able to give back to the German people part of their history that had been hidden - for which there is clear demand. Around 100,000 people a year apply to see their own Stasi files in an attempt to clear their own name, gain proof that they were unjustly imprisoned or simply to understand and overcome what happened to them or their family. News of the machine has spread far and wide and, as a result, projects are in the pipeline to help other reconciliation bodies in countries that have experienced oppressive regimes in the past.



## A valuable technology

The ePuzzler is about to be put to a range of other uses by criminal and financial investigation units and those who safeguard precious artifacts and manuscripts around the world, from Argentina to Belgium and Slovakia. It has, for example, helped several financial authorities to reassemble evidence. And soon it might be able to assist a Berlin museum in reconstructing ancient Egyptian papyrus fragments. The number and diversity of enquiries received about the ePuzzler suggest that on commercialisation it would immediately attract projects worth several million euros.

'The globally unique, innovative technology of virtual reconstruction enables us to reconstruct torn Stasi records, which allows us to improve our understanding of the system of the secret police of East Germany. Lost history can be regained - for historians and society as a whole but also with direct consequences for individuals. The value of the technology lies for us in its unique contribution to our collective memory' The Federal Commissioner for the Stasi Records



Fraunhofer reconstruction experts evaluate the ePuzzler's matching results



The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 66 Fraunhofer Institutes and independent research units at over 40 different locations throughout Germany. One of them is the Fraunhofer Institute for Production Systems and Design IPK. The Fraunhofer-Gesellschaft employs a staff of around 22,000, who work with an annual research budget totaling 1,9 billion euros. Roughly two thirds of this sum is generated through contract research on behalf of industry and publicly funded research projects. Branches in the USA and Asia serve to promote international cooperation.  
[www.fraunhofer.de](http://www.fraunhofer.de)





# A breakthrough in bomb detection

A portable explosive detection device developed by EARTO member CEA is the first in the world to be able to identify a wide range of targets in vapour form. The T-REX technology enables both greater safety for operators through non-contact sampling and greater security for citizens in public places. The breakthrough not only signals the arrival of a powerful new weapon in the battle against terrorism, its adaptable multi-sensor array also opens the door to convenient and cost-effective chemical monitoring in industrial and environmental applications.

Terrorist attacks have a profound impact on lives, livelihoods and infrastructure. Whether targeting mass transport, public events or military operations, their increasing occurrence and the challenges

The combination of three advanced sensing technologies with innovative data processing makes T-REX a fast, contactless trace detection system sensitive to several explosives with a far lower false alarm rate than existing technologies

technologies such as gas or liquid chromatography and mass spectroscopy, whose reliability limits false alarms, are nevertheless limited by their complexity, size and cost.

## A synthesis of skills

Prompted by research highlighting the urgent need among the world's police forces and security industries for a fast, contactless trace detection system sensitive to several explosives, CEA set to work. Capitalising on their capabilities in materials, data processing, electronics and gas synthesis and handling, CEA divisions collaborated to develop T-REX (Technology for the Recognition of Explosives). A unique combination of three sensing technologies - quartz crystal

microbalance, fluorescence and surface acoustic waves - the T-REX device has high detection reliability. It also has a two-step alarm process: a detection signal within 10 seconds followed by a clear identification of the threat.

The manufacturing and maintenance costs of T-REX are very low: production of the prototype cost less than half that of a current state-of-the-art hand-held ionic mobility spectroscopy device and this figure will reduce dramatically as a result of the scale effect of industrialisation

## An array of benefits

The innovation's game-changing benefits are its ability to directly detect the smallest traces of explosives, even the precursors of explosives, without any particle collection, and to sense a wide range of explosives without having to couple multiple devices together. Light and compact, the device is easily carried around and can even be embedded onto a mobile robot for remote controlled detection. As it also clearly identifies hazards and doesn't contain a radioactive source like the majority of existing ionic mobility spectroscopy equipment, its use is unencumbered by the need for specially trained operatives or stringent administrative constraints.



## A sense of success

T-REX is currently at the industrial prototype stage and undergoing evaluation in field tests - which have confirmed that humidity, temperature variation, dust and vibrations don't lead to false alarms. Technology transfer into the explosives detection industry, which is estimated to be worth up to €338m a year, is expected shortly. With portable systems already representing 50% of the market, and growing fast, a technology like T-REX representing real progress is predicted to gain a substantial part of the market in a short time. As the 14 sensors within the device can be covered by different sensitive materials, detection can easily be expanded to include compounds such as drugs and chemical agents - this market alone being worth around €450m a year.

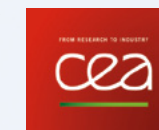
T-REX is currently being tested in several programmes and real conditions, including in railway stations and subways, as part of the SECUR-ED FP7 European collaborative demonstration project which aims to provide tools to improve urban transport security



Julian Pepinster

CEA, the French Alternative Energies and Atomic Energy Commission, is a government-funded technological research organisation focusing on four main areas: low-carbon energies, defence and security, information technologies and health technologies. It has over 15,000 employees based at 10 research centres across the country and its engineers and researchers maintain a cross-disciplinary culture and work on collaborative projects with partners around the world.

[www.cea.fr](http://www.cea.fr)





# Transforming the economics of fresh water transport

A modular textile waterbag system capable of transporting bulk quantities of fresh water by sea represents a major technical breakthrough that will lessen the financial burden of drought across Europe and beyond by reducing reliance on expensive solutions such as tanker transfer and desalination plants. Developed by a consortium led by EARTO member D'Appolonia, the REFRESH system will transform lives and livelihoods in coastal communities and islands facing water scarcity and also act as a first aid humanitarian device during natural disasters.

At least 11% of Europe's population and 17% of its territory are affected by water scarcity, mostly along the Mediterranean shore.

When a drought in Cyprus reached a critical level in the summer of 2008 and 30 tankers had to bring in water from Greece, the crisis cost around 1.25% of the country's Gross National Income and involved €7.6m of aid from the EC

negative environmental impact of desalination plants to the water purity concerns and exorbitant running costs of using refurbished oil tankers.

## Rethinking a good idea

While the idea of waterbags being transported across the sea by means of large flexible barges towed by tugboats has been around since the 1980s, no concepts have overcome inherent obstacles to reach commercialisation - until now. D'Appolonia used its engineering capabilities, knowledge of technical textiles and experience in the design and simulation of marine structures to develop a new kind of system with three key innovations. The supple PVC containers are modular in design, joined to each other by a unique watertight high-strength zip closure and feature

an embedded real-time monitoring system which automatically warns of excessive bag strain so countermeasures can be taken.

The cost of transporting 5000m<sup>3</sup> of fresh water a distance of 200km with the REFRESH system enables the final price of the water to be fixed at €2-3 per cubic metre, compared to €5-8 for water transported by tankers

## Boosting benefits

The REFRESH system represents a more effective, flexible, economically sound and environmentally friendly alternative to conventional monolithic waterbag designs and trains of separate modules. Its modular concept introduces four fundamental advantages. It allows compartmentalisation so if one module is damaged only a fraction of the transported water is lost. The full system behaves as one, avoiding snaking and bending problems. The small amount of water left in the container that can't be retrieved by pumps after

The REFRESH system of modular waterbags is responsible for less than 1/100 of the emissions of a water tanker in its lifetime

delivery can simply flow out through the container's zip, avoiding use of the large cranes usually needed to empty the containers. The zip also allows easy access to the interior of the modules for cleaning and sanitising - a big issue in sealed systems.



## Responding to emergencies

A commercial scale system is now being developed by a new project, XXL-REFRESH. This will provide demonstration trials for potential clients from the Greek islands, Israel and Chile who have already expressed interest in the innovation. The plan is to set up a joint venture to make and license the system. Sales potential in Europe is estimated at €15m a year and in the rest of the world at €150m in the medium term. A secondary, but important, application of the system - to enable the availability of clean water

'We are currently investigating options to transport large quantities of water from the south to the north of Chile. After learning about the REFRESH project we are very interested in exploring the possibility of further collaboration. The successful commercialisation of the flexible system for fresh water transport would be of great interest to the Chilean government and industry as it offers a number of benefits in comparison to other options' Representative of a privately-owned, non-profit organisation created by the Government of Chile

supplies after disasters such as earthquakes and tsunamis - will only add to global interest, with governments having the option of pre-storing the folded modular bags for flying to disaster sites or towing pre-filled to places of need.



'For this project we had to develop a new zip that is strong enough to resist the lateral pressure, that is waterproof and that can resist the hydraulic pressure that can build up in the water bag' Gianfranco Germani, General Manager, Ziplast



D'Appolonia is an Italian engineering and innovation consulting firm providing integrated services to private and public sector customers in the environment, energy, oil and gas, construction, transport, space and security sectors. With over 600 engineers and scientists, the company supports customers from conceptual design and definition of specifications up to implementation, optimisation and validation.  
[www.dappolonia.it](http://www.dappolonia.it)

**D'APPOLONIA**



# Leading the way in mass micro-manufacturing

A novel modular manufacturing platform enabling the high speed, low cost mass production of flexible micro-products has been pioneered by a consortium led by PRODINTEC, an associate of EARTO member Fedit. Initially developed for LED-based lighting systems, the technology heralds a new era of fast-growing, high-tech opportunities for European manufacturers in markets ranging from automotive to healthcare and logistics to consumer products. It will also make an important contribution to Europe's research and innovation leadership in key enabling technologies such as ICT, photonics, advanced manufacturing and nanotechnology.

Micro-components and systems are taking over more and more tasks in our everyday lives, from steering our cars smoothly to regulating our heating to helping

doctors discover why we're feeling unwell. And the prevalence of these innovative miniaturised structures, which combine different materials, parts and technologies at the micrometre scale, is predicted to continue to grow by up to 10% a year. There is, however, already an unmet need for high volume production of micro-systems at moderate cost - and

for more sophisticated micro-fabrication techniques that will enable solutions currently existing only as prototypes to be commercialised.

## Technology trio

With today's microfabrication methodologies hindering progress, an EU Framework Programme 7 consortium led by PRODINTEC set about developing and integrating three highly innovative manufacturing and assembly technologies into one seamless, high throughput production platform. A novel polymer-based process technology allowing roll-to-roll, multi-material production, a revolutionary chip self-assembly module

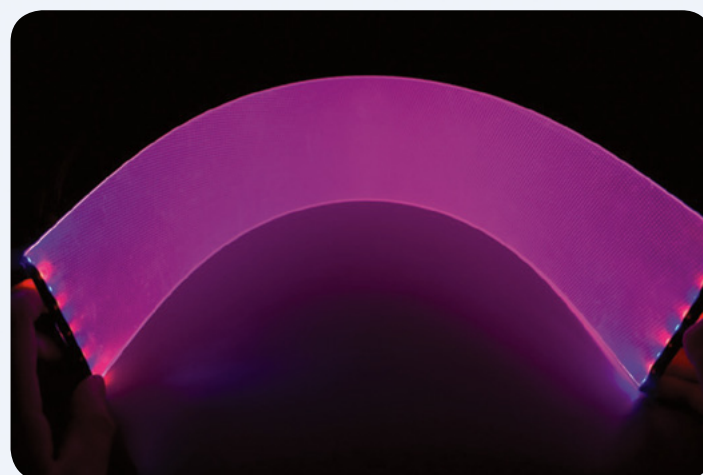
and optimised inkjet-based interconnection technologies enable the Light-Rolls solution to produce electronic micro-components on flexible plastic or metal foil substrates at unprecedented speed, scale, precision and cost-effectiveness. As well as overseeing the integration of these modules, PRODINTEC also designed and implemented the systems needed to control the production line.

The annual European market for lighting-based products is expected to be €20 billion, with the worldwide figure set to exceed €100 billion

## Flexible benefits

A major step forward in breaking down barriers to the implementation of micro-systems at the industrial level, the Light-Rolls platform produces a high yield thanks to its advanced IT systems and is highly environmentally friendly, running without dangerous chemicals and with integrated recycling. Also critical to the technology's widespread and long-term potential is its inherent flexibility. Its modules can be configured for different applications and have mechanical, fluidic and IT interfaces to make adjusting the sequence of process steps to each product easy and low-cost. And

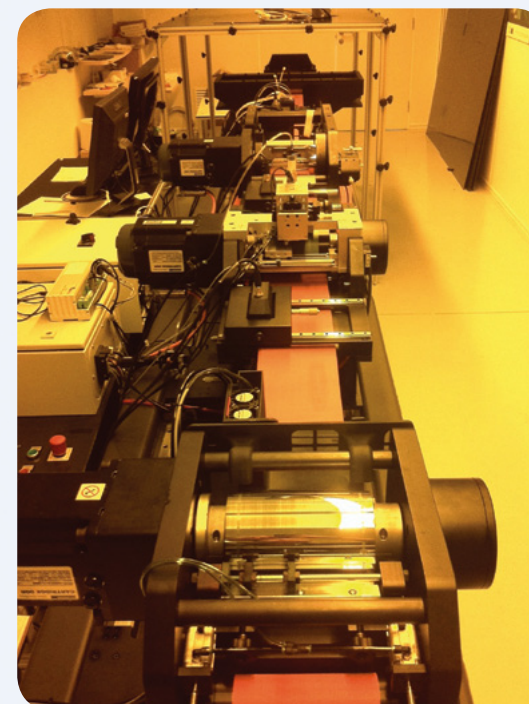
'Roll-to-roll manufacturing is predicted by many to be one of the most important means of production in the future due to the increasing demand for flexible products and the need for low cost production' David Gonzalez, PRODINTEC



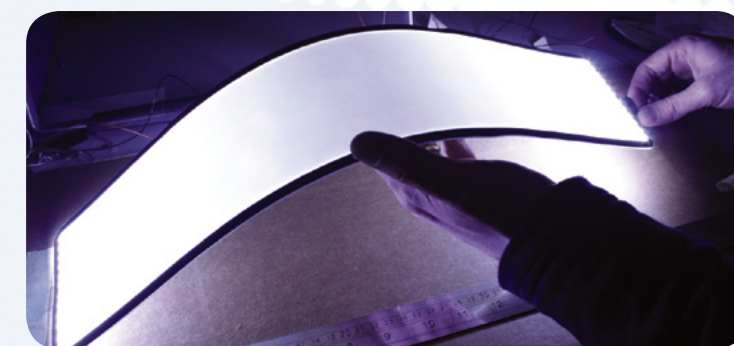
while it was first used to make LED-based lighting systems, in the future the fabrication of many other kinds of components like lab-on-a-chip and the integration of micro-energy storage for many other sectors will be possible.

## Diverse domains

The Light-Rolls technology owners are now implementing a plan to fully exploit it, working on development projects with individual industrial customers, taking part in further collaborative R&D projects, undertaking consultancy, training and workshop activities and subcontracting machine hours to micro-product developers. They expect these activities to generate revenue of more than €2m in the next few years and far higher in the future by selling the technology and know-how. The platform has aroused great interest around the world, from Europe to South America, and is seen as a key enabler for the future of automotive and architectural lighting and rollable displays as well as in domains as diverse as security, packaging, games, biosensors, fuel cells, logistics, robotics, textiles, solar cells and batteries.



'Light-Rolls enables 3D surface features, chip self-assembly and printed electrical connectivity and these three platforms enable the manufacture of lighting and backlighting products based on LED device technology' Dr James Gourlay, Design Led, UK, a member of the Light-Rolls consortium



'Achieving success will enable Europe to stay ahead of the game in micro-manufacturing. This will increase Europe's competitiveness in new production technologies and innovative products' David Gonzalez, PRODINTEC

PRODINTEC Foundation is a non-profit technology centre created in 2004 and specialising in industrial design and production. Its mission is to foster the competitiveness of industrial firms by applying technological advances both to their products and to their manufacturing and management processes. It is one of the technology centres associated to Fedit, the Spanish Federation of Technology Centres, which is the main private research, development and innovation agent in Spain.  
[www.prodintec.es](http://www.prodintec.es)  
[www.fedit.com](http://www.fedit.com)



## The Light-Rolls consortium

The project team, led by PRODINTEC, including microTEC Gesellschaft für Mikrotechnologie mbH (Germany), Norbert Schläfli Maschinen Zofingen (Switzerland), Centro Ricerche FIAT S.C.p.A. (Italy), Design LED Products Ltd (United Kingdom), ACP-IT GmbH (Austria), Fraunhofer IPA (Germany), Xaar Jet AB (Sweden) and microelectronica S.A. (Romania).



# The wireless way to detect dangerous gases

The world's first wireless optical gas detector, based on innovative gas filter technology from EARTO member SINTEF, has introduced a new level of reliability, flexibility and immediacy to the detection of very low gas levels and is set to revolutionise the industry. Based on breakthrough optical detection and ultra-low power principles, the totally new concept is set to increase safety and dramatically reduce costs for the oil and gas, petrochemical, mining, maritime and process industries.

In the world of oil and gas exploration and production, and other challenging environments, where unseen flammable and toxic gases are constantly present, accurately monitoring risk levels at all times remains one of the greatest challenges. While wired systems provide the required reliability they also have the complexity, inflexibility and expense associated with running kilometres of cabling, which is why

attention has increasingly focused on simpler, cheaper wireless solutions. But while the benefits of these are evident, so too are the challenges.

Wireless systems tend to be battery powered, and although the resultant energy constraint doesn't

matter in applications where process values change relatively slowly, for safety applications where immediate detection is demanded, it does. One of the key challenges therefore in developing a next-generation wireless gas detector was to ensure it could guarantee constant watchfulness, instant response and immediate identification of loss of contact, all without depleting its batteries.

## Simplifying sensing

SINTEF saw that the solution could lie in rejecting existing bulky gas detection instruments in favour of an entirely new kind of compact filter design based on the work of a 19<sup>th</sup> century optician. Joseph von Fraunhofer had showed that diffraction grating can be used to filter light in order to reveal the spectral absorption

'fingerprints' of gases - and this is the principle that lies behind the innovative filter technology, the Controllable Diffractive Optical Element (CDOE), at the heart of the new detector.

'The GS01 gas detector from GasSecure represents a major innovation in the field of gas detection as it is the first wireless and battery-operated system available on the market. Based on the experience we have from the Gullfaks C platform after a few weeks of testing, we are pleased to see the promising results so far. The savings in cost and schedule, combined with increased flexibility for installation, will greatly improve execution of our projects and modifications' Simon Carlsen, Statoil

Capitalising on its capabilities in optics and advanced know-how in silicon processing and process development plus state-of-the-art manufacturing techniques and facilities, SINTEF was able to design, develop and produce a new tunable optical micro-electro-mechanical filter for gas sensing. Its ultra-low power detection principle and tiny dimensions mean it requires very little energy - making it ideal for safety-critical battery-operated wireless applications.



Picture by GasSecure AS

## Raising performance

The innovative filter technology has been commercialised by GasSecure, a spin-off from SINTEF, in the form of the first wireless detection system for continuous monitoring of gas leaks in the oil and gas industry: GS01. Pilot tested on a Statoil-operated platform in the North Sea, GS01 performs equally or better than existing state-of-the-art infrared detectors and confirms the expected spectrum of unique benefits.

The system has proved its unrivalled signal reliability and a detection response time, including wireless communication, of less than five seconds. Its contribution to higher safety levels doesn't end there. It also offers constant accuracy, unlike previous best-in-class solutions, as well as easy system expansion to increase the number of monitored points. GS01 has an expected lifetime of more than 15 years, with battery life exceeding two years.

The filter at the heart of GasSecure's gas detector is based on the work of a 19<sup>th</sup> century optician, Joseph von Fraunhofer, who showed that diffraction grating can be used to filter light in order to reveal the spectral absorption 'fingerprints' of gases

## Cutting lifetime costs

Underpinning the system's performance advantages are cost savings which start with installation - around 70% cheaper than with wired solutions. Maintenance costs are also radically reduced by the compact design. The lack of wearable parts of the filter cuts operational costs too, by not requiring recalibration of the system. There's an additional bonus too: as the filter is fabricated in the same way as the semiconductor components the more that are made, the cheaper they become.

As the only wireless hydrocarbon gas detector for the global oil and gas industry, the future for GS01 is very promising - which has enabled GasSecure to secure investment of E10m. While it is initially focusing on the North Sea offshore production market, including 30 larger planned retrofit installations, GasSecure also sees applications for GS01 in e.g. tanks farms, industrial plants and for the mining industry.

## Diversifying detection

The CDOE filter technology has also been licensed to two companies who are starting to exploit it in very different markets. Nyborg AS has exclusive worldwide rights to use the system for hydrocarbons monitoring applied to ventilation control on board car carrier vessels. VS SAFETY AS intends to develop gas detection systems which will replace existing electrochemical hydrocarbon sensors used to detect gas leaks in office buildings and residential buildings - a potentially huge global market.

Picture by GasSecure AS



SINTEF spin-out GasSecure, was awarded a Frost & Sullivan Technology Innovation Award in 2011 in recognition of the uniqueness of its technology and its impact on new products, functionality and customer value. In 2012 Technoport, which promotes smart technology as a tool in the transition to a green economy, awarded its Applied Technology Award to GasSecure's development and commercialisation of the CDOE filter.

SINTEF is the largest independent research organisation in Scandinavia. Every year it supports the development of around 2000 Norwegian and overseas companies through research and development activity in technology, the natural sciences, medicine and the social sciences. SINTEF has 2100 employees and offices in Trondheim, Oslo, Bergen, Stavanger, Alesund, Houston Texas, Skopje and Rio de Janeiro plus a laboratory in Denmark. [www.sintef.no](http://www.sintef.no)





# Intelligent textile protects accident victims

A smart textile that can be transformed rapidly from soft laminate layers into rigid plastic - and back again - is set to become the universal building block for a new generation of emergency medical devices. Developed by EARTO member Tecnia Research & Innovation, through its FIK initiative, the new Varstiff fabric means that paramedics can quickly immobilise accident victims' necks, backs and limbs with customised casts and braces on the spot - and that orthopaedic patients and wheelchair users will benefit from higher-performance healthcare aids. Applications are also already evident in sectors as diverse as automotive, sport, furniture and security.

When accidents happen, one of the emergency workers' most pressing challenges is to quickly immobilise those parts of the body that may be vulnerable to

permanent damage. Current state-of-the-art immobilisation technologies include particle-filled bags that become stiff when a vacuum is applied, but their degree of rigidity reflects their thickness which means they are more bulky and less flexible than is ideal. There are also several one-time moldable solutions on

Sales of a Varstiff emergency immobiliser have been independently assessed at €26.4m over a 17 year period, and those of a knee orthosis at €80.1m

the market, such as plaster casts and heat-molded plastics, most typically used in orthopaedics, but these are not instantaneous or easily reversible and can't be reshaped during recovery.

## Shaping the future

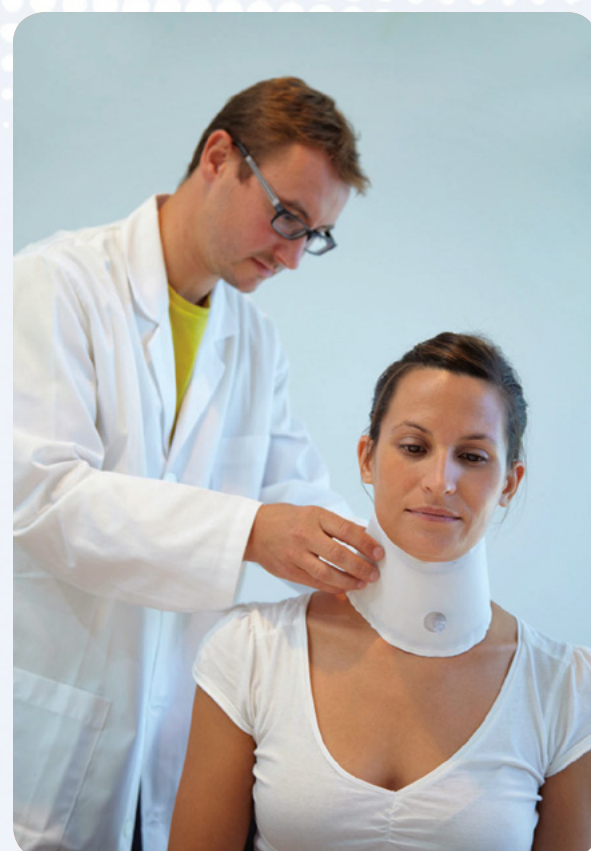
To overcome all these problems, Tecnia conceived the idea of using textile-like layers within an air-tight envelope to create a material that can adopt different shapes and realise variable levels of stiffness when a vacuum is applied - and stay that way until the vacuum is released. Through optimum selection of materials, composition and production methods it ensured essential layer properties related to high tensile stiffness, high coefficient of friction and low level of adhesion. The Varstiff material's default state is malleable and soft, but sucking out air 'glues' the layers together, making

it as hard as conventional plastic. The process is instant, easily reversible and can be repeated many times.

Thanks to the encouragement and collaboration of Janus Development S.L., Varstiff was selected by the Botin Foundation as one of the three award-winning projects in the first edition of its Mind the Gap programme which aims to close the gap between science and business to ensure that important research projects with the potential to improve the health and welfare of society reach the market. The Foundation's €0.5m support will enable the development of the first two Varstiff products

## Promising performance

Tecnia patented a super-slim body-fitting element with controlled stiffness, enabled by a built-in vacuum hose, and worked with suppliers and users to create a portfolio of demonstrator prototypes whose additional advantages range from reduced operation time by



healthcare professionals to lower cost, as there are no expensive materials or components involved, and greater comfort as the textile doesn't place any pressure on the skin. A start-up company, TEXTIA, aims initially to commercialise the most promising ideas, including a device for immobilising the victims of traffic accidents and a postural support device for wheelchair users.

## Exploiting potential

Varstiff has potential across the healthcare spectrum, from high-value new products - the emergency immobiliser and orthotic device markets have a combined value of around €100 million - to highly complex research. The innovation is currently being used by an FP7 project for benchmarking surgical tools. But it has applications in many more markets besides. It could be used in the automotive industry for personally-adjustable seats or in the leisure market for camping chairs and tables. It could also have a pioneering role in the development of high-performance protective clothing for extreme sports and the security industry.



'Varstiff is a revolution in the field of new technologies and materials. In the area of health, it has already proved its effectiveness with solutions to specific problems with innovative devices design. We are convinced that Varstiff can give new solutions in markets ranging from automotive to sports and the consumer' Jorge Alemany, Janus Developments S. L.



A custom-fit Varstiff wrist brace, for post-operative care and carpal tunnel syndrome, provides the optimum balance between support and comfort and can be applied and removed in seconds yet remain rigid while in place

Tecnia Research & Innovation is the first private applied research centre in Spain and one of the most significant in Europe, with 1,500 experts from over 27 different nationalities, focusing on transforming knowledge into GDP to improve people's quality of life. The centre creates business opportunities for companies through multi-disciplinary and applied research in the areas of sustainable construction, energy and the environment, innovation strategies, ICT, industry and transport, health and technological services.  
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# On the road to safety for cyclists

The world's first car-based safety solutions designed to protect both pedestrians and cyclists have been developed by a consortium led by EARTO member TNO to reverse the rise in fatalities and injuries among these most vulnerable road users. The SaveCAP project's exterior windscreen airbag and automatic emergency braking system, which together have the potential to save 63-72% of deaths and serious injuries in a specific group of frontal car crashes, are acting as catalysts for change in the automotive industry and variations have already been adopted by Volvo and Ford.

While the total number of traffic accident fatalities has been decreasing in recent years, a growing number of people on bicycles and on foot are being killed or

seriously injured on our roads. Today, 14% of all European traffic fatalities are pedestrians. Every year more than 2,000 cyclists die on the roads of Europe, accounting for 7% of all road deaths. In the Netherlands alone, 8,000 cyclists a year are hospitalised after accidents. With the number of cyclists only set to grow, and the financial gain of preventing road casualties calculated in the Netherlands as €2.5m per fatality and €280,000 for a heavily injured victim, there is

a clear and pressing need for dedicated in-car safety solutions for both groups of vulnerable road users.

## Understanding behaviour

To meet this need, TNO established a consortium, including the Dutch Ministry of Infrastructure and the Environment, Autoliv, Centraal Beheer Achmea and the Dutch Cyclists' Union, to demonstrate the feasibility and effectiveness of intelligent safety systems. Following research to discover the differences in pedestrian and cyclist road behaviour and kinematics

during an impact, TNO determined that the two most beneficial safety systems would be an exterior windshield airbag to prevent severe head injuries and an automatic braking system to reduce speed of impact. At the heart of both solutions are advanced sensor systems which detect, classify and calculate the likelihood of collision with pedestrians and cyclists and trigger pre-crash action such as emergency braking or airbag deployment.

The number of cyclists and pedestrians who are killed or suffer serious head injuries in a specific group of frontal collisions with passenger vehicles could be reduced by 35% with the SaveCAP exterior windscreen airbag and by 38-45% with the emergency braking system

## Raising awareness

Following successful sensor field tests in two major Dutch cities, full scale laboratory crash tests and the international launch of the proof of concept, the new technologies have been intensively promoted to raise awareness and interest among governments, car manufacturers and consumer car safety bodies like Euro NCAP. The imminent inclusion of emergency braking systems for pedestrians - and ultimately also for cyclists - in Euro NCAP's rating system is expected to have a very positive impact on market penetration of the technologies in the coming years.

Advanced sensor systems developed by SaveCAP detect the presence and distance of, and predict the likelihood of collision with, cyclists and pedestrians

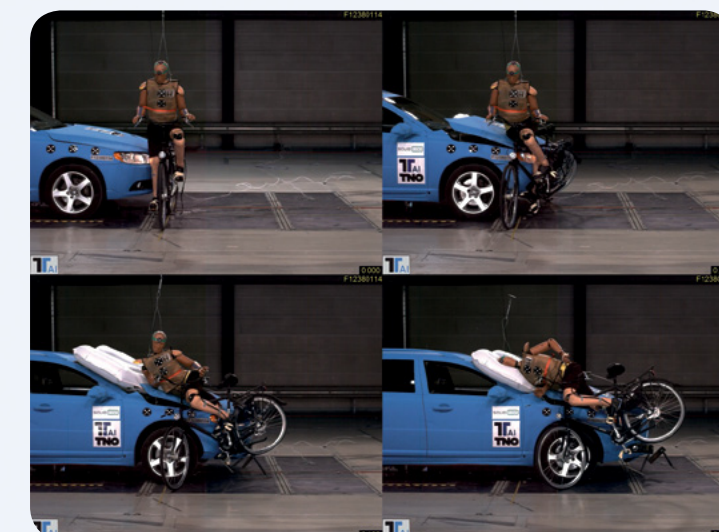


## Implementing innovations

SaveCAP has inspired automotive manufacturers to add cyclist, and not just pedestrian, safety to their technology roadmaps. Some have already adopted the technology and brought first-generation active protection systems to market. Volvo has introduced Pedestrian Airbag Technology to its V40 model, with sensors in the front bumper registering the physical contact between car and pedestrian and triggering the deployment of the airbag, which also elevates the bonnet by 10cm to allow it to dent and further cushion the impact. The company's Pedestrian and Cyclist Detection with full auto brake - which features on many models - uses a dual-mode radar unit integrated into the car's grille, a camera fitted in the front of the interior rear-view mirror and a central control unit to calculate the likelihood of collision, warn the driver and automatically activate the brakes. Progress towards next generation versions of the SaveCAP technologies is being brought forward by ASPECSS, an EU Framework Programme 7 project developing test and assessment procedures to stimulate widespread use of pedestrian and cyclist safety systems.



'Vulnerable road users like cyclists and pedestrians make up a large proportion of traffic fatalities and injuries in many countries. The work done by the SaveCAP project in analysing and proposing possible countermeasures has therefore been important for traffic safety and for Autoliv. Both the external cyclist airbag and VRU detection sensors with autonomous braking have shown significant potential in increasing traffic safety for this group' Jan Olsson, Vice President Research Autoliv



**About TNO** The 3800 TNO professionals put their knowledge and experience to work in creating smart solutions to complex issues. These innovations help to sustainably strengthen industrial competitiveness and social wellbeing. We are partnered by some 3000 companies and organisations, including SMEs, in the Netherlands and around the world. For more information about TNO and the seven societal themes that are the focus of our work, go to [www.tno.nl](http://www.tno.nl)

**TNO** innovation  
for life



# Unlocking the potential of carpooling

An advanced real time carpooling system that makes journey sharing easier, faster and more flexible than ever before is set to help reduce CO2 emissions and congestion in Europe's traffic hotspots as well as commuters' travel costs and time. EARTO member CRP Henri Tudor's Secure Dynamic Carpooling System not only intelligently and instantly matches drivers with passengers and automatically determines best routes, it also integrates breakthrough security and payment features that will unlock the true potential of carpooling.

With the financial cost of traffic congestion in Europe said to be between 0.9 and 1.5% of GDP - and its environmental impact equally high - finding ways to improve traffic flow is a high priority. In places like

Luxembourg - where 158,000 cross-border workers commute each day into a country of 525,000 residents - there is a particularly pressing need to encourage and enable wider use of mobility solutions like car sharing. Hampered by the need to plan journey sharing in advance and to negotiate timings, pick-ups, costs and routes, traditional carpooling has never succeeded on a large scale. Even existing online and mobile services haven't fundamentally resolved these issues. An alternative approach allowing real-time trans-

actions was seen as a promising route for investigation, but commercial feasibility and safety concerns had been blocking the road ahead.

## Holistic approach

Luxembourg-based CRP Henri Tudor, which has a strong focus on sustainable mobility and strong capabilities in security protocols and algorithm

programming, understood that a successful dynamic carpooling service would need to incorporate instantaneous location tracing, driver-passenger matching, optimum route planning and contract and payment handling. Also key would be secure data encryption and user authentication to build the trust

Carpooling is more affordable, relaxing and environmentally-friendly than driving alone - and dynamic carpooling can make it flexible and fast too

needed to overcome concerns about travelling with strangers. As part of the EUREKA/CELTIC WiSafeCar project, a secure multi-agent wireless communication platform was developed based on GPS navigation and optimised algorithms which achieves all of these objectives.

## Timely transactions

The technology means that users will have greater flexibility to search for a ride in real time when they need it. They will then get where they want to go in the shortest possible time, with the technology enabling a swift and secure transaction and best-choice route selection based on the user's pre-selected preferences



and live information about weather, traffic, roadworks and accidents. For many people, sharing journeys in this way doesn't just save money and fuel, it can also improve quality of life, with less time spent travelling and more interacting with new people. Of course, the technology positively impacts the environment and the economy too, reducing traffic and emissions and increasing time spent fruitfully at work.

## Diverse applications

The system, which is currently at the prototype stage, has significant potential both as a service for companies within economic activity zones and for individuals to use as a mobile app or online service via a smartphone. It's expected to be in use within two years in Luxembourg's industrial zones following trials in the ZAC-eMovin electric car-sharing project. A EUREKA/CELTIC project concerned with traffic fluency, CoMoSeF, is also working to exploit the innovation in a real environment. Other potential applications include the taxi sector, where it could be used to match taxi drivers with journey-share passengers to reduce driver downtime and customers' costs and waiting time. Delivery companies focused on 'last-mile' logistics could also benefit from its ability to optimise routes in real time.

One of the system's unique aspects is the different geographic levels of user pools: users can connect with colleagues in their own company as well as having the option to link up with users within the same industrial (or activity) zone or the same region, or even all users



There is great potential to increase the rate of carpooling: of the 61% of Luxembourg residents who commute by car for example only 10% are passengers



CRP Henri Tudor is a Research and Technology Organisation in Luxembourg which provides an essential link between research and society, reinforcing the innovation capacity of businesses and public organisations and contributing to the development and transfer of knowledge and the international influence of Luxembourg's scientific community. The organisation, which has around 450 employees, focuses on advanced materials technologies, environmental technologies, healthcare technologies, information and communication technologies and business organisation and management. Its innovation programmes target markets of key importance for Luxembourg: manufacturing, construction, ecotechnologies, mobility, transport and logistics, health, public services, finance and human capital.

[www.tudor.lu](http://www.tudor.lu)

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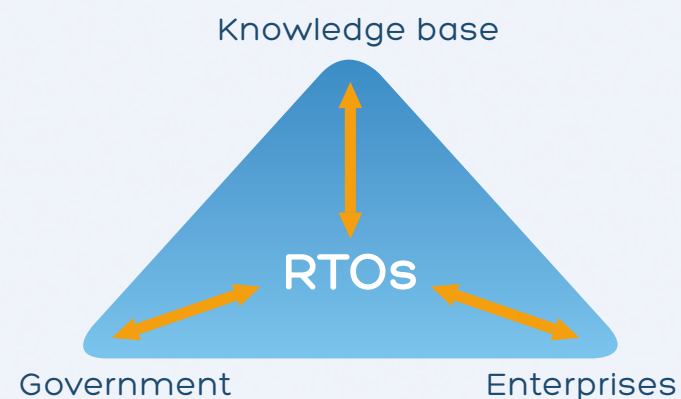
## EARTO

- ✦ is the European trade association of the Research and Technology Organisations (RTOs), a non-profit organisation founded in 1999
- ✦ promotes and defends the interests of its members towards European institutions and others
- ✦ provides its members with information and networking services to help them make the best use of European programmes relevant to research and innovation, to identify and develop joint interests, and to exchange professional experience and good practice
- ✦ groups over 350 Research and Technology Organisations with a combined staff of 150,000, an annual turnover of €15 billion, specialised equipment and facilities to a value of many € billions, and more than 100,000 customers annually

## Research and Technology Organisations

The core mission of Research and Technology Organisations is to harness science and technology in the service of innovation, to improve quality of life and build economic competitiveness

RTOs occupy nodal positions within innovation eco-systems, bringing together key players across the whole innovation chain, from fundamental to technological research, from product and process development to prototyping and demonstration, and on to full-scale implementation in the public and private sectors



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